wattnow

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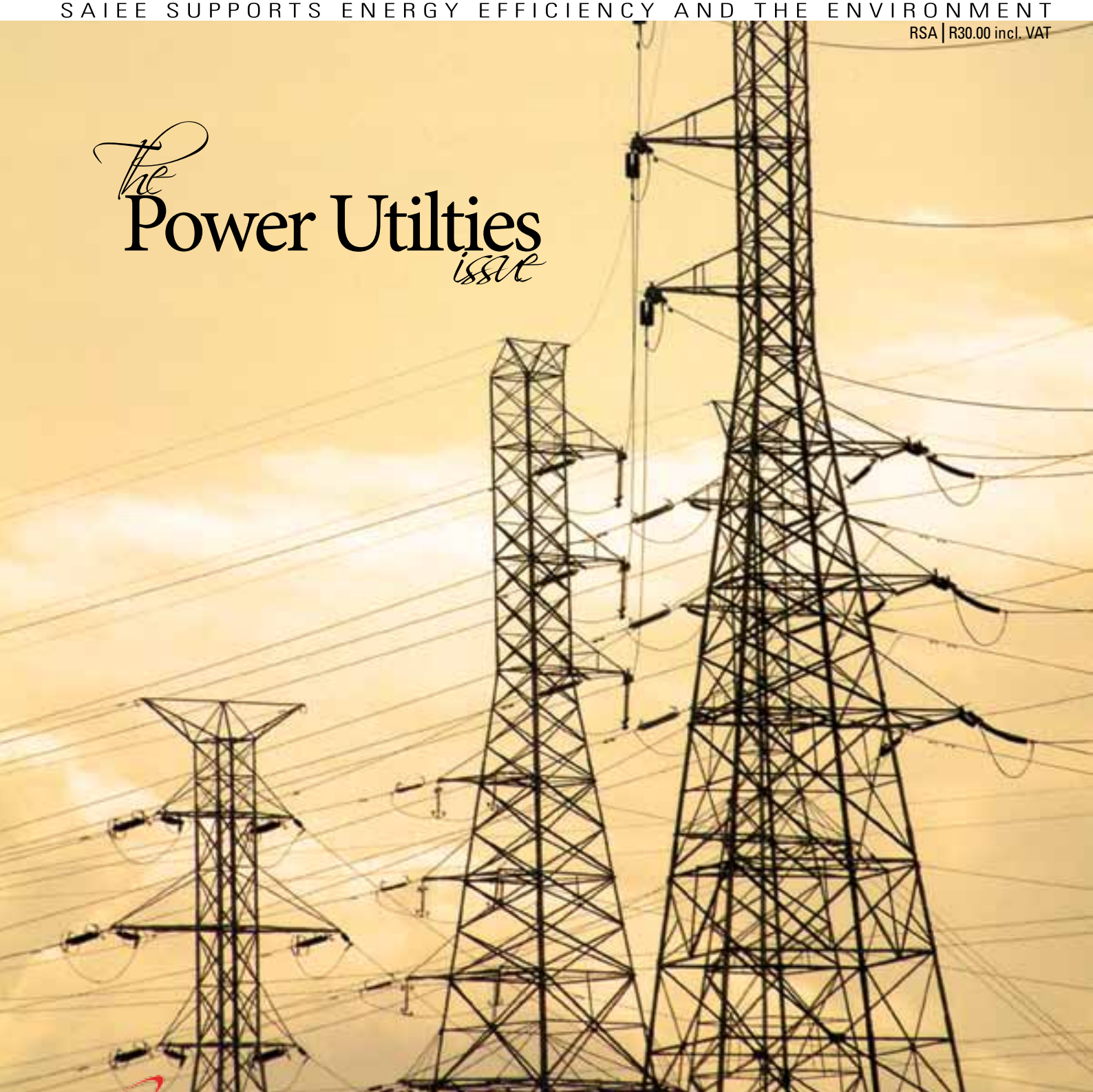

the Power Utilties issue

SAIEE THE OFFICIAL MOUTHPIECE OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | **SEPTEMBER 2012**

contents

wattnow magazine

MANAGING EDITOR
Minx Avrabos | minx@saiee.org.za

EDITORS
Derek Woodburn
Mike Crouch
Jane-Anne Buisson-Street

CONTRIBUTORS
J.P. Scholtz
Stuart Batchelor
Geoff Hainebach
Mike Crouch
Vinvent Letellier
Alice Shelton
Ephraim Kadec

EVENTS
Gerda Geyer | geyerg@saiee.org.za

PHOTOGRAPHER
Heather McCann | 011 682 3298

CPD & COURSE ACCREDITATION
Sue Moseley | suem@saiee.org.za

MEMBERSHIP & TECHNOLOGY LEADERSHIP
Ansie Smith | smitha@saiee.org.za

ADVERTISING
Avenue Advertising
T 011 463-7940 | **F** 086 518 9936
E barbara@avenue.co.za

PUBLISHER
SAIEE Publications (Pty) Ltd

SAIEE HEAD OFFICE
P.O. Box 751253 | Gardenview | 2047
T 011 487 3003 | **F** 011 487 3002
E wattnow@saiee.org.za | **W** www.saiee.org.za
Office Hours: 8am-4pm

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It is September – again and winter is a distant memory for some. The days are warming up and hopefully the electricity usage will be less now that days are becoming warmer.

In this issue of wattnow, we focus on Power Utilities. We feature articles on Transient Earth Fault Clearing Schemes on page 20, to a very informative article on Standby Power Wastages on page 30.

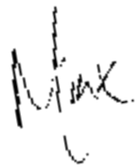
Our Technology sections sport a very interesting article on The Automobile –written by Mr Geoff Hainebach.

Mike Crouch shares with us the history of Submarine Cable systems (page 46), which is followed by an article on the new technologies involved in the current submarine cable systems.

Time is running out for our article competition where we are giving away 5 iPad's for the best submitted article by an SAIEE member (see page 5). Visit www.saiee.org.za for the t & c's.

As I promised at the last Networking Breakfast, the time has come to organize the wattnow Birthday Bash. The date is 16 November, 08h00 at the SAIEE House. Send me an email on minx@saiee.org.za if you would like to attend. Cost is R150 p/p.

Herewith the September issue, enjoy the read!



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

ALL SAIEE MEMBERS!

Write a winning Engineering article for **watt**now and win an iPad!

wattnow prizes will be awarded for articles written by SAIEE members that are published in the **watt**now magazine and that are adjudged 'excellent' by a panel of experienced engineers and academics. Articles of between 1500 and 2000 words in the Engineering categories of Communications, Control, Computers & Software and Power as well as General Interest and Science, written by SAIEE members, in good standing, and published in **watt**now will be eligible.

SAIEE members have broad and expert experience and knowledge about many Engineering projects topics in which they have been involved. **watt**now wants to access and record the experience and knowledge of the SAIEE member community and publish this to a wider professional audience.

Write about your (or others') experience and help to spread knowledge, interest in and history of our great engineering capabilities and achievements, and in doing this, earn 1 CPD credit when your article is published in the **watt**now magazine.

ARTICLES WILL BE JUDGED ON THE FOLLOWING CRITERIA:

- General technical professional interest
- Accuracy and Reliability, Technical Correctness
- Currency and relevance
- Coverage and Objectivity
- Style, language, illustrations, article structure, etc.

Awards will be made at the Annual SAIEE Banquet for the best article in each category, published between September and August of the past year. Note that a prize for each category is available but will only be awarded if articles are judged to be of a sufficient standard. The prizes for 2012 will be Apple iPads. The judging panel will be made up of experienced members of the Engineering fraternity, including academics and industrialists and their decision is final.
Detailed rules are available on the SAIEE website - visit www.saiee.org.za

SAIEE
South African Institute of Electrical Engineers

The image of the iPad is not necessarily the model to be awarded.

Greetings to All. The Council of the Institute consists of Office Bearers, Committees and Sections. I wish to speak about the Historical Section, which is ably chaired by Max Clarke. This section has accumulated about 5000 artifacts, 2500 engineering books, and 1500 journals and magazines, including Transactions of the Institute going back to our inception 103 years ago in 1909.

