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TECHNICAL PROGRAMME

Monday, March 4

Monday, March 4 8:00 - 9:00
Registration
Monday, March 4 9:00 - 9:30

Opening Ceremony
Room: Crystal Ballroom
Monday, March 4 9:30 - 10:30

Keynote Speaker 1
By Professor Lalit Goel, PhD, FIEEE Director, Renaissance Engineering Programme
Nanyang Technological University, Singapore
Room: Crystal Ballroom

Keynote Title : Power System Reliability Aspects & Cost/Benefit Considerations This keynotes speech shall present the fundamental concepts of power system reliability and cost/worth evaluation. The reliability indices used for assessing the system performance at the generation, composite generation and transmission and distribution system levels will be presented. The talk will emphasize that there should be some benefit gained by an improvement in reliability, i.e., the incremental or marginal investment cost should be related to the customer's incremental or marginal valuation of the improved reliability. Reliability cost vs reliability worth (benefit) evaluation can enable utilities to make objective decisions about investments and maintenance for enhancing supply reliability.

Monday, March 4 10:30 - 10:45
Photo Session
Room: Crystal Ballroom

Monday, March 4 10:45 - 11:00
Coffee break 1
Room: Crystal Foyer

Monday, March 4 11:00 - 12:00
Keynote Speaker 2
By Dr Ng Sing Muk, General Manager, Research & Development, Sarawak Energy, Malaysia

Room: Crystal Ballroom

Keynote Title : Embracing Innovation in Power Utility Sector Energy is the fuel of our daily life and its generation and utilization profiles have changed over time. While the next wave of the energy landscape is not certain with various possibilities, what is clear is that the development is guided by the working principle for a greener and sustainable future. It is not a surprise as the world is facing the pressing issue of global warming due to the trapping of excessive heat by the drastic rise in the concentration of greenhouse gases in the atmosphere. Currently, the power utility sector relies quite heavily on carbon-based fuel in one or the other form and transition to net zero is required before the temperature of the world rises another 1.5 deg.C. Innovation is one possible catalyst to leapfrog the sector in the race to net zero. This means things need to be done differently from business as usual, while generating more added values. We should not solely play catch-up with technological advancement and modernization, but rather sit in the driver seat to develop context specific solutions. The focus shall be on low-carbon renewable energy that is available locally, looking into how these resources can be converted into energy instead of wasting it just right at our doorstep. Some of the resources can be of a smaller scale, but still be useful for applications once converged from multiple points. It is time to hybrid various technologies that can complement each other to get the optimum and maximum outputs based on limited resources. Wastage shall be minimized or rather eliminated by adopting the circular economy model that focuses on reusing of resources back to a circular value chain. In reducing the stress on power generation, the demand side can play a vital role in adopting energy efficiency practices to reduce the load hence avoiding the need for planting more generators. Of course, timing in adopting innovative efforts is important rather than just having the technology to work. It needs to match the timing to other dimensions such as social, environmental, economic and political situations. The existing system shall be optimized to sweat the assets for better levelized cost. As a conclusion, the future of the energy needs to be shaped innovatively as we cannot adopt business as usual in the raise to net zero. We shall act fast before we reach the point of no return in tackling the issue of global warming.

Monday, March 4 12:00 - 1:00
Parallel session 1_1a: Electric Vehicle (EV)/Smart Grid
Room: Crystal Ballroom
Chair: Hasmaini Mohamad (Universiti Teknologi MARA, Malaysia)

12:00 ***Determination of Optimal Power Flow for Photovoltaic Integration into Microgrid to Minimize System Losses Using Slime Mould Algorithm...1***
Syed Norazizul Syed Nasir (Universiti Teknologi Malaysia, Malaysia); Mallam Terab Ali (MT ALI, Malaysia); Jasrul Jamani Jamian (Universiti Teknologi Malaysia, Malaysia)

The optimal power flow deals with the non-predictable constraint that requires acquiring adequate values for the control variables and contacting the most satisfactory objective function. This article implies simulating a proper photovoltaic integration point injected as a distributed generator into a radial distribution microgrid system. The Slime Mould Algorithm (SMA) is employed to attain the right bus with minimum system loss. MATLAB simulation software was utilized on the IEEE 33-bus testbed. The result showed a remarkable reduction in power loss when a photovoltaic of 2511.34 kW was injected at bus 6. The initial power loss before the DG integration was 202 kW, and after the injection, the recorded losses were lowered to 104 kW. This loss translates to an almost 48% reduction in power loss, and 11% of the total power is redundant at the bus to further increase network security and reliability. Conversely, this significant reduction further confirms that the photovoltaic integration into the microgrid improved the distribution system's voltage stability index by substantially minimizing active power losses. Moreover, the simulation results further placed the network in stable current and voltage conditions, and the system power losses and voltage deviations were optimized.

12:20 ***Enhancing Short-Term Load Forecasting: A Hybrid Approach with Prophet and Custom Feature Engineering...7***

Ritik Rajput, Namita Kumari and Ankush Sharma (Indian Institute of Technology Kanpur, India)

This paper presents an innovative hybrid strategy aimed at improving forecasting accuracy of short-term electric load forecasting by combining a custom feature engineering approach with the Prophet model. This work focuses on overcoming the limitations of conventional forecasting methods by capturing complex seasonality and nonlinear trends using Prophet's additive regression capabilities, Custom feature engineering improves data insights and solves problems with forecasting. The suggested approach's accuracy and forecast quality are demonstrated by experimental validation on an available real-world dataset. The results of multiple test cases and comparisons with existing models demonstrate the effectiveness of the proposed model. Benefits include resilience against outliers and missing numbers, domain-specific knowledge integration, and comprehensible results that give insightful knowledge about load predictions to utilities and energy providers. This hybrid approach represents a major advancement in the field of short-term load forecasting methods.

12:40 ***Optimal Charging Coordination of Electric Vehicles Considering Users Charging Behavior Using Particle Swarm Optimization (PSO)...13***

Hasmaini Mohamad (Universiti Teknologi MARA, Malaysia); Amalina Izzati Binti Md Isa (Universiti Teknologi MARA & Shah Alam, Malaysia); Nur Ashida Salim (Universiti Teknologi MARA, Malaysia); Zuhaila Mat Yasin (Universiti Teknologi Mara, Malaysia); Kanendra Naidu (Universiti Teknologi MARA, Malaysia)

In recent years, electric vehicles (EVs) have become more popular as technology has improved and support for clean transportation has grown. As the number of EVs continues to rise, more and more charging stations are being installed to the grid. Grid with high penetration of EVs causes a problem to the stability of the

distribution system. Therefore, optimal charging coordination is needed to reduce the impact of charging. This study presents optimal charging coordination of EVs in a residential distribution network considering EV users charging behavior and daily residential load demand profile in Malaysia using particle swarm optimization (PSO) algorithm. The proposed optimization is operated within operating constraints such as power demand and bus voltage constraints while achieving the objective function of minimizing power losses. The optimization also considers EV users charging behavior i.e., urgent charging and non urgent charging. EV users can choose their preferable charging mode based on the charging urgency, ensuring their preferences and satisfaction. The performance of the proposed method is evaluated using IEEE 33-bus radial distribution network with the assumption that each bus connected to a residential feeder populated with EVs. Comparison analysis between uncoordinated and coordinated charging considering four different EV penetration levels is conducted. Results show that the proposed coordinated charging manages to optimize the load with EV and produces a promising reduction in the network's power losses compared to uncoordinated charging.

Parallel session 1_1b: Renewable Energy and Storage
Room: Rafflesia Room
Chair: Nor Zulaily Mohamad (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia)

12:00 ***Improved Particle Swarm Optimization MPPT for Standalone PV System Under Varying Environmental Conditions...19***
Norazlan Hashim, Rahimi Baharom and Muhammad Khairul Azman Mohd Jamhari (Universiti Teknologi MARA, Malaysia)
A photovoltaic (PV) system is highly sensitive to dynamic changes in environmental conditions. Improving the maximum power point tracking (MPPT) algorithm is one of the most cost-effective ways to enhance its performance. Currently, the most widely used MPPT algorithm is Particle Swarm Optimization (PSO). However, as with many other artificial intelligence (AI) algorithms, PSO tends to become stagnant as it converges on the optimal solution and is therefore incapable of adapting to dynamic environmental changes. This paper presents an improved PSO MPPT called iPSO consisting of an intelligent mechanism to detect and adapt to dynamic environmental changes. In addition, to accelerate MPPT convergence, the inertia weight (w) of iPSO is decreased exponentially with increasing iterations. Furthermore, a deterministic initialization method (DIM) is employed to improve the probability of locating the global maximum power point (MPP). The MATLAB/Simulink platform is utilised to evaluate the performance of the proposed iPSO under various environmental conditions. Its convergence speed and tracking efficiency are evaluated and compared to those of standard PSO and PSO with a reinitialization mechanism called PSO-reinit. Overall, the results revealed that iPSO is 2.2 s faster and 5.7% more efficient than its closest competitor, PSO-reinit.

12:20 *A Review of Fault Detection and Diagnosis Approaches for Photovoltaic Systems Using Voltage and Current Analysis...25*

Nurmalessa Muhammad (Universiti Teknologi MARA Shah Alam, Malaysia); Nur Munawwarah Ridzuan (Universiti Teknologi Mara (UiTM), Malaysia)

Over the course of previous decade, there has occurred a substantial worldwide proliferation in the utilisation of photovoltaic systems (PVSs) for the aim of utilizing solar power. Nevertheless, it is significance to acknowledge that faults can manifest in various components of these systems, including modules, connection lines, converters, and inverters. When left unaddressed, these faults, regardless of whether they occur in standalone or grid connected PVSs, have the potential to significantly impact the overall performance, energy output, security, and reliability of the system. Consequently, the implementation of fault detection and diagnostic (FDD) technologies becomes paramount to ensure optimal operational efficiency, system dependability, and the safety of PV installations. The principal aim of this study is to comprehensively analyze the numerous classifications of failures, that may arise in PVSs, while also offering a full evaluation of FDD methods that depend on the analysis of current and voltage data. The present article aims to classify data analysis methodologies according to the distinct fault detection techniques employed, the specific type of failure being targeted, the parameters being measured, and the particular methodology being employed. Drawing from the findings of the reviewed papers, this document also highlights existing challenges and offers suggestions for the prospects of FDD techniques. These insights aim to enhance our understanding of how to effectively identify and diagnose defects within operational PV modules (PVMs) and mitigate their potential propagation.

12:40 *Standalone Dual-Axis Solar Tracker System with Battery Charger and Arduino...31*

Nor Zulaily Mohamad (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Nazrul Syaari Mohammad Rasid (Universiti Teknologi MARA, Malaysia); Mohd Abdul Talib Mat Yusoh (Universiti Teknologi MARA (UiTM), Malaysia); Ahmad Farid Abidin (Faculty of Electrical Engineering, Universiti Teknologi Mara, Malaysia); Nur Hanis Mohammad Radzi (Universiti Tun Hussein Onn Malaysia, Malaysia); Nur Ashida Salim (Universiti Teknologi MARA, Malaysia)

Solar panels have become more popular in recent years for converting solar energy into electrical energy. The solar panel can be used as a standalone device or as part of a larger solar array that connected to the power grid. However, most solar panels are now static, despite the fact that the sun's location changes from time to time. This will affect the efficiency of the solar in generating energy as well as the time it takes to charge a battery if the solar panel system is an off-grid or acts as a standalone solar panel system since the solar panel can generate the maximum energy when it is perpendicular to the direction of solar radiation. As a result, the focus of this research is on the development of a standalone dual-axis solar tracker system with battery charger. A Light Dependence Resistor (LDR) Sensor is used in the proposed tracker system to sense the intensity of light and provide the output signal in analog to Arduino UNO with ATmega328p microcontroller. Arduino UNO will regulate the rotation of the geared DC motor

through the motor driver L298N, causing the motor to rotate the solar panel based on the highest intensity of light. Test results show that the proposed dual-axis solar panel tracker system is able to capture more solar radiation, and consequently create more solar power than the fixed solar panel.

Parallel session 1_1c: Power Electronics and Drives
Room: Hibiscus
Chair: Nooradzianie Muhammad Zin (Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia)

12:00 *A Novel Counter Based Neural Network for Switching Fault Identification in Power Inverter...37*
Joseph Anthony Prathap, JAP (Presidency University, India); Shruthi M (Presidency University Bengaluru, India)
This paper proposes a novel neural network for the detection of switching faults in the power converters and inverters. The highlight of this work is the enhanced counter based neural network utilized for the identification of switching faults in the 27-level Ladder Multi-level Inverter. Though there are several machine and deep learning algorithms, the neural network algorithm present high reliability, accuracy and consistency in the classification, identification and prediction. In this work, the neural network is combined with the enhanced counter circuit to detect the fault occurrence in the inverter circuit. The proposed algorithm is developed using the VHDL code and synthesized in the FPGA board. The performance analysis is evaluated for power, area and IC layout for the proposed method.

