TUTORIALS (Provisional Details)

The following Tutorial Sessions are planned for the Earthing Africa 2017 Symposium & Exhibition:

TUTORIAL 1:

High Frequency / Low Frequency Considerations in Earthing Systems

Electric current, one of several parameters, applied to a buried electrode dictates the electrical behaviour of the electrode. Soil resistivity is a second parameter that plays a significant role in the electrode behaviour. Important to both these parameters is the frequency content of the electrode excitation current, be it a 50 Hz fault current or a lightning impulse current with higher frequency content. Particular considerations related to high and low frequency behaviour of earth electrodes are addressed in this tutorial. Typical models are noted with reference to electrode resistance and electrode impedance. The concept of equipotential and differences in larger and smaller electrodes are covered with specific implications for technology applied. Data obtained from the Practical Session at the Symposium will be used as introduction to this tutorial. Examples are given with reflections important to the design engineer.

Presented by:

Dr Pieter H Pretorius
Pr Eng, SMSAIEE, MCIGRE, MCORRISA

Pieter H Pretorius received a B.Eng (Electrical and Electronics) degree from the Potchefstroom University in 1985, an M.Eng (Bio-Engineering) degree from the University of Pretoria in 1990 and a PhD from the University of the Witwatersrand in 2000. His career in earthing, electromagnetic compatibility (EMC) and lightning protection is founded on his interest in electromagnetics. He joined Eskom in 1988 where he enjoyed career growth over a seventeen-year period to the level of Corporate Consultant. Boundary conditions drew him to independent consultancy in 2005. He also engaged as a senior lecturer at the University of the Witwatersrand for a short period. He is currently Principal Consultant with TERRATECH (South Africa), has authored / co-authored more than 100 papers, has registered three patents and has contributed chapters and parts of chapters to the Eskom Power Series and other books. He is registered as professional engineer with the Engineering Council of South Africa and is a participating member in several CIGRE Working Groups.

TUTORIAL 2:

Earthing and Lightning Protection of Overhead Power Lines

Lightning protection consists of metal structures that intercept flashes and divert them away from areas of vulnerability, leading the powerful strokes instead into earth electrodes that safely dissipate the current. On power lines, lightning protection makes use of overhead ground wires (shield wires) and neutral conductors that must be earthed at close intervals to work effectively.

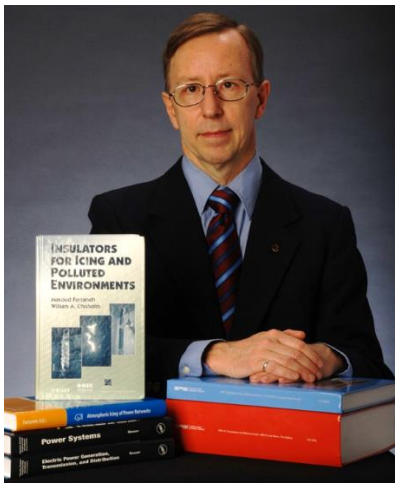
This four-hour tutorial, with suitable breaks for small technical demonstrations and questions, is addressed to the non-specialist mechanical or civil engineer, familiar with overhead line components, as well as electrical engineering students, technologists, grounding (earthing) specialists and lightning experts.

The first segment, “Lightning 101”, was developed by lightning experts in the IEEE Transmission and Distribution Committee for their Overhead Lines Subcommittee specialists familiar with towers, poles, conductors and insulators. Then, one of the original “Smart Grid” ideas, mapping the movement of lightning storms as they pass over and clear the electric supply, will introduce the principles and technologies in lightning location systems. This will reinforce the idea that lightning produces powerful electromagnetic signals that can accidently illuminate, and upset, nearby wires and cables/conductors.

The role of induced overvoltage from lightning that terminates beside an overhead line, and the simple choices that can be made in framing of distribution lines to make this problem go away, will take advantage of the latest thinking, found in IEEE Standard 1410. The tutorial will close with a snapshot of regulations from around the world, aimed at improving the customer satisfaction by reducing the number of momentary outages, as well as a rich list of resources to explore further.