Such was the volume of items for the Institute's Museum and Library that a container had to be hired a few years ago. Still there was insufficient space and some of the artifacts had to be stored off-site. In 2009 the Historical Section motivated the construction of our new head office building so that Innes House, which housed our Administration staff, could be used to house parts of the Museum, Library, and meeting rooms. The new building was completed in 2011, and by the beginning of this year Innes House, which is a Herbert Baker building, was vacated.

The Historical Section then motivated a refurbishment project for Innes House, to Council, and the first phase of the project was approved. The second phase was approved in principle, and the requisite amount of money for this will be included in next year's proposed budget.

One may ask – why go to the expense and trouble of establishing this facility? It is said that a wise man learns from history. This is evident when one visits the existing museum to see how computers, lamps and mobile phones, amongst many other devices and equipment, have developed over the years. The science of electrical engineering is a relatively young one, not much older than the Institute itself. For example, one of the first transformers to be manufactured commercially was made in late nineteenth century by Westinghouse of America. The facility will be used for tours by secondary school learners, with the hope that more learners will be inspired to take up engineering as a vocation. Other historical interest groups will also be welcome, and in time we envisage a full-time curator will be appointed.

Two examples come to mind which demonstrate the rapid progress of technology.

In 1964, I was privileged to have Professor Arthur Bleksley as my Applied Mathematics lecturer. In that year, there was no computer in the world which was powerful enough to plan the route of the Russian satellite – "sputnik". The professor, with his phenomenal brain, was hired by the Russians to do this task. Contrast the recent success of the Americans landing a roving camera on Mars. The computing power now available enabled them to land the craft at the exact planned location, and within eight minutes they were receiving photographs of the surface of Mars. This illustrates the extent of the development of computers, control systems, and drives, to mention a few of the technologies used.

The recent Olympic Games also illustrate the rapid development in telecommunications, and computing. One takes for granted that you see the full result of a race within a couple of minutes after the end of that race. The graphics used enhance one's understanding and viewing enjoyment. A gold medal can be won or lost by one hundredth of a second. This was dramatically illustrated by Chad le Clos when he beat the favourite, Michael Phelps to the gold medal by six hundredths of a second. In the early 1980's I was involved with swimming at national and provincial level. The timing equipment was only being introduced then, and was erratic at times. In a short space of thirty years this technology has been developed to be a reliable, accurate one, which is accepted by all.

I urge all of you to visit the Institutes current facilities, and to make sure that you see the new museum and library, when complete during the course of next year.

Mike Cary | SAIEE President 2012

WATTSHOT

In this issue, we feature some gadgets and gizmo's for the tech savvy!

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. Retail price R1,500.

GRIPPY PAD

Just like a gecko's amazing feet, the Grippy Pad will hold all sorts of things in place. And all without a single magnet, velcro strip, or sticky adhesive in sight.

By some marvel of manufacturing (don't ask) this advanced silicone material grips everything from iPads to Sat Navs. Just slap it on your dashboard and place your items on top. Like magic, they'll be held in place! Resistant to water, high temperatures and sunlight, it's perfectly at home on your dashboard. And it never needs replenishing - when the stickiness begins to wear off, just wipe it with a damp towel and it'll be as good as new. We're not sure if this works for geckos, too. Retail price R180.

PARROT 'AR.DRONE 2.0': HIGH-DEFINITION EXCITEMENT!

The Parrot AR.Drone 2.0, the new generation of Parrot's renowned high-tech quadricopter that can be controlled by Wi-Fi using a smartphone or tablet, is now available in South Africa.

With a new high-definition camera to enable you to take photos or record videos and the ability to easily share them plus a new piloting mode, increased stability and a brand-new look, the AR.Drone 2.0 offers an experience like no other! The Parrot AR.Drone 2.0 is proudly distributed in South Africa by SMAC, leaders in vehicle accessories and aftermarket products, now offering one of the most exciting products of the year. The AR.Drone 2.0 can be purchased online at www.smac.co.za or at leading IT stores for R3,499.

EZ ONE-HANDED BOTTLE OPENER

This has to be the latest and coolest gadget, for the coolest barman in the west. EZ One-Handed Bottle Opener's ingenious design means that only one hand is required to hold the bottle, open it and pour it. The bottle top is retained by a neat little magnet which is subtly housed on the inside of your opener, simply discard with your thumb, abandon the empty bottle and you're ready to go again. Ideal for restaurants, bars or at home. Selling pice: R95.

CAR CAMERA BLACKBOX DVR

Keep yourself protected from fraudulent lawsuits on the road with one of the most advanced car DVRs ever: The Dual Camera Car Blackbox DVR with GPS Logger and G-Sensor.

The road is full of hidden dangers and bad drivers, that's why you need to keep a car blackbox DVR in place for those stingy insurance companies. Constantly on alert, this Car DVR is installed directly on the windshield and powers on automatically when the engine is on. Dual cameras record everything on the road as well as inside the car.

This Car Blackbox DVR is also immensely useful if you get in an accident and need to clarify immediately what has just happened to the officer. A built-in battery is included for you to detach the car DVR from your windshield and playback its video directly on the 2.7 inch LCD screen, Not only is this very useful to get indemnified instantly for small cases, but it'll save you (and your passengers) a potential headache. Selling price: R2,100.

TRUE UTILITY® FIRESTASH (MINI WATERPROOF LIGHTER)

This unbelievably small waterproof key-ring canister houses a fully working lighter that is ready to ignite at your command. Attach to your key-ring for essential outdoor use. Refill with standard lighter fuel.

FEATURES: Waterproof miniature capsule | Lightweight and small | Waterproof 'O' Ring | 20mm Split Ring | Key-ring Attachment included | Selling Price: R145.

WATTSHOT

FITFLOP SUPERTONE SNEAKER

Bored with your usual sneaker? Looking for stand-out trainers that add an instant dash of understated cool to your look? Look no further than the Supertone™ sneaker from FitFlop Footwear. With a selection of colours to suit your particular style, this summer you can wear a pair with every outfit.

The nubuck Supertone™ (R1 329) is available in three colours: lake blue, boulder grey and slate grey. The versatile shoe will look great with your favourite jeans and blazer during the work week, or paired with a pair of cargo pants over the weekend. The canvas Supertone™ (R1 109) sneaker in grass green will add a bit of colour to the wardrobe of those men who veer towards the brighter side, however, if you prefer a more neutral approach to your shoes, a black canvas version is also available. For more information on FitFlops, or to locate the stockist nearest to you, visit www.fitflop.co.za,

DIGITAL LIGHTING ADVANTAGE

Samsung's LED lamps turn on instantly, are virtually UV- and infrared-free, and produce crisp light that increases style and decreases spend. Samsung bulbs consume up to 81% less energy, lowering costs, and last 36 years longer than the average bulb (based on 3hrs/day). Transition to LED is easy with Samsung bulbs, which have the same base measurement as traditional bulbs. They're non-dimmable, light up instantly, and contain no harmful substances. Samsung bulbs emit flicker-free, UV-free light and are great for track and general lighting.

FEATURES | Digital Lighting Advantage | Economical and Long-Lasting | Convenient and Safe | Versatile Usage | For more info, visit www.samsung.com

GROOM MATE® PLATINUM XL™ NOSE & EAR TRIMMER (LIFETIME WARRANTY)

The Groom Mate Platinum XL nose & ear hair trimmer is our best selling battery-free trimmer. The vast majority of our customers agree that the Platinum XL is far superior to any battery operated model. We offer an unconditional lifetime warranty on the Platinum XL which simply means that you should never have to purchase another nose hair trimmer. The patented rotary cutting blades are guaranteed to never come in contact with the sensitive areas of your nostrils and your hairs are gently trimmed, not pulled like most of the battery models available. The Platinum XL nose hair trimmer is made from solid stainless steel and is guaranteed to never rust or corrode. Clean-up is easy; simply hold the Platinum XL under running water to rinse out the hairs or for more thorough cleaning simply remove the small set screw to remove the inner shaft. R398 (incl.)

