wattnow

SAIEE SUPPORTS ENERGY EFFICIENCY AND THE ENVIRONMENT

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CABLES & ACCESSORIES

SAIEE THE OFFICIAL MOUTHPIECE OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | **MARCH 2013**

contents

wattnow magazine

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ISSN: 1991-0452

With summer nearing it's end, it is also time for us to get ready for our AGM. This sees us inaugurate a new SAIEE President, and we say a fond goodbye and a heartfelt thank you to the outgoing President, Mr. Mike Cary. It has been a privilege to work with him. He has taken every opportunity, to encourage the Engineers with whom he was dealing, to write articles for our wattnow magazine. His unwavering commitment has really made my task so much easier. Thank you Mike, I do hope I can continue to count on you for future contributions to the magazine.

This issue of the wattnow focuses on Cables & Accessories, and how important it is to choose the correct cabling system for any particular environment - read more about this on page 22.

Viv Cohen has contributed about 20 White papers for us to publish. This will keep me busy for the next 20 issues, Thank you Viv. This issue sees the first of those papers, entitled "Power: Installation Design" on page 28.

Dr Michael Grant was nominated to attend the IEC Young Professional Programme in Norway late last year - read his report on page 40.

Retirement is a very serious topic, which few people really think about when young. Did you know that only 6% of South Africans are able to retire financially independent? Read more on page 50.

Herewith another issue in the bag - enjoy the read.

Earn CPD Credits — *Visit www.**watt**now.co.za to answer the questions related to these articles to earn your CPD points.*

reetings to All.

This is to be my last **watt**now letter as President. On March the 27th, I shall be handing over the Presidency into the very capable hands of Paul van Niekerk, at the Annual General Meeting.

I have enjoyed my term of office, and hope that you have found my monthly epistle useful and interesting. You will find a copy of my report for the year 2012/2013 in the next edition of **watt**now.

One of the objectives of the Institute is to support skills development. One of the initiatives was to support Bergville Community Builders. This support begun under the Presidency of Viv Crone in 2005. Initially the programme was to teach the Teachers – particularly Science Teachers. Each year in February, the Institute participates in their careers week, as well as in their science week together with the Witwatersrand University's School of Electrical and Information Engineering. Last year the President, Andries Tshabalala, supported the building of a trailer equipped to demonstrate electricity technologies to pupils in Bergville and other rural communities.

Each year we also sponsor an award for the top matric student. The Amangwane High School in Bergville produced some very good results this year. The top student was Mbongeni Nkosi who achieved 6 distinctions. He was followed closely by Ms H Amangwane with 5 distinctions. The Institute decided to reward the top student with a prize which includes a laptop and software, which he can use for his university career.

Other areas where we support skills development are:
We are currently refurbishing Innes House (should be complete during this month). We will then relocate the museum to Innes House, and co-operate with SAASTA to bring grade 10 to 12 students to the museum, hopefully encouraging them to take up electrical engineering as a profession.

We awarded 10 under-graduate bursaries this year. We also administer a bursary on behalf of ISH for post-graduates.

We mentor young engineers. This has been done for many years, but as I wrote last month, we are busy formalizing the process to enable us to mentor many more.

Finally, we run a very successful Continuing Professional Development Programme, not only in Johannesburg but at the centres too.

Mike Cary | SAIEE President 2012

WATTSHOT

Showcasing the latest gadgets & gizmo's for the urban man & woman....

Eye Scope for iPhone

An ingenious zoom lens that fits your iPhone! This amazing iPhone zoom lens clicks on to your existing iPhone camera and gives you picture detail you never thought possible. Mobile phone photography is constantly improving and now rivals or even exceeds the quality of many small digital cameras.

The one thing that mobile phone cameras can fall down on is the level of optical zoom available. It's small enough to carry in your pocket and makes your iPhone even more functional. Compatible versions available for 3G and 4G iPhones. Price: R700 (incl.)

Mini Microscope for iPhone®

Fit this tiny gadget to your iPhone 4 and it will be transformed into a mini microscope capable of 60 x magnification.

Are you curious about all the goings on in the world beyond what our eyes are capable of seeing? You probably need a microscope – and not one of the big hulking ones from science class. If you are the proud owner of an iPhone 4, then this is the gadget for you!

Attach the mini microscope to the lens of your phone's camera and you'll be able to zoom in on your subject to really see it up close and personal. Price: R525 (incl.)

Shot Glass Chess

Become a grand master with the Shot Glass Chess Set. Let's face it, the only way most of us are going to achieve grand master status is by getting all of our adversaries very drunk and then winning by default when they collapse under the table. Each of the 32 shot glasses has an image on its side to denote which piece it represents, and together with the glass board it all makes for an attractive table top or sideboard display. Price: R325 (incl.)

WonKey™ Wonky Table Fixer

Ever been out for a meal or drink, only to have your experience ruined by a frustratingly wobbly table?

Well fear no more... This handy silicone rubber key ring will ensure your drink stays in your glass. Simply wedge WonKey under any wobbly table to keep it stable... Genius Price: R65 (incl.)

Runtastic Sports Armband for Smartphones

Now you are not limited in your movement and your hands are free. The Runtastic Sports Armband comes with a transparent display, an additional key pocket, and reflectors so you can be seen in the dark, neoprene cover for the audio receiver, and an adjustable hook-and-loop fastener to make it fit for everyone. You can wash the Sports Armband by hand and it protects your smartphone from sweat and water. Price: R250 (incl.)

Taste Explosion Salt & Pepper Shaker

Make meal times a blast with Taste Explosion, the grenade salt & pepper shakers.

Produced from quality porcelain, this pair of shakers will definitely add a bit of boom to your dining room.

White grenade for salt & black for pepper, and packaged in a secure ammo box to avoid disaster.

Specifications:

- Dishwasher and Microwave safe.
- Grade A food safe porcelain (Quality assured).
- 100ml cubed.
- 320g.
- Recyclable corrugated card & recyclable styrene seat.
- Salt and pepper not included.

Price: R165 (incl.)

iOpener for iPhone

A tough, thin, lightweight suit of armour for your iPhone 4 or 4S. How tough? Hammer tough. In fact the iOpener case has been subjected to tests so rigorous it was been beaten with a hammer and came out smiling. How thin? iOpener 4 measures just 15.8mm in overall thickness. How light? iOpener weights just 2oz.

First and foremost the iOpener® protects your iPhone. You take your iPhone™ everywhere, now you can take the party with you everywhere. Whip out iOpener®, open a bottle and the fun starts. The iOpener design team took the challenge of designing a premium personal accessory for the iPhone™ very seriously. We studied ergonomics, high strength plastics, food grade and surgical stainless steel in every grade available, and most importantly we were relentless at making it thin and light. The proof is in the pudding, the iOpener is a sleek, stylish and impact-proof case with a bottle opener that retracts into the case when not in use. Price: R299 (incl.)

Boogie Board Paperless LCD Writing Tablet

Perfect for scribbling messages, writing to-do lists, sketching digital graffiti, doing sums and drawing up mad professor-ish master plans, this ludicrously lightweight, flexible electronic pad features a pressure-sensitive screen upon which you can write, doodle and sketch using the included telescopic stylus, your finger or anything else capable of applying the required pressure.

When you need to erase your handiwork simply press the button. Clever, eh?
Price: R449 (incl.)

Mini Bluetooth Keyboard

Typing, chatting, and gaming just became easier than ever with this Mini Bluetooth Keyboard. This handy accessory is easy to carry around and works with Android devices, iPhone, iPad, iPad 2, Playstation 3, and many more devices, allowing for easy and convenient typing!

This Mini Bluetooth Keyboard allows you to enjoy responsive, featherlight typing along with portability, and Bluetooth functionality everywhere you go. The sleek and slim design fits comfortably in your hand and allows for easy typing with its 49 soft keys, including a full QWERTY keyboard and complete with a space bar and number keys. This Mini Bluetooth Keyboard even includes a FN (function) key for twice the functionality, making everything easier than ever before. With its Bluetooth 2.0 compatibility, this Mini Bluetooth Keyboard works with most smartphone operating systems and the latest consumer electronics, including.

Setup is quick and easy and in mere seconds your Bluetooth gadget or smartphone will be equipped with the ideal tool for texting, writing emails, chatting, web browsing, and even gaming! This useful Mini Bluetooth Keyboard turns typing and texting on your mobile phone into a whole new experience. Price: R380 (incl.)

WATTSHOT

Showcasing the latest gadgets & gizmo's for the urban man & woman....

Joby® GorillaMobile Ori for iPad™

Inspired by the Japanese art of the fold, Gorillamobile Ori for iPad 2 transforms effortlessly from a flat, lightweight protective case to an amazingly versatile iPad stand. Following months of research, Ori was designed to provide limitless ergonomic screen positioning and hands-free stability, without sacrificing the protection or portability of a sleek iPad case. Whether you're watching a movie on the plane, flipping through a portfolio presentation or typing an email at a café, you can position your iPad at the most comfortable height and viewing angle for you. Price R799 (incl.)

Digital Head and Neck Massager

Comfortable and portable, this Digital Head Massager relieves tension, headache, and revitalizes your brain and body anytime and anywhere you need it.

Inspired by popular Meridian treatment (Chinese medicine), this head and neck massager is designed with air sacs and acupuncture points to massage different parts of the head and neck area. It improves blood circulation, promotes movement of brain cells and eases tension and pain of head and neck. Finally, ancient Chinese medicine merges with modern technology to improve life.

With three different types of music to choose from, the built-in soothing sound of this massager resonates within your brain, relieving stress, and promoting self-recovery of your brain cells. In addition, the massager also comes with a heating function to provide you with a soft warm feeling, which in turn promotes the blood circulation around the head and neck area, and further release stress and fatigue. Price: R1,799 (incl.)

Swisstech®

The new Micro-Max® 19-in-1 Series offers our most comprehensive and versatile set of tools to date. This solid stainless steel tool set, with its patented, quick-release and self-locking mechanism, folds out into 19 different professional-grade tools. Everyday tools for everyday convenience. Tighten, loosen, wire, drill, file, open and measure with ease. Includes 2 hex wrenches, 6 screwdrivers, pliers, wire cutter, wire stripper, wire crimper, hand drill, file, bottle opener, 2 rulers (mm & inch), and 2 ruler extensions. Patent pending design provides 24/7 pocket-sized readiness. For key ring, purse, glove box and more. Price: R235 (incl.)

*All the products featured in the **watts**hot section is available online at www.mantality.co.za*

WATTSUP

Aberdare launches new range of circuit breakers

Crabtree Eletrical Accessories a, division of Aberdare Cables has launched a new range of high-performance, highly reliabile circuit breakers.

The Crabtree offering covers a range of breakers for domestic applications and complies to International and South African standards. The Crabtree manufacturing facility has been awarded ISO 9001:2000 certification. All products produced, marketed and sold by Crabtree either carries the SABS mark or are approved by SABS for sale in South Africa. This ensures that all the products that bear the Crabtree brand name deliver and ensures quality, safety and reliability.

The Crabtree range of circuit breakers consists of earth leakages, single, double, triple pole, single pole with neutral miniature circuit breakers and isolators up to 63Amps for single and three phase installations.

The miniature circuit breakers, isolators and earth leakages are designed to function in temperatures ranging between -5˚C and 40˚C, while the highest sustained temperature environment (24 hours) is 35˚C. Temperatures outside of these margins may result in reduced product performance, and must not be installed in such environments.

The products are suited for installation up to an altitude of 2000 metres above sea level. At altitudes greater than this the products may not perform in accordance with expectation. Operational relative humidity should not exceed 50%, except in low temperature environments. Humidity levels of 90% can be tolerated for periods of up to 30 days where the average daily temperature is 25˚C.

The miniature circuit breakers, isolators and earth leakages have also been designed to cope in instances where frost is experienced. In this scenario the earth leakage unit should be tested once a month by pressing the 'Test' button. The unit should trip. If the unit does not trip an electrician should be asked to investigate the cause.

LED Aurora Floodlight

Nitech delivers the new LED Aurora Floodlight - Portable lighting for Professionals.

This model is the latest development from Nitech and produces truly superb illumination using the latest technology.

With performance of up to 36 hours full power of daylight quality and shadow-free light. It is a superb light source with excellent battery life, with the equivalent to 500W halogen – 9500 lm (Lumens).

The LED Aurora floodlight is eco-friendly with up to 3000 kg annual CO2 saving and Carbon Trust Approved. Rapid recharge from any mains supply (110-230 V ac) or 12V vehicle.

The floodlight has been constructed from a waterproof (IP68) standard with high grade pressure die cast aluminium casing and a polycarbonate lens. This versatile floodlight has height extender available for raised operations. The safety of this LED floodlight is low voltage, cool and silent running with no fumes or trailing cables which enables it to be used in confined spaces.

Visual and audible warning indicates low battery voltage during operation with electronic intelligent charger and LED status indication. The economic design has virtually zero operating costs and is completely serviceable, all parts are replaceable.

Finish is in red or yellow powder coat (other colours to special order). There are various customised model options available for light output and battery power.

For further information on the LED Aurora Floodlight contact Denver Technical Products on either telephone: 011 626 2023

Aurecon becomes first global consulting engineering company to sign 49M pledge

Aurecon has once again demonstrated its commitment to sustainability by becoming the first global consulting engineering company in South Africa to sign the 49M pledge.

"Our corporate challenge is to embed sustainability as an integral part of our culture, our skills and our deliverables. Signing this pledge is confirmation of our resolve toward achieving this aim," comments Jacques Kotzé, Aurecon's Head of Facilities and Procurement.

Commending the group for taking this bold stand, 49M spokesperson Andrew Etzinger said: *"We are happy that Aurecon has taken the lead by being the first global consulting engineering firm to join the 49M cause. Energy efficiency is a challenge that requires commitment and efforts from all of us in order to keep the country's lights on and to ensure that the wheels of our economy continue to turn. Today's pledge by Aurecon gives us hope that the country is taking the issues of energy efficiency seriously and a demonstration that we all have a desire to secure a sustainable future for generations to come. This huge responsibility requires all of us to take action now."*

In support of their pledge, the group's Quality and Environment team has launched an on-going environmental awareness campaign across all of its offices in South Africa. The campaign, titled *'Think Sustainably, Act Responsibly!'*, aims to highlight important environmental issues and to share ideas around how staff can work together to lessen their environmental impact, including reducing the consumption of electricity both at work and at home. *"As one of 52 million citizens, each of us has the power to ensure that 49M makes a lasting impact on our nation,"* concludes Kotzé.

Jannie Viljoen has been appointed as Senior General Manager: Power of Powertech Transformers

QUICKEST DEGREE EVER

I started my engineering course at Wits in 1949. In those years, the Wits graduation ceremony was held on a Saturday morning during March in the Johannesburg City Hall.

In this hall, at the back of the stage were raised seats, which were used by the members of the orchestra when symphony concerts were held there. During the graduation ceremony, undergraduates were allowed to sit there provided they wore an undergraduate gown. There were about twenty of us undergraduates on the stage. The graduates sat in the body of the hall and went up in turn to receive their degree certificates.

My older sister was graduating that year as she just completed a BA degree. For this reason I decided to hire a gown and join the undergrads on the stage. Her degree was awarded and our family had a minor celebration.

The big surprise came when we looked at the Johannesburg Star newspaper that evening. There was a photograph of us undergraduates sitting on the stage with the caption "Graduates Waiting to Receive their Degrees at City Hall". Thus I realised that after only being registered for about three weeks, I was going to 'graduate'.

A.S. Meyer | FSAIEE

WATTSUP

Avaya Showcases latest Video, Collaboration and Networking Solutions to South African Partners

Avaya, a leading global provider of business communications applications, systems and services, hosted its annual PartnerConnect Conference on 23 January in Johannesburg. The conference focused on helping partners throughout the African continent grow their regional adoption of the company's innovative video, collaboration and customer care solutions.

To better understand the use of various forms of communication technologies and issues organisations are facing in South Africa, Avaya conducted a survey. The research found that 62 percent of the respondents are using video conferencing as a way to conduct meetings; they also found that 40 percent of them have close to half of their workforce operating in a mobile environment. Factors like these are the reason that in 2012, Avaya has made a number of strategic acquisitions, grown its midmarket solutions to address South Africa's burgeoning small- and medium-sized business sector, and advanced its applications to address the communications challenges facing the region's private and government sectors.

"The Time is Now" is Avaya's theme at this year's conference, highlighting the need for businesses to integrate video, voice and data communications into their customer interactions for increased efficiency and competitive advantage.

"For over a decade Avaya has been empowering their South African channel and customers to address specific, timely business opportunities in the region as companies look for better customer care solutions, move toward cloud adoption, and increase collaboration across regional and international offices – all of these initiatives create significant growth platforms for Avaya's partners in the region," commented Selvin Kristnen, Managing Director South Africa, AVAYA.

"Whether in developing expertise for specific industries or implementing new solutions such as video collaboration and social media integration, Avaya is ensuring that our partners have the training, skills, and tools needed to address these opportunities."

Empowering Municipal Engineers

Corruption and tenderpreneurship, fraud, financial mismanagement, lack of understanding of technical issues/ priorities, difficulties with job creation and skills shortages are just some of the challenges that face municipal engineers in South Africa.

