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Monday, March 8 9:00 - 9:30

Opening Ceremony

Monday, March 8 9:30 - 10:45

Keynote Address 1

Grid Modernization: Technological Advancements Beyond Smart Grid
John D. McDonald, P.E, Smart Grid Business Development Leader, GE Grid Solutions

Chair: Zuhaina Zakaria (Universiti Teknologi MARA, Malaysia)

This talk will familiarize participants with a vision for Grid Modernization, focusing on technological advancements beyond Smart Grid. The technological advancements include discussions of key industry/societal trends, Smart Grid concepts, holistic solutions, integration of microgrids and distributed generation, and ADMS software applications. The talk will also cover feeder automation business models, managing different types of data, big data, analytics, enterprise data management, Smart Grid standards and interoperability, and Smart Grid deployments and lessons learned.

Monday, March 8 11:00 - 13:00

D1: Session 1_1

Power Electronics and Applications
Chairs: Rahimi Baharom (Universiti Teknologi MARA, Malaysia),
Zulkiffli Abdul Hamid (Universiti Teknologi MARA Malaysia)

11:00 *One-Cycle Controller for UPS's Buck Converter Operation...1*
Nor Farahaida Abdul Rahman and Mohd Che Haziq Che Abang (Universiti Teknologi MARA, Malaysia)
This paper proposes a One-cycle Controller (OCC) to regulate a buck converter operation used in an Uninterruptible Power Supply (UPS) system. The controller regulates the buck converter operation to supply a constant DC voltage for charging the UPS battery. This controller exhibits fast transient and dynamic responses to the input power disturbances. It rejects power disturbances by ensuring that the average output voltage value is always proportional to the average control signal. The proposed system is modelled in MATLAB/Simulink to verify the buck converter operation to supply constant DC voltage during short-term and long-term voltage sag and voltage swell problems. The simulation results have proven that OCC can reject voltage disturbances and successfully regulate the buck converter operation. Hence, this controller is suitable to be used in the UPS system.

11:20 *Hybrid Control Design for Improvising the Performance of Multi-Tap Variable Shunt Reactors...6*

Ghulam Mustafa Abro (Hamdard University, Malaysia); Rahul Kumar (Universiti Teknologi PETRONAS); Zuhaina Zakaria(Universiti Teknologi MARA, Malaysia); Suresh Kumar (University of Polytechnic Catalunia Spain, Malaysia)

Nowadays, there is a scarcity between the demand and supply of electrical energy, this is because of the instability of high voltage transmission. This is one of the biggest issues so far in transmission lines. Researchers prefer the utilization of shunt reactors to reduce these instability issues. These conventional shunt reactors work like an ordinary electro-mechanical relay and therefore have sluggish switching response. This paper proposes the use of thyristors-based multi-tap shunt reactors that are fully controlled using an intelligent Fuzzy based Proportional Integral Derivative (F-PID) control algorithm. This proposed strategy will initiate a voltage rise at the receiver end to stabilize the system and reduces the settling time. The paper comprises of simulation results that are performed on MATLAB R2020a version and later validated with hardware design based on Arduino Mega controller.

11:40 *Harmonic Minimization Using Artificial Neural Network Technique for CHB-ML Inverter...12*

Moataz Moneer Alakkad (Universiti Teknikal Malaysia Melaka (UTeM), Malaysia); Zulhani Rasin (Universiti Teknikal Malaysia Melaka, Malaysia); Mohammed Rasheed Jubair Al-Hiealy (University Malaysia of Computer Science and Engineering, Malaysia); Rosli Omar (Technical University of Malaysia Malacca, Malaysia)

In this paper, the modified single phase nine-level CHB-MLI is proposed based on the selective harmonic elimination pulse width modulation (SHE-PWM) using artificial neural network (ANN) technique. The number of proposed switching devices reduced in a now modified CHB-MLI compared with the conventional structure of CHB-MLI which decreases the switching frequency of the system, leading to a decrease in the total power switching losses. The switching angles of CHB-MLI in this paper are detected and controlled based on the ANN technique into selective harmonic elimination transcendental nonlinear equation which is considered as the popular and powerful method for minimizing the harmonic order at the output voltage waveform of the MLI and produces a low ratio of total harmonic distortion (THD%). This paper aims to design, simulate and build up new modified structure of the single-phase nine-levels CHB-MLI and predict the real-time switch in order to generate superior switching angles by using ANN technique. MATLAB simulation has been used for designing and simulating the nine-levels single-phase CHB-MLI with ANN technique for switching angles prediction. It is found the proposed technique able to reduce hormonic contents of output waveform.

12:00 *Design and Simulation of a Solar Power System Oriented for Mobile Base Station Sites...18*

Mohammed S. Mohammed Ali Khesbak (University Bremen-Germany & Institute for Artificial Intelligence (IAI), Germany); Ahmed Ibraheem (Private, Iraq)

Due to the importance of the availability of mobile communication network operation service, this paper aims to design a solar energy-based power system for mobile communication base station site with wide range exploitation of solar energy. The system considers the design that uses solar energy as the only available source of power to minimize call traffic losses due to the absence of electricity sources. Two main design aspects are involved in this work; first is the solar array design with a high range of operation within solar current-voltage I-V characteristic exploiting by such design, sun irradiance from highest to lowest level. The second design aspect is the DC-to-DC power conversion which targets to convert the wide-range voltage output of the solar array to a constant BTS load voltage defined by the base station manufacturer. MATLAB package coding and SIMULINK models were carried out and results obtained showing a controllable PWM modulation index maintain the constant DC output load voltage with very low harmonic distortion content.

12:20 *Analysis of Different Levels for Generalized Multilevel Current Source Inverter (MCSI) with the Different SPWM Methods...24*

Nik Fasdi Nik Ismail (Universiti Teknologi Mara (UiTM), Malaysia); Norazlan Hashim (Universiti Teknologi MARA, Malaysia)

This work presents about the analysis and study of Generalized Multilevel Current Source (MCSI) topology. The work begins by comparing a Total Harmonic Distortion (THD) with various types of

Sinusoidal Pulse Width Modulation (SPWM) method for controlling the switch with different levels for generalized multilevel current source inverter (MCSI). The type of SPWM method that will be using on this topology focuses on Level Shifted Pulse Width Modulation Technique (LS-PWM), which is Phase Disposition PWM (PD-PWM), Alternated Phase Opposition Disposition PWM (APOD-PWM), and Phase Opposition Disposition PWM (POD-PWM). Next, is the comparing of total harmonic distortion (THD) with different switching frequency for Generalized Multilevel Current Source Inverter (MCSI) in order to determine the best switching frequency value for the inverter. The simulation of the topology is modelled and simulated using MATLAB Simulink software. The analysis shows the Total Harmonic Distortion (THD) output variation of the different types of SPWM method and switching frequency.

12:40 *Study Case: D-STATCOM in Low-Cost Hardware in the Loop for Voltage Sag Mitigation...30*

Shamsul Zulkifli (Universiti Tun Hussein Onn Malaysia, Malaysia); Amjad Muneim Mohammed (The General Company of Baghdad Electricity Distribution, Iraq); Fatma Yildiz Tascikaraoglu (Mugla Sitki Kocman University, Turkey)

This paper is to study a Distributed Static Compensator (D-STATCOM) for voltage sag mitigation using a low-cost microcontroller in hardware in the loop (HIL) application. A framework of HIL-Matlab-Simulink simulation is developed using Raspberry Pi (RPi) and Arduino with a combination of Proportional Integral (PI) control for mitigating the voltage sag due to sudden change of load. The simulation results are presented in both offline and online modes. During the offline mode, the D-STATCOM is able to correct the voltage sag from 0.7 (p.u) to 1.0 (p.u) when the fault happens by injecting the current using the PI control strategy. As for online modes using the HIL platform, the voltage sag has also been mitigated with less response on the time response due to low bit design in the HIL, which currently is about a 3-bit model. In the meantime, the HIL system can be developed using a low-cost microcontroller as a learning process to the researchers before actual HIL is applied, which required more complicated signal processing configurations.