12:20 *A Single-Stage AC-AC HB Inverter with Boosting Stage for Induction Heating Applications...42*
Bhavin Salvi, S Porpandiselvi and Neti Vishwanathan (National Institute of Technology Warangal, India)
Induction heating (IH) technology has gained attention of the heating appliance market due its several advantages over conventional heating technologies. Traditional IH solutions comprise of separate rectification and high frequency inversion stages. Efficiency of the IH system reduces due to more conversion stages. This paper proposes a single-stage ac-ac inverter with boosting stage. Rectification, voltage boosting and power control are done using three MOSFETs which reduces the component count. Duty cycle control is used for controlling IH load power. Provision of independent voltage boosting in positive and negative half cycle of the supply mains helps in maintaining good input current profile with simple control. The proposed ac-ac inverter offers a compact, efficient and cost-effective inverter configuration for IH applications. The operation of the proposed inverter is verified using MATLAB/Simulink software.

12:40 *Modeling and Simulation of Dual Three-Phase Induction Machine Using Matlab/Simulink...47*
Nooradzianie Muhammad Zin (Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia); Wan Noraishah Wan Abdul Munim (Universiti Teknologi MARA, Malaysia); Ahmad Farid Abidin (Faculty of

Electrical Engineering, Universiti Teknologi Mara, Malaysia); Hang Seng Che (UMPEDAC & University of Malaya, Malaysia); Khairul Safuan Muhammad and Rahimi Baharom (Universiti Teknologi MARA, Malaysia)
In the past ten years, there has been a significant increase in the development of power electronic components and embedded systems. This growth has led to a faster adoption of multiphase machines, primarily due to their ability to segment power, lower torque pulsation, stability, high efficiency and the rise of critical applications that demand a foremost of fault tolerance. As the number of phases increases, it becomes feasible to enhance the power or torque generated per rms ampere within the same-sized machine. Dual three-phase drives have garnered considerable attention due to their straightforward design, which involves rewiring from standard three-phase machines. This paper introduces a dual three-phase induction machine dynamic modelling developed using Matlab/Simulink. Simulation results for the transient response of a dual three-phase induction machine are provided under varying load conditions and speed references. The model demonstrates its effectiveness based on all the results presented.

Monday, March 4 1:00 - 2:15
Lunch break
Room: La Veranda Coffeehouse

Monday, March 4 2:15 - 3:55
Parallel session 1_2a: Electric Vehicle (EV)/Data Analytics in Power Engineering Application/Other Related Field in Power Engineering
Room: Crystal Ballroom
Chair: Kanendra Naidu (Universiti Teknologi MARA, Malaysia)

2:15 *Applications of Rough Set Theory in Demand Side Management of Electrical Power Industry: A Review...53*
Tasmeea Rahman (Universiti Putra Malaysia, Malaysia); Ts. Ir. Mohammad Lutfi Othman (Universiti Putra Malaysia & Advanced Lightning, Power and Energy Research (ALPER), Malaysia); Samsul Bahari Mohd Noor (Coauthor & Universiti Putra Malaysia, Malaysia); Wan Fatinhamamah Wan Ahmad (Universiti Putra Malaysia, Malaysia); Mohamad Fani Sulaima (Universiti Teknikal Malaysia Melaka, Malaysia)
The global demand for electricity is at its peak right now due to the exponential growth of technology. While global electricity demand is increasing, the potential scarcity of fossil fuels is roadblocking the supply side to meet this ever-growing demand. The most feasible solution to this problem is demand response strategies in demand-side management. One of the most crucial tasks toward demand response strategy implementation is dealing with the heterogeneous and inconsistent characteristics of customer consumption patterns in the power industry, which leads to inefficient demand response strategies and less customer engagement to manage the demand side. This kind of data can be analyzed with more accuracy using rough set theory, which is a powerful mathematical tool that has the strength to deal with imprecise, inconsistent, and incomplete data. This paper aims to project the current trends of rough set theory application to

implement demand response strategies in the electrical power industry by conducting a comprehensive review of the existing literature. Firstly, applications of rough set theory in terms of demand/price forecasting, fault detection, and decision rule generation in the electrical power industry are mapped out to provide a clear vision for the overall rough set theory implementation and scope. Secondly, rough set theory applications along with processes specifically in demand-side management are mapped out. Lastly, recommendations and suggestions will be provided for more appropriate and efficient future applications and research.

2:35 *Residential Customer Baseline Load Estimation Based on Conditional Denoising Diffusion Probabilistic Model...59*

Cheng Qian, Dongliang Xu, Yi Zhang, Jiayao Bao, Xinbao Ma and Zaijun Wu (Southeast University, China)

With the implementation of dynamic time-of-use (TOU) electricity tariffs and the adoption of smart household appliances, residential power consumption behaviors are becoming more complicated, which brings challenges to the estimation of customer baseline load (CBL). To improve the estimation accuracy, a novel deep learning model called the conditional denoising diffusion probabilistic model (CDDPM) is introduced in this paper. It can not only utilize the intrinsic load information of demand response (DR) participants, that is, the target customers who require CBL estimation, but also the load data of nonparticipants with similar load profiles. The experimental results show the superiority of the proposed model compared with other state-of-the-art methods.

2:55 *Pre-Research Study on HEV Regenerative Braking Energy via Engineering Psychology...64*

Othman Inayatullah and Nor Asrina Ramlee (University of Technology Sarawak, Malaysia); Yohan Kurniawan (Universiti Malaysia Kelantan, Malaysia)

Engineering psychology is human factor engineering that is often used in designing vehicles and vehicle systems, especially electric vehicles, including hybrid electric vehicles. Engineering psychology is used in the early stages of the production of a vehicle and is rarely used when the vehicle is in operation, which is the main point where man-machine interaction takes place. While driving a vehicle, the psychological role of a driver changes with the factors of travel distance, time duration, and road terrain, including environmental conditions such as heat, rain, day, and night. The amount of healthy, unhealthy, and mixed braking, as well as braking efficiency and nervousness acceleration, can all be linked to a driver's psychological level. In HEVs, braking also produces energy that can be used or stored in a high-voltage battery through the regenerative braking system (RBS). Therefore, a pre-research study was carried out to see the trend of the relationship between braking behavior and nervousness acceleration toward renewable energy. This study is an on-road study involving the roads located in Sarawak, Sabah, and Brunei, fully using HEVs in normal driving mode. OBDII equipment and the Hybrid Assistant application are used to transmit and record the resulting data. According to the study's findings, the energy generated by braking is increasing as the number of braking, the percentage of unhealthy

braking, and the nervousness acceleration value increase. This proves that engineering psychology also affects the value of renewable energy, so related research has value, but in a clustering manner.

3:15 *Power Control of Solar Cell Voltage by Using DC-DC Boost Converter...69*
Hashimah Hashim, Muhamad Yasir Mohamad Ribuang and Puteri Sarah Mohamad Saad (Universiti Teknologi MARA, Malaysia); Shafinaz Sobihana Shariffudin (Universiti Teknologi Mara, Malaysia); Zambri Harun (Universiti Kebangsaan Malaysia, Malaysia)
Solar power generation systems typically consist of a solar array and a DC-DC converter. The DC-DC converter is a device that converts the direct current (DC) output from the (PV) panel into a different DC voltage level, such as a DC-DC boost converter. This research aims to develop the DC-DC boost converter with the inverter to increase the voltage supply to the electrical grid. DC-DC boost converter with inverter was simulated using Simulink MATLAB. The analysis of the output DC voltage, current, and power was performed. Then, the analysis of the steady output current and PV solar voltage depending on solar irradiation as input at the PV panel was analyzed. The result shows that when the solar irradiation on the PV panel increased, then the output voltage and current of the PV panel would also increase. This study also involves the small signal analysis of the boost converter, which is highly useful for stability analysis. Thus, a DC-DC boost converter with solar irradiation as the input to the electrical grid would increase the voltage of the direct current generated by a photovoltaic and stabilize the output voltage control by a maximum power point tracker (MPPT).

3:35 *Enhancing Hybrid Electric Vehicle Speed Controller Based on Fractional Order PID Using Jaya Optimization Algorithm...74*
Kanendra Naidu (Universiti Teknologi MARA, Malaysia); Gowthamraj Rajendran (University of Catania, Italy); Hasmaini Mohamad (Universiti Teknologi MARA, Malaysia); Jagatheesan Kaliannan (Paavai Engineering College, India); Manoj Embrandiri (Barium Selat Sdn. Bhd, Malaysia); Lilik Jamilatul Awalin (Airlangga University, Malaysia)
The drive for sustainability has pushed forward various avenues in meeting the zero-carbon target. Electrification of vehicles has seen rapid growth, especially in replacing current internal combustion engine vehicles which relies on fossil fuel. The hybrid electrical vehicles (HEVs) that catalyze complete vehicle electrification provide a transition platform for vehicle users. The losses experienced by the HEVs which is contributed by the motor, generator, and battery have to be minimized to ensure efficient hybrid EV performance. The motor controller in the simulation model of the power-split hybrid transmission architecture is optimized using Jaya Optimization Algorithm (JOA). Two objective functions, which are speed regulation error and total electrical power loss are evaluated. Three different analyses for the Fractional order PID controller (FOPID) are carried out. The investigation comprises of comparative analysis with PID controller for first objective function, an analysis on FOPID controller based on second objective function, and an analysis of three different driving patterns. Overall improvement

is observed in the integration of FOPID for HEV to enhance the performance of speed regulation and total electrical losses.

Parallel session 1_2b: Renewable Energy and Storage
Room: Rafflesia Room
Chair: Habibah Zulkefle (Kolej Pengajian Kejuruteraan & Universiti Teknologi MARA, Malaysia)

2:15 *Comparison of Tan Sigmoidal and Elliot Activation Function-Neural Network for Tracking Global Maximum Power Point in a Partially Shaded Solar-PV Array...80*
A. Venkadesan (National Institute of Technology, Puducherry, Karaikkal, India); K Sedhuraman (Manakula Vinayagar Institute of Technology, India); Sakthivel Senthamizh Selvan (National Institute of Technology Puducherry, India)
Solar PV arrays are widely used all possible platforms ranging from rooftops to large farm type for the power generation. In the objective of extracting the maximum power, occurrence of partial shading condition (PSC) over the panels reduces the power generation. Under PSC, due to multiple peaks in P-V curve various algorithms and techniques has been proposed in the literature namely optimization, fuzzy logic and neural network (NN) for tracking the GMPP effectively. Optimization techniques which are popularly used in the literature has disadvantages such as high settling time and considerable oscillation, which is overcome by the NN approach of tracking the GMPP. However, most of the NN based MPPT technique uses tan sigmoidal activation function in the NN which is quite difficult in the case of real-time implementation of the NN. Hence, Elliot sigmoidal activation function, which exhibits a similar characteristics to that of a tan sigmoidal function, is used in the NN based MPPT algorithm for tracking the GMPP. A comparison is made between the performance and prediction characteristics of the tan sigmoidal and Elliot sigmoidal activation function based NN in tracking the GMPP and the findings are presented and analysed.

2:35 *Improved MPPT Based on Flying Squirrel Search Optimization Using SEPIC for PV Systems...85*
Indra Setyawan (Jl. Veteran & UB, Indonesia); Rizki Mendung Ariefianto (Universitas Brawijaya, Indonesia); Rini Nur Hasanah (Brawijaya University & Faculty of Engineering, Indonesia); Hadi Suyono (Brawijaya University, Indonesia)
The electricity production from PV systems depends on local solar radiation levels, as well as other prevailing meteorological characteristics such as temperature, dust, and humidity. Consequently, the electricity parameters such as voltage, current, and power levels will vary. To address this issue, PV systems use maximum power point tracking (MPPT) to regulate the voltage and current for producing the maximum power. The main goal is to regulate the PV system to achieve the maximum power or the power value as close to maximum as possible, even under varying environmental conditions. A metaheuristic approach such as the flying squirrel search optimization (FSSO) provides an advanced method for MPPT strategies. Apart from the algorithm method, this can be improved by using the suitable DC–DC converter. A SEPIC converter can be chosen as the medium for FSSO. Hence, this study presents the evaluation of the

FSSO's application in the SEPIC converter for PV systems. The simulation results show that FSSO on a SEPIC converter produces minimal ripple on both voltage and current, particularly when compared to FSSO on a common Boost converter. The FSSO-on-SEPIC converter configuration could reach a steady state at 0.4 s. Moreover, the configuration was also able to produce the MPPT's efficiency of around 99.93%, which is slightly higher than that of the FSSO-on-Boost converter.

2:55 ***Energy Management System Based on Finite State Machine for Battery-Supercapacitor Hybrid Energy Storage System on Standalone Photovoltaic...91***

M Hilmi and Vita Lystianingrum (Institut Teknologi Sepuluh Nopember, Indonesia); Mohd Fakhizan Romlie (Universiti Teknologi PETRONAS, Malaysia)

The increasing adoption of renewable energy, particularly solar power, is a current focal point due to its easy installation, cost-effectiveness, and operational flexibility. Batteries, commonly used for energy storage, face challenges of high cost and a short lifespan due to low power density. To address these issues, the integration of batteries and supercapacitors in hybrid storage has gained popularity. This study employs the Finite State Machine (FSM) method, considering the state of charge (SoC) of storage, to efficiently regulate power sharing in a hybrid energy storage system (HESS). The hybrid storage system is connected to standalone solar panels, coupled by a DC bus voltage linked to the load. The control strategy manages PV mode and Load mode to ensure energy balance, avoiding overcharging and over-discharging of both storages. Simulations, and varying irradiation levels, demonstrate that the enhanced energy management system using FSM effectively controls power flow, PV mode, and load. Additionally, the stability of the DC bus voltage is maintained with minimal fluctuation.