Consulting Engineers South Africa (CESA) has frequently lobbied and voiced its concern regarding the incapacitation of municipal engineers, which is perhaps one of the issues at the centre of service delivery protests.

CESA believes that if South Africa is serious about the empowerment of properly qualified municipal engineers, Government should invest in various interventions such as training, development and capacitating of young engineers for employment by the local authorities and make the municipal engineering profession attractive.

Currently municipal planning is done rather superficially and only a real municipal engineer and a competent team of visionary planners can sort that out. This calls for innovation in unlocking projects, a win-win mentality, and an entrepreneurial delivery mechanism with sharing of risks.

CESA calls for the embracing of the municipal engineer as atrusted advisor as well as creating a working environment to attract and retain municipal engineers. The municipal engineers must be incentivized (long term employment, purpose in life, emoluments, respect and freedom) and unqualified people should be discouraged from trying to do the job of the municipal engineer.

Infrastructure delivery's biggest stumbling block is the lack of business integrity which involves among other things; socialising with clients, conflict of interest, use of agents and partners, collusion and bribery and the disregard of procurement regulations.

CESA strongly urges structural changes to the way in which municipal engineers operate including the abandonment of long term employment contracts for key technical and managerial staff.

Tender and bid evaluation committees must include technical, legal and financial executives in joint sittings and professional teams must be allowed to compile reports in an independent manner on tenders for the bid evaluation committees.

The South African procurement legislation should include a Bribery and Corruption Act such as the UK Bribery Act of 2010, enabling the Courts to prosecute corruption and related issues more effectively as well as the naming and shaming of firms contravening the requirements of the Act.

John da Silva; Marius Botes, Pieter de Frey, Andy Bertulis, Mike Imray and Andrew Leigh.

First Tech Group: Commercial and industrial growth trajectory powered by talent, synergy and strategic expansion

The First Tech Group is built on the vision of its founders, Andy Bertulis and Jeff Wiggill, to create a dynamic, one-stop entity for a number of market sectors. The past 20 years have seen the acquisition of 18 market-leading entities to form this major commercial and infrastructural group, which is fast fulfilling its stated intention of becoming the largest infrastructural supplier on the African continent.

"By carefully identifying companies that have synergistic offerings with our existing portfolio we have been able to grow the Group very successfully in a modular but yet still strongly synergistic manner," says Andy Bertulis, Chief Executive Officer of the First Tech Group.

The four focus groups within the organisation are: First Tech Construction, Manufacturing, Piping and Mass Distribution. The Group has established a long-standing portfolio of blue chip clients in the mining and minerals, petrochemical, power generation, oil and gas, rail, HVAC (heating, ventilation air conditioning), civil engineering/building/construction, electrical, lighting, agricultural and information technology (IT) industries.

While each division within the Group retains its own personal branding, the proud acceptance of a global Group philosophy of customer-centric products and services remains an overriding success factor.

"The First Tech Group places a great deal of emphasis on acquiring and retaining the services of highly skilled and talented personnel. This is further enhanced by the ongoing training and upskilling initiatives we employ throughout the Group," explains First Tech Group Chairman Jeff Wiggill.

The establishment of the Alex Rose First Tech Group Training Academy allows the First Tech Group to provide all employees with both in-house and externally-sourced training on all levels from labourers up to management. *"In addition to formalised training programmes, we believe that knowledge sharing plays a large role in job succession. We add further impetus to the development of intellectual property through inter-company cooperation,"* Wiggill continues.

Bertulis explains that the First Tech Group is focused on creating sustainable job opportunities through its skills development programme, coupled with a targeted expansion throughout Africa.

"While we are proud of our roots and heritage as a South African company, we are proactively establishing a footprint in Africa. Furthermore, it is our intention to continue increasing our penetration of pan-African countries. Further growth is planned for our Group companies in countries like Kenya, Ghana, Tanzania and the Democratic Republic of Congo (DRC), with other countries also currently under consideration such as Zambia, Zimbabwe, Namibia and Mozambique."

"The First Tech Group will continue to seek out companies and brands that will enhance and complement our existing portfolio. In this way, we will provide our valued customers with the convenience of servicing all their needs from one common source. Internally, divisions within the First Tech Group will also benefit, and be strengthened by, the larger pool of intellectual talent and knowledge which this synergistic model makes available," Bertulis concludes.

WATTSUP

Mark Wilson and Prof Fambirai Takawira shake hands after signing the new cooperation agreement between ACTOM and the School of Electrical & Information Engineering, while (from left) Prof Willie Cronje, Andries Tshabalala, ACTOM's Group Executive Director, and Prof Rob Moore look on.

Prof Willie Cronje (second from right) discusses the equipment and capabilities of the workbenches in the energy lab with (from left) Andries Tshabalala, Prof Fambirai Takawira and Mark Wilson.

Postgrad students demonstrate some of the features of the workbenches in the energy lab to (from left) Antonio Teixeira, General Manager of ACTOM Electrical Machines, Andries Tshabalala, Mark Wilson and Paul Cuthbert, Divisional CEO of ACTOM's Power Conversion division.

New energy lab opened at Wits University's School of Electrical & Information Engineering

Substantial contributions of both funds and equipment by leading electrical engineering group ACTOM over the past two years has enabled Wits University's School of Electrical & Information Engineering to revamp its energy laboratory into a modern facility that is set to meet its teaching requirements over the next 30 years.

The laboratory, named the ACTOM Energy Lab, was opened officially on 12 February by the Head of the School, Prof Fambirai Takawira, who stated that partnerships between the university and industrial companies like ACTOM are essential nowadays for the viability and success of both, as they need to interact with each other to best achieve their respective goals.

Mark Wilson, ACTOM's CEO and Chairman, said the group's relationship with the university, which started more than 25 years ago, has gained in strength and importance over the years. *"Our latest cooperative venture of establishing the new energy lab fits hand-in-glove with our group's longstanding policy of encouraging local industrial growth and furthering local skills development and job creation,"* he said.

Wilson and Prof Takawira signed a new agreement in which ACTOM has undertaken to fund expenses relating to keeping the energy lab equipment in good order over the next five years, including paying for consumables as well as equipment and components that fail or wear out.

The new lab comprises 20 workbenches for students and a lecturer's bench. The facility is also equipped with data projectors and a video camera to provide live relays of experiments and presentations given from the lecturer's bench that students can follow on a large screen.

The old equipment in the lab that has been replaced was in use for over 50 years and consisted of ten benches containing equipment dating back to shortly after World War II.

The items of equipment in the new facility's workbenches include instrumentation kits containing meters, switches, circuit breakers and indicator lights. Each bench is provided with a portable combo unit containing current and voltage transformers, with all signals from them capable of being viewed on an oscilloscope.

Hardware installed in the benches includes isolation transformers, variable transformers, rotating machines, drives, inverters and resistive load banks. The revamp of the facility also included installation of a modern distribution switchboard that can be used to individually enable power to one or all of the 20 workbenches.

Prof Willie Cronje, the School's Professor of Energy Efficiency, Energy Processing, Machines & Drives, who was mainly responsible for planning the new facility, said: *"In the old lab we could conduct only a limited range of experiments for 80 students per semester at most. Now we can provide a much more comprehensive range of experiments for double that number."*

Leading South African bookseller Van Schaik launches unique e-textbook offering

In an innovative development for South African education, Van Schaik Bookstores has launched a unique new e-textbook offering that provides an interactive educational tool for students, lecturers and other professionals, and makes many of the locally prescribed textbooks available as e-textbooks.

"Until now, very few locally prescribed textbooks were made available as e-textbooks in South Africa. And those that were made available were simple PDF's or exact page-by-page copies of the physical book," explains Melvin Kaabwe, Digital Manager of Van Schaik Bookstores.

Using Ingram's feature-rich, Vitalsource Bookshelf® platform, the Van Schaik Bookstore e-textbook goes beyond being a mere copy of the physical book. It becomes a tool for educational engagement using embedded media such as audio and video, 3D diagrams, scalable charts and graphs as well as virtual experimentation pages. VitalSource Bookshelf, with 2.7 million registered users on 6,000 campuses worldwide, is the preferred and most used e-textbook delivery platform in higher education today. *"E-textbook use in higher education continues its dramatic growth worldwide as more students, educators and institutions adopt digital course materials for study. Coupled with this, the rise of the tablet for reading books has had a profound effect on how people interact with written material. In the digital age, there are many options for Publishers to present their content in ways that provide a richer experience than on paper,"* says Kaabwe.

Where plain black-and-white e-readers are fine for general reading, an academic textbook for study purposes requires a more comprehensive use of digital technology. The ability of tablets, cell-phones, laptops and PC's to render beautiful images and run "apps" that allow for a reader to engage with the material in new ways, definitely brings a more complete learning tool in the form of e-textbooks.

"There is tremendous educational value of being able to conduct experiments in virtual laboratories within the science e-textbooks, or for entrepreneurs to evaluate business profitability using cost-volume-production graphing techniques or even for medical students to see the inside of a human heart in 3D."

Using the VitalSource platform, best-selling titles from local and international publishers, are now available for students in South Africa as e-textbooks through Van Schaik Bookstores. In the launch phase, popular books from publishers such as LexisNexis, Juta, Wiley, and Elsevier are available to buy and keep. Books from other publishers like Van Schaik publishers and Oxford University Press will be added in the near future. The books can be read on-line, on a cell-phone or off-line via the Vitalsource Bookshelf app, which is available at no cost for the latest Windows, iOS and Android devices. The VitalSource platform is a true online/offline e-book solution, with robust iOS and Android apps complementing Mac, Windows, and browser-based access. The multiplicity of access options is crucial in an emerging environment like South African higher education.

"E-textbooks are a growing and important part of the future of education, and working with an international market leader like Ingram's Vital Source, we have the resources to enhance learning throughout Africa and meet the digital needs of the academic community today and into the future," says Stephan Erasmus, Managing Director, Van Schaik Bookstores. *"We look forward to adding more and more book publishers that are relevant to the South African student, academic or professional reader as part of our continuing commitment to providing bona-fide Academic materials."*

From left to right, CESA's Abe Thela, CESA Deputy President, Naren Bhojaram, CESA President and Graham Pirie, CESA CEO.

Is President Jacob Zuma to blame for corruption in South Africa?

Consulting Engineers South Africa (CESA) President Naren Bhojaram has cautioned that corruption is paralysing the country and eating away the moral fibre of our society. He states that *"While we all acknowledge that corruption is a huge stumbling block to service delivery, there seems not to be a political will to eradicate the scourge".*

Bhojaram presented CESA's 2013 theme, of 'Sustainability is Everyone's Business', at a media breakfast in Johannesburg. He stated that while big ticket items such as global warming, environmental pollution, and the like are important, there are basic and fundamental human needs which are top of mind issues for the average person in a developing country. He is concerned that there are still huge backlogs with proper housing, essential services such as water, sanitation, energy, mobility and food. For the average man in the street in developing nations, provision of these services mean sustainability. He contends that sustainability is more than this.

"Sustainability is also clean governance and economic freedom. This means job creation and self-sufficiency. We collectively have to balance social, political and economic issues with the wide spectrum of complex environmental issues and awareness about what the earth can provide and how carefully we use the earth's natural resources, especially those which are not renewable."

WHOSE PROBLEM IS IT?

Bhojaram questioned whether sustainability was the responsibility of global institutions and organizations such as the United Nations or is it the responsibility of civil society or business leaders. *"We can also turn to global voluntary associations such as The International Federation of Consulting Engineers (FIDIC) or local associations such as CESA. We could park the responsibility with our predecessors or make the current political leadership of the day responsible."*

He added that the easiest thing in the world is to blame others for our environmental woes, but when all is said and done, each one of us in the present is collectively responsible.

"You and I are responsible for sustainability," he averred adding that President Jacob Zuma cannot be blamed for corruption in our country because his job is to create a platform for business to operate in an ethical, responsible and sustainable way and for him and his government to lead by example. We cannot escape our collective responsibility. Therefore, let us deal with it.

"The world perception of South Africa with respect to business integrity and corruption is deteriorating at an alarming rate. The immediate but unfortunate consequence of this is the imminent driving away of foreign investors. In addition to this, it is demoralizing to the average person trying to earn an honest living. Corruption forces honest hard working citizens to leave the country. Those who leave because of the demise of an honest and fair business environment are invariably the ones who are making a positive contribution to the economy at large. Businesses that were once loyal to South Africa also consider their options in this regard."

"Strong action is required from all stakeholders to curb the scourge of white collar crime and we need the Government to take the lead in this. As business we are committed to playing our part.We have noted that business confidence dropped in South Africa in our sector in 2012 and more of our members are moving to serve clients beyond our borders, taking advantage of the pockets of opportunities in countries outside South Africa."

He went on to state that South Africa dropped, to CESA's dismay, further on the International Transparency Index and now ranks number 9 on the African continent, behind Botswana, Cape Verde, Mauritius, Rwanda, Seychelles, Namibia, Ghana and Lesotho. Transparency International ranked South Africa 69 out of 176 countries, with a score of 43, which is also the global average.

"The ANC's December Conference in Mangaung saw President Jacob Zuma win a second term as expected. The President has promised to do much more to curb corruption in our country and this is great news for our industry. We are also positive about the election of Cyril Ramaphosa as the Deputy President and believe that his business skills and acumen will bring positive energy to government operating as a business and more to stabilize the jittery economic position we find ourselves in as a country."

KEY SUSTAINABILITY INDICATORS FOR SOUTH AFRICA

Bhojaram stated that there are a number of challenges that the country face. CESA believes that the focus should be on the key sustainability indicators and deal with these in a systematic way with cooperation by all stakeholders in order to achieve success.

The key sustainability indicators for South Africa in CESA's view is that education should be declared an essential service and the profession should attract the country's top brains at commensurate remuneration. The provision of adequate education infrastructure and equipment as well as top notch educators is the key ingredient to a sustainable South Africa.

A financially prosperous South Africa is a sustainable South Africa said Bhojaram. *"In order for us to achieve financial prosperity, we need sound economic and investor friendly policies. Political certainty is essential and whilst we are and should remain a proud democracy, destabilising elements, statements and nuances should be dealt with categorically and without delay. There is no need to keep investors guessing or waiting for answers. Delayed decisive statements regarding nationalisation of the mines is a case in point."*

CESA and its members can assist in addressing the key sustainability indicators. On education, our members are actively involved in providing additional lessons for school students, lecturing and doing research and innovation projects with universities. CESA member firms are also active in mentoring undergraduate and post graduate phases of their careers. The School of Consulting Engineering run by CESA provides a large array of courses for individuals from member firms and client bodies.

Curbing corruption was CESA's theme for 2012. Members firms are obliged to comply with the CESA Business Integrity Management System as a condition of membership. CESA are willing to sign such a pact for all projects undertaken and invite our clients to do the same. Members firms are also encouraged to use the various whistle blower schemes to report all incidents of business integrity.

"The appointment of the 'right leaders' is paramount to doing clean business", proclaimed Bhojaram.

He stressed that all leaders, whether they are business leaders, political leaders or spiritual leaders, must be selected on the basis of their ethical balance. Qualities such as IQ (intelligence quotient), EQ (emotional intelligence) and PhQ (your physical quotient) should be taken as given. A sustainable future depends on our ability to put leaders in place with the highest ethical balance.

CESA clarion Call to government:

- Provide a good quality and high standard of education rather than a free education in substandard facilities with an inadequate number of lecturing staff that is of poor calibre.
- Be duty bound to report unethical behavior - break the silence for a sustainable South Africa!
- Make decisions now which will be relevant in 100 years' time. Short term decision making is not sustainable.

Bhojaram concluded by stating that sustainability is everybody's business and made an impassionate plea for the media to support CESA in lobbying Government and the private sector in its drive to expose corruption to ensure a sustainable life for all. *"Embrace new ways of doing things and most of all; let us all pull together towards a sustainable future. Sustainability is everyone's business".* wn

"South African exports down due to uncompetitiveness"

The dwindling competitiveness of the South African manufacturing sector is to blame for the dramatic decline in the country's exports to the EU, not Europe's current economic woes, a senior foreign diplomat said in Stellenbosch recently.

Mr Andreas Künne, head of the German Embassy's department for economic and global issues, was speaking at Stellenbosch University's 5th International Conference on Competitive Manufacturing.

PICTURE: ANTON JORDAAN

Mr Andreas Künne, head of the German Embassy's department for economic and global issues, speaking at Stellenbosch University's 5th International Conference on Competitive Manufacturing.

He said over the first 10 months of 2012 – the latest available figures – Germany's imports from South Africa went down by 17%, and that much the same was true of other EU countries.

"There is an argument being made by South African policymakers that the problems in Europe are the cause of the decline, but if you look at the figures, this is not true. Eurozone countries have actually increased their imports from outside Europe in 2012.

"So something must be wrong with South African exports specifically. And I will be blunt – the manufacturing competiveness in this country is not pointing upwards," he said.

"You have soaring electricity costs, your infrastructure is ageing and your skills base is not improving the way it should. Also, if you look at the labour cost per unit in South Africa, you will find it has increased by 134% since 1994. In Europe, this figure over the same period actually decreased, because of improvements in productivity."

