2018 IEEE PES/IAS PowerAfrica

Cape Town, South Africa 26 – 29 June 2018



IEEE Catalog Number: CFP18PES-POD ISBN: 978-1-5386-4164-4

Copyright \odot 2018 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

 IEEE Catalog Number:
 CFP18PES-POD

 ISBN (Print-On-Demand):
 978-1-5386-4164-4

 ISBN (Online):
 978-1-5386-4163-7

Additional Copies of This Publication Are Available From:

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400

Fax: (845) 758-2633

E-mail: curran@proceedings.com Web: www.proceedings.com



Table of Contents

EFFECT OF ANODE STOICHIOMETRY AND BACK PRESSURE ON THE PERFORMANCE OF PEMFCs	1
PERFORMANCE OF PEMFCs Emmanuel Balogun, Paul Barendse and Jessica Chamier	1
Signal Injection by Active Load Modulation for PEM Fuel Cell Diagnostics	7
MITIGATION OF LOW VOLTAGE CONTINGENCY OF DOUBLY FED INDUCTION GENERATOR WIND FARM USING STATIC SYNCHRONOUS COMPENSATOR IN SOUTH AFRICA	13
Hybridization of Battery, Supercapacitor and Hybrid Capacitor for Electric Vehicles Immanuel Jiya, Nicoloy Gurusinghe and Rupert Gouws	19
Load Management Optimization to Reduce The Demand Side Energy Cost	25
LOSS STUDY OF LCC-BASED HVDC THYRISTOR VALVES AND CONVERTER TRANSFORMERS USING IEC 61803 STANDARD	32
LOSS STUDY OF MMC-BASED HVDC CONVERTERS USING DATASHEET PARAMETERS	38
LOSS ASSESSMENTS OF KEY EQUIPMENT ON LCC-BASED HVDC CONVERTER STATIONS	44
Moehoek 22kV Power Distribution Feeder. Realibility Assessment-Perfomance Indices Katleho Moloi and Adedayo Yusuff	53
A Variable Sampling Frequency and Genetic Algorithm Fitted Predictive Controller for More Electric Aircraft Electrical Power System Shunt Active Power Filter	58
Analysis of the "sheet" charge concentration at the AlGaN/GaN interface	67
System operation planning including renewables and pumped-storage power plants Edson Bortoni, Jonas Costa, Paulo Vieira and Lidiana Sabino	73
Modeling and Assessment of Ethiopian 230 KV Power Transmission Network Voltage Stability using User-Defined and Modified Voltage Stability Indices	79
High Impedance Fault Classification and Localization Method For Power Distribution Network	84

A CONFIGURATION FOR OUTPUT VOLTAGE BOOST OF A THREE-PHASE, 3-LEVEL MULTILEVEL LEVEL INVERTER
Charles Odeh and Innocent Ewean Davidson
Development of an ANN-based Estimated Electricity Billing System
Distribution Network Reconfiguration Method with Distributed Generators Based on an Improved Shuffled Frog Leaping Algorithm
A THREE-PHASE, 5-LEVEL MULTILEVEL LEVEL INVERTER WITH OUTPUT VOLTAGE BOOST
Optimal Sizing and Placement of Solar Photovoltaic based DGs in the IEEE 9 bus system using Particle Swarm Optimization Algorithm
Determining Cross-Border Electric Power Transfer Limits: The Case of Zambia and DRC 126 Sydney Kadikula Zimba and Alison Chikova
Thermal Modeling of Power Transformers with Unbalanced Loading
Power Loss Estimation in Silicon Photovoltaic Cells Using Impedance Spectroscopy13: Olufemi Olayiwola and Paul Barendse
Sustainable Energy for Emerging Nations Development – A Case Study on Togo Renewable Energy
Comparison of Voltage Calculation Techniques for Varying Load Distribution in DG-integrated Networks
Open Design and Local Manufacturing of Small Wind Turbines: Case Studies in Ethiopia and Nepal
Approach for Screening and Ranking Potential Receiving End Points in Planning New HVDC Schemes
Analysis of Optimal PV Penetrations Levels with Time-variant Loads in Power Distribution Networks
Characterization of Lithium NCM and Sealed Lead Acid Batteries using Electrochemical Impedance Spectroscopy

