2021 IEEE Green Technologies Conference (GreenTech 2021)

Denver, Colorado, USA 7 – 9 April 2021



IEEE Catalog Number: CFP21GTC-POD ISBN: 978-1-7281-9140-9

Copyright © 2021 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:CFP21GTC-PODISBN (Print-On-Demand):978-1-7281-9140-9ISBN (Online):978-1-7281-9139-3

ISSN: 2166-546X

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



2021 IEEE Green Technologies Conference (GreenTech)

GREENTECH 2021

Table of Contents

Message from Conference General Chair xvii
Message from Technical Program Chair xviii
Organizing Committee xix
Program Committee xx.
Steering Committee xxi
Sponsors xxii
Technical Session 1: Photovoltaic Energy Systems
Pareto Optimal Smart Inverter Curve Selection for High Photovoltaic Penetration .1
Detection of False Data Injection of PV Production .7.
Hugo Riggs (Florida International University, Miami, Florida), Shahid
Tufail (Florida International University, Miami, Florida), Mohammad
Khan (Florida International University, Miami, Florida), Imtiaz Parvez
(Florida International University, Miami, Florida), and Arif I. Sarwat
(Florida International University, Miami, Florida)
Quantification of Solar Energy Grid Disturbances in the United States .13
A Case Study for Connecting Bidirectional PEV Station for Reactive Power Support to the GLEAMM Prototype Microgrid .19.
Saeed Daneshvardehnavi (Texas Tech University, USA), Cesar A. Negri (Texas Tech University, USA), Konrad Erich Kork Schmitt (Texas Tech University, USA), Stephen Bayne (Texas Tech University, USA), and Michael Giesselmann (Texas Tech University, USA)
Forward and Back Scattering of Luminescent Down-Shifting Particles in EVA Films .26
Techno-Economic Analysis of Floating Solar PV Integrating with Hydropower Plant in Bangladesh 30

Modelling Simulation and Characteristics of a Mono PERC Solar Cell under Environmental Condition .37.
Subhasri Kar (Netaji Subhash Engineering College, India), C K Chanda (IIEST, India), and Sumit Banerjee (Dr B C Roy Engineering College, India)
PV Array Fault Detection Based on Deep Neural Network 42
Technical Session 2: Smart Grid Applications
Design and Analysis of Three-Level Soft-Switched Resonant Converter for EV Battery Charger.48 Merlin Mary N J (National Institute of Technology Tiruchirappalli, India) and Shelas Sathyan (National Institute of Technology Tiruchirappalli, India)
Distribution Grid Optimal Power Flow Integrating Volt-Var Droop of Smart Inverters .54
Optimal Power Flow Considering Time of Use and Real-Time Pricing Demand Response Programs 62
Sayyad Nojavan (University of Bonab, Iran), Vafa Ajoulabadi (University of Bonab, Iran), Tohid Khalili (University of New Mexico, Iran), and Ali Bidram (University of New Mexico, USA)
Stability Impact of IEEE 1547 Operational Mode Changes under High DER Penetration in the Presence of Cyber Adversary .67
Fault-Tolerant PV Multistring Inverter .75
Model-Free Reinforcement-Learning-Based Control Methodology for Power Electronic Converters .81
Optimal Volt-VAR and Volt-Watt Droop Settings of Smart Inverters .89

Smart Inverters' Functionalities and Their Impacts on Distribution Feeders at High Photovoltaic Penetration .97. Temitayo Olowu (Florida International University), Shamini Dharmasena (Florida International University), Anjan Debnath (Florida International University), and Arif Sarwat (Florida International University)
Technical Session 3: Wind Energy Systems
Practical Aspects and Results - Providing Secondary Frequency Regulation from a Single Type 4 Wind Turbine and a Battery Storage System 105
Harmonic Analysis of a Wind Power Plant –Case Study of Modeling and Measurement .112 Bikash Poudel (Enernex A CESI Compnay, USA), Chandra Pallem (Enernex A CESI Compnay, USA), and Dave Mueller (Enernex A CESI Compnay, USA)
Optimization of Energy Storage Size and Operation for Renewable-EV Hybrid Energy Systems .118 Jun Chen (Oakland University, USA), Zhaojian Li (Michigan State University, USA), and Xiang Yin (Shanghai Jiao Tong University, China)
Renewable Energy Mix of Futuristic NEOM City .125
Ensemble Learning of Numerical Weather Prediction for Improved Wind Ramp Forecasting .133 Xiaomei Chen (Texas Tech University), Jie Zhao (Texas Tech University), and Miao He (Texas Tech University)
Optimal Performance of Switched Reluctance Generator in Stand-Alone Wind Systems .141 Pedro José Dos Santos Neto (University of Campinas, Brazil), Elmer Hancco Catata (University of Campinas, Brazil), Tárcio André Dos Santos Neto (University of Campinas, Brazil), and Ernesto Ruppert Filho (University of Campinas, Brazil)
Technical Session 4: Energy Conversion for SmartGrids and Technology
An Optimal Fuzzy Logic Control for a Fuel Cell Hybrid Electric Vehicle Based on Particle Swarm and Advisor .148
Identifying Light-Duty Vehicle Travel from Large-Scale Multimodal Wearable GPS Data with Novelty Detection Algorithms .155

