ESKOM CENTRE OF EXCELLENCE AND EPPEI SPECIALIZATION CENTRE IN HIGH VOLTAGE DIRECT CURRENT ENGINEERING SCHOOL OF ENGINEERING

UNIVERSITY OF KWAZULU-NATAL ™
INYUVESI YAKWAZULU-NATALI

Year-End Progress Report 2014

Smart Grid Building, Westville Campus, School of Engineering
University of KwaZulu-Natal, Durban, SOUTH AFRICA

Executive Summary

Electricity remains the preferred energy source for serving industrial, commercial and domestic customers. The last century has demonstrated that every facet of human development is woven around a sound and stable energy supply regime. Electricity is the engine of economic growth and development. There is a strong correlation among the per capita gross national product (GNP), per capita energy consumption, and the standard of living of any society. Economist generally agree that there are five essential pillars for economic success in the 21st century, namely: a highly educated and sophisticated population; a highly developed technology; a rich modern and high productive agricultural base; a rich base of energy-bearing materials, and an abundant supply of non-energy bearing materials.

National economic development depends critically on the presence of an educated and skilled workforce and on technological innovations that raise productivity. We therefore have to train, develop and supply South Africa with highly motivated, marketable and competent professionals who understand the new and existing issues concerning the profession, namely: generation, transportation and distribution of electrical energy to serve consumers in an efficient, safe, economic and reliable manner in a grid modernization era with increasing renewable energy penetration.

The higher education sector educates and trains; and it also undertakes pure and applied research. As one of the top three universities in Africa and among the top 500 universities across the globe, the University of KwaZulu-Natal (UKZN) was rightly identified by Eskom, Africa's largest and the world's 11th largest power utility in terms of generating capacity, as a Centre of Excellence for research in technology relating to HVDC, power systems (including lines) and high power electronics relating to AC systems. The Eskom Centre of Excellence (CoE) at the University of KwaZulu-Natal, which also serves as the Eskom Power Plant Engineering Institute (EPPEI) Specialization Centre (SC) in High Voltage Direct Current (HVDC) Engineering engages in multi-disciplinary research which focusses on research in technology relating to HVDC, power systems (including lines) and power electronics relating to AC systems. The Eskom CoE derives its mandate from the research vision of the University of KwaZulu-Natal and the Professional Services Contract (PSC) document and agreement with Eskom.

The Center seeks to be of international repute in various key areas of research excellence which *create and share knowledge, develop technology and innovative solutions* needed to uplift the quality of life of the South African people, in keeping with *the mission of UKZN as the Premier University of African Scholarship.* Thus, the Center engages in applied scientific research and technology development in support of the National Development Plan (NDP) of South African, and to improve the living standards of people in the South African society while contributing towards nation building. Eskom CoE contributes to the South African engineering and scientific expertise through fundamental and applied research, and collaborative work with international experts. The multidisciplinary nature of its research is reflected in the current and future activities with local industry and community-based development projects. The Centre engages in inter-disciplinary approaches to the resolution of real-world engineering problems facing the electricity industry. Success is measured by output variables - resource generation, research output, participation rates and international connectivity.

As South Africa undertakes the challenge to transform its economy from resource-based to manufacturing and knowledge-based economy, a key strategy is to invest in human capital while building a critical mass of skills that will enable South Africa become a major player in the global arena. There is a need to prudently manage our resources, building infrastructure, invest in human capital, integrate our markets and create an enabling environment for domestic and foreign direct investments to arrive and thrive. In the National System of Innovation, energy security has been identified as one of the "grand challenges". Research in the energy sector is not limited to production and distribution of electricity, but also to the minimization of energy usage, as well as the limitation of the negative environmental effects which are caused by the production and use of energy sources.

The University of KwaZulu-Natal's research mission has "Energy and Technology for Sustainable Development" as a focus area, which promotes leading research for the needs of South Africa. The energy sector is by far the largest contributor to global GDP and is the engine that drives the world's economy. Humankind's insatiable appetite for energy has meant that this sector influences all aspects of the economy and has direct and indirect bearing on the socioeconomic development of a country and its people. UKZN's research mission seeks to derive benefits in areas such as economic growth, educational development, cultural integration, health care delivery and social benefits for the prosperity and well-being of South Africa and other countries beyond the borders. The Centre with its team of dedicated academics, researchers, industry experts and postgraduate students will continuously be engaged intellectually and professionally in fundamental and applied research in an inter-disciplinary manner to *expand knowledge and resolve real-world engineering problems* that will strengthen the position and influence of our communities in the world arena.

In this 2014 annual report of the Center, 1 PhD and 8 MSc in Electrical Engineering students completed their studies of which two are Eskom Engineers, one US Patent Publication US 2013/0041520 was obtain in "Method and System for Facilitating Design of a High Voltage (HVDC) Control Systems and a Method for Optimizing an HVDC System"; 10 journal papers were published and 27 peer-reviewed local and international conference papers were published or presented at local and international conference and workshops.

1. Introduction

The Eskom Centre of Excellence (CoE) at the University of KwaZulu-Natal, which also serves as the Eskom Power Plant Engineering Institute (EPPEI) Specialization Centre in High Voltage Direct Current (HVDC) Engineering was established in January 2014 with the appointment of a Project Leader, and the restructuring and amalgamation of the HVDC Research Centre, Vibration Research and Testing Centre (VRTC), and Eskom-EPPEI Program. The CoE is a multi-disciplinary research center which focusses on research in technology relating to HVDC, power systems (including lines) and power electronics relating to AC systems. The Center engages in applied scientific research and technology development in support of the National Development Plan (NDP) of the South African Government, and to improve the living standards of people in the South African society and to contribute towards nation building. The purpose of the Center is to contribute to the South African engineering and scientific expertise through its own fundamental and applied research, and through collaborative work with others. The multidisciplinary nature of our research is reflected in the current and future activities of the Centre's research with industry and community-based development projects. The Centre engages in inter-disciplinary approaches to the resolution of real-world engineering problems facing the electric power industry. It has four operational research laboratories, namely:

- **HVDC Laboratory** – which focuses on High Voltage Direct Current (DC) engineering, design, analysis and testing.
- **HVAC Laboratory** – which focuses on High Voltage Alternating Current (AC) engineering, design, analysis and testing.
- **SMART Grid Research Laboratory** – A state-of-the-art modern facility for training/research development (modelling, simulation and real-time analysis) of Smart Technologies and the integration of various RE technologies into the Grid.
- **Vibration Research and Testing Centre (VRTC)** – which focusses on overhead transmission lines, mechanics of conductors, insulators, line supports and vibration analysis.

2. Research Staff

2.1 Staff affiliated with the Centre

Dr Inno Davidson	Dr. Remy Tiako
Mr. Andrew Swanson	Dr. Rudy Pillay Carpanen
Dr Richard Loubser	Dr. Leigh Jarvis
Dr. Akshay Saha	Mr. Eamon Bussy
Prof Thomas Afullo	Prof Pat Naidoo
Dr. Chitra Venugopal	Mr Timothy Akindeji
Prof. Jules Tapamo	

2.2. Collaborators

Research

Prof Joseph Ojo	Tennessee Technological University, TN, USA (Hon. Professor, UKZN)
Dr Grain Adam	University of Strathclyde, Energy Systems Research Unit, Glasgow, Scotland
Prof Kiyoto Nishijima	Fukuoka University, Dept. of Electrical Engineering, Fukuoka-shi, Japan
Asst. Prof Takao Matsumoto	Fukuoka University, Dept. of Electrical Engineering, Fukuoka-shi, Japan
Prof Nelson Ijumba	University of Rwanda, Kigali, Rwanda (Hon. Professor, UKZN)
Dr. John van Coller	WITS University, School of Electrical Engineering, Johannesburg, South Africa
Dr E. A. Young	Institute of Cryogenics, Engineering Sciences, University of Southampton, UK
Prof. Michael Gitau	University of Pretoria, Pretoria, South Africa
Prof G.K. Venayagamoorthy	Clemson University, Clemson, SC, USA (Hon. Professor, UKZN)

Industry

Dr Prathaban Moodley	Eskom, Dale Road, Midrand, South Africa
Mr. Jonathan Hunsley	eThekwini Electricity, Durban, South Africa
Mr. Roy Wienard	eThekwini Electricity, Durban, South Africa
Prof. Anthony Britten	Consulting Engineer, Midrand, South Africa
Prof. Hina Mu-Ashekele	MRC, University of Namibia, Namibia
	STRI, Sweden
Mr. Gary Slbilant	EPRI, USA
Dr Bruce Rigby	EtalumiSe (Pty) Ltd (Industry Partner)

3. Infrastructure Development

3.1 Facility Management: Smart Grid Building

The Smart Grid Research Building experienced multiple break-in, and strike of thieves and vandalising of offices on the 17th and 27th January 2014 and less successful in the most recent on 22nd November 2014. Data and equipment were stolen, and damage to infrastructure. The following turnaround measures have been undertaken and implemented at the Centre:

(i.) Restoration of research activities at the Centre; the Building and its security systems have been revamped and restored through the strong support of Eskom, UKZN Registrar, Campus Manager, Dean/HOS School of Engineering; EECE Discipline Academic Leader, Risk Management Services, Projects Officer and Prof Kirkman. New security improvement measures have been implemented.

(ii.) Staff and research students moral have been restored; while industry partner's confidence have been rebuilt. We have achieved a good turnaround in the number of postgraduate students who have completed their studies, research productivity and industry support for our research activities.