Towards Module-Level Performance and Health Monitoring of Solar PV Plants using LoRa Wireless Sensor Networks	172
Joseph Eduan Shuda, Arnold Johan Rix and Marthinus Johannes Booysen Booysen	
An overview of the Nigerian power sector, the challenges of its National Grid and off-grid development as a proposed solution	178
Comparative Analysis of a PSS and TCSC for Small Signal Stability Analysis of a VSC Based HVDC System with Onshore Wind Power Generation	184
Estimation of global and direct solar radiation in Tunisia based on geostationary atellite imagery	190
Real-Time Control of a Doubly-Fed Induction Machine for Variable Speed Constant Frequency Wind Power System Through Laboratory Test Rig	195
LOSS ALLOCATION TO LOAD NODES BASED ON NODES-EDGES SETS IN ELECTRIC POWER NETWORK	202
Challenges in Power Systems Operations, Analyses, Computations and Application of Cloud Computing in Electrical Power Systems	208
mplementation of Substation SCADA and Automation Systems in the Port of Durban Siphokazi Mnukwa and Akshay Kumar Saha	214
mproving Reliability on Distribution Systems by Means of Network Reconfiguration Rianta Bhugwandeen and Akshay Kumar Saha	220
Power Systems Inspection Robot for Contactless Busbar Voltage Measurement and Underground	226
Shaun Benjamin Barnett and Akshay Kumar Saha	
A Comparative Analysis of a Three-phase Neutral Point Clamped Multilevel Inverter Theogan Logan Pillay and Akshay Kumar Saha	232
Performance Prediction of a Photovoltaic System through Three-dimensional Thermal Modelling and Simulation Studies	238
nvestigation of Ripple Current in Pulsewidth Modulation Techniques for Flying Capacitor Multilevel Inverters	244
Characteristics of Solar Power Generation	250

POWERING GAUTRAN STATIONS AND DEPOT BUILDINGS BASED ON RENEWABLE ENERGY RESOURCE	256
Portia Xaba and Adedayo Ademola Yusuff	
Investigation into the Issues Associated with closing an automated Normally Open (N/O) point on three Medium Voltage (MV) Networks where Fault Location, Isolation and Service Restoration (FLISR) is planned	262
Real-Time Implementation and Comparative Analysis of $\alpha \beta and ghReference Framed SVPWMTechniques for a Three-Level NPC Induction Motor Drive$	268
Modelling and Control of Multiterminal LCC HVDC	274
A smart distribution box controller for customer-based operations	280
Microcontroller-Based Monitoring and Controlling of Environmental Conditions in Farming	284
Power Market and Impact of Tariff in Malawi	289
An On-line Thévenin Equivalent Estimation Algorithm and its Application to Condition Monitoring	
aCar - A Electric Vehicle Concept for Sub-Saharan Africa	301
Generation expansion planning: A survey	307
Evaluating the Cost Effectiveness of Energy Efficient Appliances	313
A tutorial on the development of a Smart Calculator to determine the Installed Solar requirements for Households and Small businesses	319
Analysis of Soil Resistivity and its Impact on Grounding Systems Design	324
Power System Static Security Enhancement Through Interline Power Flow Controller Elutunji Buraimoh, F. K Ariyo and Innocent Davidson	330
Analysis of the East Africa Power Pool (EAPP) with Renewable Energy Penetration and Proposed Asynchronous Tie Lines	336