D1: Session 1_2

Power System Operation and Planning
        Chairs: Dalina Johari (Universiti Teknologi MARA, Malaysia), Fatimah Salim
            (Universiti Teknologi Malaysia (UTM) & UTM Ocean Thermal Energy Centre
            (OTEC), Malaysia)

11:00 *Investigation of Transformer Health Prediction Through Accelerated Aging Studies of the Natural Ester/Paper Complex...35*

Gerard Ombick Boyekong, Emeric Tchamdjio Nkouetcha, A. Moukengue Imano and Ghislain Mengata Mengounou(University of Douala, Cameroon)

The life duration of the cellulosic insulation is an essential aspect in the design of power transformer. Mineral oils have been largely used as liquid dielectrics to extend the service life of transformers. However the environmental and health aspects led to the seeking of alternative liquid dielectrics. Many authors have claimed that the use of bio based liquids, especially natural esters can slow down the aging process of dielectric paper. The use of natural esters can therefore extend the actual operating life of transformers. Many vegetable oils have been elaborated. In this paper, we focus on palm kernel and castor oils, two non-comestible vegetable oils largely present in Central Africa. We show the results of a study of the aging of dielectric paper immersed in palm kernel and castor oils. We start by presenting the elaboration and performance analysis processes of methyl esters of palm kernel and castor oils. Next, we develop the aging procedure; the paper was aged at 110°C during 100 hours, samples of oils and insulating paper were taken for analyses. The various tests performed included the determination of the total acid number, the UV-visible spectroscopy and the physical changes of the insulating paper. The results obtained with natural esters are compared to those obtained with mineral oils, which was used as a benchmark. The results obtained with palm kernel and castor oils confirms the excellent dielectric and cooling properties observed with other natural esters.

11:20 *Identification of Source Neutral-To-Earth-Voltage (NTEV) Rise in the Commercial Building...40*

Mohd Abdul Talib Mat Yusoh (Universiti Teknologi MARA, Malaysia); Ahmad Farid Abidin (Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor); Nooradzianie Muhammad Zin (Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia); Nurul Nadia Mohammad (Universiti Teknologi MARA Cawangan Johor, Kampus Pasir Gudang, Johor, Malaysia); Zulkiffli Abdul Hamid and Nik Hakimi Nik Ali (Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor)

This paper presents a novel technique to identify the spot area of neutral-to-earth-voltage (NTEV) rise due to the problem of loose neutral termination (LT) in the commercial building. This technique is proposed to pin-point the spot area of problem either on the upstream or downstream side of measurement spot. In addition, this paper only focusing to the problem on the commercial building which comprise three-phase four wire conductor system. The results show the location of NTEV rise can be detected properly by using Fourier Transform (FT) which is the main core in a proposed technique. The NTEV rise due to the LT is one of the dominant problems in power quality because that problem give an adverse effect to the network distribution system where heating on the conductor cable, stray voltage, fire on the wiring system and lifetime of electrical appliances becoming shorter and shorter.

11:40 *Modelling and Simulation of Solar Water Heating System (SWH) with Thermal Storage Using Flat Plate Solar Collector...45*

Amirull Danial Mohd Hairii and Nur Ashida Salim (Universiti Teknologi MARA, Malaysia); Hasmaini Mohamad (Universiti Teknologi Mara, Malaysia); Zuhaila Mat Yasin (Universiti Teknologi Mara, Malaysia)

Electrical energy source in Malaysia is commonly from by fossil fuel such as coal, petroleum, LNG, LPG, kerosene, etc. However, these unrenewable sources of energy are neither economical nor favorable to the environment. Even though Malaysia produces enough electricity to meet current consumption levels, the reduction of electrical usage should be taken for us as a main consumer in this country in order to reduce energy consumption. Towards this end, solar energy seems to be a singularly legitimate and feasible source of alternative energy for heating water. Solar energy is permanently renewable, environmentally beneficial, and convertible to various energy forms. A solar water heating system is used to convert solar energy to thermal energy to heat water. This research investigates the application of solar energy to meet water heating needs especially in Malaysia and models the water heating system. Through modelling in the simulation, the average system efficiency for solar collector and thermal storage are determined as the total costs on a daily basis or monthly average.

12:00 *Customer Interruption Cost Based on Hidden Failure of Power System Leading to Cascading Collapse...51*

Nur Ashida Salim (Universiti Teknologi MARA, Malaysia); Mohammad Arfan Firdaus Aris Fatillah (UiTM, Malaysia); Muhammad Murtadha Othman (Universiti Teknologi MARA, Malaysia)

This paper proposes a systematic approach to calculate the customer interruption cost due to the effect of hidden failure in a power system. The distribution of electrical energy from the generation to the consumer might experience interruption due to some specific reasons. One of the reasons that could give catastrophic impact to the system is due to cascading collapse that might happen in the system. In this paper, the reliability cost from the customer's perspective being conducted in order to analyse the interruption cost based on cascading collapse. The analysis has been carried out from some sectors of the building that use the source of energy. Analysis has been made by using IEEE Reliability Test System 1979 (IEEE RTS-79) in order to verify the proposed technique is accurate. The total loading condition of the system have been calculated for this analysis in order to investigate the reliability cost towards the customers based on the interruption cost. The average probability of system cascading collapse and interruption cost of the failure shows a great impact to the consumer if the system is collapsed.

12:20 *VSI Improvement Using SVC with Aid of a Modified Lightning Search Algorithm...56*

Syed Norazizul Syed Nasir, Razman Ayop and Jasrul Jamani Jamian (Universiti Teknologi Malaysia, Malaysia)

This paper proposes an improved metaheuristic optimization technique to solve the problem of optimal location and sizing of static var compensator (SVC) in a complex power system. The main objective of this research is to achieve minimum Voltage Stability Index (VSI) after installing the three units of SVC optimally by using Modified Lightning Search Algorithm (MLSA) technique. MLSA technique is used to find the best location and sizing for the multiple SVC units. MLSA technique basically enhances Lightning Search Algorithm (LSA) which was inspired by the lightning strike phenomenon. In mathematical analysis, it is proved that MLSA give superior solution in 10 nonlinear mathematical benchmark functions compared to another algorithm including LSA. Next, the effectiveness of MLSA technique is demonstrated on IEEE 30-bus test system together with the three SVC units. From the analysis, MLSA gives better result especially in average, median and minimum VSI. Thus, it can be concluded that MLSA is a superior method in solving numerical optimization problem especially for optimal location and sizing of SVC. The optimization technique using MLSA proposed in this paper is useful for power system designers who require consistent and accurate location and sizing of SVC in real power system application.

12:40 *Determining Optimal Location and Capacity of Batteries for Enhancing Microgrid Resilience...62*

Fericko Satya Wicaksana, Rony Seto Wibowo and Ni Aryani (Institut Teknologi Sepuluh Nopember, Indonesia)

Microgrid systems can experience prolonged outages, load shed, and also can affect the resilience of Microgrid, when there are unexpected contingencies due to human error or natural disasters. Integrating Battery Energy Storage (BES) is necessary to increase the resilience of the Microgrid system by recovery the load because it can act as an additional generator and can return the power supply to the load directly in the event of a contingency. Integration BES needs an optimal location and capacity determination plan. In this paper, by using the Hybrid Multi-Objective Particle Swarm Optimization (H-MOPSO) method which is a combination of Multi-Objective Particle Swarm Optimization (MOPSO) and Non-Dominated Sorting Genetic Algorithm II (NSGA II) methods determine optimal BES placement. The objective function used in this research is to maximize annual benefits costs and minimize Load shedding under contingency conditions. This paper also uses Linear Distribution Factor (LODF) to calculate the security constraint of the Microgrid system, which will be used to manage the line limit.

D1: Session 1_3

Renewable Energy and Storage

Chairs: Haroon Rashid (Universiti Kebangsaan Malaysia & Universiti Tenaga Nasional, Malaysia),

Wan Noraishah Wan Abdul Munim (Universiti Teknologi MARA, Malaysia)

11:00 *Enhancing the Photovoltaic System Output Performance Through the Use of Maximum Power Point Tracking and Fuzzy Logic Control...68*

Ali Alzaidi (UTM, Malaysia)

Renewable energy is becoming more popular every day. This is mainly attributed to threats that fossil fuels pose towards the climate change, and also the fact that they are scarce. Thus, solutions such as solar energy are among the top trending alternatives to the fossil fuels. However, one of the main issues with solar energy, particularly with its most popular technique, the photovoltaic solar arrays, is that they are not efficient when it comes to their ratio of power to cost. In order to address this problem, we propose a voltage regulation system that enhances photovoltaic system. The main feature of this system is that it uses a DC-DC converter that regulates the power using specific voltage inputs. Combining this system with Maximum Power Point Tracking (MPPT), the efficiency of the photovoltaic panels to reach its maximum capacity. The voltage is regulated using a buck and boost converter. In order to simulate the environment, MATLAB SIMULINK is used for developing and

implementing the system, as well as applying the algorithms related to the fuzzy logic controller for Pulse Width Modulation (PWM) signal generation on the converter. The results indicated that using fuzzy logic technique is an effective method for the increasing the photovoltaic system power to cost efficiency. Other than being a novel technique, the fuzzy logic strategy is also robust and adaptable, which allows it to be combined with a multitude of systems.