3.2 Equipment

The following equipment have been purchased and installed:

Date	Order	Details	Cost Centre	Price (ZAR)
25-Jul-2014	U365546	Computer related equipment	P590	14728.8
13-Aug-2014	EFT	Purchase of PICO Technology Software - PicoScope 6404D USB3 Oscilloscope	P590	84795.61
13-Aug-2014	EFT	Purchase PICO Technology Software - PicoScope 5444B 200 MHz 4 channel AWG	P590	32580.37
26-Aug-2014	U365836	x14 Desktop Computers	P590	150727.4
26-Aug-2014	U365836	x1 Desktop Computers	P590	17468.38
26-Aug-2014	U365836	Computer related equipment	P590	847.95
1-Oct-2014	U363003	6x DELL Laptops on the 01 Apr 2014	P590	35106.16
1-Oct-2014	U363003	6x DELL Laptops on the 01 Apr 2014	P590	70212.33
2-Oct-2014	U378618	2x USB-Analog Chrono	P590	1140
6-Dec-2014	RY267790	x1 Desktop Computer	P590	15588.79

3.3 Software Purchases

The following software analysis tools have been purchased and installed:

Date	Order	Details	Cost Centre	Price (ZAR)
11-Jun-2014	EFT	DigSilent PowerFactory	P590	260522.26
28-Nov-2014	EFT	Computer Simulation Software (CST)	P590	65,687.70
18-03-2014	14-38	SuperSMITH Version 5.0 CL	ND 1930102	840 US$
13-Aug-2014	EFT	Power-World Simulator	P590	32662.5

3.4 Laboratory Development: VSC-HVDC System Research Laboratory

There are two major emerging trends in the electric power/energy (electricity) industry, namely: (i.) The modernization of the electric power system – ***Smart Grid***; and (ii.) ***Renewable energy*** (RE) integration into the electric power grid. While the modernization of the traditional HVAC power grid has enabled and catalyzed the integration of RE into the electric grid, the core technology for this integration is the power electronic converters that process the power being delivered into the power networks to serve customers. Based on these emerging global trends, it has been proposed to establish a Voltage Source Converter (VSC) High Voltage Direct Current (HVDC) System Lab, which focusses on high power electronics, converter design and their controls for grid flexibility and inter-operability.

In cooperation with Eskom Specialists and Professor Joseph Ojo, and Prof Tony Britten (Liaison), we have embarked on establishing a VSC-HVDC System Laboratory. A proposal was developed together with Professors Joseph Ojo and Anthony Britten, to secure industry funding support and donation for the establishment of this state-of-the-art VSC-HVDC System facility, to boost research and training activities in High Power Electronics. An application has also been for complimentary funding from Eskom TESP to

support this initiative, while industry solicitation continues with ABB, Siemens and Alstom, being the three world leaders in HVDC technology. An outreach to China is on track in view of their leadership in the design, testing and successful implementation of the first "Multi-terminal VSC-HVDC System. The benefits of this research laboratory include:

- **Training/Technology Exposure of Next Generation Engineers in VSC-HVDC Technology:** The proposed lab will be used for training students and graduate engineers, to gain an understanding of these technologies. These future engineers and decision makers will implement these technology-solutions for Africa's emerging economy and infrastructure requirement. It will serve as a teaching and research facility for engineering students therefore achieving a key goal of development and training of scarce-skill capacity in HVDC converter technologies.

- **Research Facility**: As a state-of-the-art facility at Eskom CoE in HVDC Engineering complementing HVDC, VRTC, HVAC and Smart Grid Research facilities, the laboratory will serve as a research facility for postgraduate students for research activities in HVDC system performance, controls, fault analysis and reliability studies, complementing our High Voltage Engineering activities at sea level.

- **Industry Collaboration -** With the Lab facility, UKZN and the Eskom CoE, can effectively enter into a collaborate with industry partners like Eskom, eThekwini Electricity, to provide professional courses and hardware hands-on training for customers, provide a place to bring professionals to interact with this technology with UKZN being a major catchment for training Engineers from SADC and graduate engineers from Africa.

A visit is being planned by an ABB Specialist team to visit UKZN in the nearest future to facilitate this engagement and endeavour.

Industry Partner: eThekwini Electricity (Mr. Jonathan Hunsley)

A team of experienced researchers in the field have been assembled, namely:

Prof Joseph Ojo
TVA Professor of Electrical and Computer Engineering
Tennessee Technological University
Cookeville, TN, USA

Dr Grain Adam
Senior Researcher/Industry Consultant
Institute for Energy and Environment
Power Electronics, Drives and Energy Conversions Group
University of Strathclyde, Royal College Building
Glasgow, Scotland

(Dr Adam is the author/co-author of two monographs: (i.) Grain Philip Adam, "Voltage source converter: modulation, control and applications in power systems", ISBN-13: 978-1493729661, Dec. 2013, publisher (creative space.com), available at www.amazon.co.uk; (ii.) Olimpo Anaya-Lara, David Campos-Gaona, Edgar Moreno-Goytia and Grain Adam, "Offshore Wind Energy Generation: Control, Protection, and Integration to Electrical Systems," Publisher: Wiley-Blackwell; 1st Edition (23rd May 2014), ISBN-10: 1118539621, available at: http://www.amazon.co.uk/Grain-Philip-Adam/e/B00K1I0F7E.)

Mobolaji Bello (Eskom Specialist)
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Prof. Michael Gitau
Power Electronics and Industrial Drives Group
University of Pretoria
Pretoria, South Africa

Local Researchers include:

Dr. Inno Davidson
Dr. Akshay Saha
Dr. Chitra Venugopal
Dr. Remy Tiako
Dr. Rudy Pillay Carpanen
Mr. Timothy Akindeji

These collaborating experts, with industry leaders ABB and our local collaborating partners at WITS University will drive the project theme: "**Renewable Energy Integration into the Grid**".

2 PhD students + 1 MSc student will be joining UKZN in 2015 and working in this area of research.

4. Human Resources Development

12 PhD, 19 MSc and several BSc students are supervised within the Centre.

4.1. PhD Students

The following 12 PhD students are supervised within the Centre.

#	Student Name / Surname	Arman Goudarzi (213570461)	Start	2013	Supervisor	Dr Davidson
1	Title of Project	Smart Grid through Optimal Scheduling and Placement of hybrid systems with their Impact to the Reserve Requirement Level in Electricity Market	Completion	2016	Co-Supervisor	
	Synopsis of Research Project: Developing a dynamic model that integrates a distribution network (customer loads); intermittent RE sources interfaced into an electricity market, and studying the dynamics and impact on reserve margin for generators in an electric power system.					
	Supervisor Comments	Good progress, but can work faster.				

#	Student Name / Surname	Burnet O'Brien Mkandawire (205521891)	Start	2013	Supervisor	Dr AK Saha
2	Title of Project	Modelling Physical Asset Risk Profile Using Systems Thinking Augmented by Stochastic and Probabilistic Inferences	Completion	2015	Co-Supervisor	Prof N. Ijumba
	Synopsis of Research Project: Current quantitative approaches to power asset management risk modelling have focussed on financial aspects such as net present value. These approaches can neither determine nor trend the impact of technologies or renewal strategies on failure risk. As a result of this, combined with the fact that benefits of renewal strategies are hard to determine as renewal does not add additional capacity that is needed for revenue generation, the value of the strategies is not appreciated. In addition, it is currently difficult to measure the effectiveness of risk assessment activities in Reliability-centred maintenance (RCM) programmes when the number of equipment is large and not adequate data is available. The project integrates stochastic and probabilistic techniques with system dynamics concepts. The aim of this research is to develop a failure risk trend monitoring model, to improve performance measurement in the RCM activities and to aid power infrastructure managers in forecasting the most appropriate timing of renewal strategies. This could be useful for the management of power infrastructure assets such as transformers.					
	Supervisor Comments	In examination process.				

#	Student Name / Surname	Neven Chetty (8422762)	Start	2012	Supervisor	Dr Davidson
3	Title of Project	DC Corona Electroporation	Completion	2015	Co-	Prof Govender
	Synopsis of Research Project: Corona electroporation is a technique that utilises ions produced by high voltage DC corona to form pores in cell membranes. One important potential application is in the medical field where this technique can be used to assist in the delivery of molecules like drugs and DNA to the interior of biological cells. The effectiveness of corona electroporation depends on various conditions and the aim of this research project is to establish the optimal conditions for effective electroporation utilizing high voltage DC corona.					
	Supervisor Comments	In progress, to complete by 2015.				

#	Student Name / Surname	Mohamed Fayaz Khan (971127590) (Eskom-EPPEI)	Start	2014	Supervisor	Dr L Jarvis
4	Title of Project	A Superconducting Fault Current Limiter (SFCL) Feasibility Study, including consideration of the Physical and Operational Factors that could influence the viability of an SFCL as an effective fault level management tool in a large power system	Completion	2016	Co-Supervisor	Dr E Young
	Synopsis of Research Project: To determine when is it economical and technically feasible to employ SFCL technology and will focus on aspects to identify when and where the grid can leverage SFCL advantages. The second focus relates to the physical and operational characteristics that need to be considered when utilising an SFCL or another suitable superconducting device as a tool to manage fault levels in a large power network. These issues would range from the effective dissipation of heat during a fault event and subsequent restrikes, to the effect of an SFCL on voltage stabilization and load losses of the power network.					
	Supervisor Comments	Good progress, needs to purchase super-conducting tape (funding needed), to complete by 2016.				

#	Student Name / Surname	Abraham M. Nyete (212536330) (EPPEI- Non Eskom)	Start	2014	Supervisor	Prof Afullo
5	Title of Project	Robust Modulation and Coding Schemes for Power-Line Communications in Long Distance HVDC Systems	Completion	2016	Co-Supervisor	Dr Davidson
	Synopsis of Research Project: The Electric power network is most expansive and ubiquitous. Communications over power lines offers one of the cheapest ways to build network, with the utility company being in full control of the communication channel (SG). Presently, the standardization of PLC technologies (esp. BB PLC) is not yet at a mature stage, and powerful error correcting codes combined with optimal modulation scheme improves system performance. This research investigation sets out to study PLC channel models; amplitude characteristics, phase characteristics, noise characteristics, attenuation characteristics, and to measure the characteristics of the PLC channel in: LV indoor Test bed, MV/HV network in consultation with utility company (ESKOM); and to Develop and test an optimal coding and modulation scheme for the PLC channel over LV/MV/HV networks.					
	Supervisor Comments	Good progress, he has conference papers in China, SAUPEC and a Journal paper expected in July 2015. A prototype is expected from him with results.				