Single carrier and Multicarrier Digital Modulation Performance under Impulsive and Background Noise: BPSK, QPSK, 8PSK and 8QAM	342
Optimum Tilt and Azimuth Angles for Solar Photovoltaic Systems in South-West Nigeria Christy Etukudor, Hope Orovwode, Samuel Wara, Felix Agbetuyi, Anthony Adoghe, B. O. Obieje and C. N. Oparaocha	348
Social Impacts of Mini-grids: Towards an Evaluation Methodology	354
Electricity consumption and load profile segmentation analysis for rural microgrid customers in Tanzania	360
Development of an Intelligent Electronic Load Controller for Stand-Alone Micro-Hydropower Systems	366
Islanding Time Evaluation in Residential Microgrids	. 372
Investigating Induced Overvoltage Transients in Microgrids and its Components	378
Cost Optimization and Design of a Hybrid Distributed Generation System for a DC Microgrid	384
Development and Implementation of a Web Based Sustainable Alternative Energy Supply for a Retrofitted Office	390
Analytical Condition Monitoring System for Liquid-immersed Transformers	396
Lightning Risk Assessment of Rooftop Photovoltaic Systems: A Case Study Approach	. 402
PROTECTION OF TERMINAL DISTRIBUTION TRANSFORMERS: A CASE STUDY OF KENYA POWER	408
New Switched-Multi-Source Inverter Topology with Optimum Number of Used Switches Cristopher Luciano, Kennedy A. Aganah, Mandoye Ndoye and Ben Oni	. 414
Peer-to-Peer Trading Solution for Microgrids in Kenya	420
Sustainability Metrics for Rural Electrification in Developing Countries Jane Namaganda-Kiyimba and Joseph Mutale	. 426

Characterisation of harmonic distortions produced by small domestic back-up generators . 432 Olusayo Ajeigbe, Josiah Munda and Yskandar Hamam
Automated Efficiency Testing of Converter-Fed Induction Motors
Sustainable Electrification System for Rural Farms in Zambia: A Case Study of a Farm in Lufwanyama
Sources of uncertainty for Monte Carlo modelling with Bayesian analysis for Sub-Saharan off-grid solar PV systems
Forecasting Energy Demand For Microgrids Over Multiple Horizons
Learning curves in the wind and solar sectors in South Africa
Customer segmentation for East African Microgrid Consumers
Remote Rural Area Water Scarcity Solution: An Innovative Green Energy Mobile DC Water Pump System
Estimation of Inverter-based Solar PV Penetration on Medium Voltage Networks Using Grid Impedance
Artificial Neural Network-based Capacitance Prediction Model for Optimal Voltage Control of Stand-alone Wind-Driven Self-Excited Reluctance Generator
A Simulation-based Evaluation of the Benefits and Barriers to Interconnected Solar Home Systems in East Africa
Optimal Power Flow Considering Frequency Security Constraint
Experimental Study of Capacitance and Thermal Stability of Polymer Based Composites Dielectric Material for Electrostatic Capacitor Applications
ENERGY EFFICIENCY AUDITS - A STRIVE FOR ENERGY AUTONOMY 509 Sengiphile Simelane, Talent Duma, Nithin Isaac and SP Daniel Chowdhury
Energy and cost analysis of an optimally controlled grid-connected Hybrid Solar Water Heating System in Bloemfontein

