RESEARCH AREAS AND PROJECTS

There are a number of active research projects being undertaken by researchers in the Department if Electrical Power Engineering at Postgraduate level leading to the Masters and Doctoral Degrees in Electrical Engineering.

The Inter-University Projects (IUP)

The theme of the IUP research project with Industry-support and Eskom Power Plant Engineering Institute (EPPEI) program, is: "Grid Integration of Renewable Energy (using power electronics)", and "Smart Grids". New and on-going research projects include:

- **Power Systems Operation and Stability**: 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. Real-time operation & control of power systems; State estimation, cyber security for power grids.

- **Transmission, Distribution and Line Engineering**: Electrical and mechanical properties of line and conductors, aeolian vibration analysis of conductors and optical ground wires. Enhancing Eskom power delivery using smart utility and HVDC Technologies; line loss minimization for energy metering; energy efficient infrastructure.

- **High Voltage Engineering**: The physics of flashover mechanism of line insulation break-down under negative HVDC polarity; characteristics of DC spark-over; gaseous partial discharge (PD), effect of CO_2 concentration on discharge characteristics; influence of dilute CO_2 concentration on AC/DC spark-over in atmospheric air; gas temperature of steady glow and streamer discharges in atmospheric air gap (at sea level).

- **HVDC Converter Design**: Development of VSC converter, HVDC cable technology as an alternative technique to conventional line commutation converter (LCC) technology, MMC topologies, design, analysis and testing, configurable/modular power electronics, application of power electronics in power systems.

The focus areas of HVDC Research are:

- Modelling, testing and evaluation of **HVDC equipment and components** – DC Breakers, DC Transformers, and insulation coordination in HVDC systems.
- **Power System Simulation studies** on the impact of **HVDC links on Eskom Network** – stability studies, contingency analysis.
- Conducting the modelling and performance evaluation of **HVDC converters designs** using the powerful Real-Time Digital Simulator at DUT and engaging Hardware-in-the-loop tools and methodologies.

- Developing **optimal HVDC system design and analysis of DC protection schemes** for interior and exterior faults in power electronic converters located on power networks including low voltage DC networks.