According to Künne, Germany is one of South Africa's largest trading partners. He said there are more than 600 German companies in the country, employing more than 90 000 people. The most important sector for Germany is the automotive industry, as is evidenced by the fact that three large manufacturers – Volkswagen, BMW and Mercedes-Benz – have plants in South Africa.

PICTURE: PHILIP HUGO

"M2 LaserCusing machine": One of the greatest assets of Stellenbosch University's Department of Industrial Engineering is this M2 LaserCusing machine, the only one of its kind in South Africa. It can be used to manufacture three-dimensional parts on a layering principle. This can be done using most metals, including titanium and aluminium. In the foreground are some of the Department's postgraduate students, as well as students from the Institute for Advanced Tooling, which is housed in the Department.

"That shows they have confidence in the country. But if something goes wrong here, our companies will have a big problem," Künne said.

However, he added, "there is no use in just complaining, you have to do something about it. And South Africa has the world's best track record in terms of successful turnarounds. There is one government document that points the way to the future – the National Development Plan 2030.

"The document says that South Africa is a middle-income country, it needs a broad mid-skills manufacturing base and a focus on niche markets, which do not require large economies of scale."

Also part of the solution, according to Künne, is for universities to produce the skills that are needed by industry.

Is his welcoming address, Stellenbosch University Rector and Vice-Chancellor Prof Russel Botman told delegates there was a need for "investment in education and training to equip a new generation of engineers and scientists with the necessary skills to meet the challenges that we face."He said the challenges facing South Africa should be seen as opportunities rather than problems.

"Innovation in manufacturing can help us restore our ecosystems, manage global warming, make renewable energy more viable, close the gaping global wealth gap, provide adequate housing and services to the urbanising poor, produce enough food for everyone and help us do more with less." Botman said universities have a key role to play.

"We have to leave the Ivory Tower, roll up our sleeves and tackle real-world challenges to justify our existence. This is exactly what we are doing at Stellenbosch. We follow a science-for-society approach, and the vehicle that we use for that is an initiative called the HOPE Project – because it looks at what we need to do now for the sake of future generations." wn

Selecting the Right Cable System for Your Environment

Cables are often the last component considered during system designs. In many situations, cables are really the system's lifeline - if a cable goes down, the entire system can stop. For example, if the cable system used for data transmission in a spacecraft fails, the communication between the craft and mission control could be lost. Cable reliability is based on both durability and signal integrity, and the ideal cable system should be engineered to last the life of the product in any environment.

COMPILED BY | MINX AVRABOS

The environments in which cable systems are being used today are becoming more challenging. For example, cables are being exposed to such things as extreme temperatures, chemicals, abrasion, and extensive flexing. A harsh environment can be considered any combination of conditions unique to an application that will compromise the reliability and performance of the cable system. Additional factors can include the need for smaller, lighter packaging for cable systems that last longer and cost less. Regardless of the application for which you are designing an electrical system, it is essential to identify all of the potential factors that can affect the electrical performance of the cable system. These variables have a direct impact on the materials used for cable insulation and jacketing as well as the construction of the cable. Using a systematic approach will help ensure that you select the best cable for your application - an approach that includes the following:

- List the constraints that will affect performance, including electrical, mechanical, environmental, and application-specific factors.

- Share this list with your cable manufacturers so they can select the best materials and construction; through testing and data analysis, the manufacturer should demonstrate that the cable would, in fact, perform in your environment.

- Understand your total cost of ownership. How much does it matter? What is the cost of a failure?

IDENTIFYING CONSTRAINTS

Many of today's applications have environmental influences that require unique materials and mechanical properties to ensure reliable cable performance. First you need to consider the electrical, mechanical, and environmental stress that the cable will encounter in your application. In addition, most applications have unique issues that can stress a cable system, such

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as the need for extreme temperatures in a geophysical application or vibration in aerospace applications.

Electrical performance is probably the first and foremost consideration in a cable system, and many factors can potentially compromise signal integrity, such as

- Electromagnetic interference (EMI) from both sources inside the cable and external sources;
- Crosstalk, which results from unwanted coupling of signals between two transmission circuits;
- Attenuation, which ultimately determines the maximum length of a signal cable; and
- Conductor resistance, which affects voltage drop over a power line.

Electrical performance is typically very reliable when there are not other environmental factors; however, when you add mechanical, environmental, or application-specific stress, it can become very difficult to maintain reliable electrical performance.

Mechanical stress occurs when cable systems are exposed to movement, often in tight spaces at high speeds, such as in hand-held devices or automation and aerospace applications. Movement includes random, rolling, and torsion types of motion. These types of flexing create kinetic energy in the cable, which can cause severe damage if not properly managed. When cables move, they rub against each other, the cable chain, or other hardware in the system, generating friction that can result in jacket abrasion. One of the biggest causes of mechanical stress on cables is when the cable is part of equipment handled by a person. An operator can kink, pinch, or crush a cable by stepping on it or rolling equipment over it. Therefore, tensile strength is essential in overcoming mechanical stress. Also, when cables move in a harsh environment, they can come into contact with sharp surfaces that can cut cables or expose them to severe abrasion. When the complexities of compensating for extreme acceleration and vibration are added, mechanical stress can significantly compromise signal integrity and cause premature failure of a cable.

Environmental stress results from the physical area in which the cables are used and exposed. Extreme temperatures affect cable materials, with low temperatures making them brittle and high temperatures causing them to become very soft. Like extreme temperatures, extreme pressures can have a significant impact on cables.

Vacuum, which is just a very low level of pressure, leaches oils and additives out of a cable, contaminating the work surface such as in a clean manufacturing process for semiconductor chips. On the other hand, hydrostatic pressure, like that found in geophysical exploration, causes gas or liquids to permeate insulation or cable jackets. Gases and liquids such as cleaning fluids, fuel, lubricants, chemicals, and steam destroy some cable materials.

Radiation can damage both insulation and jacket materials, depending on the type and dosage level. Friction, which is caused by cable movement, can compromise cable jackets by causing particulation, while contaminants such as mud, chemicals, or metal chips, can damage the cable jacket. Environmental stress can significantly shorten the life of a cable, so these issues must be taken into account when designing a cable system.

Application-specific stress results from constraints that are unique to the application in which your product will be used. For example, aerospace applications need cables to be the lightest and smallest size possible in order to minimize mass during take-off. Network routers in high-speed computing applications require long cables that transmit large quantities of information at very high data rates, so cable size and attenuation are issues for these applications. If you are plugging your cable into existing hardware, then you must ensure that your cable's connector is compatible with those on the hardware. In addition, if the cables are used in areas where the general public may come in contact with them, such as transportation and automation applications, you need to consider such safety issues as flammability, voltage, and the use of halogens.

One of the added complexities of designing a cable system for a harsh environment is that electrical, mechanical, and environmental performance are interwoven. Each has a direct impact on the other, so as you design a cable to ensure high performance in one area, you must evaluate the impact on the others.

DESIGNING THE CABLE SYSTEM

Once you have identified the operating and environmental issues that may have an impact on cable performance, the next step is to design a cable system that will withstand all of the factors of your environment. This process involves selecting the right materials for cable construction and ensuring that sufficient testing has been done to verify that the cable will survive in your application. Selecting a manufacturer with extensive expertise in a variety of cable materials, harsh environments, and your specific industry ensures that the cable system will function reliably. Consider how different the issues are that can affect a cable's performance in a spacecraft, aircraft, cleanroom, or oil exploration application.

CHOOSING THE RIGHT MATERIAL

Choosing the right materials for cable insulation and jacketing is a crucial decision. Ensuring high-quality signal integrity means evaluating the insulation and jacket materials for attributes that account for the harsh elements of your application. The dielectric materials used in signalling cables affect the signal integrity as well as robustness of the cable. The insulation material used in an outer jacket or in a hook-up wire application affects maximum voltage and resistance to abrasion. Jacket materials must survive most of the external factors (temperature, friction, liquids, and gases, for example) to protect the conductors inside the cable. The list of possible materials used in cable insulation and jacketing is very long, and many of these have been developed for specific applications such as transportation, power, and data transmission. Because these materials all have unique properties, some are more appropriate than others for harsh environments, including silicone, polyurethane, polyethylene, fluoropolymers, and enhanced fluoropolymers to name a few.

Silicone (Figure 1) is primarily used for jacket insulation and high-voltage conductor insulation. It has excellent dielectric strength, and it is well suited for high-voltage applications because it reduces corona discharge between the conductor and insulation layer.

Silicone is very flexible even at low temperatures; however, it cuts easily, and its sticky surface results in a high coefficient of friction, so it is not good for cleanroom environments and applications that require sterilization. Silicone's tensile strength and tear resistance is low, therefore requiring a thicker insulation as compared to other insulation materials. Some surface treatments are available to reduce the coefficient of friction, but these tend to wear off over time. Silicone has very good radiation resistance (up to 108 RADs), but the grades of silicone used for wire and cable insulation are known to outgas silicone oil in vacuum applications. Silicone is available as a round and flat cable jacket, but if weight is an issue, this is not your optimal choice. If you need a very flexible cable and weight is not a factor, silicone is a good choice, but it is more labour-intensive to gain access to the conductors, which results in higher costs for termination.

Figure 1: Properties of Silicone

	PROS	CONS
Electrical	Dielectric strength Corona resistance	Dielectric constant
Mechanical	Flexible at low temperatures	Low cut-through resistance High coefficient of friction High specific gravity
Environmental	Radiation resistance to 10^8 RADs	Outgases silicone oil Low resistance to oil Tacky texture
Application Constraints	Low-profile packaging	Weight Thick insulation needed, leading to large outer diameter

Figure 2: Properties of Polyurethane

	PROS	CONS
Electrical	Overall electrical performance	Dielectric withstanding voltage
Mechanical	Cut-through resistance Abrasion resistance Flexiblility Flame treatment doesn't reduce flexibility	Tacky in high-flexibility grade
Environmental	Solvent resistance UV resistance Radiation resistance Fungus resistance Halogen-free	Temperature resistance Contaminant resistance
Application Constraints	Primarily used for jacketing	

Figure 3: Properties of Polyethylene

	PROS	CONS
Electrical	Dielectric constant Insulation resistance	
Mechanical	Abrasion resistance Wide range of grades	Stiff in abrasion-resistant grades
Environmental	Chemical resistance Low coefficient of friction	Temperature resistance Adhesion Flame retardance
Application Constraints	Used for conductors and jackets	Flexibility

Figure 4: Properties of Fluoropolymers

	PROS	CONS
Electrical	Dielectric withstanding voltage Dielectric constant	
Mechanical	Flexibility Tensile strength	Abrasion and cut-through resistance
Environmental	Liquid and gas resistance Temperature and UV resistance No outgassing Coefficient of friction	Radiation resistance
Application Constraints	Used as insulation, dielectric, and jackets Flame resistance Performance standards	Additional processing required

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Polyurethane (Figure 2) is a good jacket material, but it is not used in insulation because its dielectric withstanding voltage is low when compared to other materials. Halogen-free grades are available. Mechanically, polyurethane is flexible, and it is very resistant to cut-through and abrasion. Treatment for flame-resistance does not reduce its flexibility; however, the more flexible grades tend to be sticky or tacky, which results in a higher coefficient of friction. Environmentally, polyurethane is resistant to solvents, UV rays, radiation, and fungus. Polyurethane does not have a very broad temperature range; it becomes brittle around -40°C, and its upper temperature limit is around 100°C.

Polyethylene (Figure 3) is most appropriate for conductors, because polyethylene jackets tend to be stiff, which affects the flexibility of the cable. Polyethylene has good dielectric constant properties when used in conjunction with foam. Mechanically, high-molecular weight polyethylene is abrasion-resistant and low-friction, but it is also stiff when compared to other materials. Like polyurethane, polyethylene's temperature range is rather limited, and it is difficult to bond chemical boots to polyethylene cable jackets. Overall the mechanical properties of polyethylene are reduced by flame-retardant treatments.

Fluoropolymers and Enhanced Fluoropolymers (Figure 4) such as FEP, PFA, PTFE, and engineered PTFE are excellent as insulation and jacket materials, particularly in applications when the cost of system failure is high. The dielectric withstanding voltage of Fluoropolymers is among the highest of any insulation material. Fluoropolymers can withstand extreme temperatures, but each material has its own range: FEP can handle temperatures ranging from -250°C to 150°C, while PFA ranges from -250°C to 200°C. PTFE is suitable for temperatures from cryogenic to 260°C without losing flexibility. Fluoropolymers can also withstand exposure to chemicals, acids, and aggressive solvents, and they are naturally non-flammable. PTFE and its co-polymers also have the benefit of low outgassing, critical for ultra-high vacuum (UHV) environments.

Most Fluoropolymers are flexible, but like temperature-resistance, flexibility varies depending on the specific material, with PFA being the stiffest, then FEP, PTFE, and engineered PTFE being the most flexible. In addition, anything that is added to a cable's insulation, jacket, conductors, or shield wires will outgas in a vacuum. Outgassing is not bad in itself; however, when materials outgas, they condense on cooler surfaces, which are typically the work surfaces in the application area. For example, in a satellite, silicone oil or other processing lubricants, which outgas from a cable, can fog optics. PTFE is chemically inert and does not contain any process additives, oils, lubricants, or plasticizers, which makes it the best material for vacuum environments.

One of the few negatives of fluoropolymers is that they are not very resistant to abrasion and cut-through. Certain fluoropolymers can be engineered to enhance their physical, chemical, and electromagnetic attributes, which improves a cable's ability to withstand the specific challenges of an application. For example, ethylene tetrafluoroethylene (ETFE) can be irradiated to improve its mechanical properties and chemical resistance; however, irradiation increases stiffness, so there is a significant decrease in flexibility. On the other hand, PTFE is naturally thermal-resistant and chemically inert, so its excellent temperature and chemical properties are not altered when engineered to enhance electrical or mechanical attributes.

A reputed Cabling company has developed proprietary technologies that allow PTFE to be engineered so it can withstand a wide variety of environmental and mechanical challenges (Figure 5). For example, the dielectric materials used to insulate conductors can significantly affect attenuation, cable size, and flexibility. The lower the dielectric loss, the less attenuation the cable exhibits. Typical fluoropolymers used in cable insulation have a dielectric loss of 2.1. If cable size is an issue, PTFE can be engineered to have a dielectric constant of 1.3 — the lowest dielectric constant of any material except air. At the same time, its dielectric withstanding voltage can be increased by a factor of 2.5 while achieving a very low loss tangent of 0.0004 at 10 GHz compared to PTFE's standard construction.

With these attributes, a conductor insulated with a 1/2000th-inch or 50-micron layer of ePTFE can be rated for use at 1,000 volts. The ePTFE is incredibly consistent, allowing for excellent impedance control, minimal impedance variation, and excellent signal balance, which reduce common mode conversion. Another version of engineered PTFE can be made semi-conductive and used to increase the effectiveness of a cable's shield. For issues of abrasion or cut-through resistance, the engineered PTFE attains a tensile strength that is 50 times greater than standard PTFE. And for extreme temperatures, the engineered PTFE withstands temperatures from cryogenic to 300°C. This ability to engineer the physical and electromagnetic attributes of ePTFE results in reputed cables being smaller and more flexible without compromising signal quality.

VERIFYING THE CABLE DESIGN

The second phase of designing a cable system is verifying that it is, in fact, fit for the intended application. At a minimum, you should make sure that your manufacturer understands the challenges of your environment and can provide sufficient data to ensure that the cable will not be compromised. To avoid cable failure in harsh environments, it may be necessary for the manufacturer to develop tests that evaluate electrical performance while simulating mechanical and environmental stress similar to that in your application.

A reputable cabling company has a core value that they call 'fitness for use,' which means that their products do what they say they do. Therefore, they have developed state-of-the-art labs around the world where they test the electrical, mechanical, and environmental performance of cable systems. Most manufacturers perform some level of electrical testing on every cable design before it is approved for delivery, so your basic electrical requirements can be checked against the specifications for the cable. Some industries have defined safety, environmental, and performance-related standards for cables, but many applications in harsh environments force you to go beyond the standards. In these kinds of situations, you should find out what level of performance testing, if any, the manufacturer has done to ensure that the cable will perform reliably in your application. For example, if the cable has 100 Ohm differential pairs that will be used in a flexing application, then the cable's impedance should be monitored while flex testing is performed. It is essential to monitor electrical performance and signal integrity throughout testing, and the specific type of testing that is needed depends on the environmental constraints of your application.

Mechanical testing verifies electrical performance while the cable is working in the conditions of your application - conditions such as crushing, abrasion, potential cut-through, tight bending, continuous flexing, shock, and vibration. For example, applications using hand held devices where cables use the critical motion of random flexing, an operator may also be pulling it which then tensile strength is an issue. Random flexing motion is very difficult to model in a test lab, so for this type of application, you have to run a tic-toc test with repeated bending of 180° or more to model the worst-case scenario. Then, a pull test is run to simulate the cable being used as a tether to pull the lab cart. During these tests, the controlled impedance as well as the conductor resistance on the shields is monitored. Only with this type of testing, can you be confident that the cable will handle the mechanical and operator stress without compromising signal integrity.