Presented by:

Dr William A. Chisholm (Invited Guest Lecturer)
Ph.D. (University of Waterloo), P.Eng. (Ontario, Canada), IEEE Fellow



Earthing Africa is delighted to confirm the participation of Dr William A. Chisholm, a noted international expert in lightning protection, grounding (earthing) and adverse weather effects on overhead lines. He had a thirty-year career at the Ontario Hydro Research Division, now Kinectrics, that included making lightning measurements, high voltage and impulse grounding tests on 500-kV transmission towers, installing and calibrating a lightning location system, recommending the first use of transmission line surge arresters on unshielded 230-kV lines, using airborne geomagnetic surveys to measure two-layer soil resistivity along 345-kV right-of-way, and conceiving a grounding test, the “Zed Method” that can measure earthing impedance and local soil resistivity, without lifting overhead ground wires (shield wires).

From 2007 to 2017, he led the IEEE Power and Energy Society, Transmission and Distribution Committee; co-authored books for Wiley and McGraw-Hill; developed hands-on graduate and utility courses in grounding, Smart Grid and insulation coordination; contributed quarterly columns on lightning protection, “Transient Thoughts”, to INMR magazine; and supported the development of the EPRI Zed-Meter®, a portable, computer-based instrument that standardizes the Zed Method. Off-line, he holds a Masters Swim Canada record in the 200-m butterfly.

Chisholm will participate in all aspects the conference and will deliver a special four-hour tutorial, Earthing and Lightning Protection of Overhead Power Lines, based on some of the collaborative resources developed by IEEE under his leadership.

TUTORIAL 3:

Earthing Within Wind Farms

Earthing within wind farms is important from two viewpoints: power frequency safety earthing as well as transient voltages during lightning events. The basic processes involved with lightning striking a wind turbine are discussed together with the stresses that can be imposed on the collector cables linking the wind turbines to the central substation. The design requirements for the earth electrodes for each wind turbine are discussed such that the stresses on the cables are reduced to an acceptable level. Power frequency safety earthing issues relevant to wind farms will also be discussed.

Presented by:

Dr John Van Coller

Earthing Africa welcomes Dr John van Coller, who is a Senior Lecturer in the School of Electrical and Information Engineering at the University of the Witwatersrand, Johannesburg. He lectures in the areas of Insulation Coordination, Lightning Protection, Earthing, Power Systems, Power Electronics and Variable Speed Drives. Over the years he has consulted to many companies in the above areas. He manages the Specialization Centre in High voltage (AC) within the Eskom Power Plant Engineering Institute (EPPEI) Programme. He is a member of numerous Working Groups within Cigre, including C4.27 (Benchmarking Power Quality in Transmission Systems), C4.30 (EMC in wind farms) and C4.44 (EMC in PV parks). He has presented a number courses within Eskom and for Industry.

TUTORIAL 4:

Lightning Data: 11 Years - Interpretation, Analysis and Specific Observations from South Africa

Lightning is both an awesome and a frightening spectacle.

South Africa has a detailed 11-year history of lightning with a density resolution of 4km^2 with over 350 million lightning events documented. A pattern is clear demonstrating high lightning density trends in many more areas in the country than previously anticipated and modeled. All designers of power systems and electrical installations need to take heed of the more accurate information available and make the necessary adjustments in lightning surge protection. Asset managers need to take heed and appreciate the impact of maintaining those systems to maximize the available life of plant and equipment being protected.

This tutorial will unpack the lightning exposure across South Africa over the past 11 years and explain its meaning and impact.

Access to lightning data? The South African Weather Service has taken heed of Eskom's needs and together Eskom and SAWS have recognized the need for a long-term solution. A solution that will not only meet the needs of the greater South African community and empower South African scientists to again contribute to the international leadership effort in this field but also to be able to meet the needs of Southern Africa and Central Africa and possibly the whole of Africa. To achieve these objectives, first SAWS and Eskom needed to establish a working home base sufficiently proficient to match the standards being driven in other parts of the world. Successful implementation of power system lightning risk management solutions relies heavily on accurate, reliable and consistent lightning data. Success is determined not by the mitigation solution but by the verified performance of the solutions in the presence of the same or more severe storm and lightning threat. Therefore, the SAWS owned and operated lightning location system (LLS) implemented late 2005 is a wide area multi-sensor lightning detection network (LDN) covering the whole of South Africa and portions of adjacent countries with modular capacity to expand through negotiation with neighbouring countries. Swaziland is already an active participant. The LDN is known as the "Southern African Lightning Detection Network" (SALDN). The SALDN includes continuous system tracking performance measures dictating quality.