3:15 ***Prediction the Photovoltaic System Performance via Artificial Neural Network (ANN) Technique...97***

Siti Amely Jumaat and Ahmad Fateh Mohamad Nor (Universiti Tun Hussein Onn Malaysia, Malaysia); Abdou Mani Mohamed (UTHM, Malaysia)

The demand for energy is predicted to rise rapidly in the near future as a result of population development and industrialization around the world. However, increased use of fossil fuels is responsible for the majority of environmental pollution and greenhouse gas emissions, which are widely believed to be the primary drivers of global warming and are contributing to it. This paper are present the design of artificial neural network model (ANN) that predict the power output of the photovoltaic (PV) for monocrystalline and polycrystalline types. The objective of this paper is to develop the ANN model, to evaluate power and efficiency of two different photovoltaic panel. The data was collected from 2018 to 2020. However, the input parameters are meteorological data used as input for ANN model. The voltage produced by polycrystalline is much larger than monocrystalline voltage. In contrast, monocrystalline PV panels tend to have a higher current value compared to polycrystalline PV panels. Mean square error (MSE) training of this model was equal to MSE testing and MSE validation. It means the data of model have been learning very well during training and zero means that it has an overestimate the prediction of the network. The two models have a very good fit

curve of the data as the correlation coefficient, R value is equal to 1. However, the actual and predicted values show a similarity in trends for both PV modules. The estimated voltage, current and power when compared to the actual value has no significant differences. Overall, polycrystalline panel has a better performance, and the

3:35 *PVDF/SnO2 Flexible Piezoelectric Nanogenerator Films for Energy Harvesting Application...103*

Habibah Zulkefle (Kolej Pengajian Kejuruteraan & Universiti Teknologi MARA, Malaysia); Muhammad Haziq Mohamad Hatta and Nor Diyana Md Sin (Universiti Teknologi MARA, Malaysia); Dayana Kamaruzaman (Universiti Teknologi MARA (UITM), Malaysia); Nurfadzilah Ahmad (Faculty of Electrical Engineering, Malaysia); Muhamad Naiman Sarip (Universiti Teknologi MARA, Malaysia)

Piezoelectric generator is one of these promising energy harvesters for low energy electronic devices. Polyvinylidene Difluoride (PVDF) holds promise for piezoelectric material due to its flexibility, scalability and low cost. These properties can be improved by doping with Tin (IV) Oxide (SnO2). This paper investigates the influence of SnO2 on the properties of PVDF flexible piezoelectric (FPENG) nanogenerator films. Contact angle analysis confirms the hydrophobic nature of all deposited FPENG films with the contact angles exceeding 90°. Besides, it was found that as the weight percentage of SnO2 nanoparticles increases, there is an observable morphological trend indicating that SnO2 begins to dominate the PVDF matrix. The piezo response analysis demonstrates that the film doped with 5wt% SnO2 exhibits the highest output voltage among the different weight percentages tested, indicating optimal piezoelectric performance. The film was found to produce 9.25V peak-to-peak due to uniform surface morphology with the presence of spherulite structure. These findings support 5wt% SnO2 is the optimum weight percentage for enhancing the electroactive β-phase which leads to the high piezoelectric properties of the PVDF/SnO2 FPENG films.

Parallel session 1_2c: Power Electronics and Drives
Room: Hibiscus
Chair: Wan Noraishah Wan Abdul Munim (Universiti Teknologi MARA, Malaysia)

2:15 *Design and Simulation of DC-DC Buck-Boost Converter with Voltage Source Inverter Using MATLAB/Simulink for BLDC Motor Drives...107*

Tharnisha Sithananthan (Universiti Tun Hussein Onn Malaysia, Malaysia); Afarulrazi Abu Bakar (University Tun Hussein Onn Malaysia, Malaysia); Hazwaj Mohd Phoad and Suriana Salimin (Universiti Tun Hussein Onn Malaysia, Malaysia)

The brushless DC (BLDC) motor is frequently employed in various applications, as it has excellent features compared with those of the conventional brushed DC motor. Furthermore, the BLDC motor is electrically commuted by power switches, resulting in higher reliability, more significant dynamic response, and longer operating life. A three-phase voltage source inverter (VSI) is fed to the BLDC motor to operate, as it has better performance at low speeds. The inverter

operates in 120° and 180° conduction modes. In this paper, a DC-DC buck-boost converter was implemented to act as the step-up or step-down transformer for the system, as it offers high efficiency across extensive input and output voltage ranges. A simulation using MATLAB/Simulink was carried out with different duty cycles, and the result was analyzed.

2:35 *Power Losses Analysis of Multiphase Interleaved DC-DC Boost Converter Using OrCAD PSpice Software...112*

Afarulrazi Abu Bakar (University Tun Hussein Onn Malaysia, Malaysia); Tharnisha Sithananthan and Suhaimi Bin Saiman (Universiti Tun Hussein Onn Malaysia, Malaysia); Ahmad Faiz Abdul Gani (Universiti Tun Hussein Onn, Malaysia)

DC-DC converters with multiphase structure are widely used in electrical and electronic devices because of their advantages over conventional boost converters, such as reduction in input current ripple and low conduction loss. As technology advances, more delicate needs have to be fulfilled for better load performance. Traditional boost converters are still feasible but with certain drawbacks, such as high current ripples, significant switching losses, and high switch voltage stresses. This paper presents a novel multiphase DC-DC boost converter, with an output power range between 50 Watts to 200 Watts. The number of phases for this multiphase boost converter is limited to 5-phase. This paper focuses on power losses in the converter, namely conduction losses in diodes and MOSFET, switching losses in MOSFETs, as well as losses in inductors and capacitors. Discussion includes analysis on the relationships between multiphase boost converters in terms of number of phase and power loss. Simulation results show that 3-phase DC-DC boost converter contributed to smallest losses (at P=200 Watts) with the efficiency of 94.09 %, in addition to the smaller number of components used; by comparison between 3-phase and 4-phase. The performance analysis was done using OrCAD PSpice software.

2:55 *Innovation in SVPWM Control of Single-Phase to Three-Phase with Boost Converter...117*

Mazliza Abdul Halim, Mohamad Fauzi Omar and Muhammad Naufal Ahmad Sepian (Universiti Teknologi MARA, Malaysia)

Conventionally a single-phase to three-phase converter consists of a full-wave rectifier, dc-link capacitor, and six-switch three-phase inverter. The dc-link circuit only provides a fixed voltage to the six-switch inverter and the inverter is regulated by using the traditional sinusoidal-pulse-width-modulation (SPWM) method. This conventional single-phase to three-phase converter has poor efficiency compared to other types of three-phase converter. This paper innovates a single-phase to three-phase converter with a boost converter and regulates the six-switch inverter by using space-vector-pulse width-modulation (SVPWM) method. The boost converter enables voltage boosting and allows for the variable generation of DC input voltage to the inverter. The MATLAB/Simulink software is used to model and simulate the proposed converter. The output voltage and current at rectifier, boost converter, and inverter are analyzed to validate the design of the proposed converter. The THD result for the proposed converter is 5.42 %.

3:15 *Single Phase Fault Detection of Induction Motor Using Machine Learning Approaches...122*

Udoy Roy Turza, Viswya Deb Das and Shaikh Hasib-Ul Islam (Hajee Mohammad Danesh Science and Technology University, Bangladesh); Md Ilius Hasan Pathan (Hajee Mohammad Danesh Science & Technology University (HSTU), Bangladesh); Mohammad Mominur Rahman (Hamad Bin Khalifa University, Qatar); Md. Sanwar Hossain (University of Wollongong, Australia); Md. Mizanur Rahman (Hajee Mohammad Danesh Science and Technology University, Bangladesh); Md. Khondoker Ziaul Islam (Murdoch University, Australia); Md. Md Shafiul Alam (King Fahd University of Petroleum and Minerals, Saudi Arabia); Mohammad Shoaib Shahriar (University of Hafr Al Batin, Saudi Arabia)

The induction motor (IM), an asynchronous type of AC electric motor, plays a crucial role in operational procedure in industrial sectors, which needs to be operated sophisticatedly without any error. This research investigates the occurrence of single-phase faults, which are commonly observed in induction motors, among various other types of failures, through detection and classification employing machine learning (ML) tools. This research addresses the machine's condition based on three operational modes, that include the healthy case, 5% fault and 10% fault of induction motors. In case of generating the dataset for implementation of ML tools, simple d-axis and q-axis conversions are considered for healthy situation of IM. However, on the other hand, the Park's transformation is made in modeling the faulty IM by transforming it to three phase to two phase system for accumulating the faulty dataset. Several electrical features of IM are considered in regards to generating the healthy and faulty datasets for training the ML models so that they can detect and classify the operational mode of IM. Two well-known statistical features, namely the mean and standard deviation, are chosen to measure the performance of the ML models in detecting and identifying the motor operating conditions. Several ML models are implemented to the model of the machine in testing the robustness of the fault identifying and diagnosis procedure.

3:35 *ANN and RF-MRAS Sensorless Speed Control of DTC-SVM Based FPIM Drive with Improved Flux and Torque Ripples...128*

J Kiran Kumar (NIT Kurukshetra, India)

This paper propose the artificial neural network (ANN) based sensorless speed control of five phase induction motor(FPIM) with improved speed error for electric vehicle(EV) application. Conventional sensorless speed control techniques like model reference adaptive system(MRAS), back emf (BEMF) and sliding mode observer (SMO) not suitable for medium and high speed regions and also very sensitive to change in motor parameters. Therefore, proposed scheme is a better sensorless speed estimator known as the ANN which not only overcomes the aforementioned drawbacks of conventional estimators but also has the ability to achieve state estimation for non-linear systems and reduced dependency towards machine parameters. ANN sensorless speed control is replacing entire MRAS block and reduce it mathematical modelling proportional and integral (PI) control too. ANN DTC-SVM achieve good response with reduced ripples in flux, torque and also better transient response of the DTC-FPIM based EV. During steady state and very low speed, it can minimize acoustic noise, torque, flux, current, and

speed pulsations. The proposed snesorless ANN-DTC-FPIM modelling and simulation is performed in MATLAB and done experimental validation.

Monday, March 4 3:55 - 4:10
Coffee break 2
Room: Crystal Ballroom

Monday, March 4 4:10 - 5:50
Parallel session 1_3a: Power System Operation and Planning
Room: Crystal Ballroom
Chair: Mohd Abdul Talib Mat Yusoh (Universiti Teknologi MARA (UiTM), Malaysia)

4:10 *Classification of Voltage Sag Using Arduino Uno and One Versus One Support Vector Machine (OVO-SVM)...134*
Mohd Abdul Talib Mat Yusoh (Universiti Teknologi MARA (UiTM), Malaysia); Mohd Shahrull Iman Sahari (Universiti Teknologi MARA, Malaysia); Ahmad Farid Abidin (Faculty of Electrical Engineering, Universiti Teknologi Mara, Malaysia); Nor Zulaily Mohamad (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Muhammad Iqbal Zakaria and Abdul Hafiz Kassim (Universiti Teknologi MARA, Malaysia)
Voltage sags or dips are one of the power qualities (PQ) disturbances in distribution system (DN). This problem can disrupt sensitive equipment and, if severe enough, result in power outages. Extraction of voltage sag features, such as amplitude, duration, and frequency of sags, can assist power system operators and engineers in better understanding the causes and impacts of these events, as well as developing mitigation strategies. However, the device for monitoring the PQ disturbances is very expensive and cannot be affordable. This research paper focused on classification of voltage sag on different types of bulbs using low-cost microcontroller of Arduino Uno and one versus one support vector machine (OVO-SVM) learning. So, AC Voltage module, Arduino Uno, and MATLAB software are the apparatus used to record the real-time signal of voltage sag. Then, advanced signal processing of S-transform (ST) is applied to extract significant features of voltage sag that used as an input for classifier tools of OVO-SVM. After extracting the features, OVO-SVM will be performed using Linear Kernel and Radial Basis Function (RBF). The accuracy of these two Kernel SVMs will be compared and evaluated to determine the best method for classifying voltage sag characteristics. Result shows the classification OVO-SVM using RBF Kernel is the best compared to the Linear Kernel, where its accuracy is 90.0%.