#	Student Name / Surname	Usiholo Iruansi (213573619) (EPPEI- Non Eskom)	Start	2014	Supervisor	Prof Tapamo
6	Title of Project	Power Line Defect Detection and Classification	Completion	2016	Co-Supervisor	Dr Davidson
	Synopsis of Research Project: The research investigation undertakes to identify defects in power line and classifying these defects, based on application of image processing and computer vision. The aim of this project is how to intelligently monitor power line system and its environment and the main objective lies in defect detection and classification of power line hardware. Possible defects in power line system can be categorized into: Line hardware, Towers and Right-of-way. The power line hardware include insulators, ground wire, overhead lines, spacers, dampers, compression dead-ends, suspension clamps and connection to insulators. The following research questions will be addressed: Possibility of determining power line defect detection and classification? Can this help in monitoring and maintenance of power line system? How efficient is the method of algorithm for power line defect detection and classification? Will the algorithm improve the process of automated power line defect detection and classification? Will the combination of the geometrical and texture-based feature allow for better modelling of various defects? Will the use of a feature selection method give an estimate about the expected performance allowing for a reasonable trade-off between performance and efficiency?					
	Supervisor Comments	In progress, has a conference paper, needs resources for image processing				

#	Student Name / Surname	Kayode Timothy Akindeji (214585727) (DUT Staff)	Start	2014	Supervisor	Dr Davidson
7	Title of Project	Analyzing the Impacts of Microgrid Operations and Control on the Eskom Distribution Networks	Completion	2017	Co-Supervisor	
	Synopsis of Research Project: The introduction of new concepts such as Microgrid, virtual power plant (VPP), market participation into the power grid has made it more complex. Also the interconnection of DER and RES in various forms to the distribution network through power electronic converters has raised concerns about safe operation and protection of electrical system. In view of these, the stability and control of the future electrical grid becomes a challenge. This research undertakes: to simulate and demonstrate Microgrid operation using appropriate tools (MATLAB/SIMULINK, RTDS etc.); to study the operation of available microgids in the Eskom distribution network with a view to increase penetration of more RESs and DERs; to investigate both small signal and transient stability of the Microgrid during grid-connected and island modes; to analyse the overall impact of Microgrid on the Eskom distribution networks.					
	Supervisor Comments	Good progress, few months of registration.				

#	Student Name / Surname	Zola Ntsangashe (206521431)	Start	2014	Supervisor	Dr Davidson
8	Title of Project	Electric Field and ionic current flow under HVDC transmission line	Completion	2017	Co-Supervisor	Prof Britten
	Synopsis of Research Project: Understanding of the electric field climate under HVDC transmission lines is essential to be able to predict conditions for flashovers. The objective of this study is to develop models that can be used you determine electric fields and space charge distribution associated with HVDC transmission lines, and thereby able to predict criteria for transmission line flashover voltages. The study will involve modelling and simulation, laboratory measurements and field					
	Supervisor Comments	In progress.				

#	Student Name / Surname	Daniel Kubelwa (211559874)	Start	2014	Supervisor	Dr Loubser
9	Title of Project	Experimental and Numerical Study of Aeolian Vibrations od Bundle Conductors	Completion	2017	Co-Supervisor	Dr Papailiou Dr Davidson
	Synopsis of Research Project: There is a pressing need for a practical yet realistic, semi-empirical, design tool to assess the behaviour and performance of a bundle conductor-spacer-damper system under Aeolian vibration. The chief motivation of this research is therefore to develop experimental and numerical benchmarks for the purpose of producing practical design tools to be used by transmission line designers. The power method and the energy balance principle will be used in developing the experimental and numerical benchmarks. The associated experimental work will be performed on the 85-m conductor test span at Vibration Research and Testing Centre (VRTC) of the University of KwaZulu-Natal.					
	Supervisor Comments	Good progress.				

#	Student Name / Surname	Olatunji Ajibola Akinrinde (214584016)	Start	2014	Supervisor	Dr R Tiako
10	Title of Project	Stochastic studies of high frequency transients in a wind farm	Completion	2017	Co-Supervisor	Mr. A. Swanson
	Synopsis of Research Project: High frequency transients are major cause of electrical equipment failure on the wind farm. Lightning operations and switching activities of circuit breakers causing very fast and fast frequency transients ranging from 10kHz – 50MHz are to be studied. These transients are stochastic in nature and by accurate modeling, proper protection systems can be put in place to mitigate resulting failures. The aim of the research is to model the major components on the wind farm; cable, vacuum circuit breaker and transformer with the aid of ATP version of Electromagnetic Transients Program (EMTP) while MATLAB is used to simulate the stochastic nature of the components with the use of Monte Carlo method					
	Supervisor Comments	Good progress, has trouble with which instrument to use, supervisor is suggesting ATP.				

#	Student Name / Surname	Evans Ojo (206520793)	Start	2011	Supervisor	Prof N Ijumba
11	Title of Project	Finite Element Analysis and Assessing the Self-damping Properties of Overhead Line Conductors using	Completion	2014 Extended:	Co-Supervisor	Dr Papailiou
	Synopsis of Research Project: The objective of the study is to understand the models of vibrations of transmission line conductors through modelling and laboratory experimental verifications. The outcome of the research will be the development of appropriate transmission line conductor damping systems for improved performance and reliability. The study outcomes will inform conductor materials selections and configurations.					
	Supervisor Comments	In progress, his data was lost during the break-in to the Centre, but most has been retrieved. Due to complete by June 2015.				

#	Student Name / Surname	Mr. M Gizaw (214584671)	Start	2015	Supervisor	Dr R Loubser
12	Title of Project	Aeolian Vibration Analysis of Optical Ground Wire (OPGW)	Completion	2017	Co-Supervisor	Prof G Bright
	Synopsis of Research Project: Communications are conducted using optic fibre links embedded in cables that are also suspended alongside the power conductors. The wind induced vibrations cause fatigue failures and signal degradation in the optic fibres. In addition, it is known that some types of cable construction exhibits increased attenuation of the optical signals at higher tensions, which are permitted by the National Electrical Safety Code (NESC). This research is directed towards gaining an understanding of the response of these fibre links to wind induced vibration at the required Catenary-Value of 2100m (Laboratory Test). The life of the optic fibres and signal quality will be explored. The primary objective of this PhD study is to investigate how Aeolian Vibrations affect or determine the life of the optic fiber links and quality of the signal transmitted at a Tension-to-Weight ratio more than 2100 m.					
	Supervisor Comments	A new Ethiopian student to arrive in January.				

4.3. MSc Students

The following 19 MSc students are supervised within the Centre.

#	Student Name / Surname	Kubendran Naicker (208527445) (Eskom-Non EPPEI)	Start	2008	Supervisor	Dr Davidson
1	Title of Project	Application of Distance Protection for Transformers in Eskom	Completion	2014	Co-Supervisor	
	Synopsis of Research Project: In the Eskom Transmission Network HV IDMT over-current protection and MV IDMT over-current protection is employed to provide back-up for the transformer differential protection and for uncleared external faults. MV IDMT is also employed to back-up the MV Busbar protection scheme, in the case of failure of the busbar protection scheme. This research aims to analyse the use of Transformer Distance Protection for auto-transformers in Eskom Transmission and provide a setting template with protection philosophy when enabling distance elements in Transformer					
	Supervisor Comments	In examination process.				

#	Student Name / Surname	Lungile Peggy Luhlanga (212561623) (Eskom-EPPEI)	Start	2012	Supervisor	Dr AK Saha
2	Title of Project	Round wires versus Trapezoidal wires in ACSR and ACSS overhead power transmission conductors	Completion	2014 Extended : 2015-01	Co-Supervisor	Dr R Stephen
	Synopsis of Research Project: Conductor material and shape (form) are deemed to be amongst the main determinants for optimal power transfer. Various forms such as trapezoidal (TW), aero-z (Z) and round-wires (RW) have been developed for bare overhead power transmission conductors. Interest is also shown by some power utilities to use High Temperature Low Sag (HTLS) conductors, mostly Aluminium Conductor Steel Supported (ACSS) for short transmission lines. In this study the electrical performances, such as thermal ratings, power losses and magnetic fields of ACSR and ACSS conductors in TW and RW forms are evaluated.					
	Supervisor Comments	31st Nov 2015: Lungi will be submitting to UKZN PG Office, a "Notice of Intent to Submit MSc Thesis" signed by herself and her supervisor Dr Akshay Saha. 15th Jan 2015: Lungi will be handing in a "redefined draft copy" of her MSc thesis to Dr. Saha and copied to Prof. Afullo and Dr. Davidson. 31st Jan 2015: Lungi will be submitting the 2 bound copies of the final MSc thesis to PG Office for examination with supporting authorization from Dr Saha.				

#	Student Name / Surname	Grace Kayumba Ilunga (213566569)	Start	2013	Supervisor	Dr Davidson
3	Title of Project	Influence of Fire on DC Corona	Completion	2014	Co-	Dr L. Chetty
	Synopsis of Research Project: Forest and felt fires are known to cause corona and flashovers in transmission lines. The phenomena have been well studied under HVAC transmission lines, but less understood in HVDC transmission systems. The objective of the study is to study the phenomena, through laboratory experiments and systems modelling and develop criteria for improved design and performance of existing and future HVDC transmission lines.					
	Supervisor Comments	In examination process. One conference paper + one journal paper under review.				

#	Student Name / Surname	Precious Husvu (Ms) (209511558) (Eskom-Non EPPEI)	Start	2009	Supervisor	Dr Davidson
4	Title of Project	Photovoltaic system with a Modular Multi-Level Converter coupled to Compressed Air Energy Storage for Grid Integration.	Completion	2014	Co-Supervisor	
	Synopsis of Research Project: Solar power technology has taken centre stage in power generation worldwide, with the exponential growth of PV installations. However, the utilisation of solar energy from PV systems is yet to reach its peak in South Africa. This thesis seeks to investigate the possibility of fully utilising solar energy from PV systems with a modular multilevel converter coupled to the Compressed Air Energy Storage for grid integration. The PV unit, the multilevel converter topologies, the energy storage techniques and the CAES are introduced. The analysis of the operation modes and performances of the multilevel converter, the energy storage and the CAES is done to determine the performance characteristics for the optimal configuration. The coupling of all these components is considered and these are finally integrated onto the grid. The entire system of these units for grid integration is modelled and simulated. Results are then analysed, evaluated and discussed with the conclusion, recommendations and further work being highlighted.					
	Supervisor Comments	In examination process.				