Translate the lightning data into information? Lightning data of itself serves no purpose. The presence of lightning both demonstrates the electrical nature of the storms and transfers enormous amounts of energy (Joules) into the systems it passes through as it transfers charge (coulombs) from cloud to ground. The tutorial "Lightning and Transmission lines" by Bill Chisholm will cover the details of how to mitigate against the prevailing lightning threat. This tutorial will cover the details of what that prevailing lightning threat is in South Africa and what is needed to gain that information throughout Africa to the same standards expected in South Africa. Eskom utilizes LTS (Lightning Tracking System) and FALLS (Fault Analysis and Lightning Location System) for this exercise spatially integrating the data with Eskom's power system assets.

Translate the information into knowledge? Information confirms the location of storms and severity of lightning at any particular location. Integrating this spatial information - location, growth and movement of the storms - with the location of assets delivers knowledge of imminent threat, sustained "attack" and cause of damage. *This information replaces the CSIR GFD maps and the new maps will be officially released during this tutorial*.

Make business decisions? Knowledge lays the groundwork for skilled professionals. Suitable mitigation does not eliminate the lightning event but redirects it from the plant and equipment that needs to be protected. Storm patterns are influenced by the solar activity of sun, moon and other planets in relation to the earth. Reference to the sun, the cycle is repeated approximately every 11 years. Decisions are made on merit with a long-term impact in mind, balancing capital investment and financial business losses, an option not really possible until now.

Science, models and reality: Over the past 100 years, scientists have gathered lightning data. During this time, lightning identification tools continue to develop. Early scientific findings were based on rudimentary empirical data. Mathematics and statistics has been the "go-to" solution to fill the gaps. The new lightning detection networks provide improved lightning data. The systems capture empirical data where the accuracy relies on mathematics. Debate has developed scrutinizing the accuracy and reliability of the new networked results where the same was not expected or even possible of the older solutions since the lightning strokes making up each flash were simply not being detected. Their existence had to be approximated based on controlled studies. The lightning community and lightning protection bodies still refer to "flash" activity which is and always has been an approximation of the actual stroke activity that takes place. Much work must still be done before the engineering and scientific communities can come together with the same mindset. This tutorial will cover these issues of accuracy and reliability.

Presented by:

Mr Cecil Richard Evert

Earthing Africa is pleased to welcome Mr Richard Evert, Eskom lightning specialist, working within teams developing scientific and engineering solutions to power system challenges since 1989. Richard completed a BSc Electronic Engineering in 1987 and MSc Electrical Engineering in 2004 – early detection of fires under EHV power lines.
In 1999 Eskom business requirements dictated a review of lightning detection systems and in particular, the LPATS owned and operated by Eskom since 1993. **South African Lightning Solution:** Richard was instrumental in the implementation of the new SALDN by SAWS as well as dictating a standard of operation that would stand the test of time. The lightning community and engineering fraternity rely on the statistical reliability of empirical data to build upon existing knowledge. Therefore, the data must be auditable and verified before being translated into information.

The lightning data now available from SAWS is both auditable and verifiable and a complete 11-year data set has been produced available for community protection, industrial and commercial business protection as well as research. Significant effort was invested in assuring a clear strategy for South Africa demanding technical excellence to back up scientific vision and not being diverted by sales and marketing ploys. SALDN replaced LPATS from January 2006.

Eskom lightning risk management solutions: Richard is instrumental in addressing the insulation coordination measures across Eskom as it pertains to lightning risk management. Management of

- Eskom's MTS and HV power lines covering over 78,000km connected to over 2000 substations and a power transformer installed asset base valued at more than R20 billion.
- Eskom MV networks covering over 268,000km connecting more than 300,000 MV transformers to customers. MV transformer asset base valued at more than R9 billion.