The products in the **watts**hot *section can be purchased online on www.mantality.co.za unless otherwise specified.*

WATTSUP

POWERTECH TRANSFORMERS ACQUIRES CPD POINTS FOR TRAINING COURSE

Powertech Transformers, a subsidiary of Powertech and the JSE listed Altron Group, recently announced that its Transformer Manufacturing and Design training course has been accredited by the South African Institute of Electrical Engineering (SAIEE). The training course has been awarded 4 (four) Continuous Professional Development points (CPD) and stretches over a period from July 2012 until June 2015.

The course, which includes both practical and classroom training over 5 days, covers various aspects of transformer production, inter alia: design processes (both electrical and mechanical); tank fabrication; insulation; paper-lapping; core-cutting; core stacking, winding manufacture; winding assembly; active part assembly; oil processing tanking; quality assurance and control; factory testing, protection components, first line maintenance, transport and dispatch of the transformers and research and development.

Bernard Meyer, CEO Powertech Transformers says, "As a Proudly South African Original Equipment Manufacturer, it is of utmost importance that we fulfill our duty to train and develop local talent.

Training will predominantly be provided to our customers with the ultimate objective to grow the 'informed buyer' base in the Country. This initiative will be expanded to our key suppliers and service providers, further enhancing the value chain."

Powertech Transformers manufactures power and distribution transformers for Sub Saharan Africa at its operations in Pretoria West, Cape Town and Johannesburg. The Pretoria West facility is the biggest and most sophisticated transformer manufacturing plant in the Southern Hemisphere and one of the largest in the world. Powertech Transformers Pretoria manufactures 20MVA (mega volt ampere) to 800MVA transformers with a primary voltage up to 500kV (kilo volt).

The Johannesburg operation manufactures 100kVA (kilo volt ampere) to 20MVA transformers with a primary voltage up to 132kV. It also produces neutral earthing resistors, compensators, and NECRT combinations, as well as 100kVA to 3150kVA dry type transformers with a primary voltage up to 36kV.

The Cape Town operation manufactures 16kVA to 1000kVA transformers with a primary voltage up to 36kV and 200kVA to 2500kVA miniature substations with a primary voltage up to 36kV.

SAIEE CPD COURSES

The SAIEE took its yearly courses down to East London during the first week of June 2012. This year we held Prof. Piet Swart's 3 day POWER SYSTEM HARMONICS course and PV Enterprises' 2 day PHOTOVOLTAICS SOLAR SYSTEMS course. Both courses were very well attended and were a great success. The SAIEE also organised an in-house training for ESKOM on TECHNICAL DOCUMENT WRITING.

Two new successful courses were also held during June in Johannesburg; these being the MICROSOFT EXCEL FOR ENGINEERS course and Viv Cohen's LV PROTECTION course. The Microsoft Excel Course was fully booked and very well received. Viv Cohen's courses of course are always sought after.

In July the SAIEE took its yearly course down to Bloemfontein during the 2nd week. This year we held the very popular and topical PHOTOVOLTAIC SOLAR SYSTEMS course, which was fully booked. The PHOTOVOLTAIC SOLAR SYSTEMS course was then run in Johannesburg to an over-booked enthusiastic audience. A new course on ELECTRIC ARC FLASH SAFETY presented by Zarheer Jooma was held towards the end of the month.

PROF LJ GROBLER APPOINTED AS DEAN OF FACULTY OF ENGINEERING NWU

The Southern African Association for Energy Efficiency (SAEE) is proud to announce that its President, Prof LJ Grobler, is appointed as Dean of the North West University's (NWU) Faculty of Engineering.

After 16 years of service as professor in Mechanical Engineering at the NWU's School for Mechanical Engineering, Prof Grobler will assume his responsibility as Dean from 1 September 2012. As a Mechanical Engineer from the University of Pretoria, and Pr.Eng with the Engineering Council of South Africa, he has unsurpassed experience in the academic, consulting, as well as commercial and industrial spheres relating to mechanical and energy engineering.

He obtained his PhD, specializing in retrofitting of commercial buildings with emphasis on energy management and indoor comfort, is a Certified Energy Manager (CEM®) and a Certified Measurement and Verification Professional (CMVP®) and has trained over 600 individuals in the internationally recognised Association of Energy Engineer's (AEE) CEM® programme through the local approved trainer, the Energy Training Foundation, a division of Energy Cybernetics. He was the 2007/8 President AEE based in Atlanta, USA - the first non-American to become president. The SAEE is the local chapter of the AEE.

Bringing in renewed energy into the Faculty, Prof Grobler said, *"It is an honour to receive such a platform where I have the opportunity to utilise my experience gained to facilitate in the development of the engineering skills that are of dire need in our country."*

More recently Prof Grobler won the Industry Leader Award at the Green Supply Chain Awards in recognition of the significant contribution he has made toward the industry.

Under his leadership as SAEE President he has placed South Africa on the map internationally by steering the SAEE to win the Best International Chapter award from the AEE for 2 years in a row.

WATTSUP

CLOUD IS RELIANT ON THE DATA CENTRE

It is often said that central to cloud computing is the notion of location independence. You don't need to know where the infrastructure supporting the cloud sits, and you don't care.

As long as the cloud delivers computing and storage capacity to the end user as well as access to application software and databases, all within an expectation of a high degree of reliability and redundancy, the end user no longer has to think about the data centre.

Following the ITWEB Cloud & Virtualisation Conference held in Johannesburg in July, it was obvious to me that too little time is spent thinking about the back end infrastructure when it comes to cloud. Cloud offers the virtual delivery of data centre components: virtual servers and storage and virtual networking. The decision to house your cloud services operation, or actual cloud within a data centre should involve consideration of connectivity and down time, and the ability to match capacity with the requirement of the cloud.

In many respects, the concept of cloud and that of data centre colocation are alike in their cost saving benefits to the organisation.

Accessing business applications through the internet reduces IT expenditure and resource costs in the same manner as outsourcing your data centre requirements.

The cost of designing and building a data centre is one saving, but the benefits of vendor neutrality in a data centre and having access to numerous connections out of the environment is in most cases not possible for most in-house data centres.

Key to cloud offerings is connectivity. Connectivity to international providers like Seacom and WACS, mobile operators; Cell C, Vodacom and MTN, terrestrial networks including Telkom and Broadband Infraco and fibre infrastructure provider, Dark Fibre Africa will ensure cloud providers can reach their clients and that the client in turn has choice.

In a June 2012 article, the International Working Group on Cloud Computing Resiliency (IWGCR) were quoted saying that a total of 568 hours of downtime at 13 well-known cloud services since 2007 had an economic impact of more than $71.7 million dollars.

Lex van Wyk
Managing Director | Teraco Data Environments

Cloud reliability is not covered enough, and specifically not in reference to moving core applications into the cloud.

Outcomes from the ITWEB Cloud & Virtualisation Conference included the fact that cloud is now a mature technology.

Reports stated that it is no longer about whether companies need cloud services or not, but rather about what to deploy into the cloud first.

I would say that companies need to first ask who will provide the support and infrastructure behind your cloud or cloud services, and what is the connectivity available to such infrastructure to ensure limited down time?

CAREER PLANET LAUNCHES NEW 'CONNECTION TO OPPORTUNITY' WEB, MOBI & USSD SITES

Career Planet has launched their new groundbreaking web, mobi and USSD sites. This unique platform brings together opportunity seekers with opportunity providers, using state-of-the-art technology, all for free. Career Planet is an NGO that provides a wide range of free up-to-date opportunities for the young, unemployed market of South Africa through their web and mobi services. Users have access to career advice articles as well as jobs, bursaries, learnerships, training, internships, competitions and other opportunities. Candidates can create a CV, search for opportunities, plus there are of tools and tips to help users choose the right career and make a success of it. Help is also at hand for those starting their own business.

Career Planet's unique web and mobi sites are fully integrated with each other, and users have access to the same opportunities no matter which platform they prefer. *"This day is the culmination of many years' hard work,"* says Karin Fuchsloch, Career Planet CEO. *"We are passionate about bringing together people who have potentially life-changing opportunities and the desperate youth of our country. Technology has made this and more possible."*

Businesses, individuals and government can place their opportunities on the Career Planet website, and find suitable candidates who match their search criteria at the click of a button.

