DUT DURBAN UNIVERSITY OF TECHNOLOGY
FACULTY OF ENGINEERING & THE BUILT ENVIRONMENT
DEPARTMENT OF ELECTRICAL POWER ENGINEERING

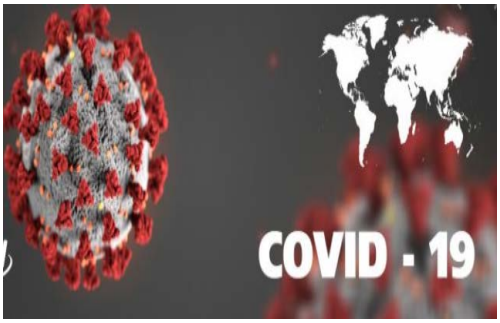
Power Digest

A newsletter publication

Vol 2020, No. 4
September

Message from the Editorial Team

No cases of COVID-19 has been reported in the department, thus far. Let us continue to observe the safety precautions in preventing the spread of COVID-19.



On behalf of the department, we are excited to welcome Dr. Makhosonke B. Dubazane

Dr. Makhosonke B. Dubazane has been appointed Post-Doctoral Researcher at the DUT Space Science Research Centre, under the supervision of Prof IE Davidson. He obtained a BSc Degree in Physics and Applied Mathematics at University of Zululand (2000), BSc (Hons.) in Applied Physics at University of KwaZulu-Natal (2007), and MSc in Physics at Wits University (2012), Thesis Title: "Magnetic properties of N-doped carbon nanospheres". In 2017, Dr. Dubazane received his PhD in Physics at Rhodes University, Thesis Title: "Modelling ionospheric vertical drifts over the African low latitude region". Dr. Dubazane worked at KwaZulu-Natal Department of Education as a Level 1 Science and Mathematics Teacher in 2004. In 2014-2017, he was a part of SANSA Space Science PhD research program. He was later appointed a Post-Doctoral Research Fellow in the Department of Geography at the University of Zululand in 2019.

List of publications in peer-review journals and conference proceedings

[1] **Dubazane, M. B., J. B. Habarulema and J. C. Uwamahoro (2017); "Modelling ionospheric vertical drifts over Africa low latitudes using Empirical Orthogonal functions and comparison with climatological model", *Advances in Space Research* 61, 326-336, https://doi.org/10.1016/j.asr.2017.10.024.**

[2] **Dubazane, M. B. and Habarulema, J. B. (2018); "An Empirical Model of Vertical Plasma Drift Over the African Sector", *Space Weather*, https://doi.org/10.1029/2018SW001820.**

[3] **Makhosonke B. Dubazane, Jonathan M. Keartland and Yusef Mishgina, "Magnetic Properties of Carbon Nanospheres at Low Temperatures", *Proceedings of SA Institute of Physics* 2011, 168-173, ISBN: 978-1-86888-688-3.**

Research

Journal Papers

[1] Ajibola Akinrinde, Andrew Swanson, Innocent Davidson, “Investigation and Mitigation of Temporary Overvoltage Caused by De-Energization on an Offshore Wind Farm”, *Energies* Vol. 13:4439, Aug 2020. DOI: 10.3390/en13174439

[2] A.A. Adebiyi, I.J. Lazarus, A.K. Saha, and E.E. Ojo, “Performance analysis of grid-tied photovoltaic system under varying weather condition and load,” *International Journal of Electrical and Computer Engineering (IJECE)* Vol.11, No.1, pp. 92-104

Refereed Conference Papers

IEEE IAS/PES Power Africa 2020

[1] P. Gbadega and K.T Akindeji, “LQR Technique for Optimal Load Frequency Controller Design of Interconnected Linear Power Systems with Quadratic Performance Index.” In *Proceedings of* 2020 I*EEE PES/IAS PowerAfrica Conference*, Nairobi, Kenya, August 2020

[2] A.A. Adebiyi, E.E. Ojo, and I.E. Davidson, "Performance Evaluation of a Grid-tied PV System in the East Coast of South Africa," In *Proceedings of* 2020 I*EEE PES/IAS PowerAfrica Conference*, Nairobi, Kenya, August 2020.

[3] A. O. Aluko, R.P. Carpanen, D. Dorrell, and E.E Ojo, “Impact Assessment and Mitigation of Cyber Attacks on Frequency Stability of Isolated Microgrid Using Virtual Inertia Control,” In *Proceedings of* 2020 I*EEE PES/IAS PowerAfrica Conference*, Nairobi, Kenya, August 2020.

[4] E. Buraimoh and I.E Davidson, “Modelling and Analysis of Standalone Inverter-Based Microgrid with Grid-Supporting Voltage-Source Control under Changing Load,” In *Proceedings of* 2020 I*EEE PES/IAS PowerAfrica Conference*, Nairobi, Kenya, August 2020.