Approaches 163	
Abdulraheem Alobaidi (Southern Methodist University, USA), Hunter Desroches (Louisiana State University, USA), and Mahdi Mehrtash (University of British Columbia, Canada)	••
Techno-Economical Study for Geothermal Direct Usage for a Dairy Factory .169	••
Integrated Power Management and Nonlinear-Control for Hybrid Renewable Microgrid .176 Muhammad Maaruf (King Fahd University of Petroleum and Minerals, Saudi Arabia), Khalid A. Khan (King Fahd University of Petroleum and Minerals, Saudi Arabia), and Muhammad Khalid (King Fahd University of Petroleum and Minerals, Saudi Arabia; K.A. CARE Energy Research and Innovation Center, Saudi Arabia)	
Probabilistic Analysis of Electric Vehicle Energy Consumption Using MPC Speed Control and	
Nonlinear Battery Model 181	•••
Technical Session 5: EV Technology and Utility Integration	
Incorporating Residential Smart Electric Vehicle Charging in Home Energy Management	
Systems .187	•••
Systems .187	
Systems 187 Michael Blonsky (National Renewable Energy Laboratory), Prateek Munankarmi (National Renewable Energy Laboratory), and Sivasathya Pradha Balamurugan (National Renewable Energy Laboratory) A Combined Rectangular/Circular Power Pad for Electric Vehicles Wireless Charging 195 Marwan H. Mohammed (University of Mosul, Iraq), Yasir M. Y. Ameen (University of Mosul, Iraq), and Ahmed A. S. Mohamed (National Renewable Energy Laboratory, USA) Optimization of Refrigeration Defrost Schedules for Demand Shifting in Commercial Buildings 201 Carolyn Goodman (Grid Fruit, LLC, USA), Jesse Thornburg (Grid Fruit, LLC, USA), and Javad Mohammadi (Carnegie Mellon University, USA) Stochastic Modeling and Optimization of Electric Vehicle Autonomous Photovoltaic Charging Station 209 Wajdi Ghraslia (National School of Computer Science, Tuinisia), Kchiche Amine (National School of Computer Science, Tuinisia), and	

The Role of Mobility Data Hubs in an Integrated Decarbonized Transportation Future .222...... Stanley Young (National Renewable Energy Laboratory), Alex Schroeder (National Renewable Energy Laboratory), Venu Garikapati (National Renewable Energy Laboratory), Joseph Fish (National Renewable Energy Laboratory), and Marjory Blumenthal (RAND Corporation) Technical Session 6: Electrical Systems, Education, and Technology Dynamic Separation of Microgrid System to Maximize Reliability in a Smart Grid .232..... Xuefei Zhu (Auburn University, USA), Jinho Kim (Auburn University, USA), Eduard Muljadi (Auburn University, USA), and R. Mark Nelms (Auburn University, USA) Residential Agrivoltaics: Energy Efficiency and Water Conservation in the Urban Landscape .237... Ben D. Giudice (George Fox University), Chad Stillinger (George Fox University), Emma Chapman (George Fox University), Matthew Martin (George Fox University), and Blake Riihimaki (George Fox University) Novel Model Predictive Control for Performance Analysis of Synchronous Servo Motor Drive 245. Yogita P. Akhare (Prairie View A&M University, USA), Warsame H. Ali (Prairie View A&M University, USA), John H. Fuller (Prairie View A&M University, USA), John O. Attia (Prairie View A&M University, USA), Annamalai Annamalai (Prairie View A&M University, USA), and Pamela H. Obiomon (Prairie View A&M University, USA) Active Learning Approaches for Sustainable Energy Engineering Education .251...... Patricia Caratozzolo (Tecnologico de Monterrey, Mexico), Samuel Rosas-Melendez (Tecnologico de Monterrey, Mexico), and Carlos Ortiz-Alvarado (Tecnologico de Monterrey, Mexico) Time Series Analysis of Electricity Consumption Forecasting Using ARIMA Model 259..... Meftah Elsaraiti (Saint Mary's University, Canada), Gama Ali (Dalhousie University, Canada), Hmeda Musbah (Dalhousie University, Canada), Adel Merabet (Saint Mary's University, Canada), and Timothy Little (Dalhousie University, Canada) Operation of a Grid-Connected AC Microgrid in Presence of Plug-In Hybrid Electric Vehicle, Price, Load and Generation Uncertainties 263. Anushree Singh (Pandit Deendayal Petroleum University, India), Avirup Maulik (Indian Institute of Technology (BHU), India), and Debapriya