4:30 *Power Systems Resilience Enhancement Through Renewable Energy Integration: Insights and Future Directions...140*
Amit Kumar (National Institute of Technology Hamirpur, India); Yog Raj Sood (NIIT Hamirpur HP, India); Ankur Maheshwari (Guru Nanak Institutions Technical Campus, India)
Grid resilience, defined as a power system's ability to endure and rebound from adverse events, assumes paramount importance in today's ever-changing world. Conventional centralized power systems have exposed vulnerabilities to

disruptions, ranging from natural calamities to cyberattacks. This paper underscores the critical role of renewable energy sources as decentralized alternatives that bolster grid resilience. These renewable sources offer a range of electricity generation options, fortifying the grid's resilience against various challenges. Moreover, this study sheds light on the complexities involved in integrating renewables and underscores their indispensable role not only in mitigating environmental impacts but also in fortifying the power grid. As we embark on a transition towards a more sustainable future, it becomes increasingly evident that collaborative research efforts will be pivotal in unlocking the full potential of renewables to enhance grid resilience.

4:50 ***Optimal Operation of Diesel Generator and Battery Energy Storage System for Total Fuel Cost Reduction in Marine Transportation...146***

Sophea E. Damian and Ling Ai Wong (University of Technology Sarawak, Malaysia); Moh Thomas (UTS, Malaysia)

The shipping industry has encountered several obstacles due to factors such as escalating fuel costs and stringent emissions laws and standards. Consequently, hybrid propulsion systems have emerged as a viable solution for various industries and manufacturers. This research aims to explore the potential for reducing the overall fuel expenses of a tugboat's engine by optimizing the operation of both the diesel generator (DG) and the battery energy storage system (BESS). The optimization of the operational state of DG and BESS is achieved through the application of a metaheuristic algorithm known as the Whale Optimization Algorithm (WOA), which possesses an exceptional ability for both exploration and exploitation. The findings suggest that optimizing DG and BESS control procedures and BESS size in a hybrid propulsion system can reduce fuel costs and improve DG efficiency.

5:10 ***Comparative Analysis for Loss Control in Power Transmission System via Composite Compensation Scheme...151***

Ismail Musirin (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Saiful Amri Ismail (Universiti Teknologi MARA, Malaysia & Selangor, Malaysia); Mohd Helmi Mansor (Universiti Tenaga Nasional, Malaysia); Zulkiffli Abdul Hamid (Universiti Teknologi MARA, Malaysia); Senthil Kumar Appusamy Venkataraman (Bharathiar University, India & Hindusthan College of Arst and Science, India); Azlina Abdullah (Universiti Tenaga Nasional, Malaysia); Shahrizal Jelani (Universiti Teknologi MARA, Malaysia)

Loss minimization in power system is still relevant in power system community. Its presence may lead to over-compensation or under-compensation if no proper compensation strategy is properly planned, especially a reliable optimization technique. One important initiative to alleviate the transmission burden which meets the load demand can be rectified by composite compensation scheme. This paper proposed a composite compensation which integrates the multi-unit of distributed generation (DG) and optimal reactive power dispatch (ORPD) which identifies the amount of reactive power to be dispatched by the generators in the system. In this study, a new and fast mutation technique is introduced to the original evolutionary programming (EP) optimization technique. It is termed

Integrated Cloning Accelerated Mutation Evolutionary Programming (ICAMEP). ICAMEP was introduced to alleviate the weakness in the standalone EP and AIS which normally stuck as local optima. The study identifies optimal locations and sizes for composite compensation in the power transmission system, demonstrating its superiority over traditional EP and artificial immune systems (AIS). The impact of multi DGs installation, validated on IEEE 30-Bus Reliability Test System (RTS) was analyzed which can help the relevant utility to make future plan and decision.

5:30 ***Optimal Integration of Active and Reactive Power DGs in Distribution Network via a Novel Multi-Objective Intelligent Technique...157***

Azlina Abdullah (Universiti Tenaga Nasional, Malaysia); Ismail Musirin (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Muhammad Murtadha B. Othman (Universiti Teknologi MARA, Malaysia); Siti Rafidah Abdul Rahim (Universiti Malaysia Perlis, Malaysia); Sharifah Azwa Shaaya (Universiti Tenaga Nasional, Malaysia); A V Senthil Kumar (Hindusthan College of Arts and Science, India)

This work introduces a novel approach called the Multi-Objective Integrated Immune Moth Flame Evolutionary Programming (MO-IIMFEP) algorithm. This algorithm aims to determine the optimal sizes and positions for Type III distributed generators (DGs) that generate both active and reactive power. The objectives involve reducing overall losses in the distribution system while adhering to voltage restrictions and taking into account the cost limitations connected with the installation of DG. MO-IIMFEP overcomes the constraints of traditional Evolutionary Programming (EP) and Moth Flame Optimization (MFO), particularly in effectively handling local optima. Fuzzy logic is employed in MO-IIMFEP to determine the best solution to compromise conflicting goals, as obtained from the non-dominated Pareto solutions. The efficacy of MO-IIMFEP in identifying optimal solutions for multi-objective problems is demonstrated through comprehensive assessments conducted on the 118-Bus Radial Distribution Systems (RDS), comparing it against MO-EP and MO-MFO. The results underscore the strategic benefits of DG installation in sustaining voltage levels, reducing power losses, and minimizing total operating costs for power suppliers.

Parallel session 1_3b: Renewable Energy and Storage/Other Related Field in Power Engineering

Room: Rafflesia Room

Chair: Nur Farahiah Ibrahim (Universiti Teknologi MARA, Malaysia)

4:10 ***Development of Slowly-Varying Electric Field Sensor for Lightning Monitoring in Legoland Malaysia Resort...163***

Erman Ramli (MHS Integrated Engineering Sdn Bhd, Malaysia); Mohd Riduan Ahmad (Universiti Teknikal Malaysia Melaka & Centre of Technology for Disaster Risk Reduction, Malaysia); Shamsul Ammar Shamsul Baharin (Universiti Teknikal Malaysia Melaka, Malaysia)

The fast and slow-varying electric fields buffer circuits have been established as sensors for characterizing various lightning types, capable of detecting both near

and far lightning. Special attention is directed towards the development of the slow electric field buffer circuit, designed to serve as a lightning warning system for detecting nearby lightning in crowded areas, such as the waterpark within LEGOLAND Resort in South Malaysia. Lightning localization and detection methods, including Magnetic Direction Finder (MDF), Time-of-Arrival (TOA), Interferometer (ITF), and Distance of Arrival (DOA), rely on rapid atmospheric electric field, magnetic field, and very high-frequency (VHF) signals. This study focuses on analyzing the slow atmospheric electric field and perform waveform analysis for determining the estimated distance and radius of lightning events at LEGOLAND Malaysia Resort. The newly installed lightning detection system at LEGOLAND features a straightforward and cost-effective setup, incorporating a capacitive antenna, slow and fast atmospheric electric field sensors, and dedicated data analysis software. Its effectiveness and precision will be thoroughly compared with LEGOLAND's existing online service.

4:30 ***Unveiling the Solar Irradiance Impact on Single and Double Diode Solar Cells...168***

Puteri Sarah Mohamad Saad, Muhammad Yasin Kasbudi and Hashimah Hashim (Universiti Teknologi MARA, Malaysia); Shafinaz Sobihana Shariffudin (Universiti Teknologi Mara, Malaysia)

The performance of single and double diode solar cells was investigated in this paper. Developing a model that accurately reproduces the system's behavior under various production conditions is one of the challenges in designing solar photovoltaic systems. Therefore, this work concerns the effect of solar irradiance for both models. By investigating this effect, the performance in terms of η, Voc, and Isc were examined. Both models' circuits were run and simulated in LT-Spice. For each type of model, the solar irradiance varied between 200, 400, 600, 800, and 1000 W/m2. At 1000 W/m2, it can be decided that the single diode model and double diode model exhibit no significant difference in efficiency with 0.7%. The Isc for both models is nearly identical at 0.2 A. While the voltage for the Voc is 4.72 V for a single diode and 4.52 V for a double diode.

4:50 ***Output Power Prediction of Grid Connected Photovoltaic System Using Using Dolphin Echolocation Algorithm...172***

Puteri Nor Ashikin Megat Yunus (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Suhaili Beeran Kutty (UiTM Shah Alam, Malaysia); Nurmalessa Muhammad (Universiti Teknologi MARA Shah Alam, Malaysia)

Photovoltaic (PV) technology converts solar energy into electricity. It is a sustainable and abundant energy source that offers efficient, clean, and reliable power generation. Numerous researchers have focused on optimizing PV systems to maximize their output. Neural networks, computational models capable of predicting trends, play a significant role in this field. This study introduces the Dolphin Echolocation Algorithm (DEA) for predicting the output power of grid-connected photovoltaic (GCPV) systems and compares different input models to identify the most favorable outcome. The optimization accuracy was evaluated using root mean square error (RMSE) and regression (R value). The primary objectives of this project are to identify the best output results by comparing four input models using the DEA. The obtained results show that the

proposed DEA outperforms the basic artificial neural network (ANN) in terms of output performance.

5:10 ***Comparison of Palm Oil Mill Effluent and Empty Fruit Bunch as Fuel for Biomass-Diesel Hybrid Power Plant...177***

Ginas Alvianingsih (Institut Teknologi PLN, Indonesia & Universiti Teknologi Malaysia, Malaysia); Haslenda Hashim (UTM, Malaysia); Asri Bagas Aditia and Fadilla Putri Wijaya (Institut Teknologi PLN, Indonesia); Adri Senen (Institut Teknologi PLN, Indonesia & Universiti Teknologi Malaysia, Malaysia)

Electrical energy has a fundamental role in life. Burung Island, an island in Indragiri Hilir Regency, Riau Province, has an electricity system supplied by the 3,5 MW diesel power plant with a daily operation time of 14 hours. Riau is the largest palm oil producer in Indonesia. POME (Palm Oil Mill Effluent) and EFB (Empty Fruit Bunch) can fuel biomass power plants. This research aims to compare the use of POME and EFB as fuel for a biomass power plant that will be operated hybrid with the existing diesel power plant. HOMER (Hybrid Optimization Model for Energy Renewables) Software simulates the hybrid power plant. From the study, it can be concluded that the POME and EFB-based hybrid system can meet the 24-hour electricity needs of Burung Island and is feasible to implement. The POME-based hybrid power plant has a better performance than the EFB-based. The POME-based power plants can reduce the workload of diesel power plants by 26.2%, while the EFB-based power plants can reduce by 23.6%. The LCOE of POME-based power plants is Rp6.615,34, while the LCOE of EFB-based power plants is Rp6.714,68.

5:30 ***Integrated Immune Chaotic Evolutionary Programming (IICEP) for Integrating Battery Energy Storage System in Transmission Network...182***

Nur Farahiah Ibrahim (Universiti Teknologi MARA, Malaysia); Ismail Musirin and Nor Zulaily Mohamad (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Nor Azwan Mohamed Kamari (Universiti Kebangsaan Malaysia, Malaysia); Mohd Noor Abdullah (Universiti Tun Hussein Onn Malaysia, Malaysia); Fathiah Zakaria (Universiti Teknologi MARA, Malaysia)

Energy consumption has experienced significant growth on a global scale in the past decade. This has caused the growing demand of renewable energy resources into grid systems which lead to the need for technological solutions that can improve the flexibility and stability of power systems. Electrical transmission networks are essential components for effectively and reliably transporting electricity. However, they are prone to power losses, which reduce overall system efficiency and raise operational expenses. This research investigates an approach of mitigating these losses by incorporating Battery Energy Storage Systems (BESS) into transmission networks. BESS has developed as a promising technology, providing several advantages such as peak shaving, load levelling, and improved grid stability. The purpose of this research is to find the best location and sizing of battery energy to minimize loss delivering to the load using a new optimization technique named Integrated Immune Chaotic Evolutionary Programming (IICEP). Previous techniques focus on locating battery storage into distribution networks. The new algorithm was specifically developed to integrate

BESS into transmission networks with a focus on loss minimization. IICEP integrated the advantages of EP and clonal features of AIS with an addition of chaotic process to offer a better solution in optimization techniques. Three battery energy storages integrated into the networks, each with the placement and sizing to meet the goal. The algorithm of IICEP is tested on IEEE 30- Bus RTS to observe its effectiveness. The results are compared with traditional EP and AIS. It shows that the IICEP technique provides slightly better optimal solution for reducing power losses.

Parallel session 1_3c: High Voltage Engineering & Technology
Room: Hibiscus
Chair: Norhidayu Rameli (Universiti Sains Islam Malaysia, Malaysia)

4:10 ***Flashover Model of Polluted Medium Voltage AC Indoor Insulators Around Electric Arc Nickle Furnace Roof...187***
Rustam Saleh (Institut Technology Sepuluh Nopember, Indonesia)
This paper discusses a mathematical model of insulators on the roof beam of a medium-voltage furnace electrical network that is contaminated under critical conditions. It addresses a dynamic arc model of contaminated insulators, referring to the formulation of the Obenaus model concerning discharge propagation. Several experiments were conducted using G7 fiberglass and Mica insulators installed on structural beams and the electrical network of a pyrometallurgical furnace with the aim of measuring flashover voltage and determining the arc parameters (n and N) of the polluted insulator. Several parameters in the dynamic model, including arc current, arc length, and arc resistance, are computed using MATLAB, incorporating the use of optimization algorithms to estimate n and N with several level of pollution and insulator types. The actual results of the proposed model are then compared with experimental findings, including comparisons with several previous studies, despite differences in voltage levels and variations in pollution layer resistances. The experimental and simulation findings indicate the medium voltage insulator's expected performance under different operating conditions per the IEC 60439 standard. The results show the feasibility of assessment of polluted material severity on different type insulators and flashover prediction, using the proposed model.