11:20 *Assessment of Grid-Connected Residential PV-Battery Systems in Sweden - A Techno-Economic Perspective...73*

Md Ahsan Kabir (Millitary Institute of Science and Technology & NA, Bangladesh); Mahmood Reaz Sunny (Uttara University, Bangladesh); Md Nazrul Islam Siddique (Islamic University of Technology, Bangladesh)

Ensuring a secure supply of electricity without harming climate is a key challenge for future power system and many renewables-based cutting-edge technologies are introduced to overcome this challenge. This paper aims to study the grid-connected residential PV-battery system at behind-the-meter scenarios in Sweden from a technical and economic perspective. The system is designed with PV arrays, inverters, Lithium-ion or lead-acid batteries. The optimal PV, lithium-ion and lead-acid battery size are determined at two locations (Arlanda and Karlstad) in Sweden based on the highest value of Net Present Value (NPV), Profitability Index (PI), the lowest value of Levelized cost of energy (LCOE) and payback period considering system losses, electricity market price, cost and PV incentives and a comparison is performed between these two locations against some techno-economic performance metrics for two combinations of PV-battery systems. Then, the best-case energy profile, bill savings, battery performance are also investigated. Finally, the system is simulated using System Advisory Model (SAM), a renewable analysis software from NREL, USA, and is found that the grid-connected PV with lithium-ion battery system is feasible and more economical considering available PV incentives in Sweden.

11:40 *Control Strategies for Brushless Doubly Fed Reluctance Generator in WECS: Review...79*

Emad Yassin, Haitham Yassin and Mohab Hallouda (Cairo University, Egypt)

With two electrical ports and one mechanical port, the brushless doubly fed machine (BDFM) has more speed and power control degree of freedom, high reliability and inherent fault tolerance capability compared with conventional singly fed machine. Recently, the BDFM has been proposed as a talented alternative for the conventional doubly fed machine. This paper is concerned with using the Brushless Doubly Fed Reluctance Generator (BDFRG) in wind power applications. The BDFRG has additional advantages when compared with conventional counterparts. Rather than dive into details, a historical review on the BDFRG and its principle of operation is presented to understand the theory of operation. This paper also introduces the modelling equations in d-q frame and space phasor. This paper focuses on the different control techniques used with BDFRG in literature to extract maximum power from wind and control the machine power factor to show how would this machine be a suitable alternative generator in wind applications.

12:00 *Bioelectricity Harvesting at Aquaponics System: Current and Future Challenges...85*

Ghaibulna Abdol Lajis and Jasronita Jasni (Universiti Putra Malaysia, Malaysia); Nur Ashida Salim (Universiti Teknologi MARA, Malaysia); Norhafiz Azis (Universiti Putra Malaysia & Centre for Electromagnetic and Lightning Protection Research, UPM, Malaysia); Mohd Amran Mohd Radzi and Mohd Nazim Mohtar (Universiti Putra Malaysia, Malaysia)

Bioelectricity is one of the high potential alternatives for sustainable energy production. Bioelectricity generated from living organisms including plants and bacteria has been discussed and explored by researchers in the past decades. Several methods of electrical energy harvesting had been researched and developed with living organisms as the sources of the energy including plant microbial fuel cell (PMFC) and plant-based cell (PBC). It was recognized that electrical energy can be harvested from living organisms and has great potential. Aquaponics on the other hands is known as the combination food production system involving aquatic species, plants, and bacteria, where it has the elements needed for bioelectricity generation. This paper will review the potential of harvesting electrical energy from living organisms at the aquaponics system and recommendations for future works.

Monday, March 8 14:00 - 15:30

D1: Session 2_1

Electric &Hybrid Vehicles, Smart Grid

Chairs: Ismail Musirin (Universiti Teknologi MARA, Malaysia),

Hasmaini Mohamad (Universiti Teknologi MARA, Malaysia)

14:00 *Wireless Power Transfer Analysis and Power Efficiency Enhancement via Adaptive Impedance Matching Network...91*

Amr Zawawi (Alexandria University, Egypt); Mostafa Mahmoud Abdelrazek (Alexandria Higher Institute of Engineering and Technology, Egypt); Tamer Abdelhamid (Faculty of Engineering Alexandria University, Egypt)

Wireless power transfer (WPT) is a new global trend technology in the last two decades. There are some difficulties face energy to transfer with high efficiency, such as the axial distance, lateral and angular misalignment between the transmitter and receiver coils. The mutual inductance between coils is changed and consequently efficiency when the positions of coils varying. This paper calculates and modeling the mutual inductance between the transmitting coil and receiving coil by the finite element method. The series-series resonant circuits is analyzed and modeled at different positions of coils. The model is designed by calculated coils inductance and resonant capacitance for transmitter and receiver circuits. The effect of changing in the supply frequency, load, axial distance and lateral misalignment on power efficiency are simulated. The Impedance Matching Network (IMN) is used to improve the power efficiency with variable axial distances and lateral misalignment. The adaptive IMN with bat algorithm technique is used to robust the power transfer efficiency.

14:20 *An Optimization-Based Control of Indoor Lighting: A Comparative Study Between Particle Swarm Optimization and Firefly Algorithm...97*

Nik Sahidah Nik Ahmad and Nur Hanis Mohammad Radzi (Universiti Tun Hussein Onn Malaysia, Malaysia)

Lighting systems are the major factor in workplace comfort, productivity and stress. In fact, proper lighting is needed to improve the performance of work, increase the appearance of the area and has a positive psychological effect on the occupancy in the building. The increasing number of buildings in Malaysia leads to the difficulty of managing the distribution of the electricity and saving energy usage due to inefficient system for lighting distribution. There are many types of lighting system and these system have different performance in terms of radiated heat, long lifetime, energy efficiency, power consumption and others. Hence, in order to identify the optimal dimming level and energy consumption, this paper present the comparison between light emitting diode (LED) and fluorescent luminaires using particle swarm optimization (PSO) and firefly algorithm (FA). In this study, the comparative results show that the advantages of the PSO algorithm with using LED luminaires, significant energy savings up to 50.4% and fully satisfied the average illuminance value accordance with MS-1525.

14:40 *A New Centralized Controller for Islanding Operation of Distribution Network Connected with Rotating Type DG...103*

Hasmaini Mohamad (University of Technology MARA, Malaysia); Javed Ahmed Laghari (Quaid-e-Awam University of Engineering Science & Technology Nawabshah Pakistan, Pakistan); A. B. Halim Abu Bakar (University of Malaya, Malaysia); Nur Ashida Salim (Universiti Teknologi MARA, Malaysia); Zuhaila Mat Yasin (Universiti Teknologi Mara, Malaysia)

The islanding operation of a distribution network connected with distributed generation may be a useful way to improve its power reliability. However, it requires a good control strategy for ensuring a safe operation of islanded system controlling voltage and frequency of the system within their permissible range. This paper proposed a centralized controller to coordinate the islanding operation

with multiple islanding configurations for rotating type DGs. Multiple islanding configurations are introduced to maximize the benefit of islanded operation. The advantage of the proposed strategy is that DG will be able to operate in different islanding areas instead of energizing only one islanding area. The proposed controller regularly communicates with the governor and excitation controllers of the DG units with the utility grid to carry out action in case of an islanding event. The performance of the proposed controller is investigated for various simulations carried out on an existing Malaysia distribution network. The simulation results show that the islanding operation for each configuration is dynamically stable.

15:00 *Photovoltaic Power Forecasting Using Recurrent Neural Network Based on Bayesian Regularization Algorithm...109*

Vita Kusuma and Avian Lukman Setya Budi (Institut Teknologi Sepuluh Nopember, Indonesia); Ardyono Priyadi (ITS, Indonesia); Vita Lystianingrum (Institut Teknologi Sepuluh Nopember, Indonesia)

Photovoltaic (PV) is a generator that utilizes solar energy into electrical energy. On-grid photovoltaic is the system can reduce electricity bills, besides that the electricity produced is environmentally friendly and free emission. PV power output intermittent depending on weather conditions. Therefore, this research will predict the power output PV one day ahead using Recurrent Neural Network (RNN) method with Bayesian Regularization Algorithm because it can solve problems regarding prediction, classification, and energy management. The measure of accuracy error from the simulation result in this study is calculated using Mean Absolute Percentage Error (MAPE). The PV power forecasting accuracy using RNN method is compared with actual data. The amount of load power that PV cannot fulfill will later be back up by the grid. The prediction of PV power using RNN method with 4 neuron hidden layers and learning rate 0.01 resulted in the best MAPE value of 2,2784 %. Based on the results, PV power forecasting output using the RNN method with historical data can be applied to determine the amount of PV power for day ahead.