#	Student Name / Surname	Yeshiv Singh (208504125)	Start	2013	Supervisor	Dr Davidson
5	Title of Project	Electrospinning of Composite Silica/PVA Nanofibres and testing their effects on the Impedance of an Air Gap	Completion	2014	Co-Supervisor	Dr L. Chetty Prof Ramjugernath
	Synopsis of Research Project: Nano fibres have got wide applications in the medical field, textile industry, and energy and filtration systems. The objective of the projects is to study the use of high voltage DC corona in the synthesis of the fibres through the electro-spinning process.					
	Supervisor Comments	In examination process. Has one journal paper and two conference papers.				

#	Student Name / Surname	Immanuel Kamati N. Mbangula (214584439) (EPPEI-Non Eskom)	Start	2014	Supervisor	Dr Davidson
6	Title of Project	Investigating the Effects of HVDC Links on the Stability of Eskom's Electrical	Completion	2015	Co-Supervisor	Dr R. Tiako
	Synopsis of Research Project: The main objective of the proposed study is to scientifically determine the effects that multiple HVDC links have on the stability of a major electrical network, such as that of Eskom.					
	Supervisor Comments	Good progress, has one journal paper and one conference paper.				

#	Student Name / Surname	Stacey Juliana Mwale (214584027) (EPPEI-Non Eskom)	Start	2014	Supervisor	Dr Davidson
7	Title of Project	Steady-state Contingency and Adequacy Analysis of the SAPP Power Grid using DigSilent Powerfactory	Completion	2015	Co-Supervisor	
	Synopsis of Research Project: The main aim of this research is to validate the security status of the regions power network by guaranteeing a particular level of performance in accordance with SAPP standards.					
	Supervisor Comments	Good progress, has three conference papers and one journal paper under review.				

#	Student Name / Surname	Viren Ramprith (200202347) (eThekiwini Electricity)	Start	2002	Supervisor	Dr Davidson
8	Title of Project	Smart Grid Technology Deployment and Impact Assessment at eThekwini Electricity	Completion	2014	Co-Supervisor	
	Synopsis of Research Project: The role and importance of smart grids as an electricity industry enabler has been recognized throughout the developed world. Major European countries, USA and India affirm this trend. What is South Africa's leading municipal electricity distributor's eThekwini Electricity's Smart Grid maturity levels compare to these countries. Is the Smart Grid Technology deployment aligned with its objectives? To ascertain the level of impact of Smart Grid implementation and whether the anticipated benefits are being realized at eThekwini Electricity. The aim of this study is to assess the various areas of Smart Grid technologies at eThekwini Electricity and to carry out technology deployment analysis and impact assessment in this					
	Supervisor Comments	In examination process.				

#	Student Name / Surname	Ganasen Reddy (206521431)	Start	2014	Supervisor	Dr Davidson
9	Title of Project	Impact of Geomagnetic Induced Current (GIC) on a Power Transformer: The Manufacturer's Design Consideration	Completion	2014	Co-Supervisor	
	Synopsis of Research Project: GICs have the ability to enter the power system through the neutral of the grounded power transformer. Various studies have been conducted on the impact of GICs on the power system and on power transformers. These studies suggest various detrimental effects of GICs on the transformer viz. core saturation, higher MVAR demand and consequential voltage loss, harmonics, hot-spot heating and consequential power transformer failure. Although the GIC values are more significant in the northern hemisphere, some research has shown that GICs are prominent in the areas south of the equator (Southern Africa). A significant amount of GIC has been calculated and recorded at transformers in southern Africa. In addition, some transformer failure in southern Africa has been attributed to GICs during the GMD event cycles. It is observed that Eskom has included within the generator-transformer specifications, GIC design considerations which the transformer manufacturer needs to comply with. This mini-dissertation aims to assess design consideration by a transformer manufacturer when considering the impact of GICs on the transformer.					
	Supervisor Comments	In progress, but is currently not responding to supervisor's communication.				

#	Student Name / Surname	Sharlene Mbuilu-Ives 214583901 (Eskom-EPPEI)	Start	2014	Supervisor	Mr. AG Swanson
10	Title of Project	Control of HVDC converter for enhancement of grid stability	Completion	2015	Co-Supervisor	Dr ALL Jarvis
	Synopsis of Research Project: The study of the HVDC system with the connected power system is of strategic importance, understanding the interaction between the systems under normal and abnormal conditions. The ability of the HVDC link to enhance stability under transient conditions is of particular importance and the research will focus on the modelling, response and control of the HVDC systems for power system stability enhancement.					
	Supervisor Comments	Good progress, has a SAUPEC paper.				

#	Student Name / Surname	Gilbert Ininahazwe (214584545)	Start	2014	Supervisor	Dr Davidson
11	Title of Project	The Physics of Insulator Breakdown under Negative HVDC Polarity	Completion	2015	Co-Supervisor	Prof Britten
	Synopsis of Research Project: One of the major challenges in high voltage transmission lines is the failure of the electrical performance of the insulator. Reduction of insulator dielectric to extreme level can result in insulation failure, certain atmospheric conditions and pollution, can aggravate the loss of insulator performance and result in arching and flashover. HVDC flashover studies have been carried extensively. Research on DC flashover is very significant since DC accumulates more pollutants than AC lines under the same atmospheric conditions, there is also great interest in installing more HVDC transmission lines. About 50% of the line faults are classified unknown and nearly every single fault occurs at negative polarity. This research project aims to generate an in-depth knowledge and understanding of the physics of this phenomenon under negative HVDC polarity.					
	Supervisor Comments	Good progress.				

#	Student Name / Surname	Gugulethu Dumakude (214584490) (Eskom-EPPEI)	Start	2014	Supervisor	Mr. Swanson
12	Title of Project	Evaluation of Smart Technology for Improvement of Reliability in Distribution Systems	Completion	2015	Co-Supervisor	Dr Davidson
	Synopsis of Research Project: The reliability of a distribution system depends on a number of factors including the location (urban or rural), the type of system and the type equipment installed. Events that affect the customer supply include failure rate of equipment, the duration of fault finding and the duration of maintenance time. The reliability of the system is quantified in terms of indices such as SAIDI, SAIFI, etc. which will determine whether a system is performing or underperforming. The use of smart technology will impact on the availability of customer supply as the technology could not only be used to reduce the failure rate of the system but also decrease the duration of fault finding and maintenance times due to a greater visibility of the system.					
	Supervisor Comments	Good progress, has SAUPEC 2015 paper and CIGRE abstract.				

#	Student Name / Surname	Brett Smith 210513734 (EPPEI-Non Eskom)	Start	2014	Supervisor	Mr A Swanson
13	Title of Project	Investigation into the role of arcing horns on 132Kv sub-transmission lines	Completion	2016	Co-Supervisor	Dr ALL Jarvis
	Synopsis of Research Project: Arcing horns are placed in a system to protect insulators against flashover by providing overvoltage protection by means of a spark gap. EThekwini Municipality have an ageing infrastructure that currently still utilise these arcing horns on the three spans closest to the vicinity of a substation. This residual practise is possibly a result of old regulations which have not yet been revised with the onset of new technology. This paper therefore will focus on conducting and analysing an insulation co-ordination study of the current existing insulation role of these arcing horns within a 132kV transmission system with a latter focus on what effect could be induced when these arcing horns are caused to shift as result of conducive circumstances caused by the environment. The investigation will explore the flashover mechanisms of these components with a shift in their structural integrity; furthermore, the break-over voltage and the shift in the operating point they cease to function optimally and would therefore require replacement, will be investigated					
	Supervisor Comments	In progress				

#	Student Name / Surname	Brady Wen (208506650) (EPPEI-Non Eskom)	Start	2014	Supervisor	Dr ALLL Jarvis
14	Title of Project	Design and Construction of a Desktop Superconductor Fault Current Limiter (SFCL) for the Study of Surges and Geomagnetic Induced Currents (GIC)	Completion	2015	Co-Supervisor	Mr. A Swanson
	Synopsis of Research Project: A SFCL is a FCL that uses a superconductor as its current limiting element. Its main favourable benefit over conventional FCL's is that it is transparent to the power grid during non-fault conditions. This means that, as opposed to conventional FCL's, no power is lost during normal operating conditions. There are several configurations that the superconductor can be set up in the FCL, each with its pros and cons. However, in order to investigate that the superconducting tape must first be properly characterised. The aim of this project is to design a test bed that can be used to characterise high temperature superconducting tape in various configurations and to design experiments to implement the characterisation. It would then also be possible to investigate the effects of GIC on the superconducting tape and hence the possibility of mitigating the effects of GIC on a power grid.					
	Supervisor Comments	Good progress, he is expected to finish at the end of February 2015.				

#	Student Name / Surname	Abu-bakr Jakoet (213572780) (Eskom-EPPEI)	Start	2013	Supervisor	Dr A.K. Saha
15	Title of Project	Evaluation of the potential risk of voltage collapse in the Cape Network as a result of GIC	Completion	2015	Co-Supervisor	Dr Leigh Jarvis
	Synopsis of Research Project: Geo-magnetic disturbances causes quasi-DC geo-magnetically induced currents (GICs) to flow through transmission lines and through neutrals of star grounded transformers. These GICs cause half-cycle saturation of transformers leading to excessive reactive power consumption on the network. The aim of research project is to determine whether a selected portion of the transmission system will be stable following a one in a hundred year solar storm event					
	Supervisor Comments	15th Jan 2015: Abu will be submitting to UKZN PG Office, a "Notice of Intent to Submit MSc Thesis" signed by himself and his supervisor Dr Akshay Saha. 28th Feb 2015: Abu will be handing in a "first draft copy" of his MSc thesis to Dr. Saha and copied to Prof. Afullo and Dr. Davidson based on "defined scope". 31st Mar 2015: Abu will be submitting the 2 bound copies of the final MSc thesis to PG Office for examination with supporting authorization from Dr Saha.				