4:30 ***Simulation of Lightning Strike Impact on a Polysilicon PV Module...193***
Anis Niza Ramani and Kyairul Azmi Baharin (Universiti Teknikal Malaysia Melaka, Malaysia); Muhammad Ammar Arfanuddin (Projek Lebuhraya Usahasama Berhad Northern Region, Malaysia); Nur Syahirah Abdullah (Ts Electrical Marketing Sdn. Bhd., Malaysia)
It is common knowledge that Malaysia's solar photovoltaic system is prone to lightning strikes because they must be installed in areas with a lot of open space to operate in full condition, which results in high radiation and a lot of lightning density. Exposure to lightning strikes can harm all electric components of solar photovoltaic systems and cause electromagnetic interference. This interference may result in losses and have an impact on the efficiency of solar photovoltaic systems. A photovoltaic module was modelled and tested under normal and

lightning conditions using COMSOL Multiphysics software to observe how the lightning affected the electromagnetic interference of magnetic field and magnetic flux density on the photovoltaic system. The Polycrystalline Silicon solar cell material was analyzed with different assigned electric current injection points which are middle and corner of the photovoltaic module. The result shows that during lightning, the simulated model produces greater electromagnetic interference than the normal condition. In addition, different electric current injection points have a significant impact on the electromagnetic interference which affects the induced current when exposed to lightning. Lastly, there was a slight impact on electromagnetic interference due to the change of solar cell material.

4:50 ***Morphological Study on Corrosive Sulphur Development in Transformer Windings...197***

Amran Mohd Selva (Advanced Lightning, Power and Energy Research Centre (ALPER) & Universiti Putra Malaysia, Malaysia); Norhafiz Azis (Universiti Putra Malaysia & Centre for Electromagnetic and Lightning Protection Research, UPM, Malaysia); Mohd Zainal Abidin Ab Kadir and Jasronita Jasni (Universiti Putra Malaysia, Malaysia); Hidayat Zainuddin (Universiti Teknikal Malaysia Melaka, Malaysia); Mohd Fairouz Mohd Yousof (Universiti Tun Hussein Onn Malaysia, Malaysia)

This study presents morphological study on transformer windings with the presents of corrosive sulphur. The thermal ageing experiment was conducted at 150 °C for 5 days. The mineral oil and Kraft paper's moisture content post drying were maintained less than 30 ppm and 0.5%, respectively. Several analyses were carried out such as Scanning Electron Microscopy (SEM), Energy dispersive X-ray (EDX) and AC breakdown voltage to understand the influence and the formation mechanism of copper sulphide (Cu2S) deposits on copper strip, the deterioration mechanism of Cu2S on Kraft paper and oil. The results were then compared and analyzed.

5:10 ***Partial Discharge Activity Analysis in Rotating Machine Using Phase Resolved Partial Discharge Pattern...201***

Mohd Helmy Halim Abdul Majid (Universiti Teknologi Mara & MHH Condition Monitoring Sdn Bhd, Malaysia); Normiza Masturina Samsuddin (MHH Condition Monitoring Sdn Bhd, Malaysia); Ahmad Syukri Abd Rahman (MHH Conditon Monitoring Sdn Bhd, Malaysia)

In the realm of rotating machinery, the inevitability of wear and aging is a constant concern. Over time, materials and components degrade, ultimately leading to the risk of failure. Yet, with diligent maintenance, many potential failures can be averted. To facilitate effective maintenance scheduling, plant operators rely on accurate machinery condition assessments. This paper introduces an innovative technique and measurement system for monitoring Partial Discharge (PD) in rotating machines, utilizing the benefit of Phase Resolved Partial Discharge (PRPD) patterns. This method offers significant advancements in maintenance strategy and planning. Utilizing inductive sensors installed on the machine's terminals to separate PD pulses and analyze sensor signals, it has been tested on

an 11 kV asynchronous motor. The test object's PD level was then measured. Given that one of the primary goals of PD monitoring is to identify insulation degradation early on, analyzing PRPD patterns is a significant tool for assessing the state of high-voltage rotating machinery and guaranteeing its dependable operation for a predetermined amount of time. Furthermore, this paper presents a case study that utilizes PRPD analysis to assess the current state of a machine, confirming its satisfactory operational condition.

5:30 ***Investigation of Lightning Electromagnetic Fields on the Distribution Power Lines Close to the Line Corridor Towers...205***

Norhidayu Rameli and Farah Najwa (Universiti Sains Islam Malaysia, Malaysia); Mohd Zainal Abidin Ab Kadir (Universiti Putra Malaysia, Malaysia); Nik Hakimi Nik Ali (Universiti Teknologi MARA & Shah Alam, Selangor, Malaysia); Ahmad Basri Abd Ghani (TNB Research, Malaysia); Nur Hazirah Zaini (Faculty of Engineering and Built Environment, Universiti Sains Islam Malaysia, Malaysia)

Urban areas have become the most rapidly developing areas in the country. With a limited area for the power transmission line, the distribution power line appears to be closely associated with the installed line corridor of the overhead transmission line tower (OHTL). However, there may be an effect of the lightning electromagnetic field (LEMF) value when lightning strikes directly on the tower which consequently generate the lightning induced voltage (LIV) on the distribution power line. Thus, a comprehensive study is conducted to observe the peak value of LEMF of distribution power lines close to the line corridor for urban planning purposes. MATLAB is used to determine the LEMF for the distribution power line. The results indicate that the LEMF value depends on the lightning current stroke value, ground reflection value and the distance between the distribution power line and OHTL. Additionally, for the distribution power line to be installed close to the line corridor, it applies in the range of 2 m to 5 m if the type of soil is a mixture of sand and clay or sand only. This study provides an advantage in understanding the peak value of LEMF within a certain range and specific types of soil to ensure safety towards humans and infrastructure and solving the issues of land inaccessibility besides achieving the sustainable development goals (SDG) 9 and 11 which making the cities and human settlement inclusive, safe, and sustainable.

Monday, March 4 8:00 - 10:00
GALA DINNER: Attire : Formal
Attire : Formal
Room: Oriental Ballroom

Tuesday, March 5

Tuesday, March 5 8:00 - 8:30
Registration

Tuesday, March 5 8:30 - 10:30
Parallel session 2_1a: Power System Operation and Planning

Room: Crystal Ballroom
Chair: Norziana Aminudin (Universiti Teknologi MARA, Malaysia)

8:30 ***The Stability Solution for 100 Percent Variable Renewable Energy Supply in Microgrid Through Batteries Energy Storage System...209***
Yasarah Labibah (Telkom University, Indonesia); Sudarmono Sasmono (Telkom University & PT Quadran Energi Rekayasa, Indonesia); Muhammad Zakiyullah Romdlony (Telkom University, Indonesia); Amir Hakim (PT PLN Persero, Indonesia); Nanang Hariyanto (STEI ITB, Indonesia); Devni Syafrianto (PT PLN (Persero), Indonesia)
Since Nusa Penida Island has a complete resource of intermittent and non-dispatchable energy resources such as wind and solar energy then maximum integration of such power plant is possible to develop. However, the stability of the grid will be a consideration of the grid operator. Based on the research that discusses grid issue when supply by one hundred percent of RERs, its only possible and allowable if the advanced grid controller or defense backup system is applied to the grid. BESS are pretty suited to support operation of distribution system, to facing the challenges created by distributed, fluctuating, and uncertain renewable energy. The main contribution of this paper is to demonstrate (based on simulation) effect of BESS to the grid as a backup system. However, the advanced grid controller may better solutions.

8:50 ***Lightning Search Algorithm for Economic Dispatch Solution Considering Practical Constraints and Transmission Loss...214***
Asif A. Rahimoon Rahimoon and Mohd Noor Abdullah (Universiti Tun Hussein Onn Malaysia, Malaysia); Halyani Mohd Yassim (Fakulti Teknologi Kejuruteraan, Universiti Teknikal Malaysia Melaka, Malaysia); Shafique Ahmed Soomro (Indus University karachi, Malaysia); Asif Raza (University of Electronics Science and Technology of China, Malaysia)
This paper presents the investigation of the Lightning Search Algorithm (LSA) performances for solving the Economic Dispatch (ED) problem. The main purpose of ED problem is to determine the optimal power output of the committed generators to satisfy the load demand and operational constraints. The LSA employs principles inspired by the natural phenomenon of lightning and the mechanism of step leader propagation. The ED constraints such as valve point effect (VPE), power balance (PB), ramp rate limits (RRL), prohibited operating zone (PoZ) with and without power losses are considered to solve the ED problem. The proposed LSA has been tested on four different test systems

comprised of 3, 6, 13 and 38-generating units to demonstrate the effectiveness of the proposed LSA. The result reveals that the proposed LSA performs well for cost minimization ($/h) compared to existing algorithms.

9:10 ***The Migration Study of 2 x 400 MW Steam Power Plant from a 500 kV Bus to a 150 kV Bus...220***

Pawenary Pawenary (Institut Teknologi PLN, Indonesia); Adri Senen and Ginas Alvianingsih (Institut Teknologi PLN, Indonesia & Universiti Teknologi Malaysia, Malaysia); Hasna Satya Dini (Universiti Teknologi Malaysia, Indonesia & Institut Teknologi PLN, Indonesia); Rahmat Febrianto Wijanarko (Institut Teknologi PLN, Indonesia)

To overcome the overload condition of 500 kV/150 kV interbus transformers in the X area due to load forecasting in 2023, 2 x 400 MW power plant is planned to be moved from 500 kV bus into 150 kV bus. This research aims to analyze the power flow and short circuit study before and after the migration is implemented. The method used in this research is a simulation using ETAP software. From the results of the power flow study, it can be concluded that the migration of 2 units of power plant can reduce the load on IBT 1 and IBT 2 both under normal conditions and during contingency in one of IBTs. In addition, it also increases the bus voltage profile, reducing losses in the 150 kV sub-system area. From the results of the short circuit study, migrating 2 x 400 MW power plant units, is safe in terms of equipment durability

9:30 ***Day-Ahead Power Flow with Stochastic Wind and Solar Power Plants Using Harris Hawk Optimization...226***

Supriya Jaiswal (NIT Hamirpur, India); Ankur Maheshwari (Guru Nanak Institutions Technical Campus, India); Mukesh Singh (NIT HAMIRPUR, India)

The increasing integration of renewable energy sources (RESs), such as wind and solar power, contributes to the escalating unpredictability of electrical power systems. Acknowledging and accommodating the stochastic nature of these sources is paramount for accurate conclusions in power system analyses. Given the inadequacy of probability density functions in addressing uncertainty in Day-Ahead Optimal Power Flow (DA-OPF), this study employs a scenario-generating method via Monte Carlo simulations. Furthermore, it applies the Harris Hawks Optimization (HHO) technique to optimize the day-ahead operation of a power system integrating stochastic wind and solar energy sources, focusing on minimizing operational costs. The analysis encompasses both standard and modified IEEE 30-bus configurations. The findings illustrate the efficacy and efficiency of the proposed algorithm in tackling this intricate challenge. Through the amalgamation of scenario generation techniques and optimization algorithms, this study presents a viable approach to manage the inherent complexity of power networks incorporating stochastic RESs.

9:50 ***Modelling of a Nonlinear Swing Equation for a Non-Salient Pole Rotor Synchronous Generator...232***

Nor Syaza Farhana Mohamad Murad (Universiti Teknikal Malaysia Melaka (UTeM), Malaysia); Muhammad Nizam Kamarudin and Sahazati Md Rozali

(Universiti Teknikal Malaysia Melaka, Malaysia); Muhamad Fahezal Ismail (UniKL MFI, Malaysia)
Modelling of a nonlinear swing equation for a non-salient two-pole rotor of a synchronous generator is considered in this paper. The aim is to verify the functionality of the model for rotor angle stability analysis and enhancement studies. The simulation of the model proves that disturbance occurrences will perturb the rotor angle stability and might as well cause the rotor angle to operate at a new operating angle. Verification of this model allows it to be used in future studies of rotor angle stability analysis and enhancement.

10:10 ***Medium Voltage Gas Insulated Ring Main Unit (RMU) Condition Assessment by Utilizing Health Index Monitoring Method in Malaysia Power Utility...237***
Raja Saharuddin Bin Raja Daud (Universiti Teknikal Malaysia, Malaysia); Muhammad Sharil Yahaya (Universiti Teknikal Malaysia Melaka, Malaysia)
This paper proposes a comprehensive method to evaluate the condition of gas insulated Ring Main Unit (RMU) by using the conventional weight and scoring method cojoin with conditional factor to improve the accuracy of the Health Index (HI) evaluation. Overall condition of RMU is conducted by implementing condition base monitoring (CBM). However, this raw data has not been simplified and systematically processed for condition assessment and further action required. The HI evaluation proposed is utilizing score and weight technique whereby CBM data are transformed to a numerical value in term of percentage according to respective compartment up to overall HI. The accuracy of the HI has been improved by applying conditional factor which considers invisible that can contribute to the changes of the index. In this paper, a condition evaluation method has been developed. Subsequently, the method has been developed to evaluate 200 numbers of 11kV distribution RMU. Recommendation of maintenance strategy has been developed as well based on HI result to optimize resources and cost management.