Technical Session 7: Reliability, Resilience in SmartGrids

High Voltage AC (HVAC) and High Voltage DC (HVDC) Transmission Topologies of Offshore Wind Power and Reliability Analysis 271

Power and Reliability Analysis 27.1.

Ashoke Kumar Biswas (University of North Dakota, U.S.A), Sina Ibne Ahmed (University of North Dakota, U.S.A), Shravan Kumar Akula (University of North Dakota, U.S.A), and Hossein Salehfar (University of North Dakota, U.S.A)

Das (Indian Institute of Technology Kharagpur, India)

A Multilayered Semi-Permissioned Blockchain Based Platform for Peer to Peer Energy Trading.27.9

Ishtiaque Zaman (Texas Tech University, USA) and Miao He (Texas Tech
University, USA)

Identification of Stable and Unstable Power Swings Using Pattern Recognition .286
Resilient Operation of Power Distribution Systems Using MPC-Based Critical Service Restoration .292 Abinet Tesfaye Eseye (National Renewable Energy Laboratory, USA), Bernard Knueven (National Renewable Energy Laboratory, USA), Xiangyu Zhang (National Renewable Energy Laboratory, USA), Matthew Reynolds (National Renewable Energy Laboratory, USA), and Wesley Jones (National Renewable Energy Laboratory, USA)
Optimal Planning of VAR Compensator for Voltage Regulation Enhancement on Power Distribution Systems against Volcanic Eruptions Events .298
Resilience Assessment in Electric Power Systems against Volcanic Eruptions: Case on Lahars Occurrence 305
Power Maximization Analysis of a Wind Electric Water Pumping System Using STATCOM and Modified Enhanced Perturb & Observe 312
Technical Session 8: CyberPhysical Systems and Security of Intelligent Power Systems
Importance of Considering Plant Ramp Rate Limits for Frequency Control in Zero Inertia Power Systems 320. Deepak Ramasubramanian (Electric Power Research Institute, USA)
Transactive Energy Rationing in an Islanded Electric Power System .323. Thomas E. Mcdermott (Pacific Northwest National Laboratory), Trevor Hardy (Pacific Northwest National Laboratory), Abhishek Somani (Pacific Northwest National Laboratory), Sadie Bender (Pacific Northwest National Laboratory), and Madison Moore (Washington Department of Agriculture)

Measurable Challenges in Smart Grid Cybersecurity Enhancement: A Brief Review 331
Synthetic High Impedance Fault Data Through Deep Convolutional Generated Adversarial Network .339.
Kun Yang (University of Denver, USA), Wei Gao (University of Denver, USA), Rui Fan (University of Denver, USA), Tianzhixi Yin (Pacific Northwest National Laboratory, USA), and Jianming Lian (Pacific Northwest National Laboratory, USA)
Offline Arterial Signal Timing Optimization for Closely Spaced Intersections .344
Priority-Based Management Algorithm in Distributed Energy Resource Management Systems .357 Nishant Bilakanti (Georgia Institute of Technology, USA), Niroj Gurung (Smart Grid and Emerging Technology Commonwealth Edison (ComEd), USA), Heng Kevin Chen (Smart Grid and Emerging Technology Commonwealth Edison (ComEd), USA), and Sri Raghavan Kothandaraman (Smart Grid and Emerging Technology Commonwealth Edison (ComEd), USA)
Green Efficiency for Quality Models in the Field of Cryptocurrency; IOTA Green Efficiency .357 Amir Abbaszadeh Sori (Islamic Azad University Babol, Iran), Mehdi Golsorkhtabaramiri (Islamic Azad University Babol, Iran), and Ali Abbaszadeh Sori (Islamic Azad University Qaemshahr, Iran)
Technical Session 9: Control of Power Electronics Systems
Control Design and Analysis for Grid-Connected Converter Systems with Island Ability .364 Pascal Winter (University of Applied Sciences Dusseldorf, Germany), Holger Wrede (University of Applied Sciences Dusseldorf, Germany), Julian Struwe (University of Applied Sciences Dusseldorf, Germany), and José Cajigal (University of Applied Sciences Dusseldorf, Germany)
Wear-Out Prediction of Grid-Following Converters for Two-Phase Three-Wire Isolated AC Power Grids 372
João Henrique de Oliveira (Federal University of Minas Gerais, Brazil), Rodrigo de Barros (Federal University of Minas Gerais, Brazil), Allan Fagner Cupertino (Federal Center for Technological Education of Minas Gerais, Brazil), Heverton Augusto Pereira (Universidade Federal de Viçosa, Brazil), and Danilo Iglesias Brandao (Federal University of Minas Gerais, Brazil)