#	Student Name / Surname	Kabwit Alain Ntambwe (212562424)	Start	2012	Supervisor	Dr R Loubser
16	Title of Project	Determination of Dynamical loads of caused by Aeolian Vibration on composite insulators : Experimental approach	Completion	2015	Co-Supervisor	Dr K Papailiou
	Synopsis of Research Project: High voltage insulators have to fulfil high reliability criteria because they are one of the main components for the operational safety and operating efficiency of the electrical power transmission system. They are exposed to mechanical loads caused by wind-induced vibrations so-called Aeolian vibration, which might affect the insulators. The objective of this project is to determine by an experimental investigation based on a realistic model, the vibrational loads of the overhead line conductor undergoing Aeolian vibrations on composite insulators (suspension and line post).					
	Supervisor Comments	In examination process.				

#	Student Name / Surname	LC Botha (213570453)	Start	2013	Supervisor	Dr R Loubser
17	Title of Project	The Effects of Fretting Marks Introduced during Strand Winding on The Fatigue Performance of Overhead Transmission line conductors	Completion	2015	Co-Supervisor	Dr R Stephen
	Synopsis of Research Project: Transmission lines generally have very long service lives. In some parts of the world conductors installed in the middle 20th century are still in existence. With the advent of new materials with a high strength to weight ratio, one would expect the conductors to live even longer. It is therefore imperative that all factors affecting the fatigue life of conductors are researched and their effect clearly explained. The aim of this research is therefore to determine how much damage can be tolerated during manufacturing of the conductors to avoid the bird cage phenomenon The influence of fretting marks on the life of the conductor will be investigated at the same time. The research will therefore look at both the conductor/clamp and inter-strand fretting fatigue. The focus will be on how much indentation result will affect the desired life of the conductor.					
	Supervisor Comments	In progress.				

#	Student Name / Surname	Modisa Mosalaosi (201508647)	Start	2014	Supervisor	Prof. T. Afullo
18	Title of Project	Power Line Communication Channel Measurements and Characterization	Completion	2014	Co-Supervisor	N/A
	Synopsis of Research Project: Power Line Communications (PLC) deals with the transport of communication signals through existing power lines. Power lines are the most ubiquitous wired medium and thus presents an attractive prospect in terms of its utilization as a communication channel. Originally designed and deployed to transmit power at 50 Hz, power line intrinsic characteristics and topology presents drawbacks for high speed data communications. It has an attenuation that increases with increasing frequency as well as the length of the cable. The branched nature of its topology gives rise to multipath propagation which leads to performance degradation in PLC systems. Moreover, numerous electrical appliances connected in the vicinity of the PLC system generate noise of impulsive nature which leads to absorption of portions of the data signal across the frequency band. This study was focused on the measurement and characterization of the numerous noise scenarios experienced by PLC channels as well as channel modelling. The multipath behaviour was studied in terms of					
	Supervisor Comments	In examination process.				

#	Student Name / Surname	Nkululeko Mazibuko (206511887) (Eskom-EPPEI)	Start	2014	Supervisor	Dr Saha
19	Title of Project	Interconnection of various power sources into the Eskom power station auxiliaries.	Completion	2015	Co-Supervisor	
	Synopsis of Research Project: There is interest in integrating renewable sources (photovoltaic plants, hydro turbine and wind) into the ESKOM power station electrical auxiliary system. Research studies are needed to identify how the integration of renewable sources will improve the reliability, availability and especially improve the generation power sent out of the power station. Thus far two 500 KW solar PV plants have already been installed into the electrical auxiliary network to improve the generation power sent out at Kendal and Lethabo power stations. Renewable sources have high variability such as wind and solar energy, therefore study models to accurately simulate the instability associated with the renewable sources needs to be developed and evaluations of how these variations will impact the power station electrical auxiliary network and identify other associated risks. ESKOM has a number of projects that are in the pipeline (approx. 100 MW of renewables sources connecting to the power station auxiliary) to integrate renewable sources into the power station auxiliary system and currently ESKOM does not have renewable energy data base in DigSilent software to perform system studies, and therefore the impact to the power station operation and associated risks are not fully known therefore urgent studies are required.					
	Supervisor Comments	Satisfactory progress. progress is good so far except some problems with the software on which he needs training (he booked for the same				

4.4. BSc Students

The following BSc students conducted their 4th year design projects and were supervised within the Centre.

1. Design and construction of an infra-red vibration recorder

Mlondi Wiseman CELE (210504110)
Description: In this innovative project, the student is required to design a circuit which will use an infra-red emitter and receiver together to determine the amplitudes of an object oscillates in the vertical direction every second. The detector should display the frequency using seven-segment LED display or on LCD display. the frequency should also be sent to a computer via RS 232 cable. The student is then required to develop an applicable code to log the frequency every second.

Supervisor: Davidson

2. Numerical Simulation of Transmission Line Conductor Oscillations

Gcina T DLAMINI (211507670)
Description: Wind-induced vibration of overhead transmission line conductors is a common phenomenon under laminar flow conditions. The cause of vibration is that the vortexes shed alternatively from the top and bottom of the conductor at the leeward side of the conductor. Aeolian vibration is a main cause of fatigue failure of conductor strands or of items associated with the line support. In this project, the student is required to develop a numerical tool to simulate the mechanical vibration of power transmission line conductors. The simulation will be used to determine the conductors' natural frequencies, modes shapes and damping.

Supervisor: Davidson

3. Design and Simulation of a CSP Plant for Micro-Grid Application

Serchen EZIKIEL (211522427)
Description: Concentrated solar power (CSP) is a RE technology used in the generation of electricity from sunlight. It is seen as a viable option to meet the growing electricity demand. CSP uses optical elements to focus sunlight on a heat transfer medium. The high temperature, high pressure, steam produced is used to rotate a turbine coupled to a synchronous generator. The result is electric power generation. The student is required to design a CSP plant model adapted for the southern hemisphere. Using RETScreen software as a decision-support tool, the student is required to develop models of CSP plants of varying capacities and carry out a performance analysis (technical and economic), including an emissions analysis of the effect of the CSP installation on the environment in terms of GHG emissions. A comparison of the unit cost of electricity from CSP and conventional resources will be performed. A physical model/artefact of the system is required to be built and demonstrated for Open Day display.

Supervisor: Davidson

4. Optimal economic load dispatch with transmission line constraints through genetic algorithms

Mitesh GOVAN (211508499)
Description: Shortage of transmission capacities, load growth and electricity industry liberalization have led to increased interest in Distributed Generation (DGs) sources. The optimal location of DGs in power systems is critical for obtaining their maximum potential benefits. The student is required to develop an algorithm to determine the optimum size and location of DGs at any bus in the distribution network, based on minimizing electrical losses/cost.

Supervisor: Davidson

5. Design of hybrid RE-based distributed power system for an industrial park

Douglas N JAMBO (211558495)
Description: The student will design the electrical layout of an industrial park that has different types of loads. The park will be supplied by different types of electrical energy sources, both renewable and non-renewable energy sources such as the grid, wind and PV. The student will specify the loads, generation capacities of the different generators, cable sizes, voltage drops, network fault levels and transformer sizing. The design will then be verified by carrying out load flow analysis on the network using an electrical software simulation tool (ReticMaster, PowerMaster, PowerFactory or PowerWorld). Simulation results will then be compared to manually calculated results for verification.

Supervisor: Davidson

6. Design implementation and testing of a high voltage insulation test rig

Bryn Takunda MANGENA (211541962)
Description: The student is required to design and build a test rig. The test rig will be used for testing the DC breakdown strength of insulation samples placed between point-plane gaps of 0.5cm. The student will then use varying voltages from 100 to 200kV to breakdown test samples placed in the test rig. The test rig should be design in such a manner to be free from corona discharge, and the path of lowest resistance should be through the test-sample only.

Supervisor: Davidson

7. Numerical calculation of the electric field in wire-cylinder geometry under DC corona

Ntando G MBATHA (210529967)
Description: The purpose of this project is to demonstrate the influence of the electric field variation on DC corona discharge in air. Corona discharge is an undesirable occurrence in power transmission line, and is the cause of power loss, audible noise and radio interference. The student is required to simulate theoretically the electrical field before and after the occurrence of corona discharge, using available engineering software tools such as Quick-Field. The student will then design and use a laboratory experimental method to determine the electric field at different voltages, before the onset corona and the electric field on corona inception voltage. Results obtained by simulation will be compared to the experimental test results and discussed.

Supervisor: Davidson

8. Analysis of the Impact of Electronic Devices on Power Quality

Jason NARAYAN (210518018)
Description: Increased use of electronic devices has been recognised to be a major source of harmonics in electric power systems. The student is required to perform experimental tests the effects of connecting small electronics to a weak power grid. The student will design and implement a weak grid in a laboratory environment. The network will then be simulated using a standalone solar-PV inverter scheme. Distortions caused by electronic devises, CFLs and similar household devises on the single phase sine wave will be observed and recorded. The student will be required to verify if the use of multiple electronic devices eliminates or reduces higher order harmonics or not. Conclusions and informed recommendations about the effects of large numbers of electronic devises on the national grid will be made and back-up experimental data.

Supervisor: Davidson

9. Optimal Placement and Sizing of DG in an Electric Power Network Using PSO

Excellent Xolani MTSHALI (211513382)
Description: The purpose of this project is to demonstrate that the random variables selection approach Particle Swarm Optimisation (PSO) is an optimal methodology of mitigating economic load dispatch (ELD) with generator constraints.

Supervisor: Davidson

10. Modelling and analysis of reticulation network with DG injection

Bheki NDLELA (210520106)
Description: There is significant growth in the use of autonomous- and distributed generations (DGs) sources deployed at sub-transmission (132 - 22 kV) and reticulation levels (<22kV) in stand-alone or grid connection notations. Installing DG at or near a customer load can eliminate the need to upgrade existing T&D networks to handle the extra power requirement. The four key strategic issues relating to DGs which are high on the agenda of any distribution company are: (a.) How much distributed generation will appear in the distribution networks? (b.) What effect will the DG have on the technical performance of the network? (c.) What changes in technical design or commercial practice will be effective within a distribution utility DG strategy? The optimal location of DGs in networks is critical for obtaining optimum technical performance (potential benefits) in electrical loss minimization, economic dispatch and reduced fault levels. The student is required to carry out the modelling and analysis of a multi-bus reticulation network model with multiple DG injection using suitable engineering software tools such as ReticMaster to determine electric losses, economic dispatch and fault levels.