Parallel session 2_1b: Renewable Energy and Storage/ Other Related Field in Power Engineering/ Data Analytics in Power Engineering Application
Room: Rafflesia Room
Chair: Ahmad Asri Abd Samat (Universiti Teknologi Mara Cawangan Pulau Pinang, Malaysia)

8:30 ***Innovative & Sustainable Solution for Protection Relays Life Cycle Management...242***
Fitriah Binti Shafei (PETRONAS, Malaysia); Mohd Faizal Hamdan (Petroliam Nasional Berhad, Malaysia); Ahmed Fadzil Bin Mustafa Kamal, Ir. Ts. (Oil and Gas & PETRONAS, Malaysia); M Fiqri Bin A Rahman (Oil and Gas, Malaysia); Norhasyidah Bt Mustafa and KhairulAzhar B Rasimun (PETRONAS, Malaysia)
This paper explains an innovative approach taken by industry in managing protection relays towards operational optimization and excellence. Protection relays are critical in ensuring reliable and safe electrical power system and supply. Often regarded as one of Safety Critical Element (SCE) in electrical systems,

protection relays are subjected to recalibration exercise to ensure its integrity and operability during electrical fault. Failure of protection relays to operate will result in production loss, extensive equipment damage and danger to personnel. As digitalization become more relevant and demanding nowadays, data centralization and the efforts towards digitalization of control and real time monitoring of protection relay status and information become crucial especially with the advancement of technology and availability of various technology applications nowadays. With centralized database and status supported with analytical tools, managing a wide range of protection relays in large scale electrical installation becomes simpler, more efficient, and enables user to take calculated risk for better decision making. For large scale electrical installation, these digitalization requirements will become eminent to supplement human intervention in daily operation and maintenance activities. This digitalization effort will become the paradigm shift for protection relays management aligning business towards operational cost optimization and efficiency.

8:50 ***CMOS-Based Ripple Correlation Control MPPT Dc-Dc Boost Converter for Perovskite Solar Cell Energy Harvester...246***

Kayode Oluwaseyi Adebunmi and Annie Ng (Nazarbayev University, Kazakhstan); Arjuna Marzuki (Wawasan Open University, Malaysia); Ikechi Augustine Ukaegbu (Nazarbayev University, Kazakhstan)

The power management integrated circuits in photovoltaic (PV) energy harvesting applications require efficient maximum power point tracking (MPPT) algorithm to maximize power output from the PV in the face of continuously fluctuating atmospheric circumstances. A CMOS-based Ripple Correlation Control (RCC) algorithm for optimizing power extraction from the Perovskite Solar cell (PSC) was designed in this work. The RCC uses the intrinsic ripple characteristics of the DC-DC boost converter to perturb the voltage and current of the PV panel to achieve MPP. The design uses a multiplier, a 2-stage op-amp, two differentiator circuits, an integrator, an XOR gate, and a deadtime circuit. The PWM stage of the MPPT consists of a comparator, and a Schmitt trigger circuit was incorporated into the PWM section of the design to minimize the system's chip size and power consumption. The effectiveness of the RCC output signal was able to drive the boost converter to produces an output voltage of 5.67V from an input voltage of 1.5V with a power efficiency of 98%. The system was designed using UMC180nm CMOS technology.

9:10 ***Solar Powered Water Pumping System with Induction Motor for Off-Grid Application...252***

Sanjay Kumar Kakodia (Maulana Azad National Institute of Technology, India); Giribabu Dyanamina (MANIT BHOPAL, India)

This paper introduces a comprehensive solar photovoltaic (PV) array-based water pumping system employing an induction motor drive (IMD). The system is designed in two stages to ensure efficient operation. The first stage incorporates a boost converter to elevate the PV array output voltage and maximize the power extraction by dynamically adjusting the duty ratio through a perturb and observe (P&O) algorithm. Whereas the second stage, DC to AC conversion for IMD is

integrated with the water pumping system. Scalar control provides an easy implementation, but it exhibits poor dynamic response and dependent speed and torque characteristics. To mitigate the poor dynamic response of scalar control, vector control has been implemented to enhance dynamic performance. The vector control provides independent torque-speed performance similar to a separately excited DC machine. The system's performance is thoroughly evaluated under various dynamic conditions, including variable irradiances. The control schemes have been implemented using MATLAB/Simulink and validated in real time using OPAL-RT 5600.

9:30 ***MPPT Optimization of PV Systems Using Cuk Converter with P&O Algorithm Under Varying Environmental Conditions...258***

Ahmad Asri Abd Samat (Universiti Teknologi Mara Cawangan Pulau Pinang, Malaysia); Aimi Idzwan Tajudin and Mohamad Adha Mohamad Idin (Universiti Teknologi MARA, Cawangan Pulau Pinang, Malaysia); Tengku Muhamad Irfan Tengku Izham (Universiti Teknologi MARA, Malaysia); Kamarulazhar Daud (Universiti Teknologi Mara Cawangan Pulau Pinang, Malaysia); Saodah Omar (Universiti Teknologi Mara, Malaysia)

This project conducts a thorough investigation into the enhancement of Photovoltaic (PV) systems by integrating a Cuk converter with a Perturb and Observe (P&O) algorithm for Maximum Power Point Tracking (MPPT) in the presence of changing environmental circumstances. The goal was to measure how well the system performs under different levels of irradiance. This project involved conducting a thorough assessment of the accuracy, efficiency, and flexibility of the MPPT system. The MPPT system repeatedly exhibited accurate tracking of the maximum power point (MPP), with accuracy ranging from 98.8% to 99.9% under varying levels of irradiance. The system demonstrated its capability to transform input power into usable output power with efficiency levels ranging from 94.7% to 96.7%. The duty cycle profiles consistently demonstrated the converter's adaptable operational behavior. Furthermore, the system demonstrated a direct correlation between changes in irradiance and corresponding increases in both input and output powers, particularly at higher levels of irradiance. The results highlighted the system's flexibility and capacity for practical application in optimizing solar energy generation.

9:50 ***Enhanced MPPT in Partially Shaded PV Systems Using PSO Optimization Technique...264***

Ahmad Asri Abd Samat (Universiti Teknologi Mara Cawangan Pulau Pinang, Malaysia); Rosheila Darus (UiTM, Malaysia); Muhammad Eillieyin Mohd Ghazali (UiTM Cawangan Pulau Pinang, Malaysia); Langlang Gumilar (Universitas Negeri Malang, Indonesia); Nornaim Kamarudin (Universiti Teknologi MARA, Malaysia); Mohammad Faridun Naim Tajuddin (Universiti Malaysia Perlis, Malaysia)

This project proposes the design of Maximum Power Point Tracking (MPPT) using the Particle Swarm Optimization (PSO) technique under partial shading conditions. Besides that, a DC-DC buck converter was designed to adapt the voltage to its appropriate value to reach a maximal power extraction for a photovoltaic (PV) system. The scope of the study focused on tracking the

Maximum Power Point (MPP) of the PV system, simulating uniform, and non-uniform shading conditions, and using a MATLAB/Simulink to model the overall system for validation purposes. The process of this research involved designing the PV system, and the buck converter, and implementing the PSO algorithm to track the MPP. The results showed that the PSO-based MPPT system effectively tracked the MPP, with varying levels of accuracy and tracking time for different shading conditions. In conclusion, the study demonstrated the feasibility of using PSO-based MPPT for PV systems under partial shading conditions was successfully designed with an accuracy of 95% and above to track the maximum power of the system. The results highlight the effectiveness of the Particle Swarm Optimization (PSO) method in significantly improving the Maximum Power Point Tracking (MPPT) technique in partially shaded photovoltaic (PV) systems.

10:10 ***Preparing Islanding Threshold Data for Machine Learning Algorithm...270***
Md Siddikur Rahman, Khairul Nisak Md Hasan, Mohd Fakhizan Romlie and Mohd Faris Abdullah (Universiti Teknologi PETRONAS, Malaysia)
Under the smart grid paradigm, numerous independent operators oversee distribution systems; therefore, for situational awareness and protection, all dispatchers need to have a comprehensive picture of the network. This visualization is made possible by a protection type micro-phasor measurement unit (μ-PMU) mounted on the relevant distributed generation (DG) bus. The potential for accidental islanding, which jeopardizes utility personnel and hinders orderly reconnection, is one of the biggest issues with DGs. The heavily sampled 'Big Data' captured by phasor measurement units (PMUs) contains important information about the system's health. Most power system challenges, such as voltage stability, power system modelling, fault event monitoring, unintended islanding, state estimate, and so on, may be addressed by efficient and timely analysis of this data. In light of this, this paper recommends using PMU to detect inadvertent islanding in real time and presents a methodology for islanding threshold data preparation for artificial intelligence (e.g., machine learning) algorithm. The discrete Fourier transform voltage and current phasors obtained from these PMUs are then processed using the Fortescue transform to compute the angle of sequence components. Under islanded conditions, the absolute angle difference between positive and zero components are employed to initiate signal for islanding. A modified IEEE 30 bus system is simulated by using Power World Simulator for data generation.

Parallel session 2_1c: High Voltage Engineering & Technology/ Energy and Environment in Power Engineering Application

Room: Hibiscus
Chair: Faranadia Abdul Haris (University of Technology MARA, Malaysia)

8:30 ***Quantifying Electric and Thermal Transformer Criticalities in Electric Arc Furnaces: A Fuzzy Logic-Based Analysis...276***
Atul Jaysing Patil (Nit Hamirpur & NIT Hamirpur, India); R Naresh (NIT Hamirpur, India); Raj Kumar Jarial (National Institute of Technology Hamirpur (HP) India,

India); Vivek Kumar (NIT Hamirpur, India); Hasmat Malik (BEARS, University Town, NUS Campus Singapore, Singapore & NSIT Delhi, India)
Electric arc furnace transformers are integral to steel mill operations, providing the necessary high current magnitudes. Traditional maintenance strategies for these transformers primarily rely on offline diagnostic tests, which compute their health index and estimate the remaining lifespan using mathematical approaches. Given that various factors can introduce stress and lead to transformer degradation, it becomes crucial to have an effective assessment system in place. This research introduces specialized fuzzy models designed to evaluate the critical states of individual components, deliver a comprehensive health index, and project the transformer's remaining lifespan. Furthermore, a decision-making framework is developed to identify malfunctioning components based on collected data. The incorporation of fuzzy rules and a color-coded health indication system enhances the model's applicability. This research offers invaluable insights for professionals and researchers dedicated to the maintenance and refurbishment of furnace transformers.

8:50 ***Effects of Different Ethylene-Based Copolymers on the Structure and Dielectric Properties of Polypropylene Blends...282***
Mohd Ridhuan Mohd Sharip (Universiti Teknologi Malaysia, Malaysia & Universiti Malaysia Sarawak, Malaysia); Kwan Yiew Lau (Universiti Teknologi Malaysia, Malaysia); M. Afendi M. Piah (Universiti Teknologi Malaysia & Institute of High Voltage and High Current, Malaysia); Dyg Norkhairunnisa Abang Zaidel (Universiti Malaysia Sarawak & Faculty Engineering, Malaysia); Ahmad Basri Abd Ghani (TNB Research, Malaysia); Amira Arifin (TNB Research Sdn. Bhd., Malaysia)
In the power cable insulation industry, polypropylene (PP) has shown great potential in the development of new power cable insulation materials because of its higher melting temperatures, excellent dielectric properties, and recyclability. However, its mechanical stiffness restricts its use in power cable insulation. In this paper, PP/copolymer blends with different types of ethylene-based copolymers, namely, ethylene-propylene-diene monomer (EPDM) and ethylene-octene copolymer (EOC), at a 10 wt% copolymer content, prepared using a melt blending method, are studied. The effects of the copolymers on the PP/copolymer blends are reported through microstructure, dielectric response, and breakdown analyses. The results show that both the copolymers disperse well in the PP matrix, but each copolymer results in different dielectric effects of PP. Remarkably, the breakdown strength of both the PP/copolymer blends is better than the conventional cross-linked polyethylene (XLPE), even though the breakdown values are lower compared to that of the pure PP. Notably, with the presence of elastomer in PP, the elongation of break for PP improved up to 400% for both PP/EPDM and PP/EOC blends. This indicates that PP blended with ethylene-based copolymers, especially PP/EOC blends, can be a suitable candidate to replace traditional power cable insulation materials.