Cooperative Control of Power Quality Compe Helmo K. Morales-Paredes (São Paulo State Us Claudio Burgos-Mellado (University of Nottin Bonaldo (Federal University of Mato Grosso, B Rodrigues (São Paulo State University (Unesp Sebastian Gomez Quintero (Pontificia Univers Chile)	gham, U.K.), Jakson Paulo Brazil), Diego Tardivo), Brazil), and Juan
Stability Margins of Grid-Supporting Converte Pascal Winter (University of Applied Sciences Julian Struwe (University of Applied Sciences José Cajigal (University of Applied Sciences Di Holger Wrede (University of Applied Sciences	Dusseldorf, Germany), usseldorf, Germany), and
Lyapunov-Based Adaptive Sliding Mode Cont Ali Al-Ameer (Saudi Aramco, Saudi Arabia) at University of Petroleum & Minerals, Saudi Ar	e
Design and Modeling of CCM Average Currer Kali Naraharisetti (Infineon Technologies, USA Channegowda (Infineon Technologies, USA), a Technologies, USA)	
Enakshi Wikramanayake (University of Texas i	tas for Decarbonization of the Electric Grid .409 at Austin, USA), Palash V.
Acharya (University of Texas at Austin, USA) Solar Initiative LLC, USA), and Vaibhav Baha at Austin, USA)	
A Review of the Second Life Electric Vehicle B Technology Perspective .416	
Economic Viability Assessment of Repurposed Regulation and Energy Markets .424	llege Northampton, USA), niversity, KSA; University of Denver, USA), Amin
Transformer EM-FL-PSO Design Optimization Rakan A. Almazmomi (Colorado School of Min	

Peak Load Management in Distribution Systems Using Legacy Utility Equipment and Distributed Energy Resources 435
Application of Secondary Var Controller in Distribution Systems to Accommodate Growing DER Penetration .442
Technical Session 11: Modeling and Control of Electronics and Power Systems
Step-by-Step Design Procedure for LCL-Type Single-Phase Grid Connected Inverter Using Digital Proportional-Resonant Controller with Capacitor-Current Feedback 448
The Islands of Cape Verde as a Reference System for 100 % Renewable Deployment .455
Optimization of Nuclear-Renewable Hybrid Energy System Operation in Forward Electricity Market .462 Jubeyer Rahman (The University of Texas at Dallas, USA) and Jie Zhang (The University of Texas at Dallas, USA)
Trust-Based User Interface Design for Islanded Alternating Current Microgrids .469
Adaptive Day-Ahead Prediction of Resilient Power Distribution Network Partitions .477
On-Line Coherency Analysis Based on Sliding-Window Koopman Mode Decomposition .484 Harold R. Chamorro (KTH, Royal Institute of Technology, Sweden), Adrian-Josue Guel-Cortez (Coventry University, UK), Camilo A. Ordonez (Universidad de Sevilla, Spain), Mario R. Arrieta Paternina (Universidad Nacional Autonoma de Mexico, Mexico), and Marko Budisic (Clarkson University, USA)

Method of Assessing Voltage Response of Inverter-Based Generation Due to System Faults .489....

Douglas Bowman (Southwest Power Pool, USA), Roy Mccann (University of Arkansas, USA), and Nathan Bean (Southwest Power Pool, USA)

Fast and Simplified Algorithms for SoC and SoH Estimation of Vanadium Redox Flow Batteries. 49.4

Bahman Khaki (State University of New York at Binghamton, United

States) and Pritam Das (State University of New York at Binghamton,

United States)