A Study of Electric Power Frequency in Southern Africa, Great Britain and Continental Europe	
Estimation of No-load losses in distribution transformer design	
A simulation Model for the Analysis of Security Attacks in Advanced Metering Infrastructure	
Aron Kondoro, Imed Ben Dhaou, Severine Rwegasira, Amleset Kelati, Hannu Tenhunen and Nerey H. Mvungi	
Lessons learned on Protection coordination considerations within inverter-based microgrids	,
Mobolaji Bello and Arindam Maitra	
OPTIMIZATION OF PV SYSTEMS USING LINEAR INTERACTIONS REGRESSION AND ANFIS MPPT TECHNIQUES	,
Adedayo Mojeed Farayola, Yanxia Sun and Ahmed Ali	
Using Internet of Things to Regulate Energy Consumption In a Home Environment 551 Josephat Kalezhi, Derrick Ntalasha and Tracy Chisanga	
VOLTAGE STABILITY ENHANCEMENT CAPABILITIES OF LTCT AND STATCOM IN A POWER SYSTEM556	,
I.G. Adebayo and Yanxia Sun	
A Novel Solar PV Micro-Grid Connected System with Battery and Ultra Capacitor Support for Fast Changing Environmental Conditions	
Power System Voltage Stability in the Presence of GIC-Like Currents	
Impact of Increased Penetration Levels of Distributed Inverter-based Generation on Transient Stability	
Simultaneous Monitoring of the Thévenin Equivalent Impedance at Multiple PCC's on a Network	
BCIT Integrated Grid Laboratory Planning Framework	,
Solar Powered DC Refrigerator with a Monitoring and Control System	
Investigation of Transformer Reactive Power and Temperature Increases Under DC 595 Sizwe Mkhonta, Talent T Murwira, David T Oyedokun, Komla A Folly and C.T Gaunt	,

EFFICIENT ENERGY MANAGEMENT SYSTEM USING PIR SENSOR	1
Economy-Wide Assessment of the Impact of Electricity Supply Disruption Using Hypothetical Extraction	7
Geospatial Framework for Estimating Household Electricity Demand for Urban Infrastructure Planning in Select African Countries	3
Sustainability of Distributed Generation in a Reconfigured Distribution Network 61 Oluleke Babayomi, Babatunde Olubayo and Taiwo Okharedia	9
Smart Metering System for Energy Management	3
Novel Reactive Power Compensation Technique for Fixed Speed Wind Turbine Generators 62 Oluwagbenga Apata and D.T.O Oyedokun	8
Accurate Metering of Apparent Power based on General Power Theory	4
The Value of Behind-The-Meter Energy Storage for Buildings: A Case Study on a University Building in South Africa	0
Supporting Social and Gender Equity through Micro-grid Deployment in the DR Congo 64 Anne-Perrine Avrin, Hilary Yu and Daniel M. Kammen	:6
Analysis of a Doubly Fed Induction Generator Through Modeling and Simulation	2
Optimal Scheduling in Offshore Wind Farms Considering Harmonic Losses and Locational Marginal Pricing	8
A Comparative Analysis and Simulation of Load Shaping Techniques	4
Load Management using Multiple Sequential Load Shaping Techniques	0
Rural Microgrid Load Profile Benefit Assessment	5
Description of Data Acquisition and Monitoring System of an Innovative PV/Th Solar Concentrator	1
Technical Analysis of Barriers to Raising the Power Delivery Ceiling in Nigeria	7

Impact of Solar Eclipse on Utility Grid Operations	393
A Study on Recycling of Carbon Dioxide to Renewable Energy	399
Storage Batteries the Future for Energy Storage	705
Solar photovoltaic generation and its integration impact on the existing power grid 7 Nhamo Dhlamini and Sp Daniel Chowdhury	710
Hybrid Battery Technologies with Battery Management System in Power and Energy Sectors	⁷ 16
Design Strategies of an Off-Grid Solar PV Plant for Office Buildings: A Case Study of Johannesburg	722
Design of a Solar Powered Desalination Plant	728
Effects of Grass and Concrete Reflective Surface on the Performance of Dual Axis Bifacial Solar PV Systems	⁷ 34
Impacts of UVC-LEDs for the disinfection of Mycobacterium tuberculosis	739
Improvement of piston engines operation as distributed generation to reduce carbon emissions	⁷ 45
Design of a Grid-Connected Solar System for Borehole Pumps	751
Design of IEC61850 based SCADA operation for automation of upgraded Nkula Substation in Malawi	758
Fuel cell micro-CHP for energy access in rural areas	764
Model based of a Pico Conduit Hydropower Generation System	769
An Application of Dissolved Gas Analysis (DGA) in the Assessment of Transformer Failures: A Focus on Geomagnetic Disturbances (GMDs)	775