SAIEE VISIT TO SOUTH AFRICAN AIRWAYS TECHNICAL AREA

A group of about thirty SAIEE members visited some of the SAA technical areas in August. They were treated to a small insight of what goes on behind the scenes at the airport.

The guide, Jock, was knowledgeable and hugely entertaining. First he took the visitors to one of the Engine Shops, and they were shown a photograph of the intake of a jet engine, which had been destroyed by a bird strike. The extent of the damage was incredible. Stored in the first hangar facility were about twenty smallish old Pratt and Whitney, Rolls Royce and other engines, each having cost between 8 and 11 million dollars. They were of the type used on the Boeing 737 aircraft, but are noisy and not fuel-efficient. Modern jet engines have primary and secondary air streams, and constant research is undertaken by engine manufacturers to reduce noise and increase fuel efficiency. The large front section primary turbine blades, made from titanium, each cost about 30,000 US dollars. Every part of the aircraft is numbered, and only certified components may be used.

The Group were taken to another huge hangar used for maintenance on the more modern turbines for the newer generation of aircraft such as the Boeing 747's and the range of Airbus aircraft. These powerful new engines are about 3 to 4 meters in diameter, and at least that long. The thrust of these large jet engines ranges from 75,000 to 110,000 lb.

They visited the Auxiliary Power Unit (APU) workshop. These very noisy auxiliary jet engines are located in the tails of modern jet aircraft. Compared with the 17,000 rpm speed of the primary engine turbines, the APU turbine rotors revolve at 40,000 rpm. The APU's are only used when the aircraft is on the ground. They are there to provide air-conditioning ventilation for the seated passengers on the ground, and high air volume for starting up each main engine before taxiing and take-off.

Although there was no engine on test in the engine test bay, the visitors were taken to see the vast facility with its control room and muffling system. As much as four tons of fuel can be used in a single engine test.

Many of the group had never flown in an aircraft, so permission was given for the group to climb up into an Airbus and see the cockpit controls. The plane was being prepared for a flight that evening.

The final hangar visited was that of the Apprentice Training Centre. In it was a Junkers aircraft about 70 years old which elicited a great deal of attention. An Airbus, whose skin had been heavily re-worked, showed the extent of the quality of training done by the apprentices at the school.

SOUTH AFRICAN AIRWAYS

Selection of System Category

SANS 10139 is a standard for Fire Alarm system design, installation and servicing for fire detection for general buildings. A fire alarm system is generally required to be installed as part of fire certificate required by the Fire Precautions Act or the workplace regulations after an audit of a fire risk assessment.

In most instances, the specifiers or end users are unable to interpret the standards and the category of systems required, and any additional information that should be provided, when assessing a fire risk. It is therefore important that the fire alarm designers/installers have a good understanding of the category of systems that will generally be suitable. The guidance provided below has been provided to assist in the evaluation process.

CATEGORIES

A ***Category M*** system is generally sufficient to satisfy the requirements of fire safety legislation in workplaces in which no-one sleeps. In the case of premises in which people sleep, quite extensive automatic fire detection is normally required. Generally, this will be a ***Category L2*** or ***L1*** system.

In premises with cellular accommodation such as hotels, there is in fact, very little difference between a ***Category L2*** and a ***Category L1*** system. In a hotel or similar sleeping risk, the bedroom floors are generally protected by a system that is effectively equivalent to a ***Category L3*** system but additional detection is provided throughout the premises, thereby making the system a ***Category L2*** or ***Category L1*** system.

The least likely subcategory of ***Category L*** system to be specified would be a ***Category L4*** system, in which automatic fire detection is provided only in escape routes. To ensure adequate warning of occupants before escape routes are made impassable by the presence of smoke (as would normally be required in a sleeping risk), at least a ***Category L3*** system would normally be required.

There may be instances in which a ***Category L4*** system would be suitable; for example, whilst workplaces in which no-one sleeps need only have a manual fire alarm system to comply with the standard, some employers provide limited automatic fire detection to enhance the safety of occupants beyond the minimum legislation requirement. An example of this would be where employees might work alone in a large building after normal office hours.

If the offices are cellular in nature, a ***Category L3*** system becomes similar to a ***Category L1*** system, at a substantial expense, it is often debated that the installation of detectors within escape routes only provides significant improvement of the safety of those employees at a reduced cost.

It is becoming more and more common for automatic fire detection to be provided as a component of a fire engineering solution, often referred to as a Rational Fire Design in which a "bundle" of fire precautions is provided to conform with the life safety objectives of legislation without applying the Codes of Practice that apply under the legislation. Fire risk assessments carried out to satisfy legislation can also identify the need for some form of fire detection, perhaps within a localised area that does not always need to comply with the recommendations of SANS 10139-1 for a ***Category L1, L2, L3*** or ***L4*** system. In such an instance, this would be considered to be a ***Category L5*** system.

The purpose of a ***Category L5*** system is to support a specified fire safety objective or address a particular fire safety problem. It should, therefore, be possible to identify and document the exact objective that the ***Category L5*** system is designed to achieve. This is solely the responsibility of the fire safety specialist and is not something that should be undertaken by the designer of the fire alarm system.

Whilst not recommended, a ***Category L5*** system can, in some cases, become a very simple in design. An example would be where in the design of means of escape.

It should never be the case that a specifier simply calls for a ***Category L5*** system without information as to the areas that are to be protected by automatic fire detection. The fire alarm contractor should reject any request to conduct a risk assessment to determine the design of a ***Category L5*** system.

A thorough fire risk assessment is required to identify and determine the need for fire detection in specific areas. However, it does not necessarily follow that the need for a ***Category L5*** system arises specifically from a fire risk assessment.

Category P systems generally improve life safety within a building, however, this is not their primary objective which is to provide protection of property or protection against interruption to the normal operations of the company as a result of fire.

By providing early detection of a fire and enabling rapid extinguishment, ***Category P*** systems, as in the case of any automatic fire detection system, also protect the environment by minimising the pollutants that are often produced by a fire and the amount of contaminated fire-fighting run-off water. The highest level of protection, a ***Category P1*** system is generally provided, this is particular to buildings that house equipment and systems which are critical to the operations of the company.

In a ***Category P2*** system, fire detection is installed in areas of high fire hazard or in areas in which the risk to property or business continuity from fire is high. Typically this would be server/network rooms, electrical sub stations, etc.

This article will be followed with more specific guidance on the design and installations of systems necessary for compliance with SANS 10139-1 and associated standards.

Watch this space in the October issue of the wattnow magazine.

AFRICA ELECTRICITY

Global players in the power sector will converge at the Gallagher Convention Centre in Midrand, Johannesburg from 23-25 October 2012 for a three day showcase designed to bring together international suppliers of products and services envisaged to assist the Southern Africa region to develop its power utilities sector in an effort to facilitate and address the challenging issues of meeting demand, energy efficiency, distribution, transmission, generation, security of supply and cost efficiency.

For exhibiting enquires please contact the team on:
T 971 4 336 5161
E sales@africaelectricity.com

Register for free at www.africaelectricity.com/register

For more information visit www.africaelectricity.com

Brought to the continent by the organizers of the successful Middle East Electricity, Africa Electricity is a one-stop-shop for networking, conducting business and learning under the ambit of a comprehensive showcase for the power, lighting, renewable, nuclear and water sectors.

"Power and energy are crucial for the sustenance of the continent, and with current challenges in the sector, it is imperative that stakeholders come together in an effort to alleviate current and future challenges. Africa Electricity delivers a cost-effective sales and marketing platform and is an ideal way of bringing together buyer, seller, and product." says Anita Mathews, Exhibition Director.

A key feature of the showcase will be The BIG Debate, a meeting place for industry stakeholders to discuss matters of key importance. The 2012 edition of the debate will feature several highly esteemed professionals and academics who will discuss, debate and deliberate with the audience on the key issues surrounding South Africa and the rest of the continent's current energy status.

Confirmed speakers include:
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Towards A Transient Earth Fault Clearing Scheme For Medium Voltage Networks

This article describes the design principles and physical implementation of an improved transient earth fault clearing method on medium voltage (MV) networks (1 kV < MV < 44 kV). Test results and operating performance statistics are provided.