15:20 *Photovoltaic Power Forecasting Using Cascade Forward Neural Network Based on Levenberg-Marquardt Algorithm...115*

Norma Mahmudah and Avian Lukman Setya Budi (Institut Teknologi Sepuluh Nopember, Indonesia); Ardyono Priyadi (ITS, Indonesia); Vita Lystianingrum (Institut Teknologi Sepuluh Nopember, Indonesia)

Renewable energy is useful energy collected from renewable resources, and renewable resources are naturally replenished within human time. Photovoltaic (PV) is a generator that converts solar energy into electrical energy. Depending on the weather, photovoltaic output is an occasional output. Therefore, this study will use the Cascade Forward Neural Network (CFNN) method with the Levenberg-Marquardt algorithm to predict photovoltaic power plants one day in advance. The measure of accuracy error from the simulation result in this study is calculated using Mean Square Error (MSE). From the simulation results, it is obtained that The Cascade Forward Neural Network (CFNN) method with the Levenberg-Marquardt could give the better MSE at the learning rate of 0.1 by mean MSE of 0,308% while the learning rate of 0.05 by mean MSE of 0,326% and learning rate of 0.01 by mean MSE of 0,322%. It is also obtained that Cascade Forward Neural Network (CFNN) method also eligible for solving photovoltaic power forecasting problem due to its accuracy and should be eligible for another renewable energy electricity source power forecasting.

15:40 *Voltage &Frequency Regulation, Power Factor, THD of Load Voltage and Current Improvement of a Electric Spring Based Smart Grid...N/A*

Md Asif (Vardhaman College of Engineeing, India); Sardar Ali (Deccan College of Engineering, India); N Sambasiva Rao (JNTU Hyderabad, Malaysia)

In this paper, investigated advantages of Electric Spring with Back to Back converter in an Hybrid system having solar and wind as energy sources and battery as storage device. PMSG is used for conversion in wind generating system. The characteristic of the electric spring in providing fast reactive power compensation and voltage and frequency stability is found to be highly useful in recovering PMSGs when unstabilized event due to weather conditions occurs. An effective control scheme is developed for Back to Back to converter to achieve stability even during severe weather conditions. Proposed converter in hybrid system is verified by simulation using MATLAB/SIMULINK. The results

show that Electric Spring Back to Back converter is efficiently stabilizing the voltage and frequency and compensating the reactive power.

D1: Session 2_3

Renewable Energy and Storage

Chair: Jasrul Jamani Jamian (Universiti Teknologi Malaysia, Malaysia),
Bibi Norasiqin Rahimullah (Universiti Teknologi MARA, Malaysia)

14:00 *Energy Gain Between Automatic and Manual Solar Tracking Strategies in Large Scale Solar Photovoltaic System- 12 Cities Comparison...121*

Mohamed Nageh and Md Pauzi Abdullah (Universiti Teknologi Malaysia, Malaysia)
The electrical power generation from a solar photovoltaic (PV) system can be maximized by using automatic solar tracker via single-axis or dual-axis solar tracker system. However, such system is more expensive and complex than the fixed solar system. Manual tracker that changes the tilt angle of PV panel on periodical basis is another alternative that can be considered. This paper compares the energy output performance of a grid connected large scale solar (LSS) PV system with the following solar tracking strategies i) automatic single axis ii) automatic-dual axis iii) manual-monthly adjusted tilt angle and iv) manual-seasonally adjusted tilt angle. 12 cities worldwide were chosen systematically for this study. PV mathematical model was developed by using MATLAB software to simulate the energy output of 1 MW LSS PV system in terms of its annual daily average energy output (MWh/day). The results show that the energy output of a single-axis solar tracker PV system is close to the dual-axis tracker system for most cities, especially the one located at 40 degrees latitude and above. Thus, single-axis tracker system is preferred due to less expensive, lower cost operation & maintenance, less complex than the dual-axis tracker. Moreover, the results show that the energy output from manual tracker with monthly optimal tilt angle is greater than seasonally. With energy gain that can reached up to 8% depending on the location's latitude angle as well as the local climatic conditions of each city. Generally, manual trackers are much cheaper, easier, most reliable, and longer lifespan than automatic trackers. Thus, manual tracking with monthly optimum tilt angle can be considered as an alternative solution between the high energy gain, expensive automatic solar tracker system and the low energy gain (relatively), yet cheap fixed panel solar PV system.

14:20 *Development of A Guided Drone Powered by Radio Frequency Energy Harvesting...127*

Win Adiyansyah Indra (Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik (FTKEE), Universiti Teknikal Malaysia Melaka, Malaysia); Safarudin Gazali Herawan (Faculty of Engineering Bina Nusantara University, Indonesia); Nur Syahirah Zamzam(Texas Instrument Electronics Malaysia); Suhaila Mohd Najib (Universiti Teknikal Malaysia Melaka, Malaysia); Nurulhalim Hassim (Universiti Teknikal Malaysia Melaka & Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik, Malaysia); Fikarwin Zuska (Faculty of Social Science and Politics, University of Sumatera Utara, Indonesia)
This paper developed a guided drone or quadcopter or quadrotors energized by Radio Frequency Energy Harvesting, one type of energy scavenging that notwithstanding its least yield power among any other energy scavenging types, its all the time accessibility, batteryless and availability wherever make its own points of interest no other sort of energy scavenging has. A 32bit Acro Naze32 Brushed Flight Controller was used in this work as it was easier to program with the BetaFlight software and able to operate with minimal supply of 3.7 Volts.. A 3 Watt independent power transmitter with frequency of 915 Mhz used to test the model to supplant the encompassing accessible radio frequency resources. The outcomes depicted that the drone was successfully flew in indoor and outdoor environment, able to take off from ground, hover in the sky and land, the maximum range of the drone is around 200 metre as a micro receiver was used for the drone construction, While the battery cycle of the constructed drone is around 7 minutes up to 12 minutes.

14:40 *Efficient Voltage Profile Based Model-Predictive Control Strategy for Stand-Alone Wind-Integrated Hybrid Microgrid Systems...N/A*

Habib Ur Rahman Habib (Huazhong University of Science and Technology, Wuhan, China & University of Engineering and Technology, Taxila, Pakistan)

Future power system depends on penetrating more renewable energy to fulfill the drastic increase in energy demand with reduced carbon emission. Wind energy integration is increasing in worldwide each year. To efficiently investigate a quality voltage for AC loads under wind speed variations, a combined control strategy is proposed in this paper. It consists of PI and model predictive control (MPC) for the three-phase rectifier and interlinking inverter, respectively. The controlled rectifier ensures a constant DC-bus voltage under variable wind speed, while MPC is used to control output AC load voltage under abrupt load changes. Unlike traditional controllers, MPC does not require PI controllers for inner current and outer voltage loop or complex modulation steps. The discrete state-space model of VSI, LC filter, and load currents are used to predict future trends of load voltage for each of eight switching states. The control strategy selects the optimal switching state that reduces the error difference between reference and predicted load voltage. The proposed scheme is tested under perturbation of generation and load parameters. The proposed MPC strategy is compared with the conventional method-based PI controllers. The presented results ensure the effectiveness of the proposed approach with 0.67% THD for the AC output voltage.

15:00 *Solar Irradiance Prediction for Voltage Variance Analysis in the GCPV System Using LSSVM...132*

Fahteem Hamamy Anuwar (University Kuala Lumpur, Malaysia)

Photovoltaic power generation is increasingly expanding into a large-scale power industry with the maturation of renewable energy technologies. Prediction of accurate solar irradiance is essential to ensure system efficiency and performance. The Least Square Support Vector Machine (LSSVM) model is proposed for predicting solar irradiance of grid-connected photovoltaic (GCPV) output power. The impact of the increase in photovoltaic power on the power flow of the grid voltage fluctuation is simulated and analyzed using MATPOWER. The result shows that LSSVM produces promising results for the short-term prediction of solar irradiance and photovoltaic output.