9:10 ***Structure and AC Breakdown Strength of Polypropylene/Ethylene-Octene Copolymer/Magnesium Oxide Nanocomposites...287***

Mohd Ridhuan Mohd Sharip (Universiti Teknologi Malaysia, Malaysia & Universiti Malaysia Sarawak, Malaysia); Kwan Yiew Lau (Universiti Teknologi Malaysia, Malaysia); M. Afendi M. Piah (Universiti Teknologi Malaysia & Institute of High Voltage and High Current, Malaysia); Dyg Norkhairunnisa Abang Zaidel (Universiti Malaysia Sarawak & Faculty Engineering, Malaysia); Mohd Aizam Talib (TNB Research, Malaysia); Showkat Bhawani (Universiti Sarawak, Malaysia)

With the rapid development of recyclable power cable insulation materials, polypropylene (PP) blended with elastomers has attracted much attention as an important technique in improving the mechanical properties of PP. However, the incompatibility between PP and elastomer can cause a decrease in the breakdown strength of the PP blend. This study explores the effect of 1 wt% of magnesium oxide (MgO) nanofiller on the structure and dielectric properties of PP blended with ethylene-octene copolymer (EOC) at various elastomer amounts. The morphology, dielectric response, and breakdown strength of the materials are reported to illustrate changes in the structure and dielectric properties after the addition of the nanofiller. The results show that the MgO is homogenously dispersed in the PP/EOC blends and causes a change in permittivity values. The addition of the MgO also increases the breakdown strength of the PP/EOC blends. Based on the results, the PP/EOC/MgO nanocomposites hold a significant promise for the development of new recyclable power cable insulation materials.

9:30 ***Simulation of Partial Discharge Phenomenon in Epoxy-Resins Insulation Under Very Low and High Stressing Frequencies...291***

Mohamad Nur Khairul Hafizi Rohani (Universiti Malaysia Perlis, Malaysia); Umar Musa (Ahmadu Bello University-Zaria, Nigeria); Firdaus Muhammad-Sukki (Edinburgh Napier University, United Kingdom (Great Britain)); Sulaiman Haruna Sulaiman (Ahmadu Bello University, Nigeria); Abdullahi Abubakar Mas'ud (Jubail Industrial City & Jubail Industrial College, Saudi Arabia)

In this paper, the phenomenon of partial discharge (PD) within an air-filled void in epoxy-resin insulation test sample was investigated under the influence of very low frequency (VLF), 0.1 Hz, as well as power frequency (PF), 50 Hz, of the applied AC voltage stress. A 3D model of the test sample was developed in COMSOL Multiphysics and simulated alongside MATLAB. The model was found to produce electric field magnitudes adequate enough to initiate PD within the void. The distribution of field in the test sample after PD event indicates a much a significant drop in cavity field as compared to the bulk sample. It is seen from the PD results that the voltage frequency influences the phase-resolved PD distribution in the sample, with more PD repetition rate recorded under 50 Hz, PF as compared to the 0.1, VLF case.

9:50 ***Daylight-Adaptive Lighting Control Techniques: A Comparative Analysis of Particle Swarm Optimization and Firefly Algorithm...294***

Khairul Rijal Wagiman (Universiti Tun Hussein Onn Malaysia); Mohd Faiz Adnan, Imran Hussin and Mohd Hairwan Md Nor (Universiti Tun Hussein Onn Malaysia, Malaysia); Asri Din (Universiti Teknikal Malaysia Melaka, Malaysia)

Lighting in commercial buildings consumes a substantial amount of energy. Therefore, this paper developed particle swarm optimization (PSO) and firefly algorithm (FA) as control techniques for lighting systems to improve energy efficiency and satisfy occupants' visual comfort in an indoor environment. An office room was considered to test the performance of the PSO and FA techniques. The proposed methods showed superior performance in minimizing the cost of energy consumption by more than 60% while satisfying illuminance-based metrics mentioned by the European Standard EN 12464-1. Based on the comparative result, PSO outperformed FA by 3% in energy savings. Due to its performance, the proposed PSO method can be utilized for other types of buildings.

10:10 ***Optimal Power Flow Solution Based on Multi-Verse Optimizer Algorithm Incorporating Renewable Energy Sources...299***
Yog Raj Sood (NIIT Hamirpur HP, India); Ankur Maheshwari (Guru Nanak Institutions Technical Campus, India); Supriya Jaiswal (NIT Hamirpur, India)
Due to the escalating complexity and rapid growth of electrical power networks, transmission lines are experiencing unprecedented stress. This leads to overloads, increased power losses, and heightened operational costs. Addressing these challenges requires the execution of optimal power flow (OPF) for secure and economical power system functionality. This research introduces the application of recent multi-verse optimizer (MVO) algorithm for solving OPF problems within the modern power systems. These systems incorporate both thermal power plants and renewable energy sources (RESs), such as wind and solar energy facilities. The uncertainty associated with the power generation of wind and solar power plant is effectively addressed using Weibull and Log-normal probability density functions, respectively. The proposed algorithms efficacy and efficiency is evaluated against various optimization techniques considering the modified IEEE-30 bus system. Simulation outcomes indicate that, relative to alternative approaches, MVO algorithm effectively finds the most precise optimal solution to the power systems OPF problems.

Tuesday, March 5 10:30 - 10:45
Coffee break 1
Room: Crystal Ballroom

Tuesday, March 5 10:45 - 12:45
Parallel session 2_2a: Power System Operation and Planning
Room: Crystal Ballroom
Chair: Zuhaila Mat Yasin (Universiti Teknologi Mara, Malaysia)

10:45 ***Assessing the Impact of Galvanic Corrosion on the Ampacity of ACSR/TW and ACCC/TW Conductors...305***
Izzat Nawawi and Shahnurriman Abdul Rahman (Universiti Sains Islam Malaysia, Malaysia); Konstantinos Kopsidas (University of Manchester, United Kingdom (Great Britain))

Galvanic corrosion may happen to overhead conductors with dissimilar metal composition and would adversely affect the conductors' structural durability, electrical performance, and lifetime. The deterioration resulting from corrosion may accelerate the degradation of the conductors if left unaddressed. This paper aims to assess the impact of galvanic corrosion on the ampacity of commonly used Aluminium Conductor Steel Reinforced (ACSR/TW) and the more advanced Aluminium Conductor Composite Core (ACCC/TW). By using the COMSOL Multi-Physics software, the electrochemical reactions that happened during corrosion between materials within the conductors are modeled. Consequently, the conductors' electrical conductivity and its ampacity are estimated based on the structural deformation level experienced by the aluminium strands. The results indicate that, bimetallic ACSR/TWs are more susceptible to galvanic corrosion compared to ACCC/TWs resulting in a substantial loss of surface area. A considerable reduction in ampacity up to 12.6%, is noted in the modeled ACSR/TW conductors following 25 months of continuous exposure to corrosion. In contrast, the carbon fiber core of ACCC/TW demonstrates better resistance to galvanic coupling during the same exposure period, thereby contributing to lesser ampacity reduction rate of 10.7%. This research provides an initial study on the galvanic corrosion and its impact on overhead conductor's ampacity.

11:05 *Comparative Analysis in DG Installation Scheme for Resilience Enhancement...311*

Fathiah Zakaria (Universiti Teknologi MARA, Malaysia); Ismail Musirin (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Norziana Aminudin and Dalina Johari (Universiti Teknologi MARA, Malaysia); Sharifah Azwa Shaaya (Universiti Tenaga Nasional, Malaysia); Nur Farahiah Ibrahim (Universiti Teknologi MARA, Malaysia)

This paper presents a comparative analysis of the Distributed Generation (DG) scheme for resilience enhancement. This study models categories of hurricanes as disruptive events, considering data on the fragility of transmission towers concerning wind speeds. The simulation involves generating sustained winds corresponding to different categories of hurricanes, following the Saffir-Simpson Hurricane scale. The transmission power system will encounter power outages when the transmission tower collapses. The installation of DG is one of the suitable efforts to alleviate this phenomenon where it is used as a compensating device to improve power grid resilience. In this study, the Evolutionary Programming (EP) and Artificial Immune System (AIS) optimization techniques are used to determine sizing and strategic locations for the placement of multiple DG units for loss control in the power system. The resilience status of the system is also observed. The proposed optimization techniques are validated on the IEEE 30-Bus Reliability Test System (RTS) under varying loads. Verification was conducted through a comparison of optimization outcomes obtained from EP and AIS techniques. The findings illustrate the effectiveness of these algorithms in significantly reducing total loss and improving the resilience of the tested system.

11:25 ***Optimization of Automatic Generation Control Performance for Power System of Two-Area Based on Genetic Algorithm-Particle Swarm Optimization...317***
Hazlee Azil Illias (University of Malaya, Malaysia); Nurullah Nurjannah (Universiti Malaya, Malaysia); Hazlie Mokhlis (University of Malaya, Malaysia)
The purposes of automatic generation control (AGC) in a power system are to control the interchange of tie-line schedule in various power system regions, maintain the frequency within the required range and distribute the load among different generators. Thus, it is important to ensure that the performance of AGC is at its optimum level. One of the methods to optimum the performance of AGC is by implementing PID or proportional-integral-derivative controllers. In this project, the performance of AGC for power system of two-area is optimized using a properly tuned PID controllers via combination of particle swarm optimization (PSO) and genetic algorithm (GA) algorithms or GA-PSO. The proposed method was compared with AGC with PID controllers but without optimized by any algorithm and optimized using GA and PSO. According to the results, it was observed that combination of GA-PSO is able to optimize the AGC with PID controllers better than without optimization and using PSO and GA alone.

11:45 ***Modeling and Assessing the Impact of Flash Floods on a Power Distribution System...322***
Suhail Afzal (Universiti Malaya, Malaysia); Hazlie Mokhlis, Nurulafiqah Nadzirah Mansor and Hazlee Azil Illias (University of Malaya, Malaysia); Jasrul Jamani Jamian (Universiti Teknologi Malaysia, Malaysia); Mohd Khairun Nizam Mohd Sarmin (TNB Research, Malaysia)
Power system is considered a lifeline of the modern community because the functionality of critical infrastructures such as transportation networks, banking systems, and emergency health facilities rely on the supply of electrical energy. Although the power system is appreciably reliable, severe weather events such as hurricanes and floods have caused large-scale power outages. These widespread power cuts not only result in a significant monetary loss but also create socio-economic and security problems. Therefore, utility operators must have an earlier preparation for these extreme weather events to reduce damage to power system assets such as electrical substations and to restore electricity supply as quickly as possible. In this respect, a probabilistic model to forecast rainfall intensity is proposed in this paper. Further to this, the Monte Carlo technique is employed to predict flood-induced failures in power distribution systems. Finally, the impact of these failures on system performance is evaluated to plan a resilient network restoration strategy following a flood event. The proposed methodology is tested on the IEEE 33-bus system and provides a solid foundation for the efficient allocation of resources and effective deployment of repair crews to enhance power distribution system resilience for flash flooding.

12:05 ***Comparative Analysis of Multi Optimization Techniques Under Load Variations in Optimal Reactive Power Dispatch...327***
Rahmatul Hidayah Salimin (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia); Zulkiffli Abdul Hamid and Norziana Aminudin (Universiti Teknologi

MARA, Malaysia); Ismail Musirin (Universiti Teknologi MARA Shah Alam, Selangor, Malaysia)
Power System Compensation Schemes encompass a range of strategies, including the integration of distributed generation (DG), flexible AC transmission system (FACTs) devices, power scheduling, capacitor bank placement, and optimal reactive power dispatch (ORPD). ORPD, a current trend, also involves optimizing transformer tap changer settings (TTCS). However, the efficacy of TTCS optimization is questioned due to its potential impact on transmission line parameters. To avoid over-compensation and under-compensation, these schemes necessitate optimization. Evolutionary Programming (EP) and Artificial Immune System (AIS) are widely employed in power system optimization, yet their susceptibility to getting stuck at local optima limits their effectiveness. This hybrid, termed Integrated Accelerated Clonal Evolutionary Programming (ICAEP), exhibits promising results in optimizing ORPD under load variations. The paper introduces the implementation of the accelerated mutation technique in ICAEP, showcasing exceptional performance compared to standalone EP and AIS methods. ICAEP can be adapted for various optimization problems, marking a significant advancement in addressing challenges associated with power system compensation, particularly in optimizing ORPD under varying loads.

Parallel session 2_2b: Other Related Field in Power Engineering/ Electric Vehicle (EV)
Room: Rafflesia Room
Chair: Mohd Ezwan Mahadan (Universiti Teknologi MARA Johor Branch, Pasir Gudang Campus & Universiti Teknologi MARA Shah Alam, Malaysia)

10:45 *Review of Deep Learning-Based Hotspot Detection in Solar Photovoltaic Arrays...332*
Mohd Zulhamdy Ab Hamid (Universiti Teknologi MARA Cawangan Pulau Pinang, Malaysia); Kamarulazhar Daud (Universiti Teknologi Mara Cawangan Pulau Pinang, Malaysia); Zainal Hisham Che Soh, Ir (Universiti Teknologi MARA, Malaysia); Muhammad Khusairi Osman (Universiti Teknologi Mara (UiTM), Malaysia); Iza Sazanita Isa (Universiti Teknologi Mara, Malaysia); Nurul Huda Ishak (UiTM Pulau Pinang, Malaysia)
This review paper conducts a detailed exploration of the burgeoning field that leverages deep learning techniques for hotspot detection in solar photovoltaic (PV) arrays. Hotspots represent a paramount concern within PV systems, as they not only result in efficiency degradation but also pose potential safety risks. This analysis encompasses a wide array of deep learning models and methodologies employed for hotspot detection, providing a rigorous assessment of their performance metrics. Furthermore, we engage in a forward-looking discussion concerning the promising future prospects and emerging trends within this dynamic and evolving research domain. As the global demand for renewable energy sources continues to rise, effectively addressing hotspots becomes more crucial for ensuring the sustainability and efficiency of solar PV arrays.