BY | J.P. SCHOLTZ **|** PR.ENG **|** MSAIEE

Clearing an earth fault (EF) in existing Eskom low resistance earthed medium voltage (MV) networks is achieved by opening a 3-phase feeder circuit breaker, a downstream auto recloser or a downstream fuse. Existing protection does not discriminate between transient and permanent EFs, with the consequence that customer supplies are interrupted by protection operations for every transient EF, at least for the time taken for the system to reclose and restore supply.

An interruption of less than 5 minutes is regarded as a momentary supply loss, as defined by NRS 048-6:2006. Eskom's own distribution network key performance (KPI) standard, however, is much stricter and specifies momentary interruption duration as a supply loss of < 2 minutes for supply voltages ≥ 1 kV. Thus supply losses < 2 minute is not officially regarded as an outage by Eskom, and therefore does not count against any KPI. However, any supply loss longer than about 50 ms results in computers resetting, bottling plants stalling and water pumps stopping due to motor contactors dropping out. From a utility's point of view this may not be a major problem, but for farmers to manually restart water pumps may be costly and time consuming, especially on large farms with many pumps. Similarly, uncontrolled production line stoppages in bottling and other processing plants can cause material losses and/or equipment damage.

It has been well documented that 50% to 80% of all MV network faults are EFs, both transient and permanent [6, 7 & 8]. About 70% to 80% of these EFs are transient in nature [1 & 2], which may be extinguished by interrupting the fault current for a short period, say 10 s, thus allowing the object causing the fault to fall free or move away from the contact point, and ionized air to clear from the fault path.

Based on the above facts that about 56% of all MV network faults are transient EFs and could be cleared by momentarily interrupting the EF current a method of transient EF clearing, without customer supply interruption, has been devised, tested and implemented.

This method entails instantaneous interruption of an EF current upon detection, by disconnecting the medium voltage neutral-to-earth connection for a defined period, allowing a transient EF to clear. Through this action the solid or low resistance earthed network is temporarily converted into an unearthed network. This method is called the transient earth fault-clearing scheme (TEFCS).

THEORY OF THE TEFCS

Typical EF pick-up settings on Eskom's low resistance earthed MV feeders are 40 to 80 A, and 4 to 15 A for sensitive earth fault (SEF). (All voltages and currents referred to are in RMS values, except where indicated as peak values.) The EF protection usually operates on a normal inverse definite minimum time lag characteristic, and the SEF operates on a definite time delay of between 5 and 15 s.

The minimum auto-reclose dead time is normally not set below 3 s. Through the years Eskom has found dead times shorter than 3 s tend to result in a larger number of unsuccessful auto-reclose operations, presumably because there is insufficient time for ionized air to disperse.

Implementing a TEFCS is achieved easily in Eskom's MV networks by temporarily disconnecting the neutral-to-earth connection of the neutral earth compensator with fault current limiting resistor (NECR) in the source substation. In practice, a fast acting circuit breaker is installed between the NECR neutral and the substation earth. By implementing the neutral circuit breaker (NCB) it is envisaged that most transient EFs on any part of the complete MV network will be successfully cleared, without any customer supply interruption.

The NCB principle may also be applied to a solidly earthed network provided that the EF current is interrupted sufficiently quickly to reduce ionization of air and fault point damage by the high EF current. Also, implementing a TEFCS on a solidly earthed network requires all network equipment to be insulated from earth for the full phase-to-phase voltage. Protection grading with the TEFCS may be problematic due to high EF currents.

Opening the neutral circuit breaker temporarily converts the network from a solid or low resistance earthed network to an unearthed network for the duration of the dead time of the neutral circuit breaker. The NCB dead time will initially be set at 10 s to allow enough time for the cause of a transient fault to clear from the line.

The NCB must be adequately rated to carry the total combined EF current of

FEATURE

Towards A Transient Earth Fault Clearing Scheme For Medium Voltage Networks

continues from page 21

all NEC neutrals connected through it to earth, for the maximum protection operation duration, which will be dictated by the NEC or NECR rating. This is particularly important for solidly earthed networks where high EF currents are expected.

The NCB protection pick-up setting must be set lower than the lowest SEF setting implemented on the whole MV network, connected to the same busbar as the NECR, as it must operate proactively for EFs that might develop into heavier current faults.

TEFCS operation is based on the property of an unearthed (isolated neutral) network with a single phase-to-earth fault having no fault current, except for a small capacitive current (magnitude is network length dependent) due to an unbalance in line capacitance to earth. During such an EF the whole system remains operational until another fault occurs on another phase, resulting in significant phase-to-phase fault current [3, 4, 5].

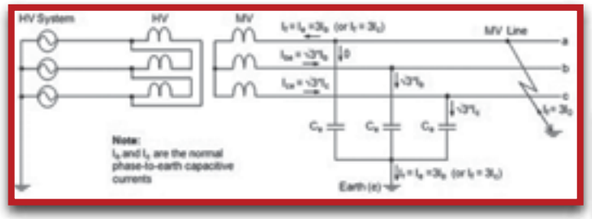

Figure 1
Capacitive currents in an MV network with isolated neutral during an EF.

Success of the TEFCS depends mainly on the type of EF, speed with which the protection and NCB operate to minimize the amount of ionized air, and on how quickly the object (tree branch, animal, etc.) causing the fault is moving away from the live equipment to establish safe clearance before the neutral earth connection is restored.

A person making contact with live MV apparatus without immediately falling free has a low chance of survival. According to IEC 479-1, 500 mA through a human body for more than half a second will be fatal in all contact incidents. Therefore, as far as human and animal life is concerned, the safety risk associated with the TEFCS approach is not higher than that of existing MV networks, and might be improved by fast NCB operation.

TEFCS TEST INSTALLATION

The proposed TEFCS has been implemented on one of Eskom's 3-wire overhead 11 kV networks in order to evaluate the performance of such a scheme. Total length of the combined backbone and spurs is 217 km of delta configured (A-frame) line construction on wood poles.

The source substation has two 66/11 kV 10 MVA YNd transformers feeding the 11 kV busbar, which has a normally closed bus section breaker. Each transformer has an NECR on the MV side in order to provide a network neutral earth point for MV EF detection. The neutral resistor limits the EF current to 360 A per NECR. The 11 kV network consists of four lines with a total of 456 pole-mounted delta/star connected 11 kV/400 V distribution transformers ranging in size from 16 to 500 kVA, and a few 1 MVA ground mounted transformers.

A neutral voltage shift on the MV network will not affect the customer's LV voltage levels due to the Dyn distribution transformers.

The AC key diagram of the TEFCS trial site substation is depicted in Figure 2. Three of the MV feeders are overhead and one is a partial overhead/cable feeder.

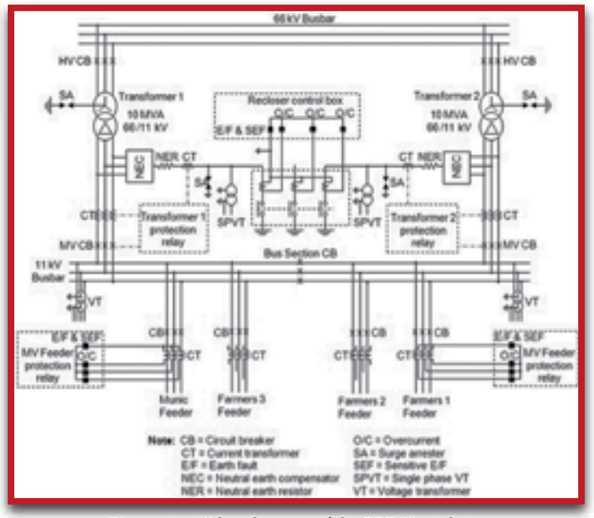

Figure 2 *- AC key diagram of the TEFCS trial site.*

One major advantage of the Eskom MV overhead networks is that they are all fully insulated for phase-to-phase voltage, i.e. all line insulators, all equipment connected to the lines and all substation equipment are all rated to withstand normal phase-to-phase voltage to earth. NECR neutrals are fully insulated for normal phase-to-neutral voltage.