15:20 *Optimization of a Micro Hydro Power Plant...N/A*

Somila Hashunao (NERIST, Deemed University, Nirjuli, Itanagar, India)

Electrical power plays a crucial role in both economical and social development. Micro Hydro Power being economical and reliability and having no environmental pollution, is a magnificent approach of utilizing renewable sources of energy from small rivers and streams They are usually run -off-river type, as they require very small or no reservoir for running the turbine. The flowing water runs directly into the turbine and then flows back into the river or stream for other purposes. This led to a minimal impact to the environment. The Government of India has classified those plants having an installed capacity up to 25 Mega Watt to be Small Hydro power plants. The Ministry of New and Renewable Energy or MNRE has been given the authority and responsibility in developing this sector. According to MNRE, those power plants having a generation capacity up to 100 kilo Watt are regarded to be Micro Hydro Power Stations /MHPPs In some remote or urban parts of the country, on grid electrification becomes a problem due to cost consideration and other factors. In order to address for this matter, there is a need to exploit off grid renewable energy solution. A Python programming has been done so as to address for the optimization problem of a Micro Hydro Power Plant. The optimization problem that has been addressed here is a single objective function where the cost of the plant is the fitness function (minimization problem).

D1: Session 2_2

Internet of Thing (IOT) & Data Analytics

Chairs: Naeem M. S. Honnoon (Universiti Teknologi MARA, Malaysia),
Siti Zaliha Mohammad Noor (Universiti Teknologi MARA, Malaysia)

14:00 *Lux Meter Integrated with Internet of Things (IoT) and Data Storage (LMX20)...138*

Muhammad Danial Ahmad, Siti Zaliha Mohammad Noor and Nor Farahaida Abdul Rahman (Universiti Teknologi MARA, Malaysia); Faranadia Abdul Haris (University of Technology MARA, Malaysia)

This project presents a prototype of lux meter integrated with Internet of Things (IoT) and data saving. Some commercial lux meters do not have data storage and cannot connect to the internet. Therefore, this project developed a prototype of a lux meter with additional features such as data logger and IoT. The prototype is using NodeMCU as its controller because it is cheap and easy to use. Besides, the sensor used for this prototype is BH1750 light sensor. It has a wide range sensor, and it could detect up to 65535lx value. Then, the data obtained also can be stored and saved in the Secure Digital (SD) card. These features will allow the user to secure the data and use it in the future. For IoT, there is a built-in WiFI module which is ESP8266 where it connects the prototype to the application in a smartphone which is the Blynk application. In the application, it will show the reading of the lux from the prototype, and there is a graph analysis of the lux measurement. Apart from measuring the lux, this prototype is also suitable for monitoring applications as the measurement can be monitored from a smartphone. However, the experimental test is done at home obeying Movement Control Oder (MCO) due to Covid-19 in this area.

14:20 *Distributed Clustering for User Devices Under UAV Coverage Area During Disaster Recovery...143*

Abdu Ahmed Saif (UM-Malaysia & Yemen, Malaysia); Kaharudin Dimyati and Kamarul Noordin (University of Malaya, Malaysia); Nor Shahida Mohd Shah (Universiti Tun Hussein Onn Malaysia (UTHM), Malaysia); Saeed Alsamhi (Electronics Engineering, India); Qazwan Abdullah Mohammed Tarbosh (UTHM, Malaysia); Nabil Farah, farah (UTeM, Malaysia)

An unmanned aerial vehicle is a promising technology for providing wireless coverage to ground user devices in the event of disasters, which all of communication infrastructure was destroyed. UAVs battery life is challenging during service delivery in post-disaster scenario. Therefore, selecting cluster head among user devices plays a vital role in detecting UAVs signals and processing data for improving UAV energy efficiency and reliable connectivity. This paper focuses on performance evaluation of the clustering approach performance in detecting wireless coverage services with improving energy efficiency. The evaluation performance is a realistic simulation for the ground-to-air channel line of sight. The results show that the cluster head can effectively link the UAVs and cluster members at minimal energy expenditure. The UAVs altitudes and path loss exponent affected to user devices for detecting wireless coverage. Moreover the performance of bit error rate in the cluster heads is consider for reliable connectivity in post-disaster communication. Clustering stabilizes the clusters linking the uncovered nodes to the UAV and its effectiveness in doing so resulted in its ubiquity in emergency communication

14:40 *Embedded Wireless Stingless Beehive Monitoring and Data Management System...149*

Noor Hafizah Khairul Anuar (Universiti Teknologi Malaysia, Malaysia)

In this paper, an embedded wireless stingless bee monitoring system, which investigates the environment's temperature and humidity effect on the bee activity and honey production of Heterotrigona Itama, a stingless bee species, is presented. The variables observed by the system are the weight of the honey container, the temperature inside the hive, humidity inside the hive, temperature of the environment outside of the hive, the humidity of the environment outside of the hive, and bee activity counter. The sensors used are Strain Gauge Load Cell (SGLC) sensor for weighing purposes, DHT22 sensors for temperature and humidity, and infrared transceivers bee counter sensor for bee activity monitoring. All installed sensors were controlled by using a NodeMCU microcontroller. All data were recorded and transferred to a Google Firebase real-time database. The proposed system offers an android application to access the recorded data called EMAS apps. EMAS fetches all the information from the database and represents it on graphs and pages in the user smart devices. This paper analyses the data obtained for 36 hours from a single hive. Results obtained represent a relationship between the temperature collected and bee activity with the honey produced. It was observed that in the morning, the increase of temperature leads to high traffic of bees going out of

the hive, which decreases the weight of the hive to 2.7 Kg. Meanwhile, in the evening, the decrease in temperature leads to high traffic of bees going into the hive, which increases the hive weight to 4.5 Kg. For future work, to enhance the system's performance, installation of the embedded system into an array of hives was advised and long-term data observation process was required.

15:00 *Traffic Flow Prediction Using SVR-Ant Colony Optimization: A Practical Case of Tehran Highway...155*

Hossein Zeynal (Tehran Farayand Dena Engineering Co., Iran); Zuhaina Zakaria (Universiti Teknologi MARA, Malaysia); Ahmad Kor (Tehran Farayand Dena Company, Iran)

Traffic estimation is one of the most important issues in traffic control parlances. In this work, an integrated approach is proposed, which is a combination of three algorithms including K-means clustering, Support Vector Regression (SVR) and Ant Colony Optimization (ACO) approach. Using the K-means clustering algorithm allows obtaining optimal values for SVR via ACO algorithm and then employ it to predict traffic flow. To carry out simulations, two realistic cases of traffic flow prediction for Tehran-Karaj and Tehran-Damavand highways is investigated at two checkpoints in the morning and afternoon periods. Further, to evaluate the quality of solutions obtained from the proposed method, a time series model was used to end comparisons. Based on the results, the NRMSE forecast error for the proposed method presents less as opposed to well-known SARIMA method for morning and evening periods. Therefore, the proposed method outperforms SARIMA in terms of prediction error; that is by 0.26 versus 0.31 and 0.11 versus 0.18 for Tehran-Karaj highway during the morning and evening intervals. According to the results for two main highways, the proposed method exhibits its suitability for practical application in traffic prediction with accurate solution and simplicity of application in real cases.

15:20 *An Improved ANFIS Based Traffic Flow Control Through a Novel Approach on Input Selection...161*

Hossein Zeynal (Tehran Farayand Dena Engineering Co., Iran); Zuhaina Zakaria (Universiti Teknologi MARA, Malaysia); Ahmad Kor (Tehran Farayand Dena Company, Iran)

This paper introduces a new technique for efficient control of traffic flow in congested area. It is done through an optimal prediction of traffic flow, which is an important issue in intelligent transportation systems (ITS). However, the traffic flow is affected by manifold factors including nonlinear behavior of motorists. Therefore, it can be defined as an intensely non-linear time-variant system. As a practical case, the traffic system on a 5-street intersection in the city of Mashhad, Iran is tested. In this work, an innovative input selection adaptive network-based fuzzy inference system (ANFIS) approach is proposed which is an added- value to the ANFIS prediction system used in this work. ANFIS is a fuzzy system that possesses the self-training neural-network adaptive capability which has been served as an optimal controller proven by many applications. The flexibility of welcoming additional number of parameters plus with training process made ANFIS a good choice for various non-linear applications. The proposed technique has been modeled in MATLAB software and obtained results exhibit that the ANFIS model with the novel effective input determination technique represented promising outcomes. The results were compared with the classical model to support the proposed objectives.