[5] E. Buraimoh, A.A Adebiyi, O.J. Ayamolowo and I.E. Davidson, “South Africa Electricity Supply System: The Past, Present and The Future,” In *Proceedings of* 2020 I*EEE PES/IAS PowerAfrica Conference*, Nairobi, Kenya, August 2020.

[6] S. Ndaba and I.E. Davidson, “The implementation of smart meters for electric grid improvements and reliable power flow data on electrical power distribution networks,” In *Proceedings of* 2020 I*EEE PES/IAS PowerAfrica Conference*, Nairobi, Kenya, August 2020.

icABCD 2020

[7] M. Estrice, G. Sharma, K. Akindeji, and I. E. Davidson, "Application of AI for Frequency Normalization of Solar PV-Thermal Electrical Power System," in *2020 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD)*, 2020: IEEE, pp. 1 - 4.

[8] Shikhar Sewnarain, Chiemela Onunka and Kayode Akindeji, “Assessment of Tidal Energy as Alternative Energy Source in South Africa,” in *2020 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD)*, 2020: IEEE, pp. 1 - 7.

[9] S. B. Masikana, G. Sharma, K. Akindeji, and I. E. Davidson, "Voltage Stability Enhancement Studies for Distribution Network with Installation of FACTS," in *2020 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD)*, 2020: IEEE, pp. 1 - 6.

[10] S. C. Tshikomba, M. Estrice, E. Ojo, and I. E. Davidson, "Curbing Electricity Theft Using Wireless Technique with Communication Constraints," in *2020 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD)*, 2020: IEEE, pp. 1 - 6.

[11] M. Joshi, G. Sharma, and I. E. Davidson, "Load Frequency Control of Hydro Electric System using Application of Fuzzy with Particle Swarm Optimization Algorithm," in *2020 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD)*, 2020: IEEE, pp. 1 - 6.

[12] Jonas Dakora, Innocent Davidson and Gulshan Sharma, “Review of Modern Space Solar Power Satellite Systems and Space Rectenna,” in *2020 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD)*, 2020: IEEE, pp. 1 - 5.

Research

Call for Conference Paper Submission (SAUPEC)

The first South African Universities Power Engineering Conference (SAUPEC) was hosted by the Department of Electrical and Electronics Engineering at Stellenbosch University in January 1990. The event came about at the initiative of Prof. Ron Herman and Dr. Koos Holtzhausen, both faculty members of the Department of Electrical and Electronic Engineering at Stellenbosch University at the time, with the view to establish a forum where academics and research students in power engineering can present their work to their peers, network and exchange ideas. The idea of a SAUPEC attracted strong support from leading academics in the field of power engineering.

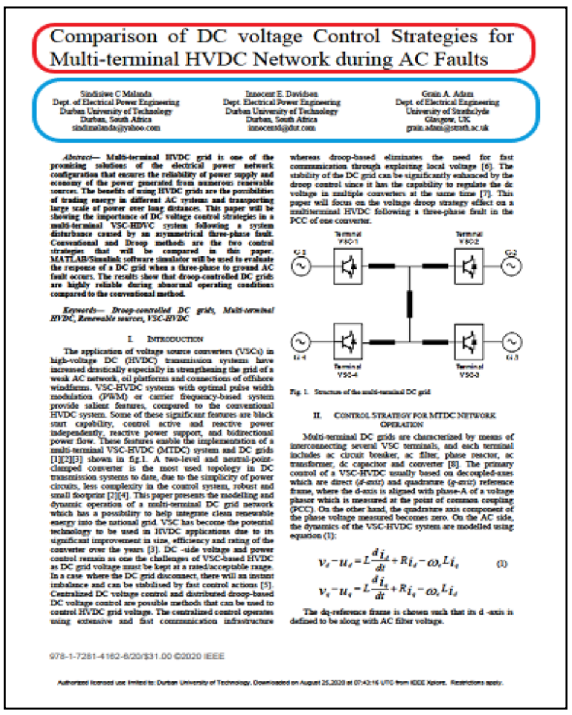
It is with great pleasure that we announce the SAUPEC/RobMech/PRASA 2021 incorporating the 29th Southern African Universities Power Engineering Conference, the 13th Robotics and Mechatronics Conference of South Africa and the 3rd Annual Symposium of the Pattern Recognition Association of South Africa. This flagship Southern Africa regional conference will be hosted by the School of Electrical, Electronic and Computer Engineering of the North-West University, in conjunction with the South African Institute of Electrical Engineers (SAIEE). SAUPEC, RobMech and PRASA brings together experts from the industry, academics and students in engineering, computer science, pattern recognition, robotics and mechatronics to present research papers, network, and expand the fraternity that has been built as part of the SAUPEC, RobMech, and PRASA legacies. The conference will incorporate the Eskom Tertiary Education Support Programme (TESP) report-back meeting.