The cable's electrical performance should also be measured while simulating the environmental conditions in which it will operate - conditions such as temperature, altitude, and pressure extremes; vibration and acceleration; exposure to liquids or gas; or humidity. For example, if you are designing a cable used in an aircraft, temperature cycling and altitude testing will simulate the environment in combination with several mechanical tests. Adding a clamp force during the temperature cycling test allows monitoring of the insulation's dielectric withstanding voltage to see how the jacket and conductor changes. Also, it is important to monitor impedance during altitude change, mechanical shock, and vibration tests. After the cable is put through these tests, the manufacturer should again verify the electrical performance, insulation, and jacket materials because you want to ensure that the cable will perform reliability throughout the life of the system.

UNDERSTANDING TOTAL COST OF OWNERSHIP

Throughout the cable selection process, it is important to consider the total cost of ownership. For products that will be used in harsh environments, the consequences of the cable system being compromised or failing are usually high, and the total cost of ownership includes much more than the initial cost to purchase the cable.

Total costs should include installation, maintenance, and replacement costs; manufacturing downtime and losses due to bad product; and most of all, safety issues. For example, in the aerospace industry reducing mass is a critical issue because every gram of weight adds an additional $60 to the cost of launching a spacecraft.

An extremely durable cable system that bundles engineered PTFE with other materials specifically for lightweight applications, were recently developed. These systems have enabled aeronautical engineers to reduce cable size by as much as 40 percent, which directly relates to reductions in their launch costs.

Before selecting any cable system, you should do a cost analysis to ensure that you have considered the full impact of cable failure. WN

Article information courtesy of W. L. Gore & Associates, Inc.

Power: Installation Design

The design of an electrical installation is usually based on the requirements for "normal operation", that is the correct dimensioning of the electrical components in order to supply existing and future loads with sufficient electrical power.

BY | VIV COHEN **|** FSAIEE

The factors to be considered for "normal operation" are the voltage, current and frequency rating of the equipment. The provision for normal operation is the major expense of the installation and assumes no failures of equipment and no mistakes by personnel.

The voltage rating equipment is aimed at having the correct insulation levels to limit the number of insulation failures. If we consider that the cost of insulating electrical equipment constitutes a major portion of the overall cost, it is clear that the correct choice of insulation level is an important factor.

Many standards are available laying down minimum insulation requirements. Associated with this is the current rating of the equipment aimed at ensuring that the temperature rise in the equipment, caused by the flow of current at full load, is not excessive. The temperature in the conductors must be kept below certain thermal limits to prevent damage to the insulation and danger to personnel.

The correct choice of frequency rating is important to prevent the overheating of the iron parts of electromagnetic machines, these also being a possible cause of insulation degradation.

In practice, it is futile and not economically justifiable to try to prevent electrical failures completely. If an electrical installation were designed solely with this in mind, it would be extremely expensive, and when failures did occur, they would result in intolerable outages, damage to equipment and danger to personnel.

The aim of good electrical power system design is to prevent the cause of failures as far as possible and then to include the means to reduce the effect of any failures on the rest of the installation.

The aspects of design aimed at preventing insulation failures are:

- The provisions of adequate insulation – many standards are aimed at this;
- Insulation co-ordination – the provision of surge arresters at locations where over-voltages caused by outside influences such as lightning can cause electrical stresses on the insulation;
- Mechanical strength – to prevent vibration and mechanical movement damaging the insulation materials;
- Prevention of overloading through correct operating procedures and adequate design;
- Regular inspection and maintenance.

Accepting that failures can and do occur in practice, the methods of reducing the effects of these failures are:

- The provision and correct application of protection devices that can detect an electrical failure in order to quickly and selectively initiate the disconnection of the faulty equipment;
- The provision of circuit breakers, initiated by the protection devices, that can quickly and safely interrupt the fault current without damage to themselves;
- Electrical equipment should be designed to withstand the mechanical and thermal stresses resulting from fault currents;
- The magnitude of the fault currents can be kept as low as possible by avoiding too large a concentration of supply capacity or by using current limiting impedance.

From an operation and control point of view, provision must be made at the design stage for switching-in or out of the major components of the electrical installation. It must be possible to disconnect components when they are not in use, or to carry out maintenance, repairs or extensions.

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On l.v. electrical installations, manually operated switches "ON/OFF" indication is normally provided for this purpose.

In some cases it may be necessary to operate these switches electrically from a remote location. Attachments are available to do this. In these cases, auxiliary contacts on the switch would be required to provide electrical indication of the switch's position at the operating point.

SAFETY

A fundamental principle forming the basis of SABS 10142-1- *"Code of Practice for the Wiring of Premises"* is the intention to *"ensure the safety of persons, livestock and property against hazard that may arise in the reasonable use of an electrical installation. The two major hazards inherent in the use of an electrical installation are shock currents and excessive temperatures that may cause burns, fires and other injurious effects."*

To this end, personnel must be protected against contact with live parts of the electrical installation.

This is achieved by the full insulation of all exposed live parts and the provision of barriers and enclosures where this is not the case.

To prevent the possibility of high *"touch potentials"* in the event of a fault between the live parts and the enclosure, all metal enclosures must be earthed by means of a low impedance earth as laid down in the Wiring Rules.

In the design practice, electrical component, particularly cables, should be adequately rated to ensure that they do not become overloaded and reach dangerous temperatures when in use.

The design requirements affecting the safety of personnel are covered in detail in the Wiring Rules.

EARTHING

The neutral of an electrical system can be insulated from earth or earthed. In South Africa, the SABS Code of Practice lays down that on all l.v. systems, the neutral shall be earthed at the supply transformer or generator and that an earth continuity conductor be provided and connected to all exposed conductive parts. Australian wiring practices are based on the MEN system that requires the common connection point between the neutral and earth to be created in the distribution board.

The purpose of this is to ensure that when an earth fault occurs anywhere on the electrical installation, it can be discharged safely to earth. More importantly, the provision of an earth fault current return path ensures that there is sufficient current to allow detection by an overcurrent element.

OVERLOAD CURRENTS

Every component making up an electrical installation is designed for use at a particular rated current. When it is used within these limits it will have a specific service life expectancy, which is the length of time for which the insulation will remain operationally safe.

Under normal conditions, the heat generated by the flow of current through the resistance of the component (proportional to I^2R) must be transferred across the insulation to the cooling medium.

Unfortunately, materials that are good electrical insulators are often good thermal insulators and if the current rating of the component is exceeded, there is a build up of heat within the insulation.

When a component is overload, the temperature in the insulation exceeds the limit beyond which the insulation begins to deteriorate and the service life will be shortened. This deterioration depends on both the temperature rise and time for which the insulation is exposed to the overload. Precautions should be taken to avoid, or at least reduce to a minimum, overloading of electrical components.

SHORT CIRCUIT CURRENTS

Short circuit currents, also known as fault currents, are said to occur when abnormally high currents flow due to the partial complete failure of the insulation. There are several possible causes of insulation failure, the most important being:

- Deterioration of insulation due to high temperatures associated with overload currents;
- Failure of insulation due to faulty design, manufacture or workmanship;
- Mechanical damage of the insulation;
- Damage to the insulation due to electrical surges or overvoltage (for example lightning).

Short circuit currents can result in severe damage to property and, in extreme cases, injury to persons. When short circuits occur and large fault currents flow, they can cause severe mechanical and thermal stresses in cables and other components. The mechanical or dynamic forces are related to the square of the peak fault current.

The thermal stresses caused by the rapid heating up of components to high temperatures are related to the square of the r.m.s-current and the time for which they flow. For these reasons and others, it is essential to isolate the faulty equipment as quickly as possible after the short circuit occurs.

TYPES OF FAULT

On a three phase electrical system, there are essentially four types of fault or short circuits that can occur:

- Three phase fault (3ø fault);
- Phase to phase fault (ø-ø fault);
- Phase to phase to earth fault (ø-ø-E fault);
- Phase to earth fault (ø-E fault)

Other types of fault often referred to, such as phase to neutral or phase to phase to neutral faults, are in fact special cases of ø-ø-E and ø-E faults, because in almost all l.v. electrical installations in Australia, New Zealand and South Africa, the neutral is earthed somewhere along its path.

It is necessary to consider the various types of fault that can occur because the magnitude of the short circuit current is a function of both the type of fault and the impedance of the current path between the source and the point of fault.

When designing an electrical installation, we must be able to calculate the highest possible short circuit current to ensure that components such as cables are designed to withstand the mechanical and thermal stresses.

If we are concerned only with the worst case (that is highest short circuit current) it is not necessary to calculate the fault current for all the possible cases. It can be shown using symmetrical components, that the three phase bolted short circuit results in the highest short circuit current in the majority of practical l.v-installations.

In some exceptional cases, if the zero sequence impedance is less than the positive sequence impedance, the earth fault current can be higher than the three-phase fault.

SYMMETRICAL AND ASYMMETRICAL FAULTS

It is well known that when a short circuit occurs on an a.c. electrical system, a transient, asymmetrical current can sometimes occur, where the first current peaks can be up to twice the calculated symmetrical current peak. This effect is shown in Figure 2b.

The presence of this transient current depends on the point of the wave at which the short circuit actually takes place. To understand the mechanism of this condition, we assume that a sinusoidal source voltage $U_m.\sin(\omega t + \alpha)$ is applied to the faulted circuit of resistance R and inductance L at a time t = 0s.

The short circuit current that will flow is described mathematically by the equation:

$$I_{sc}(t) = \frac{U_m}{Z}[\sin(\omega t + \alpha - \phi) - e^{-Rt/L}\sin(\infty - \phi)]$$

where: α = voltage
ϕ = power factor angle.

This equation shows that the short circuit current comprises:

- an alternating component of the same frequency, ω, as the source voltage;
- a d.c. component that decays exponentially with time depending on the time constant T of the circuit (T=L/R s).

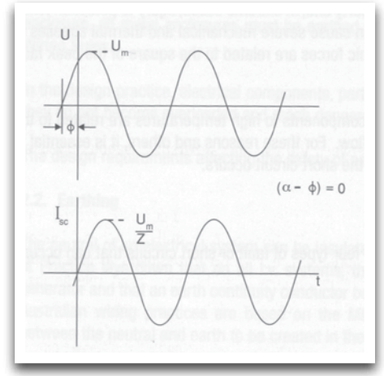

Figure 2a
Symmetrical short circuit condition

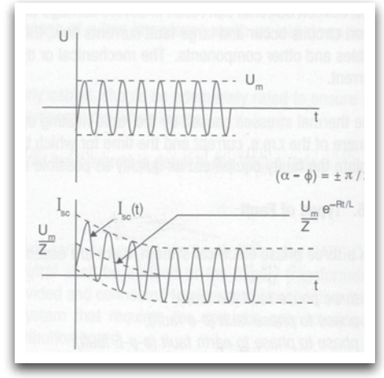

Figure 2b
Asymmetrical short circuit condition

Power: Installation Design

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SYMMETRICAL CONDITION

From the equation, it can be seen that the d.c.component is zero of the short circuit takes place at the instant when $\alpha - \phi = 0$ or π. This is known as the symmetrical condition and the short circuit current is sinusoidal and symmetrical.

$$I_{sc}(t) = \frac{U_m}{Z} \sin\omega t$$

$$I_{peak} = \frac{U_m}{Z}$$

ASYMMETRICAL CONDITION

From the equation, it can also be seen that the d.c.component will be a maximum if $\sin(\alpha - \phi) = \pm 1$ or $(\alpha - \phi) = \pm\pi/2$. This the maximum transient condition where the first few current waves are asymmetrical.

$$I_{sc}(t) = \frac{U_m}{Z} [\sin(\omega t \pm \pi/2) + e^{-Rt/L}]$$

$$I_{peak} < 2 \times \frac{U_m}{Z}$$

For short circuit currents that occur on points of wave between the two above extremes, various levels of transient asymmetrical current will result.

The design of MCCBs takes into account that fully asymmetric fault currents can and do occur and they are adequately dimensioned to withstand and interrupt the fault current. The way in which this is achieved varies depending on the design. On zero current interrupting breakers, the MCCB is designed to absorb the thermal stress of the maximum current offset. Current limiting breakers, on the other hand, rely on their ability to interrupt the current before it can reach its maximum prospective level.

Consequently, no additional calculations are necessary to accommodate this condition when short circuit current calculations are done. Apart from an understanding of its existence under certain fault conditions, the transient asymmetrical short circuit system may be ignored on l.v. electrical system applications.

SHORT CIRCUIT CAPACITY OF ELECTRICAL EQUIPMENT

A major consideration, often overlooked in the selection of any component of the electrical power installation, is its short circuit capacity. The short circuit capacity is the thermal stress that the component can absorb without damage and is proportional to the square of the r.m.s. current and time (I^2t). The rapid heating up of conductors during fault conditions causes these thermal stresses.

All the components in the installation such as cables, busbars, contactors and MCCBs must be capable of carrying the maximum prospective short circuit current for the time it takes to interrupt the fault. Reducing the short circuit current, or reducing the fault interruption time, can lower the thermal stresses in these components.

In l.v. installations, the short circuit currents should be kept as low as possible by avoiding too large a concentration of transformer or generator capacity at any one point. When protection devices such as fuses or MCCBs are used, the short circuit current interruption time is less than one cycle (20mS) and the thermal stress on the electrical components such as busbars and cables is fairly low. Consequently, the short circuit capacity of these items on l.v. installations are usually adequate.

The short circuit capacity of the MCCB itself should be carefully chosen. It is essential that the short circuit capacity of the MCCB is higher than the maximum prospective short circuit current available at its point of installation, to ensure that all possible short circuit currents are interrupted without damage to the MCCB. This must be balanced by the cost of MCCBs, which increases rapidly as the short circuit capacity is increased.

The most economical choice is to use the MCCB with a short circuit capacity just above the maximum prospective short circuit current. It is clear that the accurate calculation of short circuit currents is an important aspect of the application of MCCBs.

THE THREE-PHASE SHORT CIRCUIT

The importance of the accurate calculation of the maximum prospective short circuit current has been emphasized. It has also been stated that the three phase fault condition results in the highest short circuit current on almost all practical l.v. electrical installations.

In spite of the fact that the asymmetrical short circuit current condition results in the highest peak current, it has become accepted practice to use the symmetrical three phase bolted short circuit current as the maximum prospective short circuit current condition. Some of the reasons for this are:

- The calculation of the symmetrical three phase short circuit current is relatively easy because it can be treated on a single phase basis.
- The maximum asymmetrical condition can be taken into account in the design of the circuit breaker.
- A "bolted"-fault is assumed because this allows one to neglect the arc resistance in the fault, this simplifying the calculation.
- The three-phase short circuit current is the maximum for almost all practical l.v. electrical installations.

Some manufacturers also give the asymmetrical short circuit capacity of MCCBs. This may be regarded as additional information for marginal applications.

THE RELIABILITY OF PROTECTION DEVICES

In contrast with most other components of an electrical installation, protection devices may stand idle for long periods of time before being called on to operate. When a short circuit does occur on the electrical installation, they are required o operate correctly in a matter of milliseconds.

A basic requirement, therefore, of any protection device is that it is inherently reliable, otherwise the purpose of using the device to offset the effects of faults on an electrical installation, falls away.

It is not only mechanical reliability, which is referred to here. The reliability of the protection is also concerned with the correct application and the correct installation and maintenance, otherwise the full capabilities of the protection device will not be realised. (For example, if an MCCB is subjected to a higher short circuit current than that for which it was designed and it fails in service, the lack of reliability was a result of poor application.)

For a reliable protection system, it is essential that the correct MCCB is chosen for a particular application; that it is installed correctly in accordance with the manufacturer's instructions and that it is checked from time to time (particularly in bad environmental conditions), to ensure that it is in good working order.

The protection device chosen for any application should also be of a simple, robust and inherently reliable construction; it should be well made and have a proven track record.

Overloading of electrical equipment causes degradation of the insulation because of the thermal build-up at the interface between the conductor and the insulation. If this is not controlled, it can lead to a reduction of the service life of the equipment, resulting eventually in a short circuit when the insulation fails.

The heat energy developed in a conductor depends on the square of the r.m.s. current (I^2), the resistance (R) of the conductor and the time (t) for which the current flows. Since the resistance (R) depends on the cross-sectional area of the conductor and assuming that this has been correctly chosen for the maximum load, the overloading depends on the value of I^2t. So, it is possible to detect an overload condition by monitoring the current flowing into an item of equipment and the time for which it flows.

A typical time/current curve showing the boundary between the normal and overloaded condition of an item of electrical equipment is shown in Fig 2c.

The ideal overload protection device should fulfil the following requirements:

- It should allow normal currents (below rated) to flow continuously under normal conditions.