Significant effort was invested in assuring skills development across all Eskom disciplines relevant to power system risk management and is still ongoing in 2017 with emphasis also on standards and active business practices. Richard's primary passion now is to realize power system improvements across all of the above Eskom networks.

TUTORIAL 5:

Comprehensive Risk Assessment for Lightning Protection Systems

A Risk Assessment is an exercise carried out on a structure or site to calculate the value of the average annual loss of humans or goods due to lightning (and/or the effects thereof), relative to the total value of the humans or goods on the site/in the structure. According to IEC/SANS 62305-1, a risk assessment shall be carried out in accordance to IEC/SANS 62305-2 in order to evaluate the need for lightning protection of a structure or site.

There are 4 risks considered in a risk assessment, R_1 - R_4, which correspond to 4 specific types of loss. Each risk (R) has a tolerable value (R_T) and if $R>R_T$ for any of R_1 – R_4, measures must be taken to reduce the risk and a lightning protection system may be required. It is therefore important that a risk assessment be carried out with diligence and understanding as failure to do so may lead to devastating consequences and or losses.

As Dehn Africa, we have a 100 years' worth of lightning and surge protection knowledge at our disposal. In the lecture, a comprehensive discussion on the process of carrying out a Risk Assessment will be conducted beginning from the definitions, criteria of selecting the risks and associated losses, factors that influence the risk, evaluation of the risk components and the measures that can be taken to reduce the risk below R_T. A short form Risk Assessment will also be introduced which can be applied to specific applications such as Rooftop Photo-voltaic systems.

Presented by:

Mr Alexis Barwise

Earthing Africa welcomes Mr Alexis Barwise who is the managing director of DEHN AFRICA, the newly opened local subsidiary of the 107-year-old, family owned, German manufacturing company of lightning protection, surge protection and earthing components, DEHN + SÖHNE. He serves as an active member on several SABS committees and working groups and holds a Bachelor's degree in Electrical and Electronic Engineering from the North-West University.

He is a founding member and director of the newly established ELPA (Earthing & Lightning Protection Association). Throughout his career he has gained an in-depth knowledge as an electrical design engineer, systems engineer in the world of EPCM contracts/fields across several different industries. Prior to spearheading this new operation in Johannesburg, Barwise filled numerous roles at Schneider Electric, a global specialist in energy management.

TUTORIAL 6:

Earthing of the Neutral in Medium Voltage Systems

Neutral Earthing is a subject in electrical engineering which is as old the proverbial hills; it is also a topic in which the reasons for certain practices have tended to be forgotten as time passes, and, consequently, tend not to be challenged, or indeed, fully comprehended. It thus remains a subject of great importance in the design and operation of power systems. It is therefore the intention of this tutorial to provide a holistic review of the essence of why and how the relevant practices have evolved, and where the technology may be going.

The historical review to be given will first encapsulate how neutral earthing practices have also been influenced, to some degree, by the historical need to protect adjacent telephone systems from noise and high fault current induced overvoltages. (This is still a technical issue, as far as the writers are aware.) The tutorial continues by giving a summary of how the various neutral earthing practices evolved during the last century, in both Europe and North America; the differences are duly contextualised and analysed.

It is explained how why unearthed medium voltage systems are susceptible to the phenomenon of the arcing ground, and how this may be alleviated by the use of reactive compensation applied between the neutral point of the three-phase supply and earth. As alternatives to resonant earthing (namely, the use of the Peterson Coil), the attributes of resistive and direct earthing of the neutral are explained; the applications of the neutral or grounding transformer are described in terms of the need to limit fault currents to economic and compatible levels, namely, the compatibility by the degree of insulation grading on the transformer neutral. The origin of the 300-Amp limit of earth fault current in local MV systems is also described and justified.

The implications of the foregoing practises for human safety and electrocution risks are assessed; in particular, it is shown that none of the practices can provide a way of detecting body currents arising from contact with low hanging conductors.

The possible application of retrospective resistive earthing of the neutral in transmission systems ("lifting the neutral") as a means of limiting the severity of voltage dips, is reviewed and assessed in terms of the present transformer insulation designs (neutral grading, as specified by Eskom).