Supervisor: Davidson

11. Modelling and Measurement of Corona Loss in Conductor under Different Temperatures

McBryn SUWEKEN (211557463)
Description: The performance of HVDC transmission has been a subject of studies in terms of transient faults. However HVDC systems operating under different environment conditions such as snow, rain, high temperature and sometimes under wild fire conditions have not been fully investigated. Farms/forest are susceptible to unpredictable devastating wild fires due to extreme weather conditions, or escape fires. HV networks experience flashovers due to the effect of high temperature caused by sugar cane fires and wild bush fires. The student is required to design and perform laboratory based experiments to determine the effect of high temperature on partial discharge sing different air gap and studying the space charge of corona; investigate the effect of wild fires on power quality; and to calculate corona loss under different temperatures. The student will access the repetition rate of partial discharge occurrence, determine the current and study the space charge of corona discharge. Experimental work will be undertaken under different voltages from the onset corona and above. Negative and positive corona will be evaluated.

Supervisor: Davidson

4.5. New Admissions MSc Students 2015

The following MSc students have been admitted to UKZN and will be supervised within the Centre.

Name: Emmanuel Oluwafemi Oni
Degree: MSc
Topic: Technical Performance and Stability of Eskom Power Network Using 600, 800, 1000KV HVDC

Name: Andrew Williamson
Degree: MSc (Eng) in Power and Energy Systems
Topic: Field-Effect Limits and Design Parameters for Hybrid HVDC/HVAC Transmission Lines

Name: Shiraz Yusuf Khan
Degree: MSc (Eng) in Power and Energy Systems
Topic: Comparative Analysis of a Hydro-Pumped Storage and Underground Pumped Hydroelectric Energy Storage Schemes

In addition, **3 new PhD Students** applications are currently being processed for admission in January 2015

5. Centre Outputs and Research Productivity

5.1. Completed Studies

The following students have completed their studies and submitted their thesis for examination in 2014, for graduation in April 2015.

PhD Students

Name of student: **Mr. Burnet O'Brien Mkandawire**
Student no. 205521891
Degree Programme: PhD in Electrical Engineering
Topic: Modelling Physical Asset Risk Profile Using Systems Thinking Augmented by Stochastic and Probabilistic Inferences
Supervisor: Dr Akshay Saha
Co-Supervisor: Prof Nelson M. Ijumba

MSc Students

Name of student: **Ms. Precious F. Husvu (Eskom Engineer)**
Student no. 209511558
Degree Programme: MSc (Eng) in Power and Energy Systems
Topic: Photovoltaic system with a Modular Multi-Level Converter coupled to the Compressed Air Energy Storage for Grid Integration.
Supervisor: Dr Innocent Davidson

Name of student: **Mr. Kubendran Naicker (Eskom Engineer)**
Student no. 208527445
Degree Programme: MSc (Eng) in Power and Energy Systems
Topic: Application of Distance Protection for Transformers in Eskom
Supervisor: Dr Innocent Davidson

Name of student: **Mr. Kabwit Alain Ntambwe**
Student no. 212562424
Degree Programme: MScEng in Mechanical Engineering
Topic: Determination of Dynamical loads of caused by Aeolian Vibration on composite insulators: Experimental approach
Supervisor: Dr Richard Loubser
Co-Supervisor: Dr K Papailiou

Name of student: **Mr. Modisa Mosalaosi**
Student no. 201508647
Degree Programme: MScEng in Electrical Engineering
Topic: Power Line Communication Channel Measurements and Characterization
Supervisor: Prof. T. Afullo

Name of student: **Mr. Grace Kayumba Ilunga**
Student no. 213566569
Degree Programme: MScEng in Electrical Engineering
Topic: Influence of Fire on DC Corona
Supervisor: Dr Innocent Davidson
Co-Supervisor: Dr Leon Chetty

Name of student: **Mr. Virendra Ramprith (eThekwini Electricity)**
Student no. 200202347
Degree Programme: MSc (Eng) in Power and Energy Systems
Topic: Smart Grid Technology Deployment and Impact Assessment at eThekwini Electricity
Supervisor: Dr Innocent Davidson

Name of student: **Mr. Yeshiv Singh**
Student no. 208504125
Degree Programme: MScEng in Electrical engineering
Topic: Electrospinning of Composite Silica/PVA Nanofibres and testing their effects on the Impedance of an Air Gap
Supervisor: Dr Innocent Davidson
Co-supervisor(s): Dr Leon Chetty
Prof Diresh Ramjugernath

Name of student: **Mr. Clement Malamba Siame**
Student no. 209511568
Degree Programme: MScEng in Electrical engineering
Topic: HVDC Corona Induced Fire under Direct Current Power Lines
Supervisor: Mr. A Swanson
Co-supervisor(s): Prof. NM Ijumba

5.2. Graduated Students

The following students graduated in 2014.

MSc Students

Name of student: **Mr. Silesh Mansingh**
Student no. 9039310
Degree Programme: MScEng in Electrical engineering
Topic: The Impact of Energy Efficient Lighting on Power Networks
Supervisor: Prof. NM Ijumba
Co-supervisor(s): Mr. R Govender

Name of student: **Mr. Yatshamba Daniel Kubelwa**
Student no. 211559874
Degree Programme: MScEng in Mechanical engineering
Topic: The Relationship between the Bending Amplitude and Bending Stress/Strain at the Mouth of a So-Called Square-Faced Clamp for Different Conductor Sizes and Different Tensile Loads: Experimental Approach
Supervisor: Dr RC Loubser
Co-supervisor(s): Dr KO Papailiou

Name of student: **Mr. Avern Malcolm Athol-Webb**
Student no. 204511710
Degree Programme: MScEng in Mechanical engineering
Topic: The Computational Investigation of the Wind-Induced Vibration of Overhead Conductors
Supervisor: Prof G Bright
Co-supervisor(s): Dr TR Loubser

Name of student: **Mr. Leonard Matake**
Student no. 210545310
Degree Programme: MScEng in Mechanical engineering
Topic: Investigating the Performance of Facts Devices (SVCs) in the Eskom Network
Supervisor: Dr A.K Sah
Co-supervisor(s): N/A

Name of student: **Mr. Raventhran Moonsamy**
Student no. 931303563
Degree Programme: MScEng in Mechanical engineering
Topic: Investigating the Financial Recovery of Embedded Generation in Medium Voltage Distribution Systems
Supervisor: Prof NM Ijumba
Co-supervisor(s): Dr L Chetty

Name of student: **Mr. Jonathan Tempies**
Student no. 207528057
Degree Programme: MScEng in Mechanical engineering
Topic: A technical evaluation of concentrating solar power generation technologies for the Upington area of South Africa
Supervisor: Mr M Brooks
Co-supervisor(s): Prof NM Ijumba

Name of student: **Mr. Alzaan Du Toit**
Student no. 207528059
Degree Programme: MScEng in Mechanical engineering
Topic: An Investigation into the Power Consumption Efficiency at a Base Metal Refinery
Supervisor: Prof N Ijumba
Co-supervisor(s): N/A

5.3. Research Productivity - Patent

The following research outputs have been achieved:

[1] **US Patent Publication: US 2013/0041520 A1.** Method and System for Facilitating Design of a High Voltage (HVDC) Control Systems and a Method for Optimizing an HVDC System, by Dr. Leon Chetty.
Synopsis: This invention relates to a method of and a system for facilitating design of a classic High Voltage Direct Current (HVDC) control system, a method for optimizing a classic High Voltage Direct Current (HVDC) control system, and a HVDC control system. In particular, the invention comprises the steps of determining at least a current control plant transfer function for a rectifier and/ or inverter of the classic HVDC control system by using a time domain current equation; determining at least a voltage control plant transfer function for at least a rectifier of the classic HVDC control system by using a time domain voltage equation; using the determined current control plant transfer function for the rectifier and/or inverter, and/ or the determined voltage control plant transfer function for at least the rectifier to facilitate design of the HVDC control system.

5.4. Research Productivity – Referred Journal Papers

[1] L. Chetty and N.M. Ijumba, "System Identification of Classic HVDC Systems", ***Transactions of the South African Institute of Electrical Engineers*** (SAIEE Africa Journal), Vol. 102, Number 4, December 2011, pages 113-118.

[2] L. Chetty and N.M. Ijumba, "Quantitative Feedback Theory Design of Line Current Commutated HVDC Control Systems", ***Transactions of the South African Institute of Electrical Engineers*** (SAIEE Africa Journal), Vol. 104, Number 1, March 2013, pages 2-10.

[3] I.E. Davidson, H. Muashekele and N. Mukapuli, "Benguela Community-UNAM Wind-Power Demonstration Project - Experiences in Implementation". ***Journal of Energy and Power Engineering***, USA, Vol. 8, **2014**, pp.1067-1072.

[4] L. Chetty and Y. Singh, "Reliability Assessment of High Voltage Direct Current Grid Protection Schemes", ***Quality and Reliability Engineering International Journal***, John Wiley, **2014**.

[5] Evans E. Ojo and Sergey Shindin, “Finite Element Analysis of the Dynamic Behaviour of Transmission Line Conductors Using MATLAB”, ***Journal of Mechanics Engineering and Automation***, Volume 4, Number 2, February **2014**, pages 142-148.

[6] K.N.I. Mbangula and I.E. Davidson, "Power System Modelling and Fault Analysis of NAMPOWER'S 330KV HVAC Transmission Line," ***Journal of Energy and Power Engineering***, USA, Vol. 8, **2014**, pp.1432-1442.

[7] B.O. Mkandawire, N.M. Ijumba and A.K. Saha, “Transformer risk modelling by stochastic augmentation of reliability-centred maintenance,” ***Electric Power Systems Research***, Elsevier, Vol. 119, **2015**, pp.471-477.

[8] Mahmoud Ebadian, Ashakn Edrisian and Arman Goudarzi, “Investigating the effect of high level of wind penetration on voltage stability by quasi-static time-domain simulation (QSTDS)”, ***International Journal of Renewable Energy Research***, Vol.4, No.2, 2014, pp.355-362.

5.5. Research Productivity – Referred Journal Papers (Accepted for Publication)

[9] B.O. Mkandawire, N.M. Ijumba and A.K. Saha, “Component Risk Trending Based on Systems Thinking Incorporating Markov and Weibull Inferences,” accepted for publication by ***IEEE Systems Journal****, 2014* [in Press].