All 11 kV pole-mounted line equipment is required by Eskom standards to be fitted with gapless metal-oxide surge arresters (MOVs) rated 12 kV maximum continuous overvoltage (MCOV) and 10 kA peak value lightning current impulse (In). It is envisaged that these surge arresters will all contribute to quenching any prospective overvoltage spikes that may be generated by arcing EFs.

For the TEFCS, the two NECR neutrals have been protected with gapless 6.6 kV metal-oxide surge arresters (MOVs) rated MCOV=8 kV and In=10 kA peak.

A standard 3-phase pole-mounted auto recloser has been installed as the neutral circuit breaker. Two single core 11 kV XLPE cables were used to connect the two NECR neutrals to two poles of the auto-recloser.

At a location selected for fault throwing tests one side of a fuse cut-out fitted with a solid link was connected to the B-phase of one of the four overhead lines, and the other side was connected to an arcing horn. The other side of the arcing horn was connected to an earth electrode with 90-ohm resistance to earth. The cutout and arcing horn were used to physically apply EFs to the network, as illustrated in Figure 3.

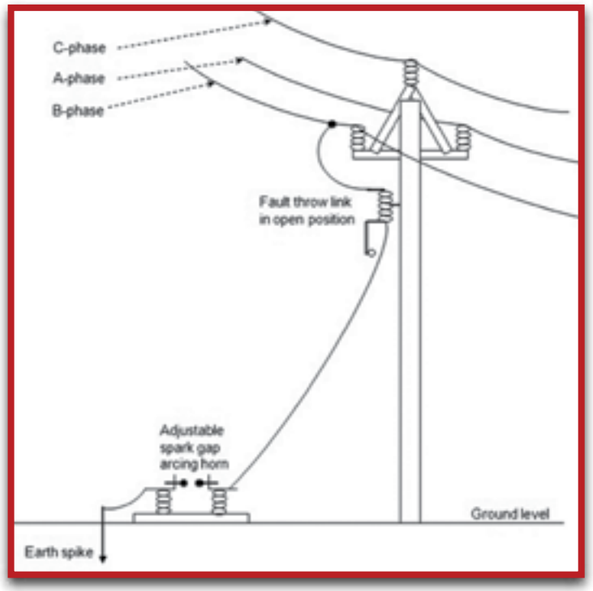

Figure 3*- Fault throw test installation with cutout and arcing horn.*

Physical selection of the TEFCS trial site was based on the following criteria:

- Stakeholders of this specific Eskom substation and 11kV network are supportive of trying a new method of EF clearing that may reduce nuisance network operations and improve customer supply quality.
- It is a rural network within reasonable distance from the main regional technical centre, making it easy to attend to possible problems and visit the site regularly during the trial period.

TRIAL SITE COMMISSIONING TESTS

Single phase EFs were initiated by means of a thin wire strand (0.2 mm diameter) bridging the adjustable spark gap of the arcing horn and closing the link.

With the neutral circuit breaker open a solid EF was applied to the B-phase to show that the two healthy phase voltages would rise to normal phase-to-phase voltage to earth, and that the NECR neutral-to-earth voltage would rise to normal phase-to-neutral voltage to earth during an EF as depicted in Figure 4, with the results shown in Figure 5.

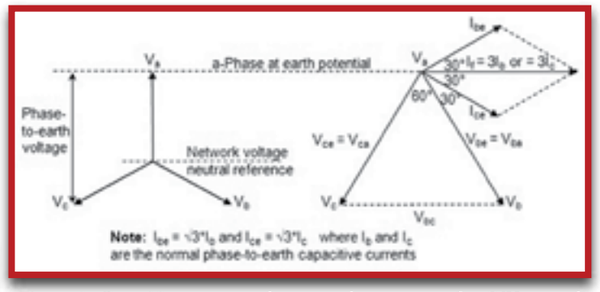

Figure 4 *- Capacitive current and system voltage vectors of an MV network with isolated neutral during an a-phase-to-earth fault condition.*

With the NCB in the open state and no EF applied the 11kV busbar phase-to-earth voltage stayed unchanged, and the NECR neutral-to-earth voltage remained at zero volts. Upon applying the B-phase EF at the fault-throw site, the R- and W-phase voltages at the source substation busbar (disturbance recorder installed on the busbar VTs) increased from normal phase-to-neutral voltages with respect to earth (6.35 kV), to 10.5 kV and 11.8 kV respectively with respect to earth.

The faulted phase voltage with respect to earth dropped from 6.35 kV to 1.35 kV, and the NECR neutral voltage increased to 6.3 kV with respect to earth. A capacitive EF current of 16 A was measured at the fault throw point.

The extent of overvoltage produced by arcing EFs was tested on the trial site network by establishing sustained arcing EFs using a 4 mm spark gap on the arcing horn, with the NCB in the open position. Capacitive EF current measured at the fault point during the tests was about 18.5 A.

Apart from the expected rise in healthy phase and NECR neutral voltages, the highest peak phase-to-earth overvoltage recorded by the disturbance recorders during the sustained arcing EF was 17.7

Towards A Transient Earth Fault Clearing Scheme For Medium Voltage Networks

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With the NCB closed a 4 mm spark gap flashed over spontaneously upon closing the fault throw link to energize the one side of the arcing horn.

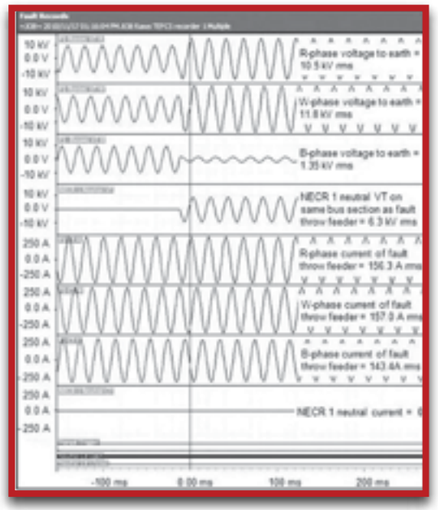

Figure 5 - Voltages and currents of the unearthed network before and after application of a solid B-phase EF.

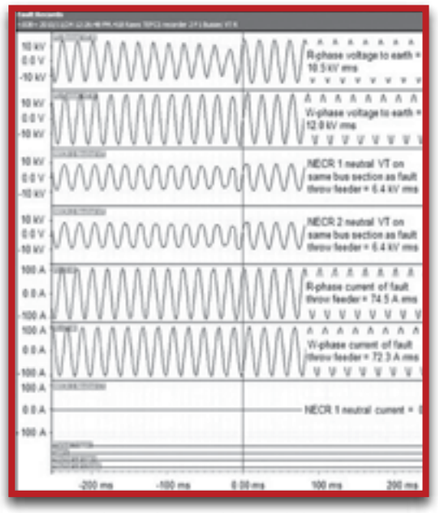

Figure 6 - Voltages and currents of the unearthed network during a sustained arcing B-phase EF.

kV. This is about 2.0 times the normal peak phase-to-neutral voltage.
Disturbance recordings for this test looked very similar to those of Figure 5 with slight distortion of the voltage waveforms of the healthy phases and the neutral voltages due to the arcing, shown in Figure 6.

Through further testing it was attempted to establish the effect of feeder length (influence of the network's phase capacitance-to-earth size) on the self-extinction of an arc across an air gap.

This could not be established due to the low capacitive fault current and the narrow spark gap adjustment range between spontaneous flashover (4 mm), compared with a spark gap of 6 mm allowing reliable arc quenching with all four feeders connected to the same busbar. This 2 mm difference was too small to be controlled with the crude arcing horn test rig adjustment mechanism.

Capacitive fault current measured at the fault throw point with all four lines connected was about 18 A, about 15 A with three lines, about 5 A with two lines and about 3 A with the fault throw line only. (Munic feeder =4.2 km; Farmers 1 = 90.8 km; Farmers 2 = 72.7 km & Farmers 3 = 49.8 km).

With all four lines connected, correct automatic operation of the TEFCS for transient EFs was verified by initiating arcing EFs by sweeping a green tree branch across a 5 mm spark gap on the arcing horn test rig. Sustained arcing across the spark gap caused the NCB to open in about 80 ms. The NCB closed after its 10 s dead time, resulting in successful clearing of a transient EF.