Both way effects of PV Generator MPPT on BLDCM Centrifugal Pump BEPT Performance	'81
Hugues Kazeza and Sp Daniel Chowdhury	01
Voltage Dip Measurements to Locate Faults on High Voltage Reticulation Feeders	'87
Roof-Top Solar Power Augmentation to Auxiliary Supply of Passenger Train	'93
Brackish Water Desalination Using Solar Still with Built-in Heat Exchanger Coupled to Solar Collector	'99
AUTOMATED IRRIGATION AND WATER LEVEL MANAGEMENT SYSTEM USING RASPBERRY PI	304
An Experimental Study of Adsorption Cooling System by Using Low Grade Heat Source . 8 $H\ M\ Elgohary,\ H\ M\ Soliman\ and\ Sp\ Daniel\ Chowdhury$	310
Design of Energy Monitoring System for the Boiler and Chiller Plants in Netcare private Hospital	317
Design of Photovoltaic (PV) Solar Power plant to Supply Electricity and To Pump Water to Chele Community	321
Advances in Telecontrol and Remote Terminal Units (RTU) for Power Substations8 B Madonsela, Innocent Davidson and C Mulangu	327
Postgradute Forum	
Design and Implementation of a Solar Energy Measurement and Monitoring System 8 Ayoade Agbetuyi, Hope Orovwode, Joseph Olowoleni and Chukwuebuka Nwangwu	33
Applying Internet of Things in Monitoring and Control of an Irrigation System for Sustainable Agriculture for Small-Scale Farmers in Rural Communities	341
Solar Photovoltaic Power Estimation: A One Day Analysis Using Neural Network as a Technique	346
Renewable Energy: Enhancement in the Operation and Design of Hybrid Power Systems . 8 $Tselane\ Mashilo$	352
HYBRID SOLAR-WIND POWER SYSTEM FOR TRUCK REFRIGERATION8 Paul Njoroge, Lavender Ndunya and Paul Kabiru	358
RENEWABLE ENERGY INTEGRATION ENHANCEMENT USING ENERGY STORAGE TECHNOLOGIES	364

Modelling and Optimization of Hybrid RE for Powering Remote GSM Base Station 869 Sempe Leholo, Pius Adewale Owolawi and Kayode Timothy Akindeji
Design of a Low-Cost System to Monitor Geomagnetically Induced Currents in Transformer Neutrals
Enhancing Security in Distributed Internet-of-Things Based Communication System for Agent Driven Smart Micro-grid
Impact of Electrical Power Systems on the Environment in Kenya, Rwanda and Tanzania 885 Enock Chambile, Nelson Ijumba, Burnet Mkandawire and Jean de Dieu Hakizimana
Agent Based System for improved Control and Monitoring of a Solar Driven DC Microgrid890 Diana Rwegasira, Hannu Tenhunen and Nerey Mvungi
Locomotives Energy Management with Inter-Vehicle Train Couplers
Electrical Design for a Combined Cooling, Heating and Power for Go-Green Data Centers 901 $Aubrey\ Ngobeni\ and\ Sp\ Daniel\ Chowdhury$
A Review of Grid Tied PV Generation on Radial LV Distribution Networks
Detection of Underground Power Cable Theft: Strategies and Methods
Green Building Design Strategies for an Energy Efficient HVAC System
Design Optimisation and Performance Evaluation of Flux Switching Machines for Geared Medium-Speed Wind Generator Drives
Life Cycle Cost Comparison between Motors Equipped with VSD and Dampers for Pumps and Fans
Economic Analysis for Distributed Energy Supply Wind-Thermal Pumped Storage System and Technical Performance
Generation expansion analysis in low data settings