[10] G.P. Adam and I.E. Davidson, “Robust and Generic Control of Full-Bridge Modular Multilevel Converter High-Voltage DC Transmission Systems,” accepted for publication by ***IEEE Transactions on Power Delivery*** [in Press].

[11] Mwale, STJ and Davidson I E, "A Steady-state Contingency Analysis of the SADC Regional L Grid using the N-1 Criterion”, accepted for publication by ***Journal of Energy and Power Engineering***, USA. (in Press)

5.6. Research Productivity – Submitted Journal Papers

[12] K.G Ilunga, L. Chetty and I.E. Davidson, “Influence of Fire on DC Corona”. Paper submitted to the ***SAIEE Africa Journal***, South Africa. (Under Review). Manuscript # 2014-559

[13] A.M Nyete, T.J.O. Afullo, and I.E. Davidson, “An alternative approach in the modelling and characterization of noise in power lines for communication applications” Paper submitted to the ***International Journal of Electrical Power and Energy Systems*** (Under Review) Elsevier, Dec 2014. Manuscript # IJEPES-D-14-01916.

5.7. Research Productivity – Local Conference Papers

[1] S.T.J. Mwale and I.E. Davidson, “Security Analysis of the SADC Regional Electric Power Grid Using DigSilent Powerfactory Software Tool”. ***1st Eskom Power Plant Engineering Institute Student Conference***, 5 - 6 May 2014, Eskom Academy of Learning, Dale Road, Midrand, South Africa. URL: http://www.crses.sun.ac.za/service-conferences-eppei.php

[2] K.N.I. Mbangula and I.E. Davidson, “System Modelling and Fault Analysis of a HVAC Transmission Line”. ***1st Eskom Power Plant Engineering Institute Student Conference***, 5 - 6 May 2014, Eskom Academy of Learning, Dale Road, Midrand, South Africa. URL: http://www.crses.sun.ac.za/service-conferences-eppei.php

5.8. Research Productivity – Referred International Conference Papers

[3] N.K Chetty and L. Chetty, “A Review of Factors that Affect Corona Electroporation of in-vitro samples in High-voltage Point-plane Gap Test Apparatus”, Proceedings of the 21st ***South African Universities Power Engineering Conference***, Potchefstroom, South Africa, Pp. 44-50, 31 January and 1 February 2013.

[4] Bello M M, Smit R, Carter-Brown C and Davidson I E, "Power Planning in a Smart Grid Environment - A Case Study of South Africa," Proceedings of the ***IEEE Power Engineering Society (PES) 2013 Meeting***, Vancouver, BC, Canada, 21-25 July 2013. IEEE Explore Digital Object Identifier: 978-1-4799-1303-9/2013.

[5] Stacey Juliana Mwale and Innocent Ewean Davidson, "Security Analysis of Electric Power Supply in SADC Region,” Proceedings of the ***11th edition of the IEEE Region 8 Africon Conference***, Mauritius, September 9-12, 2013, pages 1455-1460. IEEE Catalog Number: CFP13AFR-POD, ISBN: 978-1-4673-5942-9

[6] B.O. Mkandawire, A.K. Saha and N.M. Ijumba, “Modelling Impact of Transformer Asset Management Strategies on Costs Using Systems Typologies and Probabilistic Inferences,” Proceedings of the ***22nd South African Universities Power Engineering Conference***, 30-31 January, Durban, South Africa, 2014, Volume 22, pp.147-152. (ISBN: 978-1-86840-619)

[7] A. Goudarzi, and A.K. Saha. "Comparison of Evolutionary Optimization Techniques On Economic Load Dispatch With Transmission Line Constraints,” Proceedings of the ***22nd South African Universities Power Engineering Conference***, 30-31 January, Durban, South Africa, 2014, Volume 22, pp 212-217. (ISBN: 978-1-86840-619)

[8] A.C. Britten, “The Convergence of HVDC Cable and Voltage Source Converter Technologies: New Scope for HVDC Transmission,” ***Proceedings of the 22nd South African Universities Power Engineering Conference***, 30-31 January, Durban, South Africa, 2014, Volume 22, pp 117-122 (ISBN: 978-1-86840-619)

[9] A.C. Britten, “The Scope of EPPEI-Sponsored Research into HVDC at UKZN: A Personal View” ***Proceedings of the 22nd South African Universities Power Engineering Conference***, 30-31 January, Durban, South Africa, 2014, Volume 22, pp 136-138 (ISBN: 978-1-86840-619)

[10] S.T.J. Mwale and I.E. Davidson, "SADC Power Grid Reliability - A Steady-state Contingency Analysis and Strategic HVDC Interconnections Using the N-1 Criterion," Proceedings of the ***2nd International Symposium on Energy Challenges and Mechanics***, 19-21st August, **Scotland**, United Kingdom.

[11] S.T.J. Mwale and I.E. Davidson, "Power deficits and outage planning in South Africa". Proceedings of the ***2nd International Symposium on Energy Challenges and Mechanics***, 19-21st August, **Scotland**, United Kingdom.

[12] B.O. Mkandawire, A.K. Saha and N.M. Ijumba, "Stochastic Evaluation of Impact of Power Utility Asset Management Paradigms on Sustainable Energy Supply," ***Proceedings of the 11th International Conference on Industrial and Commercial Use of Energy***, 19-20 August, Cape Town, South Africa, 2014, pp. 293-301. (ISBN: 978-0-9922041-6-7; DOI: 10.1109/ICUE.2014. 6904199, Publisher IEEE.)

[13] A.M Nyete, T.J.O. Afullo, and I.E. Davidson, "Performance Evaluation of an OFDM-based BPSK PLC System in an Impulsive Noise Environment". ***Proceedings of the 35th Progress in Electromagnetics Research Symposium (PIERS)***, Guangzhou, China, pp. 2510-2513, 25-28 August 2014.

[14] A.M Nyete, T.J.O. Afullo, and I.E Davidson, "On Rayleigh Approximation of the Multipath PLC Channel: Broadband through the PLC Channel," ***Proceedings of the 2014 Southern Africa Telecommunication Networks and Applications Conference (SATNAC)***, Port Elizabeth, South Africa, 31 August-3rd September 2014.

[15] I.E. Davidson and N.K. Mbaimbai, " Modelling and Analysis of a CSP Plant Technology for Small Power Networks -Technical and Financial Evaluation," Proceedings of *the* ***4th Solar Integration Workshop, International Workshop on Integration of Solar Power into Power Systems***, Berlin, Germany, November 10-11, 2014, pp.438-444.

[16] I.E. Davidson and N.K. Amaambo, "Comparative Analysis of Wind Turbine Technologies for Harsh Environments," Proceedings of *the* ***13th International Workshop on Large-Scale Integration of Wind Power into Power Systems*** *as well as on Transmission Networks for Offshore Wind Power Plants*, Berlin, Germany, November 11-13, 2014, pp.810-816.

[17] A. Goudarzi, I. Davidson, A. Ahmadi and G.K. Venayagamoorthy, "Intelligent Analysis of Wind Turbine Power Curve Models," Proceedings of the ***IEEE Symposium on Computational Intelligence Applications in Smart Grid*** (IEEE SSCI 2014), 9 – 12th December 2014, Orlando, FL, USA. IEEE Explore Digital Object Identifier: 978-1-4799-4546-7/14/$31.00 ©2014 IEEE

[18] Y. Singh, D. Ramjugernath, L. Chetty and I E Davidson, "Synthesis of Composite Polyvinyl Alcohol and Silica Nanofibres Using Electrospinning," Proceedings of the MAM-14, ***7th International Symposium on Macro- and Supramolecular Architectures and Materials***, November 23 - 27, 2014, Johannesburg, South Africa

5.9. Research Productivity – Referred International Conference Papers (Accepted for Presentation)

[19] A.M. Nyete, T.J.O. Afullo and I.E Davidson, "Intra-building power network noise modelling in South Africa," Paper accepted and to be presented at the ***23rd South African Universities Power Engineering Conference*** to be held in Johannesburg, South Africa, 28-30 January 2015.

[20] A. Edrisian, A. Goudarzi, I. Davidson, A. Ahmadi and G.K. Venayagamoorthy, "Enhancing SCIG-based Wind Turbine Generator Performance through Reactive Power Control". Paper accepted and to be presented at the ***Clemson University Power Systems Conference*** (PSC 2015), March 10-13, 2015, Madren Conference Center, Clemson University, Clemson, SC, USA

[21] G.C. Dumakude, A.G. Swanson, R Stephen and I.E. Davidson, "Evaluation of Smart Technology for the Improvement of Reliability in a Power Distribution System," Paper accepted and to be presented at the ***23rd South African Universities Power Engineering Conference*** to be held in Johannesburg, South Africa, 28-30 January 2015.

[22] S. Mbuilu-Ives, A. Edwards, A.G. Swanson, N. Parus, "Stability Enhancement of HVAC networks using HVDC links," Paper accepted and to be presented at the ***23rd South African Universities Power Engineering Conference*** to be held in Johannesburg, South Africa, 28-30 January 2015.

[23] N. Mazibuko, A.K Saha and M. Manyage, "Interconnection of various power sources into the Eskom power station auxiliaries," Paper accepted and to be presented at the ***23rd South African Universities Power Engineering Conference*** to be held in Johannesburg, South Africa, 28-30 January 2015.

[24] K.N.I. Mbangula and I.E. Davidson, "Detailed power system transient stability analysis using expert system concepts and stability improvement of a large multi-machine HVAC network using HVDC technologies," Paper accepted and to be presented at the ***23rd South African Universities Power Engineering Conference*** to be held in Johannesburg, South Africa, 28-30 January 2015.

[25] K.A Ntambwe, R.C. Loubser, K.O. Papailiou, "Experimental Investigation of Aeolian-Vibrational Loads on Composite Insulators," Paper accepted and to be presented at the ***23rd South African Universities Power Engineering Conference*** to be held in Johannesburg, South Africa, 28-30 January 2015.