Power: Installation Design

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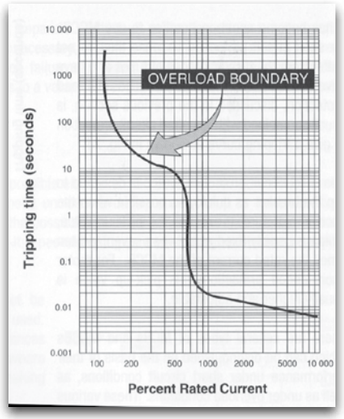

Figure 2c
Overload boundary of typical item of electrical equipment

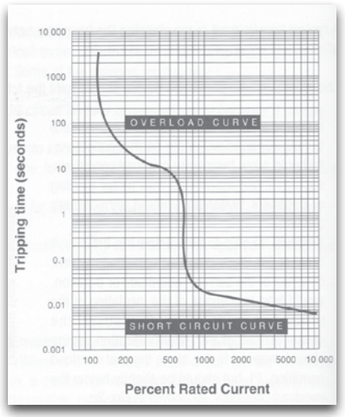

Figure 2d
Typical tripping curve for an MCCB

- It should allow temporary overload conditions, such as those associated with motor starting or capacitor switching, without unnecessary tripping.
- It should be able to detect and trip the circuit breaker for those overload conditions which, by virtue of the current magnitude or duration, would lead to damage of the insulation of the protected equipment. Obviously, the characteristic of the ideal protection device should respond to the same thermal overload condition, I^2t, but should be slightly below the overload boundary, as shown in Fig. 2c.
- It should be capable of being reset to allow the equipment, which has tripped out on overload, to be easily returned to service after the cause of the overload has been identified and removed.

The above protection requirements have been provided to a greater or lesser degree by several types of device over the years. Initially, fuses were commonly used, but the limitations of fuses led to the development of the circuit breaker.

SHORT CIRCUIT PROTECTION DEVICES

When the insulation between phases or between phases and earth breaks done, short circuit currents of up to 20 times the rating of the supply transformers can be expected to flow into the fault. To reduce the thermal and dynamic stresses that can occur in cables and transformers, the short circuit should be interrupted as quickly as possible.

Fuses, originally invented by Thomas Edison, have been used from the very earliest electrical times for short circuit protection of electrical equipment. They are still used widely today for this purpose, but the modern HRC fuse (high rupturing capacity) has a performance capability far in excess of the old 'fusewire' mounted in a ceramic cartridge.

Although modern fuses have advantages in some applications where their speed, currently limiting ability and inherent "fail safe" design are important factors, they also suffer from several disadvantages. These are associated with the fact that they must be replaced when "blown". The indication of the "blown" fuse is not always clear and on three phase systems, only the one fuse will blow for a short circuit between one phase and earth.

This is particularly undesirable on motor circuits, where single phasing can damage the motor. These problems can be overcome but this required the use of striker-pin fuses in conjunction with circuit breaker to trip out all three phases and indicate the tripped circuit.

It has become common practice to use MCCBs for short circuit protection because they do not suffer from the disadvantages of fuses and have several additional advantages. The overload protection, discussed in the previous section, is usually combined with the short circuit protection to give a tripping curve as shown in Fig. 2d.

The short circuit protection device is designed to trip the breaker as quickly as possible when the short circuit current exceeds the pick-up value, which is usually fixed at between seven and ten times the rated current of the MCCB. For motor short circuit protection, this pick-up value is usually higher and adjustable. There are several types of MCBs and MCCBs, which can be distinguished on the basis of their performance under short circuit conditions, as well as under, overload conditions. WN

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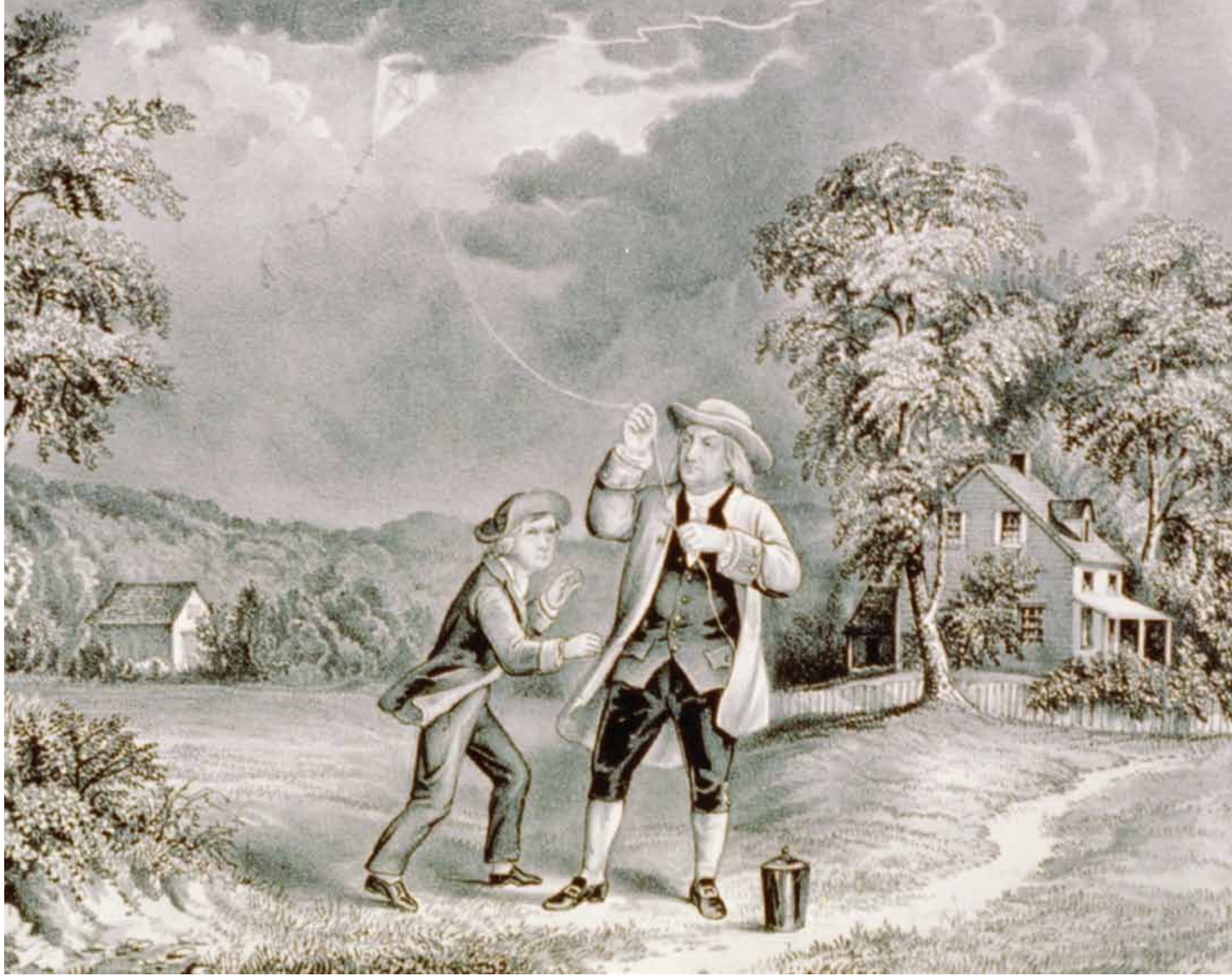
Lightning does not always strike the highest point...



Lightning has always fascinated and terrified mankind. In ancient times lightning was attributed to a variety of gods such as Zeus and Thor. Benjamin Franklin's famous kite experiments and lightning rod sparked off a scientific research effort that is still on-going.

BY I DR. J.P. HOLTZHAUSEN

Since then the science of lightning protection has developed to such an extent that buildings, power lines and substations can be protected to a high degree of certainty. The basic premise is that a leader develops from the negatively charged cloud base. When the leader gets close to protruding objects, discharges emanate from the sharp points, 'attracting' the lightning. Thus the concepts of 'attractive radius', 'striking distance' and 'rolling sphere' are used to design lightning protection systems.

Thus, I thought I understood the principles of lighting protection, but a recent breakaway into nature provided unexpected insights. Over New Year we spent some nights at Kromrivier Hut, belonging to the Paarl branch of the Mountain Club of SA in the Du Toits Kloof Mountains just off the old pass.

A friend of ours stayed at the hut over Christmas and recounted that some severe lightning flashes occurred during the night of 24 December 2012.

On an outing afterwards we noticed a burnt spot on the mountain side, shown in Figure 1. We immediately suspected lighting as a cause of the fire. We were however puzzled by the following:

- Why was the apparently flat surface struck in preference to the surrounding hilltops and protruding rocks?
- Why did the fire not spread into the surrounding dense and dry fynbos growth?

Lightning does not always strike the highest point. . .

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Figure 1: Burnt spot, apparently caused by lightning

Figure 2 & 3: Closer views of the burnt spot.

Accompanied by my wife, I embarked on a "bundu-bashing" expedition to obtain closer information. The results of our investigation are shown in Figures 2 and 3. The burnt area is oval shaped with approximate dimensions 5 by 50 metres. There were no clear indications of a point of strike.

The approximate position of the lightning strike is indicated by the arrow on the map in Figure 4.

Data obtained from the Southern African Lightning Detection Network (SALDN) of the South African Weather Service are shown in Figure 5 and in Table 1. The ellipses indicate the certainty of the prediction.

Stroke no.	Time of occurrence	Current (kA)
1	2012-12-24: 00:45:35	+20
2	2012-12-24: 01:12:23	-72
3	2012-12-24: 01:21:16	-53
4	2012-12-24: 01:24:07	-27
5	2012-12-24: 01:25:11	+20

Table 1: SALDN data pertaining to strokes

It will be noted that a number of lightning strokes occurred between 00:00 and 01:30 on 24 December 2012. After considering the position of the event it was concluded that stroke no 1 is the one most likely one coinciding with the event in question. Of interest is the fact that it has a positive polarity and a moderately sized current magnitude.

DISCUSSION

Firstly, the reason for the fire not spreading is probably due to a heavy local shower that followed or preceded the lightning flash.

There are basically two types of lightning as shown in Figure 6, negative and positive lightning. Negative lightning is the most common kind and consists of a negative leader discharge, emanating from the negative cloud base. As the negative leader approaches earth, positive charge is induced on the earth surface and protruding objects.

Often positive streamers emanate from these objects and intercept the lightning current. This is the basis of the operation of the Franklin rod.

Less than ten per cent of all lightning is positive [1]. As shown in Figure 6 this type of lightning originates in the positive charge centre at the top of the cloud. The characteristics of positive lightning differ markedly from those of negative lightning. Apart from differences in the mode of leader propagation the positive charge on the leader induces negative charge on the earth surface and high objects, such as lightning rods. The resulting upward negative discharges are weaker and have far less of an attractive effect on the lightning stroke than in the case of negative lightning.

Positive lightning therefore does not necessarily hit the highest point. These points were confirmed by Prof. Ian Jandrell from the University of the Witwatersrand [2]. Quite often the current magnitude of positive lightning is high, often up to 300 kA, although lower magnitudes also occur. The main stroke is often followed by a continuing current of low magnitude. The behaviour of positive lightning is therefore less predictable than negative lightning and lightning protection is more difficult. The Franklin rod approach is therefore not effective in the case of positive lightning. If reliable protection is required for important facilities such as ammunition magazines, a mesh-type or Faraday cage may be required.

Figure 4: Likely location of lightning strike, indicated by the arrow.

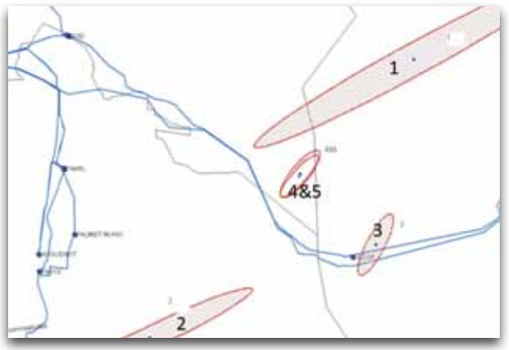

Figure 5: SALDN lightning data for 2012-12-24

CONCLUSION

The lightning stroke that caused the wild fire had a positive polarity and did not hit the higher hills or rocks as explained above. This event highlights the danger of positive lightning and the difficulty in providing protection in that case.

The fire was probably prevented from spreading by a timeous rain shower. wn

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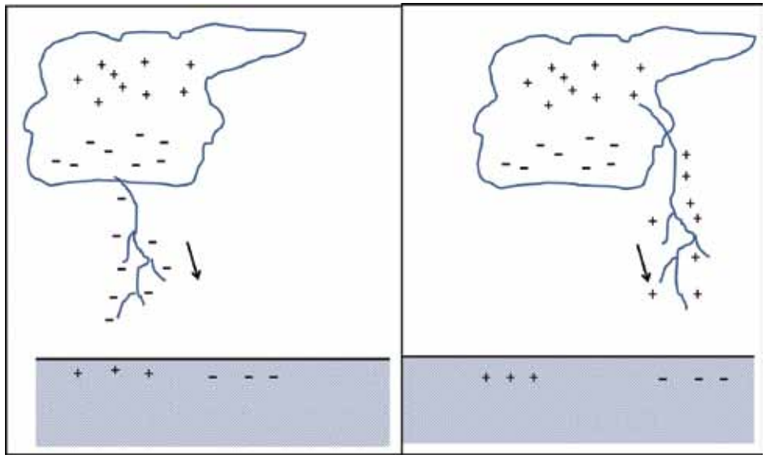

Figure 6: The main types of lightning flash [1].

a) Negative lightning *b) Positive lightning*

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IEC Young Professional Programme

The South African Institute of Electrical Engineers (SAIEE), through their Technology and Knowledge Leadership committee maintains a presence on and relates to numerous standardisation committees; and in particular those within the established framework of the International Electrotechnical Commission (IEC).

The South African National Committee of the IEC approached the SAIEE with a proposal for collaboration to identify and part-sponsor one delegate from South Africa to attend the 2012 Young Professional programme. The Institute nominated Michael Grant to attend the IEC Young Professional programme that ran in parallel with the 2012 IEC General meeting from 1 to 5 October 2012 in Oslo, Norway.

This report briefly describes the management structure of the IEC and the points of engagement for experts wishing to contribute to standardisation. The report also details the activities of Michael Grant at the 2012 IEC Young Professional programme and lists a series of recommendations to establish formal support for the programme through the South African Institute of Electrical Engineers.

The International Electrotechnical Commission (IEC) is an international standards organisation, founded in 1906, with representation from 164 countries. The international representation consists of a council of 82 member countries, with each country represented by a national committee. All European and North American countries are members; as is Brazil, Russia, India, China, Australia, and South Africa. Africa is represented by South Africa, Ghana, Kenya, Sudan, Libya, Tunisia, Morocco, and Algeria. Except for Nigeria, Kenya, and South Africa, the rest of sub-Saharan countries are only affiliates.

National committees are primarily responsible to provide relevant representation of all interested parties in their country, but are also required to prevent the unauthorised reproduction and distribution of IEC publications as well as drive the implementation of IEC standards as national standards. National committees are therefore expected to promote the objectives of the IEC and support local and international IEC activities. Thus the identification and development of people to undertake IEC work is one of the primary roles of a national committee.

The IEC council is administered by the Council Board, which, in turn, is administered by the executive committee (IEC officers). IEC officers have offices at the central office in Geneva; there are also offices in Sydney, Singapore, Boston and São Paulo to assist with regional integration. These offices support 170 technical committees, with 1,100 working groups through which

Figure 1: Member countries (navy, 82), Affiliates (light blue, 82), and non-affiliated (grey). Copyright © 2012 IEC.

IEC Young Professional Programme

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10 000 experts contribute. These efforts have been realised through over 6 000 standards to which more than 300 000 products, systems, and services have been certified.

In addition to the council, there are three supporting boards, which report into the IEC council:

- The standardisation management board which is responsible for the management of international standardisation activities, through the management and support of technical committees, strategic groups, and advisory committees;
- The market strategy board which is responsible for setting marketing priorities and technology management; and
- The conformity assessment board which is responsible for conformity assessment activities and systems.

This structure is detailed in Figure 2, below, and shows the relationship between the three supporting boards, and the composition of the IEC council, council board, and executive committee.

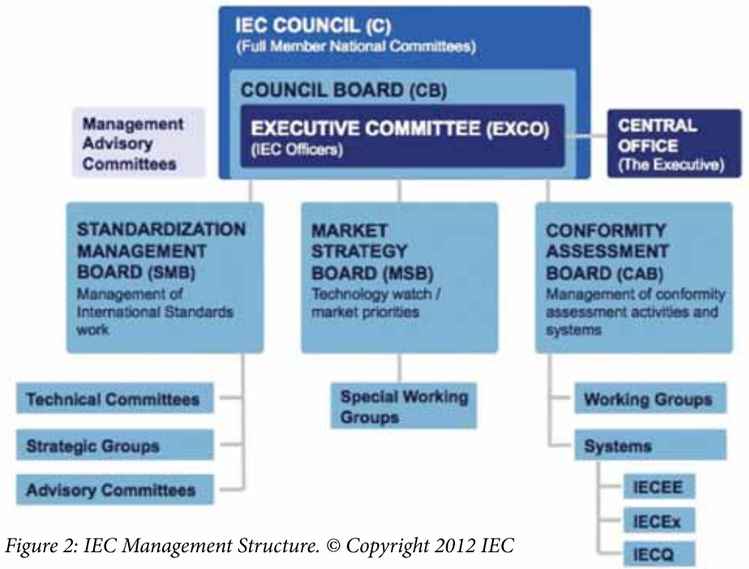

Figure 2: IEC Management Structure. © Copyright 2012 IEC

THE IEC YOUNG PROFESSIONAL PROGRAMME

The Young Professional (YP) programme is intended to be an entry point for young professionals into a career of standardisation and IEC involvement; and forms the focus of the IEC's succession planning programme. The YP programme was started in 2010 when it was realised that the median age of the 10 000 IEC experts was 61 years - and thus more than half of the IEC's experts were due to retire over the next 5 years. The age profile of South African experts involved in IEC committees is similar to the global profile and thus similar developmental programmes are required locally.