After the neutral circuit breaker opened, during one of the tests, arcing continued for up to about 5 s since fault inception. This resulted in the upstream auto-recloser tripping on SEF (4 A @ 5 s trip setting). It cleared the EF and locked out due to a one-trip-to-lockout setting. The neutral CB then closed about 5 s after the fault was cleared.

Figure 7 depicts a typical transient EF incident on the TECFS trial site. This fault was cleared within 300 ms.

OBSERVATIONS FROM TEST RESULTS

The most significant observation from the sustained arcing EF tests is that no potentially harmful overvoltage were experienced on the 11 kV network as 17.7 kV was the highest peak voltage encountered during the 10 s dead time of the NCB. As a comparison it may be noted that an 11kV circuit breaker may be pressure tested at 24 kV for 5 minutes.

From the commissioning tests it was found that SEF tripping of feeder CBs and auto-reclosers upstream of an EF is a real possibility during sustained arcing EFs as these protections operate on the residual current of the line. With the NCB open during one of the sustained arcing tests, one of the four feeders (not the fault throw feeder) tripped on SEF, after which all SEF protection upstream of the fault throw point, including the four feeder CB protections in the substation, were switched off in order to resume testing.

Seeing that it was found possible for feeder protection devices to operate on SEF during sustained arcing periods, with the NCB open, it may be concluded that there is not much sense in setting the NCB dead time much longer than the shortest SEF operating time on the given network. This may be to the detriment of clearing EFs as the time allowed for ionized air to blow away and the fault-causing object to fall away is now reduced by this dead time upper limit.

Using a pole-mounted auto-recloser as a NCB was effective and easily implemented as it is fully self-contained with its integrated protection. From a cost, commissioning and maintenance point of view it is a better solution than a conventional circuit breaker and protection that needs to be located in a relay house, requiring more cabling, space and commissioning labour.

With the NCB closed a 4 mm spark gap flashed over spontaneously upon closing the fault throw link to energize the one side of the arcing horn. A 6 mm spark gap allowed reliable repeated clearing of arcing EFs.

With a 5 mm spark gap it was possible to initiate sustained arcing EFs by bridging the spark gap with a thin wire strand before closing the fault throw link. Through automatic opening of the neutral CB upon fault inception, and closing after a 10 s dead time, the NCB operation successfully cleared the faults. From this then it may be deduced that a 5 mm gap is about the minimum size that might allow the TEFCS to clear a transient EF.

In practice the TEFCS would probably achieve much faster EF clearing times than conventional EF and SEF protection would manage for the same fault, especially for prospective high current EFs. This assumption is based on the fact that the EF current is reduced to a minimum level (capacitive line current only) within about 90 ms, the NCB opening time. This theory will be put to test in the TEFCS trial site.

It should be noted that successful clearance of transient EFs downstream of fuses would depend on the fuse size and fault current magnitude. Fuse saving may take place for low magnitude EFs.

For example, in the case of the EF depicted in Figure 7 (with two NECRs sharing EF current, total current is 2x 104.3 A = 208.6 A), the EF protection relays would have tripped the feeder circuit breaker in about 1.5 s, which is five times slower than the 300 ms within which the TEFCS cleared the fault. In principle, this faster clearance should increase the possibility of a human or animal surviving a contact

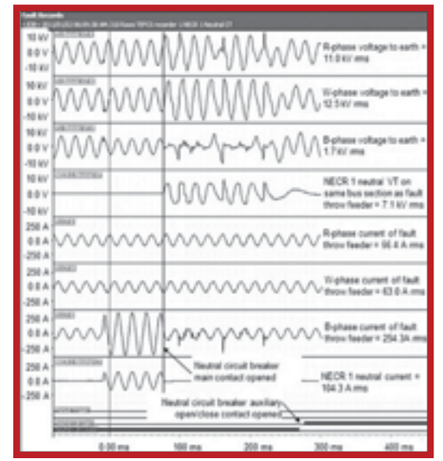

Figure 7 - Typical EF clearing by the TEFCS. Note that the actual EF current is double that indicated for NECR 1 as a similar magnitude current is flowing in the NECR 2 neutral. Total EF current = 208.6 A.

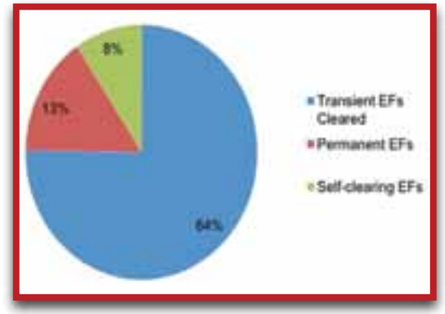

Figure 8 - EFs encountered by the TEFCS trial site network.

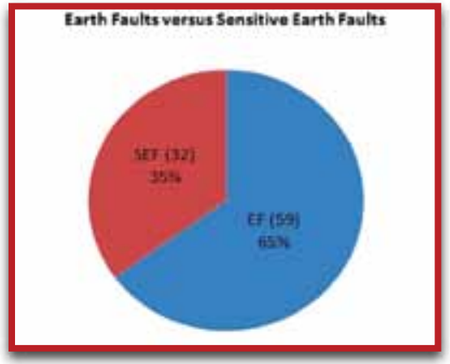

Figure 9 - Breakdown of EFs (>10 A) and SEFs (<10 A) for the 91 network faults that involved earth.

Towards A Transient Earth Fault Clearing Scheme For Medium Voltage Networks

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Physical fault throw tests on a 217 km, low resistance earthed, MV network indicate that TEFCS neutral switching is a potentially useful method of clearing transient EFs.

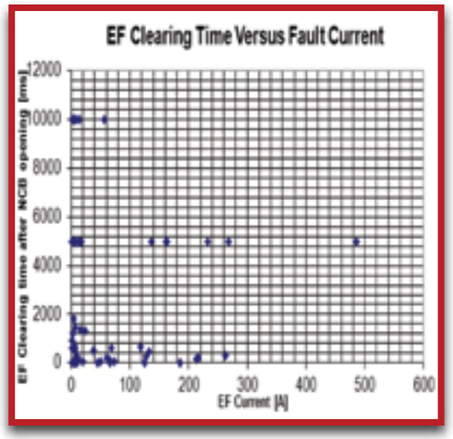

***Figure 10** - Distribution of clearing times of 58 transient EFs cleared by the TEFCS. Maximum EF current successfully cleared was 486 A.*

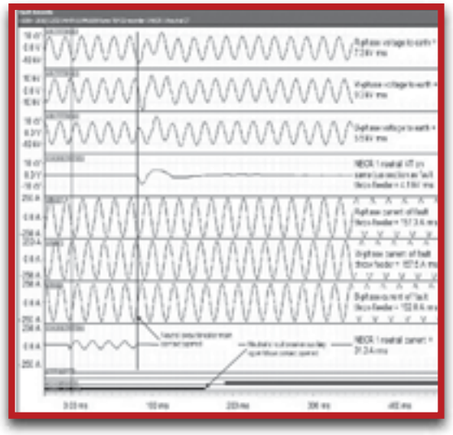

***Figure 11**- B-phase fault cleared in 215 ms. NCB main contacts opened in about 85 ms. Note that the NCB's auxiliary status contact lags the main contact by about 85 ms. The total EF current is 62.6 A due to the two NECRs.*

incident, and reduce the extent of injury. The TEFCS may therefore be viewed as an additional protection "layer" below the conventional protection "layer", which will increase quality of supply, and may improve the survival rate of, and injury to animals and humans coming into contact with live apparatus.

TRIAL SITE OPRATIONAL DATA AND DISCUSSION THEREOF

Over a 15 month period stretching from 24 November 2010 up to 14 March 2012 the 11 kV overhead TEFCS trail site network of 217 km experienced 91 EFs of which 58 (64%) were cleared by the TEFCS, 7 (8%) transient EFs cleared before the NCB could physically open, and 26 (28%) were permanent EFs for which a fuse operated or a CB tripped and locked out. It has been confirmed that 4 of the 65 transient EFs (58 + 7) cleared by the TEFCS were due to lightning, but there may have been more EFs due to lightning. These EF statistics are graphically presented in Figure 8.

From the above it may be deducted that 72% of all network EFs were transient in nature, thus correlating well with internationally claimed figures.