5.10. Research Productivity – Referred International Conference Presentations

[26] L. Chetty, N. M Ijumba, N. K. Chetty, Y. Singh and K. G. Ilunga. "Evaluating the effect of paint coatings on the Corona Performance of Conductor Surfaces", ***18th International Symposium on High Voltage Engineering***, Hanyang University, Seoul, Korea, 25 August – 30 August 2013.

[27] M. F. Khan, A. L. L. Jarvis, E. A. Young, R. G. Stephen, "Comparison of Superconducting Fault Current Limiters against Traditionally Employed Practices in the Management of Fault Levels in the South African National Grid". Paper number ASC2014-1LOr3B-061 presented on 11th August 2014, at the ***Applied Superconductivity Conference***, Charlotte, NC, USA. [Full paper submitted for peer review in a Special Edition of the IEEE Journal of Applied Superconductivity].

5.11. Research Productivity – Submitted Conference Abstracts

[1] A.M. Nyete, T.J.O. Afullo and I.E. Davidson, "Indoor Broadband PLC Noise Characterization using Alpha Stable Models". Abstract submitted for the Power-Gen Africa 2015 Conference to be held at Cape Town International Convention centre, Cape Town, South Africa, 15-17 July 2015.

[2] P. Husvu and I.E. Davidson, "Photovoltaic system with multi-level converter coupled to the compressed air energy storage system for grid integration". Abstract submitted for the Power-Gen Africa 2015 Conference to be held at Cape Town International Convention centre, Cape Town, South Africa, 15-17 July 2015.

[3] K. Naicker and IE Davidson, "Application of distance protection for transformers in Eskom transmission system". Abstract submitted for the Power-Gen Africa 2015 Conference to be held at Cape Town International Convention centre, Cape Town, South Africa, 15-17 July 2015.

[4] K.N.I. Mbangula, S.T.J Mwale and I.E. Davidson, "Improving Power System Stability and Reliability of a Large HVAC Network Using Strategic Placement of HVDC Lines". Abstract submitted for the Power-Gen Africa 2015 Conference to be held at Cape Town International Convention centre, Cape Town, South Africa, 15-17 July 2015.

6. Scientific Liaisons and Industry Collaborations

The following are project specific focus groups at various levels of development at the Centre:

Smart Grids

eThekwini Municipality – UKZN Partnership

- Mr. Jonathan Hunsley, eThekwini Electricity
- Prof. Ganesh K. Venayagamoorthy, Clemson University, Clemson, USA
- Mr. Timothy Akindeji, Durban University of Technology

EPPEI / Eskom Specialists: Relationship building with Eskom Specialists

- Mr. Abre L'Roux — Eskom-EPPEI Coordinator
- Dr Prathaban Moodley — Technical Manager (HVDC/Smart Grid)
- Dr Rob Stephen — Technical Manager (VRTC), Master Specialist
- Mobolaji Bello — Power Delivery Engineering Specialist / Industrial Mentor
- Riaz Vajeth — HVDC Specialist
- Keri Pickster — HVDC Specialist
- Nishanth Parus — Industrial Mentor
- Nishal Mahatho — Senior Specialist – Insulators, Research, Test & Development

High Voltage Engineering: South Africa – Japan Technical Cooperation

- Professor Kiyoto Nishijima / Asst. Professor Takao Matsumoto, Fukuoka University, Japan.
- Professor Nelson Ijumba
- Professor Anthony Britten
- Dr John van Coller, WITS University

Power Converters and HVDC System Dynamics:

Power Electronics, Control Theory Applied to HVDC Power Systems, VSC-HVDC System

- Prof Joseph Ojo, Tennessee Technological University, TN, USA
- Mr. Jonathan Hunsley, eThekwini Electricity
- Prof. Michael Gitau, University of Pretoria, Pretoria, South Africa
- Dr Grain Adam, Senior Researcher/Industry Consultant, University of Strathclyde, Glasgow, Scotland
- Mobolaji Bello (Eskom Specialist), Power Delivery Engineering, Eskom, Midrand, South Africa.

7. Research Focus: 2015.

The following are the approved research focus areas in HVDC for EPPEI 2015:

1	The Physics of Flashover Mechanism of Line Insulation Breakdown under Negative HVDC Polarity; Gaseous PD; Effect of CO_2 Concentration on Discharge Characteristics; Influence of Dilute CO_2 concentration on AC/DC Spark-over in Atmospheric Air; Characteristics of DC Spark-over; Gas Temperature of Steady Glow and Streamer Discharges in Atmospheric Air Gap (at Sea Level)
2	Technical Performance and Stability Analysis of Eskom Power Network Using 600, 800, 1000KV HVDC - Grid Planning Applications; Increasing transmission line loading capacity near their steady-state, short-time and dynamic limits - upgrading of transmission lines by increasing voltage and/or current capacity
3	Enhancing Eskom Power Delivery Using Smart Utility and HVDC Technologies; Line Loss Minimization in HVDC Lines for Energy Metering purposes
4	HVDC Power Generation and Grid Integration of RE in Eskom Network
5	HVDC Converter Station Design; Development of VSC Converter / HVDC Cable Technology as an alternative technique to Conventional Line Commutation Converter (LCC) Technology

8. Capacity Building – Courses and Research Seminars

Conducted the following community outreach programs and activities during this period:

24th January 2014 — **HVDC Postgraduate Seminar**
Presenters: MSc (Yeshiv Singh, Grace Ilunga; PhD (Evans Ojo, Neven Chetty)

2nd March 2014 **High Voltage Engineering Seminar**
Professors Kiyoto Nishijima, Teruhiko Kohama & Takao Matsumoto
Fukuako University, Japan

9-11th April 2014 **Postgraduate Course: High Voltage Engineering**
Presenter: Prof Tony Britten

24th April 2014 **Eskom CoE Postgraduate Seminar**
Presenters: MSc (Abu-Bakr Jakoet, Alain Ntambwe, Brett Andrew Smith, Gugulethu Dumakude, Larry Botha, Immanuel Mbangula, Modisa Mosalaosi, N Mazibuko, Sharlene M'buili Ives, Stacey Mwale);
PhD (Abraham Nyete, Arman Goudarzi, Daniel Kubelwa & Mohamed Khan)

24-26th April 2014 **Postgraduate Course: HVDC Systems Design**
Presenter: Prof Tony Britten

26th May 2014 **Eskom CoE Seminar - Smart Grids**
Presenters: MSc (Viren Ramprith, Chih-Fong Wen, Gugulethu Dumakude)
PhD (Usiholo Iruansi, Arman Goudarzi)

22-26, 28th July 2014 **Postgraduate Course: Advanced Electrical Machines**
Presenter: Professor Joseph Ojo, TVA Professor of Electrical & Computer Engineering, Tennessee Technological University, USA

4-8th August 2014 **Postgraduate Course: Power Electronics and Applications in Power & Renewable Energy Systems**
Presenter: Professor Joseph Ojo, TVA Professor of Electrical & Computer Engineering, Tennessee Technological University, USA

11th August 2014 **Vibration Workshop**
The National Metrology Institute of South Africa (NMISA)
Presenter: Mr. Ian Veldman

25th August 2014 **Expert Seminar – Smart Grids**
Computational Approaches for Handling Big Data in Smart Grids
Professor Ganesh Kumar Venayagamoorthy
Duke Energy Distinguished Professor of Electrical and Computer Engineering, Clemson University, Clemson, USA

12th September 2014 **Industry- LMS (Belgium) Testing Solutions Seminar**
Closed Loop Vibration Qualification Testing
Presenter: Z Abdul & Javier Garcia Lopez, Siemens PLM Software

30th October 2014 **Industry Seminar – Renewable Energy Integration into the Grid**
Presenter: **Mobolaji Bello,** Eskom Specialist, Planning and GIS Centre of Excellence, Power Delivery Engineering, Group Technology Division, Eskom Holdings SoC Limited, South Africa

Other activities that have taken place at the Centre and organised from the Centre include: Industry Visits, hosting local and international visitors.

Partner Companies and Suppliers

The following major companies have been represented during our seminars, namely:

Eskom – SA Electric Utility	IMPUCUKO CC	THRIP
Reutech Communications	Electric Power Research	Esteq Test & Measurement
Toyota	Institute (EPRI)	NMISA
Aberdare Cables (PMB)	Africa Cables	National Instruments
Pfisterer	Hulamin Rolled Products	Loadtech Loadcells
Preformed Line Products (PLP)	Babcock	Coast to Coast Technologies.
MALTA Engineering Company (PTY)	eThekwini Electricity NRF	

9. Research Capacity Building

9.1 Appointment of 3 Honorary Professors

During this period, the following Distinguished Professors and International Experts in their respective fields were appointed as Honorary Professors to the Centre and UKZN:

Honorary Professors, UKZN
Professor Joseph Ojo, (High Power Electronics)
TVA Professor of Electrical and Computer Engineering, Tennessee Technological University, TN, USA.

Professor Nelson Ijumba (High Voltage Engineering)
University of Rwanda, Kigali, Rwanda

Professor Ganesh Kumar Venayagamoorthy (Smart Grids)
Duke Energy Distinguished Professor of Electrical and Computer Engineering, Clemson University, Clemson, USA

9.2 Software Training Courses

During this period, students at the Centre attended the following training courses:

[1] **DigSilent PowerFactory "Power System Stability Course"**, Johannesburg, South Africa. **14-16 July 2014**. Instructor: DigSilent BUYISA (Pty) Ltd.

[2] **DigSilent PowerFactory "Basic Professional Training Course"**, Centurion, Johannesburg, South Africa, **12 - 14 May 2014**. Instructor: DigSilent BUYISA (Pty) Ltd.

10. Research Funding

The following funding and research grants have been obtained in 2014.

Eskom TESP Grant (Smart Grids)	**R200000.00**
Eskom EPPEI (UKZN SC in HVDC)	**R3750000.00** (PSC Contract – Dean/HOS School of Engineering)

The following research grants have been applied for and a number of other local and international sources are being pursued or processed for 2015, but not listed:

SATREP Grant	**South Africa-Japan Technical cooperation** Applied for **100 Million Japanese Yen** for 2015-2017 (Final stage of processing. Supported by DST, South Africa
Eskom TESP Grant (HVDC Centre)	Applied for **R1207000.00** for 2015
Eskom TESP Grant (Microgrids)	Applied for **R405000.00** for 2015

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