Thus the objectives of the YP programme are to prepare young professionals for IEC involvement, to develop a network of young professionals to support the IEC, and develop a pipeline of professionals to sustain the IEC. The YP programme is held in conjunction with the IEC's general meeting, as this is the only opportunity to expose the participants of the programme to the operation of the council as well as format and function of the three supporting boards. Participants are also afforded the opportunity to contribute to various technical committees that are also meeting during the week of the general meeting.

THE 2012 YOUNG PROFESSIONAL PROGRAMME

The 2012 IEC Young Professional programme was held during the first week of October 2012 in Oslo, Norway and consisted of three days of technical sessions followed by an industrial visit. The programme was held in parallel with the 2012 IEC General meeting, which was hosted by the Norwegian national standards body, NEK. NEK was also celebrating 100 of service years since their incorporation in 1912.

Further YP participation in meetings associated with the General Meeting during the remaining days of the week was encouraged. 58 young professionals attended the meeting, with 30 countries represented. South Africa sent two delegates to the YP programme: Michael Grant (author) and Target Mchunu (Eskom).

Young professionals attending the event were selected to the programme through at least one of the following ways:

1. Essay motivation;
2. Interviews by selection committee; or
3. Motivation by national or mirror committee members or industrial association.

Most of the 58 attendees were selected through an essay competition with the final selection made by the national committee or national electro-technical institute after a short presentation by each of the finalists.

DAY 1

The first day consisted of a general presentation to the YP group outlining the various activities for the rest of the programme; followed by a question and answer session with IEC technical officers. This was followed by observing the standardisation management board meeting and then the opening ceremony for the general meeting.

The following IEC officers were present and gave short presentations:

- Klaus Wucherer Frans Vreeswijk - IEC President (Plenary opening address)
- Frans Vreeswijk - IEC General Secretary & CEO (Welcome message; and IEC 2011 Masterplan)
- Katharine Fraga - Young Professionals programme Coordinator (About the programme)
- Peter Lanctot - Technical Officer (Looking forward with the IEC; and What to expect at a technical meeting)
- Gabriel Barta - Head of Technical Coordination (About conformity assessment)
- Richard Schomberg - EDF VP Innovation Sourcing & Transfer EU (The joys of developing standards)

DAY 2

The second day began with participants attending a technical meeting: the author attended the TC64 meeting (Electrical installations and protection against electric shock) and made contributions to a working group meeting on photovoltaic installations.

The YP programme then observed the conformity assessment board meeting, after which there were small break-out sessions; the author attended the explosive atmospheres session as this topic has direct relevance to the installation of electrical equipment in mining and industrial operations as found in South Africa.

DAY 3

The third day began with a breakfast meeting between YPs and their national committee members; followed by an interactive session through which the YP programme members provided some strategic thinking to the IEC executive.

The day was completed with a visit to Det Norske Veritas (DNV) headquarters, just outside Oslo. DNV is a risk management company with specific competence in the identification, assessment of risk and risk management advisory services. DNV was incorporated in 1864 to provide technical evaluation of Norwegian merchant vessels.

The tour included access to their electrotechnical testing laboratories, which are the best in the world and are rarely exhibited publicly. DNV is also well known for the high voltage laboratories at KEMA (Arnhem, Holland).

DEVELOPMENT OF SAIEE YOUNG PROFESSIONAL PROGRAMME

A local Young Professional programme requires both the selection and financial support of the delegate. The IEC sponsors the accommodation of the Young Professional for the duration of the programme, and so the support required is in the form of travel, additional accommodation, and living expenses. It was understood that this was the first IEC Young Professional award made by the SAIEE and so many required policies and procedures are yet to be established.

The absence of such policies and procedures did not detract from or limit the experience, but the establishment of such guidelines will make the next event easier to incorporate into the operational budget of the institute thereby assuring the longevity of the award.

The 2013 IEC general meeting is to be held in Delhi, India (October 2013). As with the 2012 YP programme, the 2013 YP programme will be held in parallel to the General Meeting. It is with these deadlines in mind - with the expectation that the SAIEE will send another delegate to the 2013 IEC YP programme - that the rest of the proposal has been compiled.

IDENTIFICATION OF POTENTIAL YOUNG PROFESSIONALS

Many competent and highly motivated YP's exist throughout the electrotechnical industry. It is possible that they are not members of either the Institute or even a members of one of the IEC mirror committees/working groups. Therefore the call for participants in the local YP programme should be aimed at mentors that have direct exposure to the practicing YP.

ENGAGEMENT AND DEVELOPMENT OF YOUNG PROFESSIONALS

There is a clear business case for the engagement and development of YPs. Indeed the IEC states that: "Successful companies recognize standards and conformance as business tools and manage them alongside quality, safety, intellectual property and environmental policies."

IEC Young Professional Programme

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Standardisation and alignment with existing international standards has been shown to reduce the time to market and shorten iterative product design cycles. There is the additional benefit that compliant products, by virtue of their certification, inherently have access to other international markets.

Thus standardisation reduces the economic risk of new product research and development whilst simultaneously reducing the research and development lifecycle costs. This business case must be communicated to mentors in order to reach their mentees and develop a sustainable local young professional programme.

SELECTION OF DELEGATE

A deep understanding of the IEC and standards development is not required for participation in the YP programme - indeed it is exactly this skills base that the YP programme aims to develop. However a command of the English language and the ability to verbally present thoughts and ideas to a diverse group of participants are critical participation skills.

Therefore, in line with international best practice, an essay competition - in English - is proposed, and depending on the volume of submissions received, a small group of finalists must then present their work to the SAIEE Council for final vote and award.

After discussions with the chairman of the South African National Committee (SANC) of the IEC (Mr Paul Johnson), the following essay topic is proposed:
"Where is there a standards gap?" with the following deadlines applicable:

- Essay submission: 15 March 2013.
- Presentation (if selected as a finalist): 20 April 2013.

The essay submissions will be adjudicated by the Technology and Knowledge Leadership committee of the SAIEE, with a recommendation of finalists made to the SAIEE Council. It is proposed that the finalist presentations are made to Council for final selection and award.

SUPPORT OF DELEGATE

The IEC sponsorship includes accommodation for the duration of the Young Professionals programme. However it must be recognised that young professionals not only lack the financial resources to cover airfares and accommodation, but will also require a subsistence allowance and travel insurance.

The South African Revenue Service provides a per-day advisory and, just like the University of the Witwatersrand, the SAIEE should use this rate to determine the level of funding required. This amount is adjusted, by country, to reflect the cost of living (and indeed visiting). External sponsorship opportunities exist, where companies from the electrical engineering fraternity support the YP programme, under the auspices of the SAIEE.

CONCLUSION

The IEC YP programme is an intense kick-start for young professionals wishing to get involved in standardisation activities. The opportunity is richly rewarding and an invaluable contribution to the development of the career of the delegate attending.

Delegates attending the IEC YP programme leave, having obtained a detailed understanding on how the IEC is structured and how the commission operates. Participants are also educated on the procedures associated with standardisation and standards development - both of which are critical to the development of new standards. The SAIEE is uniquely positioned to identify and develop potential young professionals. To this end, a proposal for a formal local young professional programme has been presented, and short-term deadlines set. wn

CPD TRAINING COURSES

MARCH 2013

Mastering Power System Fault Calculations
By: Prof Piet Swart
5-6 March 2013

Finance Essentials for Engineers
By: Tony Lydall
7-8 March 2013

LV Protection
By: Viv Cohen
13-14 March 2013

Photovoltaic Solar Systems
By: Attilio Dalvit
27-28 March 2013

APRIL 2013

Mastering Power System Harmonics
By: Prof. Piet Swart
11-12 April 2013

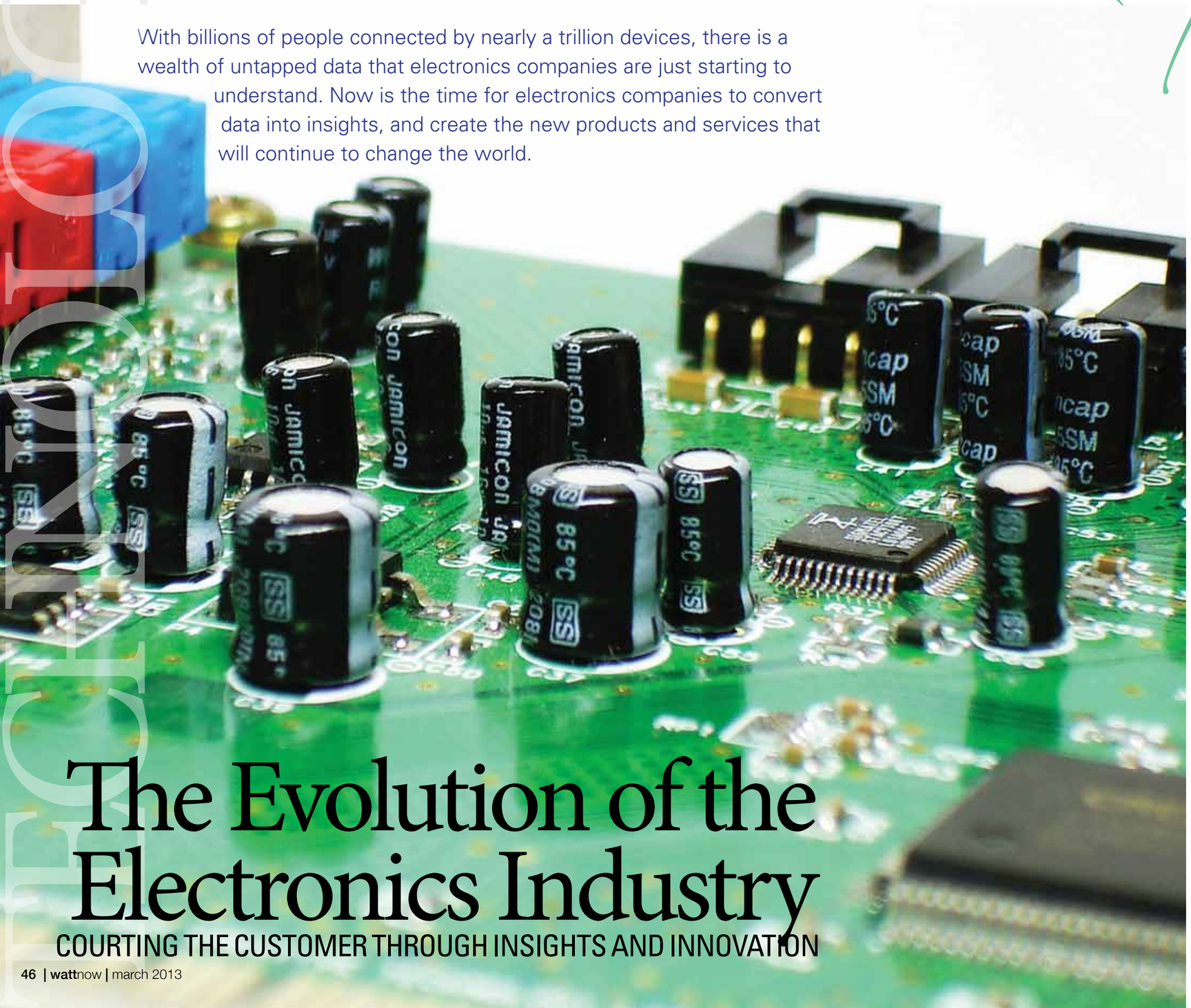
Microsoft Excel for Engineers
By: Jade Scott
17-18 April 2013

Short Circuit Currents
By: Viv Cohen
25 April 2013

Should you require further information on any of these listed course and would like registration forms please contact: Roberto Benites 011 487-9042 or email roberto@saiee.org.za

Earn CPD Credits

With billions of people connected by nearly a trillion devices, there is a wealth of untapped data that electronics companies are just starting to understand. Now is the time for electronics companies to convert data into insights, and create the new products and services that will continue to change the world.



The Evolution of the Electronics Industry

COURTING THE CUSTOMER THROUGH INSIGHTS AND INNOVATION

Transistor by transistor, the electronics industry is literally changing the world. Consider the following: today's fastest computers can now achieve 10 quadrillion operations a second[1]; by 2015, there will be more than seven billion mobile devices in the world, both consuming and generating massive amounts of data.[2] And right now, there are more than one billion transistors for each person on the planet.[3]

With innovations like these, it's no surprise that the electronics industry outspends all other industries in research and development.[4] Despite an impressive track record of pioneering technology, however, today's electronics industry is itself in a state of disruption. Product life cycles are compressing, emphasizing the need to create innovative products and services faster and cheaper than ever before.

Competitive pressures are at an all-time high, with aggressive new entrants and a continuing need to contain operational costs. And though profit margins for some electronics segments, including network equipment and medical devices, remain relatively high, most others are under heavy margin pressure.

Together, these trends are driving electronics companies to find new growth opportunities. Many believe that the best way to do that - perhaps the only way to do that - is to transform their business models by getting ever closer to their customers.

In fact, a recent IBM® study showed that 94 percent of global electronics industry CEOs identified customer intimacy as the number-one priority over the next five years.[5] CEOs realize that innovative products and services are only successful when those products and services deliver on customer needs.

The best route to this customer intimacy is through the data that the electronics devices and equipment create and collect. With billions of people connected by nearly a trillion devices, this data represents a wealth of untapped resources that electronics companies are just starting to understand. However, as revealed in a recent international study, a vast majority of electronics companies are unprepared to manage the impact of all this data and make use of social media as a strategic business tool.[6] Now is the time for electronics companies to convert data into insights, and to create the new products and services that will continue to change the world.

COURTING THE CUSTOMER

In the 21st Century, innovation for its own sake is not enough. The key to success is not just bringing new products to the market, but enhancing business-to-business interactions and peoples' lives. Greater customer intimacy means a shift in the traditional relationships between buyers and sellers. It becomes one of partnership - a mutually beneficial feedback loop in which companies use customer insight to innovate, and customers become active participants in the business.

Insight resulting from analysis of data can be used to redefine product development and customer experiences. Investing in an array of capabilities that create deeper insights and promote smarter products and services can pay off in terms of faster and higher returns. Most electronics companies have already invested in some form of customer information and product lifecycle management. While investing in these individual capabilities can produce good returns, an end-to-end approach offers systemic benefits that will yield exponential returns. For example, the value of customer data can be greatly enhanced

The evolution of the Electronics Industry

continues from page 47

The ability to achieve rapid time-to-market with intuitive and, even more importantly, relevant offerings is a major factor in market credibility.

through investments in analytics that drive deeper insights. Tying these insights to product development can shorten time-to-market and produce offerings that are more aligned with customer needs.

To this end, a four-phase roadmap, with each phase building on the one before, can help improve an electronics company's cumulative cash flow and innovation capabilities. IBM uses their C.O.R.E model:[7]

- Capture the data (collect, integrate and standardize data to make it more useful)
- Optimize insights (apply analytics to the data to yield deep customer and operational insight)
- Revamp development (increase credibility in the marketplace through introduction of more intuitive and relevant products and services)
- Enhance the experience (extend the value of products through value-added services)

CAPTURE THE DATA

The first step is focused on gathering as much useful and relevant information as possible, whether it is from product usage, mining social media or tracking customer interactions with service personnel. All relevant sources of data should be tapped.

Amazon.com is a great example of why robust data collection is important. Its intelligent recommendation engine, informed by public user feedback, uses buying and viewing histories to increase sales. The result has been a surge of demand for e-books, revolutionizing the way people shop for, purchase and read books.[8]

OPTIMIZE INSIGHTS

In the second step, companies analyze the data they captured to spot hidden trends, predict outcomes and lend certainty to decision making. It is a critical capability, because it creates a basis for action - something that raw data alone cannot provide.

Analytics can help reveal the most intelligent and profitable course of action based on answers hidden within the data. As an example, officials of a leading telecom company monitored social media, call records and other subscriber data in real time. They then analyzed the data to predict churn and move proactively to increase customer retention, resulting in a quick 10-percent return on investment.[9]

REVAMP DEVELOPMENT

Insights from analyzing data must be used to transform how products and services are created and managed. The ability to achieve rapid time-to-market with intuitive and, even more importantly, relevant offerings is a major factor in market credibility.

Investments in revamping development focus on making the company more efficient by injecting automation and integration into the product development process. Enhanced collaboration is a key outcome of these investments, helping team members across different disciplines become more effective by sharing insights and information throughout the development chain.

ENHANCE THE EXPERIENCE

Today's consumers respond to direct, continuous and high-touch connections to trusted brands. Offering real-time, pervasive service execution, device and subscriber management are critical drivers for brand preference and customer loyalty. Adding new services does more than boost product sales; it also provides opportunities to interact, partner and gather information to enhance experiences. Electronics companies such as Ericsson (in network management) and Ricoh (in document management) are shifting their business models from products to services.

Ericsson now offers managed services that help companies design, build and manage entire network infrastructures. Once mainly known as a copier and printer manufacturer, Ricoh now offers professional services to help companies manage document-intensive business processes.