Technical Session 12: Energy and Power Communications and Standards

Design and Implement a High Voltage Low Power Supply with Wide-Bandgap Device Applied for Electric Vehicles Applications 502
Salah Eltief (University of Denver, USA), Mohammad Matin (University of Denver, USA), Abdulmunim Guwaeder (Langston University, USA), and Ahmed Khobaiz (The Higher Institute of Poly-Technical, Ghrian- Libya)
Game Approach for Sizing and Cost Minimization of a Multi-Microgrids Using a Multi-Objective Optimization 507
Liaqat Ali (Curtin University, Australia), S.M. Mayeen (Curtin University, Australia), Hamed Bizhani (University of Zanjan, Iran),
and Marcelo Godoy Simoes (Electrical Engineering Department Colorado School of Mines, USA)
Operational Issues of a Microgrid at Tomia Island Considering Photovoltaic Penetration Level 513
Yunita Muharram (Auburn University, USA), Dedet Candra Riawan
(Institut Teknologi Sepuluh Nopember, Indonesia), Jinho Kim (Auburn
University, USA), Eduard Muljadi (Auburn University, USA), and R. Mark Nelms (Auburn University, USA)
Multi-Timescale Simulation of Non-Spinning Reserve in Wholesale Electricity Markets .520 Binghui Li (The University of Texas at Dallas, USA), Cong Feng (The University of Texas at Dallas, USA), and Jie Zhang (The University of Texas at Dallas, USA)
Audible Noise Reduction in Switched-Mode Power Supplies Operating in Burst Mode .528
Distributionally Robust Chance-Constrained Scheduling Strategy for Community Microgrid under a Peer-to-Peer Trading Framework .533
Optimal Placement of Energy Storage in a Power System with Wind Generation .541

Grid Impedance Impact Analysis of the Weak Grid-Tied VSC .547..... Hong Hu (East China Branch of State Grid Corporation of China, China), Rui Yin (Shandong University, China), Shanshan Wang (China Electric Power Research Institute, China), Yuanyuan Sun (Shandong University, China), Guanglu Wu (China Electric Power Research, China), Bing Zhao (China Electric Power Research Institute, China), Jianhua Li (East China Branch of State Grid Corporation of China, China), Haoyin Ding (East China Branch of State Grid Corporation of China, China), Lu Cao (East China Branch of State Grid Corporation of China, China), and Lin Yu (China Electric Power Research Institute, China) **Technical Session 13: Green Technologies** Secure under Frequency Load Shedding Scheme with Consideration of Rate of Change of Farhad Elyasichamazkoti (University of Utah, USA) and Saeed Teimourzadeh (EPRA Electric Energy Co, Turkey) A Voltage Sensitivity Framework for Optimal Allocation of Battery Energy Storage Systems .558... Hassan I. Alhammad (King Fahd University of Petroleum & Minerals, Saudi Arabia), Mustafa F. Alsada (King Fahd University of Petroleum & Minerals, Saudi Arabia), Khalid A. Khan (King Fahd University of Petroleum & Minerals, Saudi Arabia), and Muhammad Khalid (King Fahd University of Petroleum & Minerals, Saudi Arabia; K.A. CARE Energy Research and Innovation Center, Saudi Arabia) A Binary Search Algorithm Based Optimal Sizing of Photovoltaic and Energy Storage Systems .563 Anjan Debnath (Florida International University, Miami, USA), Temitayo Olowu (Florida International University, Miami, USA), Imtiaz Parvez (Florida International University, Miami, USA), and Arif Sarwat (Florida International University, Miami, USA) Stochastic Approach for Optimal Sizing and Allocation of Energy Storage Systems .569..... Yousef M. Alhumaid (King Fahd University of Petroleum and Minerals, Saudi Arabia), Khalid A. Khan (King Fahd University of Petroleum and Minerals, Saudi Arabia), and Muhammad Khalid (King Fahd University of Petroleum and Minerals, Saudi Arabia; K.A. CARE Energy Research and Innovation Center, Saudi Arabia) Efficiency Assessment of a Residential DC Nanogrid with Low and High Distribution Voltages Using Realistic Data 574 Saeed Habibi (Missouri University of Science and Technology, USA), Ramin Rahimi (Missouri University of Science and Technology, USA), Pourya Shamsi (Missouri University of Science and Technology, USA), and Mehdi Ferdowsi (Missouri University of Science and Technology, USA) On Efficiency and Performance Improvement of Three-Phase Induction Motors in Refrigeration

χv

and HVAC Applications 580.

Olusegun Solomon (Olriz Center, Inc.) and Parviz Famouri (West

Virginia University, USA)

Wind Farm Electrical Asset Components: Insulation Diagnostics through Partial Discharge
Measurements 586.
Gian Carlo Montanari (Florida State University Tallahassee, FL, USA)
and Riddhi Ghosh (Florida State University Tallahassee, FL, USA)
Author Index 593