15:40 *Suspended Core Cladding Structured Photonic Crystal Fiber for THz Wave Guidance...N/A*

Md. Abdullah Al Mahmud (University of Asia Pacific, Bangladesh); Mohammad Rakibul Islam (Islamic University of Technology, Bangladesh); Farhana Akter Mou and Md. Moshiur Rahman (University of Asia Pacific, Bangladesh)

In this work, a suspended core cladding structured photonic crystal fiber (PCF) has been proposed for efficient THz wave propagation. Guiding properties of developed PCF are investigated through the Comsol Multiphysics with the finite element method. Due to the strategic geometrical optimization, it renders improved performances in the most of the crucial cases. It exhibits ultra-low effective material loss of 0.022 cm-1 at 0.9 THz, besides, near-zero flatten dispersion is observed in the wide THz spectrum. Moreover, to ensure the suitability of proposed PCF, other significant guiding properties

such as confinement loss, dispersion and v-parameter, etc. are observed in the same THz frequency. Furthermore, fabrication feasibilities in the existing manufacturing platform are also discussed in detail.

Tuesday, March 9

Tuesday, March 9 9:00 - 10:30

Keynote Address 2

Towards Digital Utility - Challenges and Opportunities
Ir. Dr. Mohd Fadzil Mohd Siam, Head (Corporate Strategy & Sustainability), Strategy & Regulatory Division, Tenaga Nasional Berhad

Chair: Hazlie Mokhlis (University of Malaya, Malaysia)

Tuesday, March 9 11:00 - 13:00

D2: Session 1_2

Electrical Machines & Drives and High Voltage Engineering & Technology
Chairs: Norhafiz Azis (Universiti Putra Malaysia & Centre for Electromagnetic and Lightning Protection Research, UPM, Malaysia),
Mohd Abdul Talib Mat Yusoh (Universiti Teknologi MARA, Malaysia)

11:00 *Analysis of Fault-Tolerant Dual Three-Phase Induction Machine Using Graphical User Interface...167*

Wan Noraishah Wan Abdul Munim (Universiti Teknologi MARA, Malaysia); Hang Seng Che (UMPEDAC & University of Malaya, Malaysia); Mahdi Tousizadeh (University of Malaya, Malaysia); Muhammad Hazizi Ahmad Khairi (Universiti Teknologi MARA, Malaysia)

This paper provides a fault-tolerant study of dual three phases induction machine in consideration of minimum-loss (ML) and maximum-torque (MT) strategy with single and two isolated neutral points under one to three open-circuit faults. For any given torque, the ML offers lower copper loss compared to MT, but a smaller range of torque operation. The machine's post-fault output is measured in terms of derating factor, minimum copper loss and minimum peak current. The simulation results supports the validity of the theoretical post-fault current limits. Furthermore, in order to make the user understands what to expect when performing post-fault tolerant of a machine, the graphical representation of a program using the Graphical User Interface (GUI) was specifically created for learning and teaching aid in course such as Electric Drives and Machines.

11:20 *Positive Cloud-To-Ground Lightning Observed in Shah Alam, Malaysia Based on SAFIR 3000 Lightning Location System...178*

Dalina Johari, Muhammad Fariz Aiman Misri Amir and Norazlan Hashim (Universiti Teknologi MARA, Malaysia); Rahimi Baharom (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Faranadia Abdul Haris (University of Technology MARA, Malaysia)

Compared to negative cloud-to-ground (CG) lightning, positive CG are less frequent but can produce strokes with higher peak currents making them to be potentially more dangerous. This paper presents an investigation on positive cloud-to-ground (CG) lightning activity in Shah Alam, Malaysia recorded

by SAFIR 3000 lightning location system (LLS). For this study, a total of 572,282 LLS data from 2013 to 2015 were analyzed. We found that only 1.6% of the total CG flashes were contributed by positive CG while the remaining 98.4% were dominated by negative CG. We also observed that the occurrence of positive CG follows the weather pattern of Malaysia, with a strong connection between positive CG and rain events. Most positive CG occurred in November, while the least occurred in February. Our results showed that the highest peak current for positive CG was 86.7 kA with average geometric mean and median values of 14.2 kA and 12.8 kA, respectively. The negative CG recorded a higher peak current of 139.6 kA with average geometric mean and median values of 13.6 kA. Previous studies conducted on positive CG in Malaysia may be an overestimate if weak positive flashes were included in the analyses. Due to a limited number of existing studies on positive CG conducted in Malaysia, more researches should be conducted.

11:40 *Typical Measurement to Detect Interlaminar Losses...188*

Gugun Bonar Maruhum Jusman Daniel (PT PLN (PERSERO), Indonesia); Andhika Pratama (PT. PLN (Persero), Indonesia); Harry Gumilang (PLN, Indonesia)

Interlaminar Losses Failures are failures that ever happened to high voltage transformers 150/20 kV in PLN UIT JBT during 2018. This type of failure is typically hard to detect due to unclear result based on electrical testing. Typically, electrical measurement such as Tan Delta, DC Insulation Test, DC Resistance (RDC) cannot clearly detect this type of failure. Therefore, a proper measurement that can predict this type of failures is highly needed to prevent catastrophic failures on power transformer. The main cause of this failure is when a magnetic core (MC) plate, aimed to discard leakage current through core bushing, runs into certain defect. This defect could occur because the MC plate is accidentally connected to more than one Core Layers, which is forbidden. As a result, this forbidden connection yields interlaminar losses inside the transformer especially between core layers. The interlaminar losses produce heat that can be detected by DGA (Dissolved Gas Analysis) measurement. Certain pattern of DGA result is shown in order to describe these phenomena. When engineers encounter similar pattern to this DGA result, they can perform a preventive action to the transformer asset, particularly to the core.

12:00 *Electrical Properties and Raman Scattering of Palm Oil Based Carbon Nanotube...N/A*

Abdul Rashid Abdul Rahman (National Defence University of Malaysia, Malaysia); Nur Sabrina Suhaimi (Universiti Pertahanan Nasional Malaysia, Malaysia); Muhamad Faiz Md Din (National Defence University of Malaysia, Malaysia); Mohd Ishak (Universiti Pertahanan Nasional Malaysia, Malaysia)

This paper studies the electrical efficiency of carbon nanotubes (CNT) with nano-sized diameter inserted into palm-based oil at various concentrations (0, 0.0125, 0.025, 0.0375, 0.05, 0.125, 0.25 and 0.5 g/L). Dispersion methods, including sonication and drying process were systematically applied for producing stable CNT nanofluids. Several parameters such as electrical properties (AC breakdown voltage) and dielectric properties (dissipation factor, relative permittivity and resistivity) were measured accordingly based on IEC 60156 and IEC 60247 international standards. The test results reveal that the higher concentration of CNTs dispersed in palm oil, the lower AC breakdown voltages produced. At 0.5 g/L concentration, the average of 50 breakdown was 22.30 kV, which is 72.33% decrement compared to palm oil without any nano-filler. Besides, the permittivity and resistivity of CNT nanofluids decrease as concentrations increased, while dissipation factor increases along with CNT concentrations. In order to further support this indication, Raman analysis is measured to relate the behavior of AC breakdown voltages and chemical structure of CNT nanofluids. Based on the Raman spectra at 2800-3200 cm-1 region, it is shown that the value of total unsaturated fatty acid and total fatty acid decreased as concentrations of CNT increased. This occurrence directly influences the degradation performance of AC breakdown voltages.

12:20 *Electrical Properties of Waste Mineral Oil Recycled Under Various Treatments and Doping with Nanoparticles for Transformer Application...198*

Muhammad Haikal Mohd Tukiman (National Defense University of Malaysia, Malaysia); Nur Sabrina Suhaimi (Universiti Pertahanan Nasional Malaysia, Malaysia); Muhamad Faiz Md Din (National Defence University of Malaysia,

Malaysia); Abdul Rashid Abdul Rahman and Mohd Ishak (Universiti Pertahanan Nasional Malaysia, Malaysia)

The transformer is used as a device to step-up or step-down electrical power and operate continuously for a long period. Mineral oil is the medium most commonly used as a transformer insulation since it has been functioned as cooling agent for its properties but has been substituted over a period of time. In this research, some properties of wasted mineral oil recycled under different process and doping with various concentration of Carbon Nanotube(CNT); 0.001g/L, 0.005g/L, 0.01g/L, 0.015g/L, 0.02g/L, 0.025g/L, 0.03g/L and 0.035g/L) are studied accordingly. It is observed that, there is 96.90% enhancement in case of AC breakdown voltage at 0.005 g/L concentrations compared to wasted mineral oil without any addition of nanoparticles. Tan delta value, permittivity and resistivity of oil samples also reflect the value of breakdown voltage obtained in this study. It is figure out that, CNT nanofluid can reach the greatest breakdown efficiency as good insulating oil at 0.005g/L CNT concentration which promising advantage for future transformer applications.