Finally, as regards reticulation schemes, it is explained that as the arcing ground will not occur in such systems, direct earthing / grounding of the neutral is the only viable, and indeed obvious option.

Co-Presented by:

Adjunct Prof Antony Christopher Britten
Pr Eng, FSAIEE

Earthing Africa welcomes Prof Tony Britten whose entire career was spent in various technical positions in ESKOM (the main utility in South Africa); this gave him wide experience in the power electrical and high voltage disciplines; this covered exposure to research, design and operational issues. He retired from Eskom in 2013, and now works from home.

His career is best summarised by projects he has worked on; these include the selection of the insulation clearances corona requirements for ESKOM's first high altitude 765 kV transmission lines, contributions to the design of compact 400 kV lines, the refurbishment of the Apollo HVDC Converter Station, and lightning and safety problems in distribution networks. He is presently investigating aspects of the anomalous performance of the Cahora Bassa HVDC lines under conditions of extreme corona on the ground conductors.

He has also contributed to the writing of several of ESKOM's technical books (known collectively as the ESKOM Power Series). Finally, he is presently contributing to CIGRE Guides on the insulation properties of fires under lines and electromagnetic interference from FACTS devices. He also acts as an external examiner for University dissertation at the MSc level; he is a Registered Professional Engineer and a Fellow of the South African Institute of Electrical Engineers.

And

Mr Stuart van Zyl

Earthing Africa welcomes Stuart van Zyl who is a Chief Engineer at the Protection, Telecommunications, Measurements and Control (PTM&C) Centre of Excellence in Eskom's Technology Group. He is a power system protection engineer specializing in the design and setting of distribution and sub-transmission protection systems and fault- and incident investigations.

Stuart is presently involved with protection and substation automation technology direction setting at all voltage levels across the Eskom wires business.

Stuart has a keen interest in the topic of neutral earthing of power systems. He undertook a revision of Eskom's MV/LV transformer earthing standard and lead the Eskom working group which compiled Eskom's standard for neutral earthing of Transmission and Distribution networks.

Stuart holds a Master's Degree in Power Engineering and a Bachelor's Degree in Science (Physics, Mathematics) from the University of Cape Town. He is a Senior Member of the South African Institute of Electrical Engineers (SAIEE) and a registered professional engineer in South Africa.

TUTORIAL 7:

Requirements of Low Voltage Surge Protective Devices (SPD)

The protection of electrical installations against, lightning induced transient overvoltages, partial lightning currents and power system switching surges, has become critical for all economies depending on reliable power systems. The challenge not only lies in the reliability of these systems but also in the fact that they have to be smarter, greener and more effective, which can only be achieved through using sensitive architectures such as Building Management Systems (BMS), Power Factor Correction (PFC) and IT services. However, these reliable, smart and green power system have different requirements with regards to protection than the connected sensitive devices/systems controlling them, therefore it is important to understand the application and requirements of low-voltage SPDs.

This tutorial, presented by DEHN Africa, will address lightning protection zoning concept, the impulse withstand rating, the requirements that SPD's must fulfil, the test classes that SPDs need to be tested to and finally, common application mistakes will also be addressed.

Presented by:

Mr Veiko Raab

Earthing Africa is pleased to welcome Mr Veiko Raab who received his engineering degree (Dipl.-Ing.) from the Technical University of Ilmenau (Germany) in 1990. He joined DEHN + SÖHNE GmbH+Co.KG in 1991 and is currently working as a Director of International Technical Services & Support. Prior to taking on his current position in 2014 he worked as a Senior Executive in the International Sales Department where he was responsible for the Asia-Pacific Region. Before that he was with DEHN+SÖHNE's application engineering department for more than nine years. During all these periods, he provided technical support for lightning and surge protection on national and international projects. Parallel to this, he held training courses on lightning and surge protection for DEHN's customers as well as being a guest lecturer on training courses organized by the Association for Electrical, Electronic & Information Technologies of Germany (VDE). He is the author of several articles published in technical magazines and of a handbook about Surge Protection published in Germany