11:05 *Observation of Vertical and Tortuous Lightning Channels Using a High-Speed Camera...338*

Nor Asrina Ramlee (University of Technology Sarawak, Malaysia)

Lightning data acquisition methods in Malaysia have begun to incorporate advanced tools such as high-speed cameras. However, comprehensive reports on the results of this method are still limited. Due to this circumstance, little is known about the characteristics of optical lightning. Thus, this study was carried out using a high-speed camera installed in Malacca, Malaysia. An investigation was conducted into the optical profile of the cloud to ground lightning channel termination. Temporal analysis has been conducted on the termination behaviour of 37 discharge channels, including vertical and tortuous return strokes, solely based on the camera records. It was discovered that 68% of the return strokes were tortuous and 32% were vertical lightning channels. Multiple strokes lightning for both vertical and tortuous events were observed in 25% and 24% of the sample, respectively. From 22 first return stroke samples, 57% of vertical and 53% of tortuous channels ended at a new location than the previous first return stroke. All 24 subsequent return strokes in total for both vertical and tortuous lightning used the same channel with the preceding first return strokes and terminated at the same location. Both vertical and tortuous channels produced first return strokes at 143 ms and 129 ms of interval, while subsequent return strokes were produced at 47 ms and 29 ms of interval respectively. All these findings contribute to the field of lightning physics, particularly in relation to optical lightning observation in Malaysia. Despite its scarce occurrences, the flashes with multiple striking points on the ground within a short duration might produce fatal damage. Thus, they should be taken into consideration in designing lightning protection.

11:25 *Resilience Analysis of a Shipboard Power System with Disruptive Events and Varying Ship Load Conditions...343*

Worl Vincent F. Torres and Rodolfo Aguirre, Jr. (University of the Philippines Los Baños, Philippines)

Sustainable marine ships are in top priority of the governing bodies to address the adverse impacts of climate change. Thus, the maritime industry is starting to develop a full-electric shipboard power system (SPS) that consists of energy storage systems (ESS), electric propulsion, and necessary loads to operate a ship. In this study, resilience analysis was conducted by simulating a battery-operated ship, the Ampere ship. SPS environment of the ship was constructed and simulated under varying loads and disruptive events using MATLAB Simulink. Different case problems were considered in the simulation to incorporate the resilience analysis in the ship during disruptive events. The results of the simulation which include the electrical parameters of voltage and current were further analyzed using correlation method. Results showed that a strongly positive correlation exists between currents from voltage spikes and dips for cold-ironing conditions, while a strongly negative correlation is present between values of current after voltage spikes and voltage dips when in sailing conditions.

11:45 *Centralized Protection and Control: Alternative Digital Application for Advanced Relay Protection System - A Proven Case Study...349*

Fitriah Binti Shafei, Salmey Bin A Halim, M Khairil Bin M Hatta, Faizah Binti Othman, Nur Azra Azmi and M Ridhwan B Ahmad Fuad (PETRONAS, Malaysia)

This paper describes the criticality of managing electrical protection system data and parameters digitally, the efforts in digitalizing electrical protection system in oil & gas industry, the collaborations involved in realizing the efforts, best practices from a proven case study as well as some recommendations proposed to improve current ways of managing, monitoring and controlling electrical protection system to enhance operational day to day activities towards digital substation journey. Centralized Protection and Control or CPC, as the name suggests, provides the concept of centralizing and relocating electrical protection parameters, data, settings, and such into a centralized- single location to ease operation or users to monitor and operate the system. The concept of CPC has been introduced many years back. This is due to the demand and needs to ease and simplify the operation of electrical system. Centralized protection and control play a pivotal role in ensuring the reliability of electrical system been enhanced which encompass technology applications, methodologies, and protocols designed to safeguard assets, manage operations efficiently, and mitigate risks within small or complex networks. With the intent to move away from hardware and adopting the advanced technology of software into relay protection function, as a result, CPC has been accepted and applied in industry and potential in providing solutions and solving operational pain points.

12:05 *Powering the Future: The Latest Breakthrough in Wireless Charging for Electric Vehicles...355*

Matthew Fry (Cardiff Metropolitan University, United Kingdom (Great Britain)); Muhammad Usama Islam (University of Louisiana at Lafayette, USA); Syed Zahurul Islam (Universiti Tun Hussein Onn Malaysia UTHM, Malaysia); Jasim Uddin (Cardiff Metropolitan University, USA)

Recently, the Electric Vehicle (EV) market has experienced significant growth and is projected to expand exponentially with the advancement of technology. Major industries are increasingly adopting the concept of producing hybrid or fully electric cars, resulting in electric vehicles becoming a common sight in today's era. This research examines the potential of wireless power transfer systems as an alternative method of charging electric automobiles. Despite the widespread use of traditional plug-in charging, wireless charging proves to be more effective and convenient. The study evaluates various approaches to integrating wireless charging into an electric vehicle prototype, represented by a remote-control car. It also explores the background and advancements of wireless charging technology. By optimising the design of the transmitter and receiver, based on circuits used for mobile phone chargers, the necessary power (5V, 2A) is provided to the remote-controlled car. Voltage regulators are utilized to manage the output voltage of the receiver circuit during simulations, which assess the circuit's performance under different conditions. The results suggest that wireless charging could serve as a practical and environmentally friendly alternative to conventional charging methods.

12:25 *LSTM-Based Deep Learning Method for Excessive Neutral-To-Ground Voltage (NTGV) Localization in Secondary Distribution Systems...361*

Mohd Ezwan Mahadan (Universiti Teknologi MARA Johor Branch, Pasir Gudang Campus & Universiti Teknologi MARA Shah Alam, Malaysia); Ahmad Farid Abidin (Faculty of Electrical Engineering, Universiti Teknologi Mara, Malaysia); Mohd Abdul Talib Mat Yusoh (Universiti Teknologi MARA (UiTM), Malaysia); Nur Dalila Khirul Ashar (Faculty of Engineering Universiti Putra Malaysia Serdang, Selangor, Malaysia); Rijalul Fahmi Mustapa (Universiti Teknologi MARA, Malaysia); Muhammad Asraf Hairuddin (Universiti Teknolog MARA, Malaysia)

The excessive neutral-to-ground voltage (NTGV) on the secondary distribution system (SDS) may lead to unnecessary losses and safety hazards. Methods for troubleshooting and monitoring the root cause of these issues are limited. This paper introduces a deep learning (DL) method that utilizes real-world data to pinpoint the source of the problem due to ground fault events, whether upstream or downstream of the measurement point. The method employs a specialized recurrent neural network (RNN), specifically long short-term memory (LSTM), adept at processing time-series signals. Using 921 two-cycle NTGV time series data from various SDS locations, the study shows that the proposed method effectively locates the source of NTGV with 98.6% accuracy on the test dataset. The developed architecture is novel, representing the first implementation for feature learning and classification of NTGV source problems.

Parallel session 2_2c: Energy and Environment in Power Engineering Application/Power System Economics and Electricity Markets
Room: Hibiscus
Chair: Zulkiffli Abdul Hamid (Universiti Teknologi Mara, Malaysia)

10:45 *Prediction of Transmission Losses Allocation Using Artificial Neural Network and Z-Bus Tracing...367*

Zulkiffli Abdul Hamid (Universiti Teknologi Mara, Malaysia); Vistien Anak James, I Musirin and Nur Ashida Salim (Universiti Teknologi MARA, Malaysia)

In a deregulated power market, it's essential to allocate transmission losses charges to consumers to cover the transmission system's operating costs. However, determining the allocated transmission losses in Megawatts precedes charge allocation. This paper proposes a method for predicting the allocation of real power losses in deregulated power systems using Artificial Neural Network (ANN) and the Z-Bus tracing technique. The ANN is employed to forecast the allocation of real power losses to consumers. Three distinct training algorithms - Levenberg-Marquardt, Bayesian Regularization, and Scaled Conjugate Gradient backpropagation - are considered in developing the proposed ANN. The Z-Bus tracing technique is utilized to generate data samples for training the ANN. Simulation results demonstrate promising predictions on losses allocation through the integration of ANN and the Z-Bus tracing, albeit with varying performances across different training algorithms.

11:05 ***Peer-To-Peer Energy Trading for Optimal Power Management of Networked Microgrid Based on Particle Swarm Optimization...373***
Ahmed Sahib Tukkee, Jr (University Putra Malaysia & UPM, Malaysia)
The deliberation of power between small interconnected multi-Microgrid systems can increase the reliability and economic benefits of power systems. In this study, a two-level hierarchical energy management strategy is proposed based on a peer-to-peer energy trading model to efficiently manage a multi-Microgrid system operating in a grid-connected mode. In the first level, the optimal size of individual Microgrids is calculated using the particle swarm optimization approach in accordance with the best annual benefit. Accordingly, the surplus and shortage of energy are calculated and sent to the second level of energy management strategy. At the second level, Microgrids are classified as sellers or buyers based on the net power consumed, and the best energy trading is determined over several rounds. To reduce harmful gas emissions and preserve the environment, two important indicators are evaluated: the level of carbon dioxide emissions and the contribution of renewable energy resources. As compared to the conventional peer-to-grid energy trading model, the outcomes demonstrated that the peer-to-peer energy trading model may enhance annual earnings while lowering gas emissions.

11:25 ***Energy Consumption and Energy Efficiency Prediction Using Artificial Neural Network...379***
Fatin Nuraini Khairunizam, Nur Ashida Salim and Hasmaini Mohamad (Universiti Teknologi MARA, Malaysia); Zuhaila Mat Yasin (Universiti Teknologi Mara, Malaysia)
The purpose of this project is to determine the accurate energy consumption for heating and cooling of a building by using Artificial Neural Network (ANN) and to implement ANN for energy efficiency prediction. In this project, the data that has been obtained from Kaggle website was trained in ANN model using Levenberg-Marquardt (LM) method. The input variables are relative compactness, roof area, overall height, surface area, glazing area, wall area, glazing area distribution of a building, and orientation while output variables are the building's heating and ventilation demands. The training dataset consists of data from 768 residential buildings. The dataset was divided into 70 percents training samples, 15 percents validation samples, and 15 percents testing samples. The ANN model was able to predict heating and cooling loads with regression value (R) of 0.99174 and Mean Squared Error (MSE) of 1.6725 and able to show that surface area is the most effective factor in heating and cooling load. This process aids in the identification of prospective areas for enhancement, such as the modification of equipment schedules, the optimization of control settings, or the implementation of energy-conservation measures.

11:45 ***Review on DC Microgrid Protection Schemes...385***
Mukesh Kirar (Maulana Azad National Institute of Technology, India); Yogendra Kumar (Maulana Azad National Institute of Technology, Bhopal, India); Shweta Rani (India)

A DC micro-grid is an emerging power distribution system that integrates various renewable energy sources, energy storage devices, and loads within a localized area. Ensuring the reliable and safe operation of a DC micro-grid is of paramount importance. This abstract provides an overview of a DC micro-grid protection scheme designed to safeguard the system against faults, disturbances, and abnormal operating conditions. For detection of fault and location estimation in DC micro-grids with various renewable energy sources (RESs) such as PV, wind, and batteries, a new differential protection technique based on the relay's sensitivity is proposed in this study. When a failure occurs, it could result in undesired resource disconnections and render the system unreliable. The suggested method successfully identifies faults in the DC micro-grid, according to simulation results.

12:05 ***Enhancing Energy Efficiency in Developing Countries: Modelling and Simulating Home Energy Management System (HEMS)...391***

Zuhaina Zakaria (Universiti Teknologi MARA, Malaysia); Saleem Ahmed (Quaid e Awam University of Engineering, Sciences & Technology QUEST, Pakistan); Ghulam E Mustafa Abro (Interdisciplinary Research Center for Aviation and Space Exploration KFUPM Saudi Arabia, Saudi Arabia)

Developing countries face severe electricity shortage, necessitating sustainable solutions. This paper explores the transformative impact of rooftop photovoltaic (PV) and energy storage system (ESS) installations on the operational costs of electricity in smart homes within developing regions. The study incorporates the innovative concept of Home to Grid energy exchange (H2G) and integrates these technologies into a comprehensive Home Energy Management System (HEMS). Taking into account user preferences and system constraints, complementary power sources, including PV, grid power, and batteries, are evaluated. Employing MATLAB/SIMULINK (2017a), the HEMS is modeled and simulated to assess its effectiveness.

Tuesday, March 5 12:45 - 2:00
Lunch break
Room: La Veranda Coffeehouse