D2: Session 1_3

Power Electronics and Applications/Electrical Machines & Drives
Chairs: Nik Hakimi Nik Ali (Universiti Teknologi MARA, Malaysia),
Nor Farahaida Abdul Rahman (Universiti Teknologi MARA, Malaysia)

11:00 *Microcontroller Based Pure Sine Wave Inverter...173*

Nasim Ahmed (Bangladesh University of Engineering and Technology (BUET), Bangladesh); M. Ziaur Rahman Khan(Bangladesh University of Engineering and Technology, Bangladesh)

The design of a microcontroller-based pure sine wave single phase inverter is presented here. The system has an output of 220V and 50 Hz. The sinusoidal pulse width modulation technique has been used for the design. The circuit is simulated in Proteus to ensure the output results are verified practically. The experimental result shows a good argument with the simulation data. The inverter has fewer harmonics, is simpler to design compared to the traditional inverter technology. The designed inverter is tested on various AC loads and is essentially focused upon low power applications.

11:20 *A Single-Phase Grid-Connected Inverter Using Phase Control Method...183*

Nasim Ahmed (Bangladesh University of Engineering and Technology (BUET), Bangladesh); M. Ziaur Rahman Khan(Bangladesh University of Engineering and Technology, Bangladesh)

The design of a single-phase grid-connected inverter (GCI) using the phase-control technique is presented here. The circuit has fewer harmonics and a simpler design than traditional GCI technology. The performance of GCI has a direct influence on the entire distributed generation system. The control architecture of GCI must ensure the capability of matching inverter output voltage and frequency with continuously fluctuating grid voltage and frequency. The dynamic sinusoidal pulse width modulation technique (SPWM) has been used to control the power switches of the inverter. The finished design is simulated in MATLAB/SIMULINK to ensure output results.

11:40 *A New 2-Dimension Extendable Multisource Switched Capacitor Boost Multilevel Inverter with Reduced Components...192*

Yew Wei Sia (Curtin University, Malaysia); Kah Haw Law, Lenin Gopal and King Hann Lim (Curtin University Malaysia, Malaysia); Kiing-Ing Wong (Curtin University of Technology, Malaysia)

This paper proposed a novel extendable configuration of switched capacitor boost multilevel inverter (SCBMLI) based on multisource and switched capacitor (SC). The proposed topology can boost the DC voltage sources with self-voltage balancing across all the DC capacitors via binary-asymmetric method and series-parallel connection. Specifically, it can produce 57 and 113 level of AC output voltage by using 16 and 18 number of switches, respectively. With the aim of achieving low total harmonic distortion (THD) of 5% set by IEEE Standard 519-1992 for a range of different modulation indexes (MI)

(i.e., from 0.3 p.u. to 1 p.u.), this work is targeted to apply to high voltage transmission line in future for power quality improvement. In addition, by taking IEEE 1547 standard into consideration, the optimum configuration of the proposed topology to synthesize its peak AC output voltage within the tolerance boundary (i.e., from 0.95 p.u. to 1.05 p.u.) is sought after to maintain power system reliability for distributed energy resources (DER). To verify the performance of the proposed SCBMLI, detailed analysis with the variables of THD as well as the number of levels and the root-mean-square (RMS) of AC output voltage and current are simulated in MATLAB/SIMULINK. Finally, a comparative assessment with recently developed topologies is performed to demonstrate the advantages of the proposed SCBMLI.

12:00 *High Reactive Power Compensation Accuracy for Cascaded H-Bridge Inverter Based Decoupling Feed-Forward Current Vector Controller...204*

Kah Haw Law (Curtin University Malaysia, Malaysia); Yew Wei Sia (Curtin University, Malaysia)

The Static Synchronous Compensator (STATCOM) has gained popularity among many utilities for solving power quality problems in distribution substations. There are many types of topologies for STATCOM found in the literature, of which the Multilevel Cascaded H-bridge Inverter (MCHI) is the most adaptable and energy efficient power inverter topology. The aim of this paper is to define a control scheme and its transfer function in order to achieve low-switching frequency and high-bandwidth power control of MCHI. The controller of the proposed STATCOM system is implemented to provide vector control for reactive power or Voltage-Ampere Reactive (VAR) compensation at the Point of Common Coupling (PCC) under balanced loading conditions. To accomplish this, mathematical equations for a STATCOM system is derived in dq-coordinates based on Park's transformation. Then, the designed equations are used to calculate appropriate values of the controller's gain parameters for realizing the cascade Pulse Width Modulation (PWM) STATCOM with various voltage and current ratings. Lastly, the performance of the proposed control scheme is verified through simulation and numerical analysis using MATLAB-Simulink.

12:20 *Diagnostics for Rotating Electrical Machine Insulation...N/A*

Bernhard Fruth (Power Diagnostic Service, Switzerland)

This contribution discusses diagnostic procedures and some models which are applied to determine condition or operational risk of high voltage rotating machines. These are mainly AC and DC tests and visual inspections applied during an outage and partial discharge and ozone monitoring during operation.

12:40 *Impacts of Ambient Temperature Change on the Breakdown Voltage of a Distribution Transformer...N/A*

Michael S. Okundamiya, Emmanuel Esekhaigbe and James Owa (Ambrose Alli University, Nigeria)

The aim of this paper is to determine the effects of ambient temperature variation on the breakdown voltage of a distribution transformer. Three different insulation oil samples (naphtha mineral, paraffin mineral and silicon base transformer oil) were collected from six distribution transformers (300 - 500 kVA) across two business units (Asaba and Ugbowo) of Benin Electricity Distribution Company during May and June, 2017. The oil samples were analysed using the 60 kV Megger OST60PB portable oil tester, to determine the trend of breakdown voltage of the oil insulation under varying temperature. A 3rd order polynomial model was deduced for each sample type with coefficient of determination within the range of 96.99 - 99.95 %. The observed average breakdown voltage is 43.6 kV (for naphtha base mineral transformer oil), 42.2 kV (for paraffin base mineral transformer oil) and 46.8 kV (for silicon base transformer oil) within the temperature range (26°C - 32°C). The result indicates that the breakdown voltages of the considered transformer oil types are satisfactory but the silicon base transformer oil has the best breakdown voltage.

D2: Session 1_1

Power System Operation and Planning/Power System Economics and Electricity Markets

Chairs: Ahmad Farid Abidin (Universiti Teknologi MARA, Malaysia),
Nur Ashida Salim (Universiti Teknologi MARA, Malaysia)

11:00 *Single and Double PQ Disturbances Classification Based on Stockwell Transform and Support Vector Machine...210*

Mohd Saiful Najib Ismail @ Marzuki (Universiti Teknologi MARA Cawangan Terengganu); Ahmad Farid Abidin (Faculty of Electrical Engineering, Universiti Teknologi Mara, Malaysia); Mohd Zamri Bin Jusoh (Universiti Teknologi MARA & Cawangan Terengganu, Malaysia); Dalina Johari (Universiti Teknologi MARA, Malaysia)

Power quality disturbances can cause electrical appliances to malfunction, upsetting users who need the full performance of their device. A current and voltage waveforms interruption in power quality disturbances phenomena is due to the increased usage of electronic equipment. The problems to cater are, it can be harmful to users as well as reduce life expectancy of electrical products. In order to overcome this problems, classification of power quality disturbance is needed in order to provide the accurate information before the correct mitigation technique can be taken. In this paper, detection and classification technique, Stockwell transform, and Support Vector Machine were employed to classify nine types power quality disturbances including a single and multiple disturbances. Features were extracted to obtain a solid input for the classification purpose. The performance of the technique was analyzed and discussed to prove the reliability and the persistency of the technique.

11:20 *A Review of Operation Planning and Distribution Network Optimization of AADC Network...216*

Maha Aldahmi (AlAin Distribution Company, United Arab Emirates); Omar Reyadh Al Ahmad (AADC, United Arab Emirates)

This paper presents the procedure used to optimize the 11kV network of AADC at Al Ain area in the United Arab Emirates. The paper first describes the details process used to forecast the summer peak load for all feeders and power transformers of all primary substations. Also, the optimization mathematical model is discussed as well as the actual preparation plans followed according to this model, where the 11kV network components are studied from different prospective concentrating on the security of supply standards (SoS) approved by the regulator in addition to the objective of load losses reduction. As a result of optimization study, the normally open points (NOPs) are chosen based on this criterion. Moreover, any expected load violations or security constrains like unsecured 11kV rings and 33/11kV substations are obtained and investigated for further operational and planning actions. Furthermore, contingency plans are prepared for the extreme unsecured cases to be ready and overcome any overloading problems that might be faced during the peak season or any emergency case. A standardized optimization process is driven illustrating different teams' contribution and efforts to achieve network optimization based on tasks responsibility.