We invite all Electrical Power Engineering and Electronic Engineering students to submit original papers in areas, including but not limited to:

TECHNICAL TOPICS

- Power Generation
- Renewable Energy
- Distributed and Embedded Generation
- Smart Grids and Microgrids
- Energy Economics and Tariffs
- Power Engineering Education
- Energy Management and Energy Efficiency
- Power Electronics
- Transmission, Distribution and Reticulation Networks
- Protection and System Automation
- High Voltage Engineering
- Quality of Supply, Reliability and Condition Monitoring
- Load Modelling and Demand Side Management
- Electrical Machines and Drives
- Electromagnetic Compatibility (EMC) & Electromagnetic Interference (EMI)

An example of a SAUPEC conference paper is given below:



Comparison of DC voltage Control Strategies for Multi-terminal HVDC Network during AC Faults

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Abstract— Multi-terminal HVDC grid is one of the promising solutions of the electrical power network configuration that ensures the reliability of power supply and economy of the power generated from numerous renewable sources. The benefits of using HVDC grids are the possibilities of trading energy in different AC systems and transporting large scale of power over long distances. This paper will be showing the importance of DC voltage control strategies in a multi-terminal VSC-HDVC system following a system disturbance caused by an asymmetrical three-phase fault. Conventional and Droop methods are the two control strategies that will be compared in this paper. MATLAB/Simulink software simulator will be used to evaluate the response of a DC grid when a three-phase to ground AC fault occurs. The results show that droop-controlled DC grids are highly reliable during abnormal operating conditions compared to the conventional method.

Keywords— Droop-controlled DC grids, Multi-terminal HVDC, Renewable sources, VSC-HVDC

I. INTRODUCTION

The application of voltage source converters (VSCs) in high-voltage DC (HVDC) transmission systems have increased drastically especially in strengthening the grid of a weak AC network, oil platforms and connections of offshore windfarms. VSC-HVDC systems with optimal pulse width modulation (PWM) or carrier frequency-based system provide salient features, compared to the conventional HVDC system. Some of these significant features are black start capability, control active and reactive power independently, reactive power support, and bidirectional power flow. These features enable the implementation of a multi-terminal VSC-HVDC (MTDC) system and DC grids [1][2][3] shown in fig.1. A two-level and neutral-point-clamped converter is the most used topology in DC transmission systems to date, due to the simplicity of power circuits, less complexity in the control system, robust and small footprint [7][4]. This paper presents the modelling and dynamic operation of a multi-terminal DC grid network which has a possibility to help integrate clean renewable energy into the national grid. VSC has become the powerful technology to be used in HVDC applications due to its significant improvement in size, efficiency and rating of the converter over the years [3]. DC -side voltage and power control remain as one the challenges of VSC-based HVDC as DC grid voltage must be kept at a rated/acceptable range. In a case where the DC grid disconnect, there will an instant imbalance and can be stabilised by fast control actions [5]. Centralized DC voltage control and distributed droop-based DC voltage control are possible methods that can be used to control HVDC grid voltage. The centralized control operates using extensive and fast communication infrastructure whereas droop-based eliminates the need for fast communication through exploiting local voltage [6]. The stability of the DC grid can be significantly enhanced by the droop control since it has the capability to regulate the dc voltage in multiple converters at the same time [7]. This paper will focus on the voltage droop strategy effect on a multiterminal HVDC following a three-phase fault in the PCC of one converter.

Fig. 1. Structure of the multi-terminal DC grid

II. CONTROL STRATEGY FOR MTDC NETWORK OPERATION

Multi-terminal DC grids are characterized by means of interconnecting several VSC terminals, and each terminal includes ac circuit breaker, ac filter, phase reactor, ac transformer, dc capacitor and converter [8]. The primary control of a VSC-HVDC usually based on decoupled-axes which are direct (d-axis) and quadrature (q-axis) reference frame, where the d-axis is aligned with phase-A of a voltage phasor which is measured at the point of common coupling (PCC). On the other hand, the quadrature axis component of the phase voltage measured becomes zero. On the AC side, the dynamics of the VSC-HVDC system are modelled using equation (1):

$$v_d - u_d = L\frac{di_d}{dt} + Ri_d - \omega_s L i_q \qquad (1)$$

$$v_q - u_q = L\frac{di_q}{dt} + Ri_q - \omega_s L i_d$$

The dq-reference frame is chosen such that its d -axis is defined to be along with AC filter voltage.

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Events and Announcements	Upcoming Conferences
Departmental Research Committee (DRC) **~~14 August 2020~~** **~~21 August 2020~~** **25 September 2020** **23 October 2020** **Faculty Research Committee (FRC)** **~~27 August 2020~~** **~~03 September 2020~~** **06 October 2020** **03 November 2020**	**NEIS 2020 – Conference on Sustainable Energy Supply and Energy Storage Systems ,14-15 September, 2020, Hamburg, Germany** **ICRERA 2020** **9th International Conference on Renewable Energy Research and Applications, September 27-30, 2020, Glasgow/UK** **IEEE Region 8 AFRICON 2021, 13-15 September 2021, Arusha, Tanzania**

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