CONCLUSION

The idea of creating experiences that matter lies at the heart of competitiveness in today's electronics industry. It's actually not a new concept.

Decades ago, companies like Kodak and Polaroid understood that they were really in the business of creating memories, not just selling cameras and film. However, they were surpassed by other electronics companies that focused on delivering differentiated experiences.

Today, the focus on the customer experience has grown to the point where it practically overshadows the products themselves. That context is essential when considering new ways to innovate and generate revenue. The key technology lever is to apply analytics to data, resulting in new insights to drive innovation.

Ultimately, however, the electronics industry will need leaders that accept the challenge to transform their companies and the industry at large. wn

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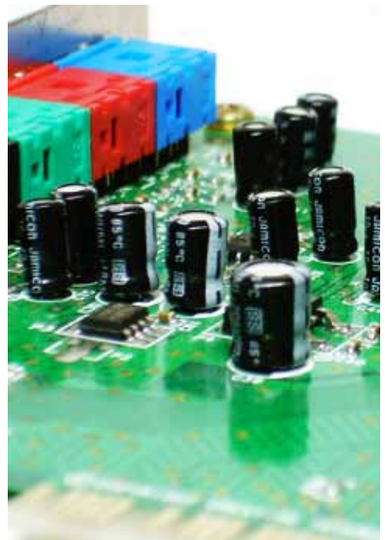


BY | NICK BATTERSBY **|** PPS INVESTMENTS

Only 6% of South Africans are able to retire financially independent.

It is estimated that a mere 6% of South Africans are able to retire financially independent. So as a key driver to funding a secure retirement, the preservation of accumulated retirement savings is critically important.

When leaving an occupational retirement fund – whether due to resignation, retrenchment or the closing of the fund – you have two options when it comes to your accumulated retirement savings. The first of these is cashing in.

However, if you choose to withdraw the money you've saved thus far, you'll receive a relatively small portion tax-free but will be taxed on the rest of it at the rate then applicable by SARS. This means that your savings pool is depleted, that a fair chunk of it has gone to the tax man and that you have to start saving for retirement from scratch. The decision is irreversible.

Alternatively, you could choose to preserve your savings. If following this course of action, your savings will be transferred into a preservation pension fund (if originally transferring from an occupational pension fund) or a preservation provident fund (if originally transferring from an occupational provident fund) for reinvestment – without incurring any tax.

This means that you continue to benefit from compound growth, where future returns are earned on the total value of your investment, including your initial investment amount and all the returns you've previously generated as well. You will avoid any tax implication (and will only be taxed upon your retirement), which means that you can earn compounded returns on the full value of your current savings amount.

Upon retiring from a preservation pension fund a maximum of one third of your retirement proceeds may be taken as a cash lump sum, a portion of which is tax free (currently the first R315 000).

The remaining two thirds of your capital need to be utilised to purchase post-retirement income from a registered insurer. However, a preservation provident fund has no prescribed codicil relating to the purchase of an annuity. The full value of your retirement proceeds may thus be taken as a cash lump sum, of which the first R315 000 is currently tax free.

If you're thinking of changing employment in future, try to resist the temptation to tap into your retirement savings when doing so and consider investing in a suitable preservation fund instead.

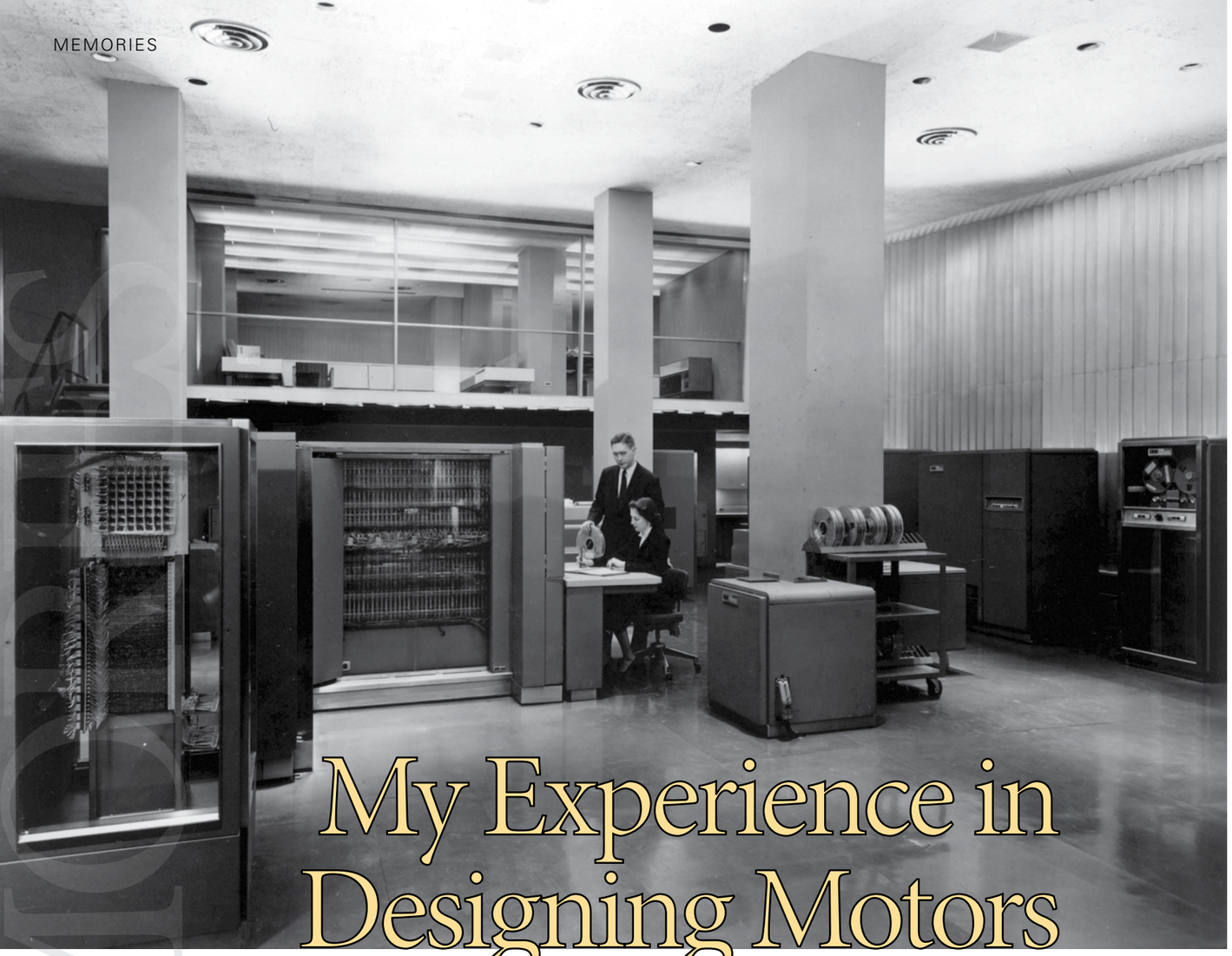
If you've changed employment in the past and already have one or more preservation funds in place, it may be worth considering whether you can lower the fees you're paying by transferring to a more cost-effective fund. Remember that even a small reduction in fees could have a significant impact on the ultimate value of your investment.

The importance of preserving your retirement savings in a cost-efficient portfolio becomes especially evident when considering industry statistics. Unfortunately, the numbers don't look good. A recent survey by Alexander Forbes shows how ill-prepared South African retirement fund members really are. In fact, it is estimated that only 26% of retirement fund members will reach retirement financially secure.

To do so, one has to save at least 13 cents of every rand ever earned, while most retirement fund members only contribute between five and six cents. To make matters worse, fund members have an average contribution period of 27 years and six months, while most careers span over 40 to 45 years.

Remember that a failure to preserve accumulated retirement savings means that you have to start saving from scratch – and now have less time to save.

So when thinking of changing employment, keep in mind that consistent, contractual saving throughout your career is the best way to save towards a secure retirement. Also consult your intermediary and evaluate the fee structure of existing preservation funds, in ensuring that your investment offers you a flexible and cost-efficient portfolio. wn



My Experience in Designing Motors

In the year 1956, I started working for the First Electric Company as a motor designer. After I qualified in electrical engineering at Wits, I had spent two years training in England, which included learning to design electric motors.

BY | ALAN MEYER **|** FSAIEE

In those years all the calculations for the designs were done on slide rules. The design process consists of initially setting the motor dimensions by using the nearest existing design and proportioning the new design to cater for the present specific requirements. A detailed calculation was then undertaken to determine the actual performance of the new motor. Doing this by slide rule might easily require a day or two of continuous calculations since the first attempt generally needed modification. This of course was very tedious work.

In 1959 I was sent by the company to the parent companies in England, British Thomson Houston and Metropolitan Vickers to learn about their latest developments in electric motors and to gain more experience with the latest design methods. At that time they were just introducing ways of getting computers to carry out the performance calculations. The computers were ones that were available at their local universities.

I came back to South Africa determined to see if we could find ways to do our calculations on any locally available computers. Unfortunately the UK programs were written in machine language to suit their computers so unless a similar computer was available locally they could not be directly used. The few computers that were then in this country were used for financial purposes and not engineering. We thought we were successful when the Standard Telephones and Cables company had a computer (Stantec Zebra) that could do our work and we started earnest discussions with them. After a few meetings they told us that their company was closing their computer division internationally and we were back to square one.

After a short while we learnt that Wits University was getting a modern computer and this could compile Fortran programs. They were running a course for anyone interested in learning Fortran. We had heard about Fortran which was one of the first high level languages that could be programmed using algebraic expressions. A few of our engineers and myself attended the course and came back convinced that we could now write our design program in our own office.

The computer that Wits had acquired was an IBM1620 which was programmed using punched tapes and had a magnetic core memory.. After a good few weeks we had written the first draft of our design program. We all went to Wits for a test run on the computer. When we had only entered about a quarter of our program the computers memory was overloaded so we had another great disappointment!

Then we learnt that the CSIR in Pretoria had acquired an IBM 704 computer. This was a very large computer but also was from a previous generation in that it operated purely with electronic valves and had no solid state chips at all. The size of this computer was such that it is doubtful if it could be accommodated in the whole of our new SAIEE House. The heat given off was such that a large air-conditioning plant was needed to keep this computer from overheating. There were also two technicians on duty at all times to replace faulty valves. The internal memory was just one large magnetic drum.

The process was to write the original program in Fortran and code on to punched cards, one card for each statement. This deck of cards, called the source deck, was entered on the card reader and the computer then produced a binary deck of cards, termed the object deck. After the object deck was produced, an individual design which consisted of the numerical values for a particular motor design was placed behind the object deck and the performance figures for that design were calculated and printed out. The data for many individual design calculations could be stacked behind each other and this enabled a large set of motor performance calculations to be speedily obtained.

It took nearly two hours of computer time to produce the object deck and the cost for this compilation was about 300 Rand, a large amount for those years. This would not have been too bad if the source deck was bug free. In actual fact there were often minor errors that prevented the program from giving valid outputs. While these were easily located and corrected, the re-compiling of the object deck caused a considerable expenditure. We therefore decided that the only solution was to be able to read the binary coded object cards and avoid the costs.

We therefore attended a two day course learning binary arithmetic and could then locate the errors on the object deck.

Now, if there was a space omitted, we could use a hand punch to correct this. The problem was if a hole was punched on the card where there should not have been. The solution was to find a little cardboard punching from the hand punch, and rub this into the incorrect hole. Luckily our accounts department had a machine for copying cards, and this was used to give us a usable card in the object deck.

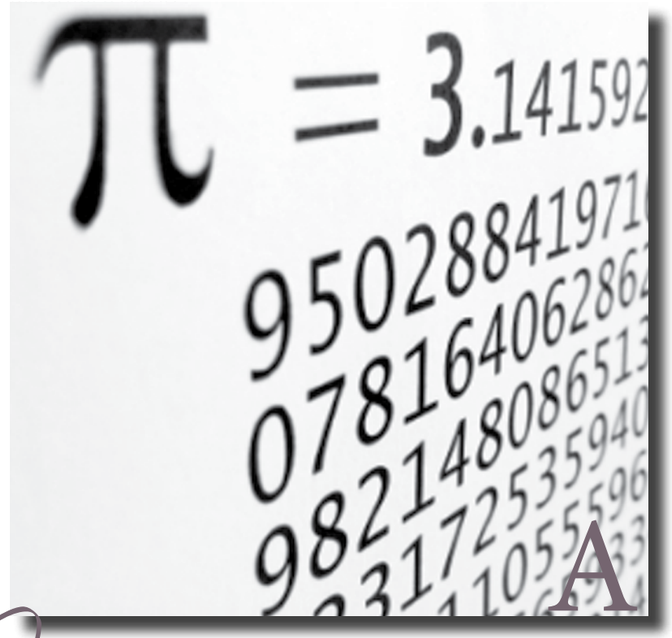
After some weeks we at last had a sound method of doing our motor calculations. This proved to be a boon to all our design engineers. It did mean that we had to travel to Pretoria once a week but it was clearly worth our while.

After that things moved quite rapidly. IBM installed their IBM 360 computer at a service bureau in the centre of Joburg and this made travelling easier. Then the American GE Company installed a computer that enabled data to be entered via a telex machine. Later still our own company installed a Burroughs Computer in the accounts department that could handle our calculations with data entered via telex.

My own responsibilities were changed at this time so I was no longer directly concerned with motor design.

Nevertheless, it was soon after this that the availability of PC's enabled each designer to carry out the calculations at his own desk.

Now the design process does not only consist of the motor performance but involved CAD and finite element calculations. wn



This all started when a junior member of our family was asked in her school maths class to write a short piece about an aspect of Pi (π) that had particularly caught her interest. This was eventually passed up to her uncle Bill, who did a bit of maths, for comment. My comment was probably not quite what the teacher had in mind but it became quite interesting when it got going.

A Piece of Pi

BY | W A (BILL) BRADING | CENG UK | FSAIEE | FIET

My first reaction was to turn to the excellent little book called "The Joy of Pi" by David Blatner, Penguin Books 1997. About halfway into the book – the pages are not all numbered as the book contains the first million digits of Pi so some of the pages have the number spelled out – at page sixty three we find the following statement:

$$\int_0^\infty \frac{(\log x)^2}{1+x^2}\,dx = \frac{\pi^3}{8}$$ (he means natural logs (ln) of course.)

The author implied that this was one of the Indian mathematician Ramanujan's mysterious revelations. So I set out to prove it and came up with something more. My reasoning follows.

Since the logarithm is squared the integral should be unchanged if its sign is changed from plus to minus. This means that x could be replaced by 1/x . If we do this then this is confirmed.

$$\ln x \to -\ln x \quad x \to \frac{1}{x} \quad dx \to -\frac{dx}{x^2} \quad \int_0^\infty \frac{(\ln x)^2}{1+x^2}dx \to -\int_\infty^0 \frac{(-\ln x)^2}{(1+\frac{1}{x^2})x^2}dx = \int_0^\infty \frac{(\ln x)^2}{1+x^2}dx$$

$$\int_0^\infty \frac{(\ln x)^2}{1+x^2}dx = 2\int_0^1 \frac{(\ln x)^2}{1+x^2}dx \quad \text{or} \quad 2\int_1^\infty \frac{(\ln x)^2}{1+x^2}dx$$

This shows that the summation from 0 to 1 (x) is equal to the sum from 1 to infinity (1/x). Note; this was confirmed by a computer evaluation.

Now let $u = \ln x$ then $x = e^u$ and $\frac{du}{dx} = \frac{1}{x}$ so $dx = xdu = e^u du$

When $x = 0 \quad u = -\infty$ and when $x = 1 \quad u = 0$

$$2\int_0^1 \frac{(\ln x)^2}{1+x^2}dx \to 2\int_{-\infty}^0 \frac{u^2 e^u}{1+e^{2u}}du \qquad (1)$$

The integrand of (1) may be expanded as a geometric series and integrated term by term.

$$\frac{u^2 e^u}{1+e^{2u}} = u^2 e^u\left(1 - e^{2u} + e^{4u} - e^{6u} + ...\right) = u^2\left(e^u - e^{3u} + e^{5u} - e^{7u} + ...\right)$$

$$2\int_{-\infty}^0 u^2 e^{nu}\,du = 2\left|\frac{e^{nu}}{n^3}\left(n^2u^2 - 2nu + 2!\right)\right|_{-\infty}^0 \quad n = 1,3,5..... \qquad (2)$$

$$= 4\left(1 - \frac{1}{3^3} + \frac{1}{5^3} - \frac{1}{7^3} + ...\right) \qquad (3)$$

Notice that the only active element in (2) is $\frac{e^{nu}}{n^3}2!$ as all other terms vanish at the limits. The bracketed series is well known and belongs to the class of Dwight 48.39[1]:

$$1 - \frac{1}{3^{2m+1}} + \frac{1}{5^{2m+1}} - \frac{1}{7^{2m+1}} + ... = \frac{\pi^{2m+1}}{2^{2m+2}(2m)!}E_m$$

Where E_m is the mth Euler number. In this case m=1 and E_1=1 so the bracketed series (3) is: $\frac{\pi^3}{2^2 2} = \frac{\pi^3}{32}$ hence the integral (1) equals $\frac{\pi^3}{8}$ This proves the statement in the "Joy of Pi".