11:40 *Optimal Unit Commitment for Minimizing Total Operating Cost Using Ant Lion Optimizer...221*

Zuhaila Mat Yasin (Universiti Teknologi Mara, Malaysia); Izni Nadhirah Sam'on and Nur Ashida Salim (Universiti Teknologi MARA, Malaysia); Nur Fadilah Ab Aziz (Universiti Tenaga Nasional, Malaysia); Zuhaina Zakaria (Universiti Teknologi MARA, Malaysia)

This paper presents a new technique namely Ant Lion Optimizer (ALO) to determine optimal unit commitment. The proposed technique is simulated on IEEE 39-bus test system which consists of 10-unit generators with consideration of system constraints in unit commitment such as power balance, system reserve requirement, generation limit of generators, and minimum up and down time constraints. ALO is inspired based on hunting behavior of ant lion. There are five main steps, which include random walk of ants, trapping of ants in antlions' trip, building trap, sliding of ants towards antlion, catching prey and rebuilding the pit. The proposed ALO algorithm is able to identify the global optimum solution since the intensity of ants' movement is adaptively decreased as the number of iterations increase. In addition, the exploration of search space is guaranteed within the limitation of set-up boundaries. This behavior will enhance the optimization towards the optimal and global

solution. The performance of the proposed algorithm is compared with the performance of Dynamic Programming (DP) technique in terms of generation scheduling, total operating cost (TOC) and computation time. From the results obtained, ALO provides better generation scheduling with lower TOC, as compared to DP technique. The cost saving per year performed by ALO technique as compared to DP is $236,520. Based on the results, ALO provides better solution as compared to DP in terms of providing better generation scheduling, and significant reduction of TOC and with lower computation time.

12:00 *Reverse Power Flow Analysis in Distribution Network...227*
Muhammad Syahir Bin Turiman (TNB Research Sdn. Bhd., Malaysia)
Distributed generation (DG) including small hydro generation, solar PV generation and bio energy installed in a certain distribution network area has led to a condition which power generation by DG within the distribution network is more than the local consumption. The condition where DG generation has excess and power flows from the distribution network back to the grid is referred as Reverse Power Flow (RPF). In this paper, an analysis of RPF has been conducted focusing on a selected distribution network with a total capacity of 20MW mini-hydro generation installed to the substation. By utilizing DigSilent simulation software, a base case study has been analyzed and a base case simulation network model was then validated by comparing the simulation results with the historical data from SCADA. Based on the validated network simulation model, several case scenarios have been studied where the capacity of the installed DG into the distribution network were increased. The impact of RPF on voltage profile at 11kV bus, transformer tap change occurrence, transformer losses and distribution network losses has been analyzed in all scenarios and the results were then presented.

12:20 *Resilience Based Decision Metrics for Dispatching Mobile Emergency Truck Generators in Distribution System...233*
Muhamad Arif Fikri Bin Abd Malek (University of Malaya, Malaysia); Hazlie Mokhlis (University of MAlaya, Malaysia); Munir Azam Muhammad, Abdullah Bajwa and Nurulafiqah Nadzirah Mansor (University of Malaya, Malaysia); Jasrul Jamani Jamian(Universiti Teknologi Malaysia, Malaysia)
Mobile emergency truck generators (METGs) are possible solution to counter the damages inflicted by unprecedented stochastic weather events in distribution systems (DSs). It plays an important role in enhancing the resiliency of DSs. However, there are no metrics that can be used to effectively dispatch the optimal number of METGs and quantify the resilience of DSs. In this regard, a dynamic metric consisting of Network Reconfiguration, including METGs, is proposed to achieve an effective restoration strategy. A decision-making variable method is implemented to sequentially dispatch the right number of METGs to restore critical loads by creating multiple microgrids. The aim is to maximize the load restored following the disturbance to the weighted critical load. To validate the performance of the proposed metrics, the IEEE 33-Bus test system is employed. The test results confirmed the efficiency of the solution proposed in decreasing the interruption of customer electricity.

12:40 *Intelligent Decentralized State Estimation Algorithm Based on the Firefly (FA) Algorithm for Distributed System...239*
Mohammed Rasheed Jubair Al-Hiealy (University Malaysia of Computer Science & Engineering, UNIMY); Mohammad Shahir Bin Abdul Majed Shikh (University Malaysia of Computer Science and Engineering, Malaysia); Abdurrahman Bin Jaliland Suhaila Abdul Rahman (University Malaysia of Computer Science & Engineering, UNIMY, Malaysia)
The state estimator actually depends on many factors, such as data sensitive regarding the sensors accuracy, the availability of raw data, the network database accuracy, and the time skew of data. Many researchers already been studied multi-area power system state estimation and most of them investigation of state estimation schemes including different state estimators for each a central coordinator and control area. Therefore, accurate and timely efficient state estimation algorithm is a prerequisite for a stable operation of modern power grids. This paper introduce an intelligent decentralized State Estimation algorithm based on firefly algorithm for distribution power systems. The mathematical procedure of distribution system state estimation which utilizing the information collected from available measurement devices in real-time. Static state estimation based upon majority

consensus is proposed for radial power distribution systems. Rather than just look at the local networks, we should use the new bus as the method for analysing the whole scheme. Therefore the model reduces to a system of equations with an undefined (or) an underdetermined nonlinear system, in which the state elements associated with an agent overlap with adjacent agents and a radial distribution. The algorithms to approximate the states of these structures were first developed though a key method used the proposed algorithm to equate this approach with weighted least squares strategy, PSO, and genetic algorithm (GA). At the end, we present the results of the application of the developed approach to a network based on IEEE 13 bus test system. The result a proved to be computational efficient and accurately evaluated the impact of distributed generation on the power system.

13:00 *Experimental Investigation of High Impedance Faults in MV Overhead Distribution Networks Due to Mango Tree Branches...N/A*

Andre Pinto Leao (Universidade Federal do Pará, Brazil); Maria Emilia de Lima Tostes (Federal University of Pará - UFPA & CEAMAZON, Brazil); João Paulo Vieira and Ubiratan Holanda Bezerra (UFPA, Brazil); Ádrea Lima de Sousa (Universidade Federal do Pará, Brazil); Wesley Heringer (Federal University of Pará, Brazil); Juan Paye (Universidade Federal do Pará, Brazil); Murillo Cordeiro (UFPA, Brazil); Marcelo Santos (Pará Energy Equatorial, Brazil)

The high impedance fault (HIF) has as one of its main characteristics the low magnitude of the current produced, causing its detection and location to be impaired for the equipment currently used to protect electrical power systems, which favors the driver remain energized, increasing the likelihood of fires and the risk of death for living beings. Records of HIF characteristics in trees are a gap in the literature, making it difficult to develop new algorithms and identification methods. This study presents details of the voltage and current characteristics of HIF shunt in Mango tree branches, the result of experimental tests carried out in a laboratory designed and assembled for simulation of HIF in aerial distribution networks, aiming to obtain data for future modeling HIF shunts on trees. These oscillographs were captured using a commercial protection relay.

13:20 *An Approach to Calculate Missing PMU Data of the Microgrid Distribution Network...N/A*

Ahmed Amirul Arefin (Universiti Teknologi PETRONAS, Malaysia); Ts. Ir. Mohammad Lutfi Othman (Universiti Putra Malaysia & Advanced Lightning, Power and Energy Research (ALPER), Malaysia); M A Parvez Mahmud (Deakin University, Australia); Hashim b. Hizam (UPM, Malaysia); Noor Izzri Abd. Wahab (Universiti Putra Malaysia, Malaysia); Syed Zahurul Islam(Universiti Tun Hussein Onn Malaysia UTHM, Malaysia)

Phasor Measurement Unit (PMU) is now very popular in the power system since it can ensure the maximum reliability of the microgrid by creating an intensive monitoring system. This paper discusses a coherent approach to recover missing PMU data to elevate the reliability of the micro grid. The proposed scheme categorized the missing data from its current located position and offered a specific solution for each category. To validate the performance of the proposed system, a 23 bus microgrid network is designed and originated the PMU data from that model. The result shows that the proposed scheme is well applicable to the islanding detection system. Also it can recover the overall 30% frequency data from scheme calculation which will be surely able to increase the entire reliability index.