It became apparent that the reasoning up to equation (1) would apply also to any even power of the logarithm so the integrand could be expanded as $\frac{u^{2k}e^u}{1+e^{2u}} = u^{2k}(e^u - e^{3u} + e^{5u} - e^{7u} + ...)$ but although the integration of this series of terms becomes considerably more complicated than (2) above everything vanishes at the limits as before except the active element, which now becomes $\frac{e^{nu}}{n^{2k+1}}(2k)!$ s o the series is now $1 - \frac{1}{3^{2k+1}} + \frac{1}{5^{2k+1}} - \frac{1}{7^{2k+1}} + ... = \frac{\pi^{2k+1}}{2^{2k+2}(2k)!}E_k$

A Piece of Pi

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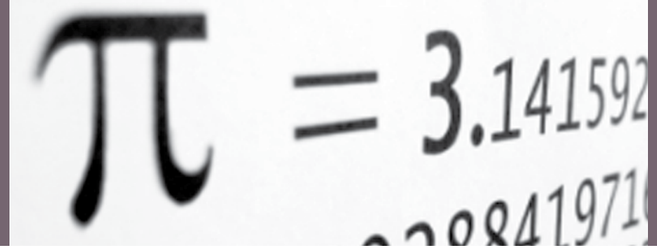

LISTING A FEW EXAMPLE RESULTS:

$$\int_0^\infty \frac{(\ln x)^4}{1+x^2}dx = 5\left(\frac{\pi}{2}\right)^5 \quad \int_0^\infty \frac{(\ln x)^6}{1+x^2}dx = 61\left(\frac{\pi}{2}\right)^7 \quad \int_0^\infty \frac{(\ln x)^8}{1+x^2}dx = 1385\left(\frac{\pi}{2}\right)^9$$

This pattern still applies for $k = 0$ when $\int_0^\infty \frac{1}{1+x^2}dx = \left|\arctan x\right|_0^\infty = \frac{\pi}{2}$ a familiar result.

So in general $\int_0^\infty \frac{(\ln x)^{2k}}{1+x^2}dx = E_k\left(\frac{\pi}{2}\right)^{2k+1} \quad k = 0,1,2,3.....E_0 = 1$

A listing of the Euler numbers will be found on the web together with the algorithm for generating them. wn

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SAIEE AFRICA RESEARCH JOURNAL:

Call for papers

As of 2008, the SAIEE Africa Research Journal has received more research articles (from around 20 in 2008, to averaging approximately 50 articles per annum between 2010 and 2012).

An increasing number of submissions are now from the international scholarly community, including Asia and the United States of America.

Over the past three (3) years, the journal's annual acceptance rate has varied between 16 % and 40 %. This remains in-line with international journals of similar stature.

The journal publishes original research, where originality is assessed through a peer-review process. Each paper is subjected to two (but usually more) reviewers, primarily from the international engineering and scientific community, and enjoys the reputation of being a primary research journal of electrical engineering and associated fields in Africa.

- The journal was originally established as the "Transactions of the SAIEE" in 1909 at the same time as the institute.

- The journal is listed on the "Department of Higher Education and Training List of Approved South African Journals," and in this way articles are recognized for financial subsidy to higher education institutions in South Africa.

A long-term vision for the journal: priority is being given to indexing on Thomson Reuters (formerly ISI) Web of Knowledge. The journal editorial team recognizes that the procedure relating to this relates to improving our citation index, which aligns to our quest for excellence. For an improved search service experience, the journal, since 2004, is published online.

We call upon researchers to consider the SAIEE Africa Research Journal as a medium for publishing their novel scholarly research, and in this way contribute to the body of published knowledge.

For more information, including our editorial process, please visit: www.saiee.org.za/arj
For suggestions or comments, please contact Prof. Saurabh Sinha or Gerda Geyer (SAIEE Staff Partner)
E-mail: researchjournal@saiee.org.za

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SAIEE

SAIEE Membership Benefits

Members of the SAIEE now enjoy the following a wide array of benefits:

You simply cannot afford not to be a member!

- A discount of up to R1110 on their ECSA registration fee, which is due in April every year, provided that they join the SAIEE before the end of March that same year.
- Upon joining the SAIEE there is a standard entrance fee of R700, an annual membership fee of R923 for Members, and between R1129 and R1223 for Senior members depending on age. Most of this will be recovered through the ECSA discount.
- SAIEE members receive 11 issues of the wattnow magazine valued at R330.
- The SAIEE Africa Research Journal (ARJ) our peer reviewed research publication (which incorporates the SAIEE Transactions) is also available to SAIEE member's quarterly upon request.
- The real rewards of being a member can be realized through attending monthly lectures, debates, tours and site visits organized by the SAIEE. These are mostly free of charge and provide refreshments at no extra cost. Members are awarded valuable CPD credits for attending these events.
- Membership has significant career benefits, as membership holds prestige and recognized status in the profession. SAIEE gatherings provide excellent opportunities for members to interact with normally inaccessible captains of industry.
- SAIEE letters after your name indicate your membership grade and are a useful measure of your experience.
- Members receive generous discounts on the SAIEE run CPD courses and earn (category 1) CPD credits. Members also have the option of joining the wattnow online CPD program at a fraction of the cost.
- The SAIEE mentorship program assists members to gain professional status through the Institutes large database of mentors.
- SAIEE members are awarded 1 CPD credit (Category3) for being a member of the SAIEE.
- Members are able to serve on organizing committees and gain valuable experience and professional networking in doing so.
- Use the electrical engineering library at SAIEE House.

APPLICATION REQUIREMENTS FOR SAIEE MEMBERSHIP

It is always exciting to receive an application as it means that we will soon be welcoming another new and valuable SAIEE member to our family of nearly 6000 members. However, more often than not the application is incomplete. To avoid unnecessary delays in the process it is important to highlight the problems regularly experienced within the administration with received applications:-

Many applicants do not read the list of requirements.

WE REQUIRE THE FOLLOWING DOCUMENTS:

- Copy of the applicants ID;
- Certified copies of achievement certificates;
- A copy of the applicants latest CV;
- The completed application form;
- Proof of payment for the application and membership fee which are required upfront. ***Please use surname and initials as payment reference.***

Copies of the required documentation should accompany the application forms but unfortunately we still find application forms are sent in without it.

A number of applicants do not complete the application forms adequately, ***please complete the form in full.***

Payment of both application fees and membership fees are frequently not paid timeously.

Only once all the above requirements have been met is the application considered complete, enabling the process to continue efficiently.

Please, help us to help you receive the many benefits of SAIEE Membership sooner rather than later!!

2013 Membership fees

Rates as from 1st January 2013

Grade of Membership	Annual Subscriptions paid by 28 February 2013		Annual Subscriptions paid after 28 February 2013		New Members FEES * see Notes 1 & 4 below.	
	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)
Student	**117**	82	130	92	130	92
After 6 yrs study	**752**	526	835	593	835	593
Associate	**752**	526	835	593	835	593
Member	**831**	582	923	648	923	648
after 6 years	**972**	680	1,079	765	n/a	n/a
after 10 years	**1,016**	711	1,129	801	n/a	n/a
Senior Member	**1,016**	711	1,129	801	1,129	801
after 6yrs/age 40	**1,102**	771	1,223	868	1,223	868
Fellow	**1,102**	771	1,223	868	1,223	868
Retired Member (By-law B3.7.1)	**465**	326	515	365	n/a	n/a
Retired Member (By-law B3.7.3)	**nil**	nil	nil	nil	n/a	n/a

NOTE

1. Entrance fee for all grades of membership is R700 (except Students which is free)
2. Transfer fee to a higher grade is R400.00 for all grades of membership (except Student within 3 months of qualifying).
3. Members are encouraged to transfer to a higher grade when they qualify. It will be noted that the fees of Member and Senior Member grades after 10 and 6 years respectively are equal to the fees at the next higher grade.
4. Members elected after June 2013 pay a reduced subscription fee.

By-law B3.7.1 reads "a member in good standing who has been a member of the Institute for at least ten (10) consecutive years, has reached the age of sixty (60) and who is no longer actively engaged in the profession, may apply to Council for an adjustment in the amount of his subscription.

By-law B3.7.3 reads "any member complying with the conditions of B3.7.1 but who has been a member of the Institute for not less than 25 consecutive years, shall be exempt from the payment of further subscriptions." Members who comply with the requirements of By-Law B3.7.3 may make written application to Council for exemption form paying subscriptions.

By-law B3.9 reads "any member in good standing who has been a member for fifty (50) consecutive years shall be exempt from the payment of further subscriptions."

Members not in good standing by failing to pay their subscriptions by end of June of each year will be struck-off the SAIEE membership role - subject to Council decree.

Members in good standing and no longer in substantive employment and do not receive payment or salary for work done may apply to Council for a reduction in their annual subscriptions.

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Mentorship

The offer comes at a time when our country is suffering a shortage of skills, and we believe that mentoring is an essential requirement in the training and development of the next generation of engineers. If, as a member of the SAIEE, you believe that you need a mentor you can request a mentorship service from the Institute.

The service will be of particular benefit to those young engineers working under the leadership of busy and pressurized Professional engineers, who may not have the time to assist young engineers in discussing and planning their career paths.

This initiative is particularly relevant to young engineers who are working in an environment devoid of engineers or with non technical managers. The young engineer may feel frustrated because he or she cannot benefit from the wisdom of an experienced engineer.

It will give a young engineer, the mentee, a chance to talk to a mentor, who will be his or her advisor, teacher and role model, away from the work environment. His or her mentor, matched to a similar profile, will understand the mentee's work and personal situation, having been there him- or herself.

The mentee will be able to discuss problems and frustrations with his independent mentor, who would have no stake in the outcome, and who would be able to provide an unbiased opinion and advice. The mentee might not be able to do so with his superiors, particularly if he is unhappy, and is considering an alternative career. The mentor and mentee could arrange to meet regularly, on terms that would suit both parties. The goal is to ensure both Mentee and Mentor have enough time to communicate any concerns or advice they have.

The mentor could recommend to the mentee what course of action to take without being too prescriptive while the final decision and the consequences remain with the mentee.

Among its more than 5500 members the SAIEE has many experienced engineers who are willing to act as mentors. They are spread across the country and include engineers who are experienced in steelworks, furnaces, rolling mills, mining, manufacturing, electrical generation, transmission and distribution, through to light industrial, process control, instrumentation, telecommunication, robotics, automation, software development and engineering management of these sectors.

So if you feel that you would benefit by talking to a mentor, please contact Sue Moseley on the number below. She has a database to match the profiles of mentors and mentees. wn

SAIEE

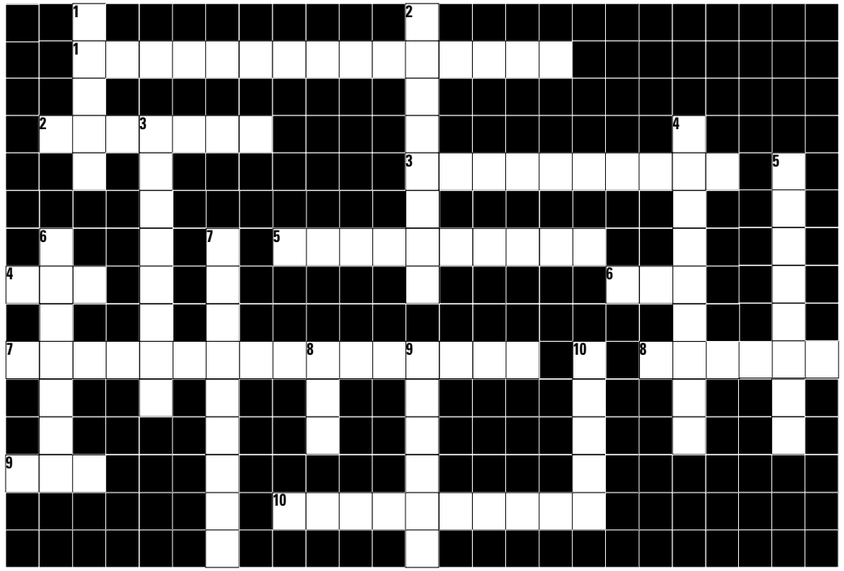
PROSPECTIVE SAIEE MENTORS

If you feel you that you have the time and interest to help mentees, please contact Sue Moseley on 011 487 9047 or suem@saiee.org.za.
In addition you gain CPD credits for when you are required to re-register.

Have some fun and stand a chance to win R1000. Complete the March issue crossword puzzle and send it with your name, surname and contact details to: *Managing Editor, March 2013 Crossword Puzzle, P.O. Box 751253, Gardenview, 2047* or email it to *minx@saiee.org.za*. The completed crossword puzzle should reach us by no later than **30 March 2013**. The winner of R1000 will be announced in the May 2013 issue of the **watt**now magazine.

win R1000

BERGMAN FISHER ASSOCIATES, DESIGNERS OF A SAFER GREENER ENERGY EFFICIENT FUTURE, ARE THE PROUD SPONSOR OF OUR CROSSWORD PUZZLE.



ACROSS

1. In 1897, what type of cable was used for 11,000 volt circuits installed for the Niagara Falls power project? (6,9)
2. What type of strength measures the force required to pull an object to breakingpoint? (7)
3. Cable consists of three major components. Name 1 of the three. (11)
4. Megahertz (abbr.)
5. See 3 across (10)
6. Oxygen-Free Electronic Copper (abbr.)
7. See 3 across (10,6)
8. Which prescious metal is the only metal with a higher electrical connectivity than copper? (6)
9. International Organisation for Standardisation (abbr.)
10. What type of coppers are used to resist hydrogen embrittlement when extensive amounts of cold work is needed? (6,4)

DOWN

1. The gradual deformation of a material from constant expansions and contractions under "load, no-load" conditions. (5)
2. Power cables use stranded _____ or _____ conductors. (8, 6)
3. What type of cabels are encased in foil or wire mesh? (8)
4. A process whereby two or more metals are joined together by a heating process. (9)
5. In 1844, who patented vulcanised rubber? (7,8)
6. See 5 down.
7. A material's ability to deform under tensile stress. (9)
8. Electrolytic-tough pitch (abbr.)
9. See 2 down.
10. South African Institute of Electrical Engineers (abbr.)

January issue answers:

ACROSS 1 Fossil Fuel **2** James Blyth **3** Geothermal **4** Of **5** HBar **6** VAWT **7** OTEC **8** NECSA **9** Betavoltaics

DOWN 1 Flashsteam **2** Cogeneration **3** Drysteam **4** Photovoltaic **5** Binary Cycle **6** Yes **7** Heron **8** Alexandra **9** Hello

Terms and conditions: 1. Only one entry per person. 2. Winners will be notified via email. 3. Incorrect information will automatically disqualify the entrant. 4. Anybody may take part except the office staff of the SAIEE, their family members and members of the Publications Committee. 5. **watt**now magazine and the SAIEE cannot take any responsibility for lost entry forms or any damage, losses or injuries related to the draw of the prize. 6. The winner must be prepared to be photographed and such photograph will be published in the relevant issue of the **watt**now magazine. 7. Closing date for entry is 30 March 2013. 8. The winner will be announced in the May 2013 issue of the **watt**now magazine. 9. The Managing Editor's decision is final and no correspondence will be entered into.

Calendar of events

If you want to see your function or event listed here, please send the details to Minx Avrabos at minx@saiee.org.za

MARCH 2013

12-16	2013 IEEE International Conference on Orange Technologies	Tainan, Taiwan	conf.ncku.edu.tw/icot2013
13-14	4th annual IT Leaders Africa Summit	Johannesburg, RSA	www.kineticevents.net
13-14	3rd Southern African Digsilent User Conference	Blue Valley Golf Estate, Centurion, South Africa	www digsilent.co.za
13-15	iEECON 2013 : International Electrical Engineering Congress	Chiang Mai, Thailand	www.ieecon.org
19-22	Conference on Systems Engineering Research 2013	Georgia Institute of Technology, Atlanta, USA	cser13.gatech.edu
27	SAIEE AGM	War Museum, Saxonwold, Johannesburg	geyerg@saiee.org.za

APRIL 2013

8-11	Power & Electricity World Africa	Sandton Convention Centre	www.terrapinn.com
9-10	Sustain & Build Africa	Sandton Convention Centre	www.terrapinn.com
9-10	The Lighting Show Africa	Sandton Convention Centre	www.terrapinn.com

MAY 2013

4-6	Led Expo Mumbai	Mumbai, India	www.biztradeshows.com
8-9	Electrical Manufacturing and Coil Winding Expo	Frontier Airlines Center, Milwaukee, USA	www.biztradeshows.com
10	2013 SAIEE CEO Charity Golf Day	t.b.c.	geyerg@saiee.org.za
14-15	African Utility Week	Cape Town International Convention Centre	www.african-utility-week.com
23	President's Invitation Lecture	University of Johannesburg	geyerg@saiee.org.za

JUNE 2013

3-6	ECCE Asia 2013	Melbourne , Australia	www.ecceasia2013.org
16-19	2013 IEEE Transportation Electrification Conference and Expo	Metro Detroit MI , USA	www.itec-conf.com
23-26	2013 IEEE 14th Workshop on COMPEL	Salt Lake City UT , USA	www.ece.utah.edu/compel13

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