Out of the 91 EFs, 24 (26%) had fault currents >100 A. For more detail see Figure 10 as it graphically presents the EF current versus fault clearing time for all 58 transient EFs cleared by the TEFCS during the abovementioned period.

The highest EF current successfully cleared by the TEFCS is 486 A, while the highest recorded fault current thus far was 841 A (permanent EF). Only 3 of the 32 SEF faults indicated in Error! Reference source not found. were permanent faults with magnitudes of 2 A, 4 A and 6 A respectively.

Fault Current Magnitude	Number of Faults Out of 91	Number of Faults in %
<5 A	14	15
<6 A (Feeder SEF setting)	19	21
<10 A	31	34
<20 A	43	47
<50 A	52	57
<60 A (Feeder EF setting)	55	60
<100 A	62	68
<150 A	70	77
<200 A	73	80

***Table 1:** Number of EFs, out of the total number of 91, with magnitudes below a given threshold.*

23 of the 59 EF faults were permanent faults, ranging from 15 A to 841 A.
From Table 1 it may be seen that 21% of EFs were below the 11 kV feeder SEF pick-up of 6 A, and 60% of EFs were below the 60 A EF pick-up. For this network then 60% of the total number of EFs encountered by the network would have been cleared by SEF protection under normal conditions, all resulting in trip delays ≥ 6 s and possible escalations to phase-to-phase faults. As indicated in Figure 10, most EFs were cleared by the TEFCS in < 2 s. From a safety point of view this constitutes a dramatic improvement.

Figure 11 through to Figure 15 are fault recordings obtained from the TEFCS trial site and are included here to indicate the network behaviour before, during and after NCB opening.

It should be pointed out that the disturbance recording depicted in Figure 12 is from a second recorder and do not display exactly the same traces as being displayed by the other recordings. The actual trace designation appears on the right hand side of each trace, together with it rms value. The recording of Figure 11 is typical of a fast clearing fault after closing of the NCB.

Figure 12's recording clearly shows the rise in the two healthy phase voltages from phase-to-earth voltage to full phase-to-phase voltage, and that of the NECR neutrals rising from zero to phase-to-earth voltage upon NCB opening during a B-phase EF condition.

It is of utmost importance to note that these phase-to-earth voltage fluctuations are completely transparent to the customers as all distribution transformers are of the delta/star type, which implies that the LV voltage is only dependent on the MV phase-to-phase voltage. This has been verified by the installation of a number of quality of supply recorders on the LV circuits at different transformer locations.

Figure 14 depicts similar traces to that of Figure 12, except that the phase-to-neutral voltage of the faulted phase is also present in the recording.

The traces of Figure 15 are from one of the 7 out of 91 transient EFs, which cleared by itself before the NCB physically had the time to open.

CONCLUSIONS

Physical fault throw tests on a 217 km (including all spurs), low resistance earthed, MV network indicate that TEFCS neutral switching is a potentially useful method of clearing transient EFs. This has been substantiated by 15 months of operational data obtained from an 11 kV TEFCS trial site.

A significant finding during the commissioning fault throws, and subsequent operation of the TEFCS trial site, was that no extremely high over voltages of

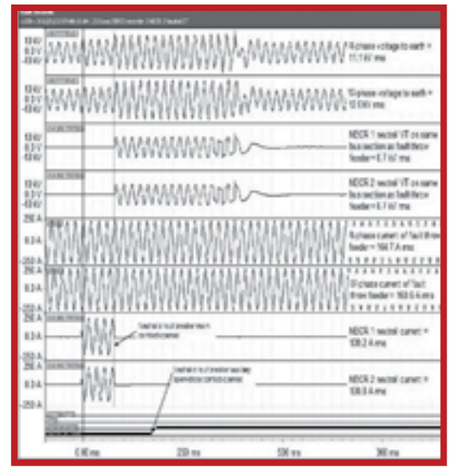

***Figure 12**- B-phase fault cleared in 392 ms. NCB main contacts opened in about 89 ms. Note that the NCB's auxiliary status contact lags the main contact by about 100 ms. The total EF current is 270 A due to the two NECRs.*

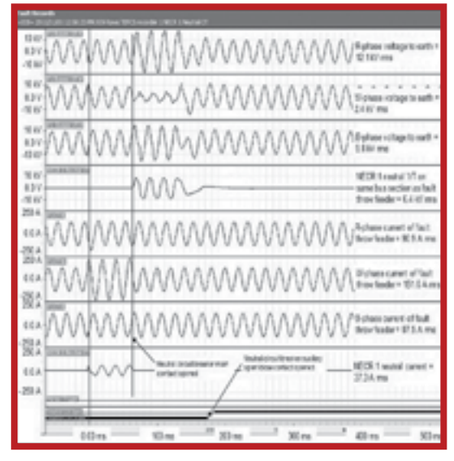

***Figure 13**- W-phase fault cleared in 220 ms. NCB main contacts opened in about 75 ms. Note that the NCB's auxiliary status contact lags the main contact by about 110 ms. The total EF current is 75 A due to the two NECRs.*

Towards A Transient Earth Fault Clearing Scheme For Medium Voltage Networks

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Currently three 22 kV TEFCS trial sites have been commissioned on networks with lengths ranging from 17 km to over 500 km.

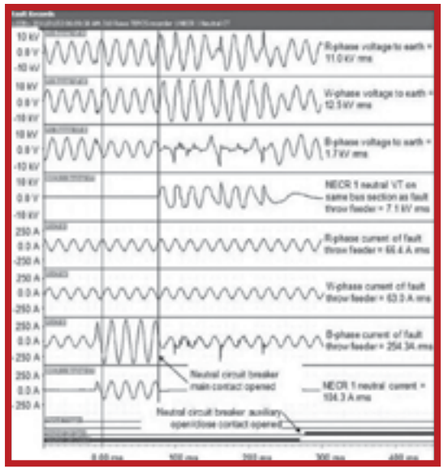

***Figure 14** - B-phase fault cleared in 242 ms. NCB main contacts opened in about 98 ms. Note that the NCB's auxiliary status contact lags the main contact by about 200 ms. The total EF current is 208 A due to the two NECRs.*

***Figure 15** - R-phase fault cleared in 71 ms, about 25 ms before the NCB main contacts opened. NCB main contacts opened in about 86 ms. Note that the NCB's auxiliary status contact lags the main contact by about 80 ms. The total EF current is 215 A due to the two NECRs.*

between 3 and 6 times normal phase-to-earth voltages were established on the healthy phases during the applied arcing EFs, as predicted by some technical papers [9 & 10]. The highest peak voltage encountered thus far during a network fault was a peak phase-to-earth voltage of 20.4 kV, which translates to an overvoltage of about 2.3 times the normal 11 kV peak phase-to-neutral voltage, was briefly recorded on the 11 kV network during one of the sustained arcing fault throw tests.

Thus far the trial site has shown that nuisance interruptions due to transient EFs could be reduced to zero. As a result of the reduction in nuisance trips customer supply quality has improved.

Fewer supply outages will reduce customer losses in bottling plants for instance, reduce computer data losses, prevent cleaning out and restarting of crusher plants, etc.

Due to "instantaneous" tripping of the NCB, the TEFCS may also enhance the safety of humans and animals through fast fault clearance.

Based on commissioning test results and subsequent operational data from the TEFCS trial site, it is concluded that the TEFCS has the possibility to reduce nuisance tripping on 11 kV overhead networks by up to 70%. This should be motivation enough to implement such schemes throughout the Eskom's 11 kV networks.

Currently three 22 kV TEFCS trial sites have been commissioned on networks with lengths ranging from 17 km to over 500 km. Similar performance trends are being noticed, but with about a 50% EF clearing success rate, compared to the 11 kV trial site's 70% success rate. The oldest 22 kV trial site has been in operation for about 8 months and the latest one was commissions a few months ago. These trial sites will have to be in operation for at least another year before a well informed decision could be made, but the limited operational results obtained thus far is very promising. wn

ACKNOWLEDGEMENTS

Eskom Distribution, Western Region provided the resources needed to successfully establish a trial site to test the TEFCS concept on a typical rural MV line.

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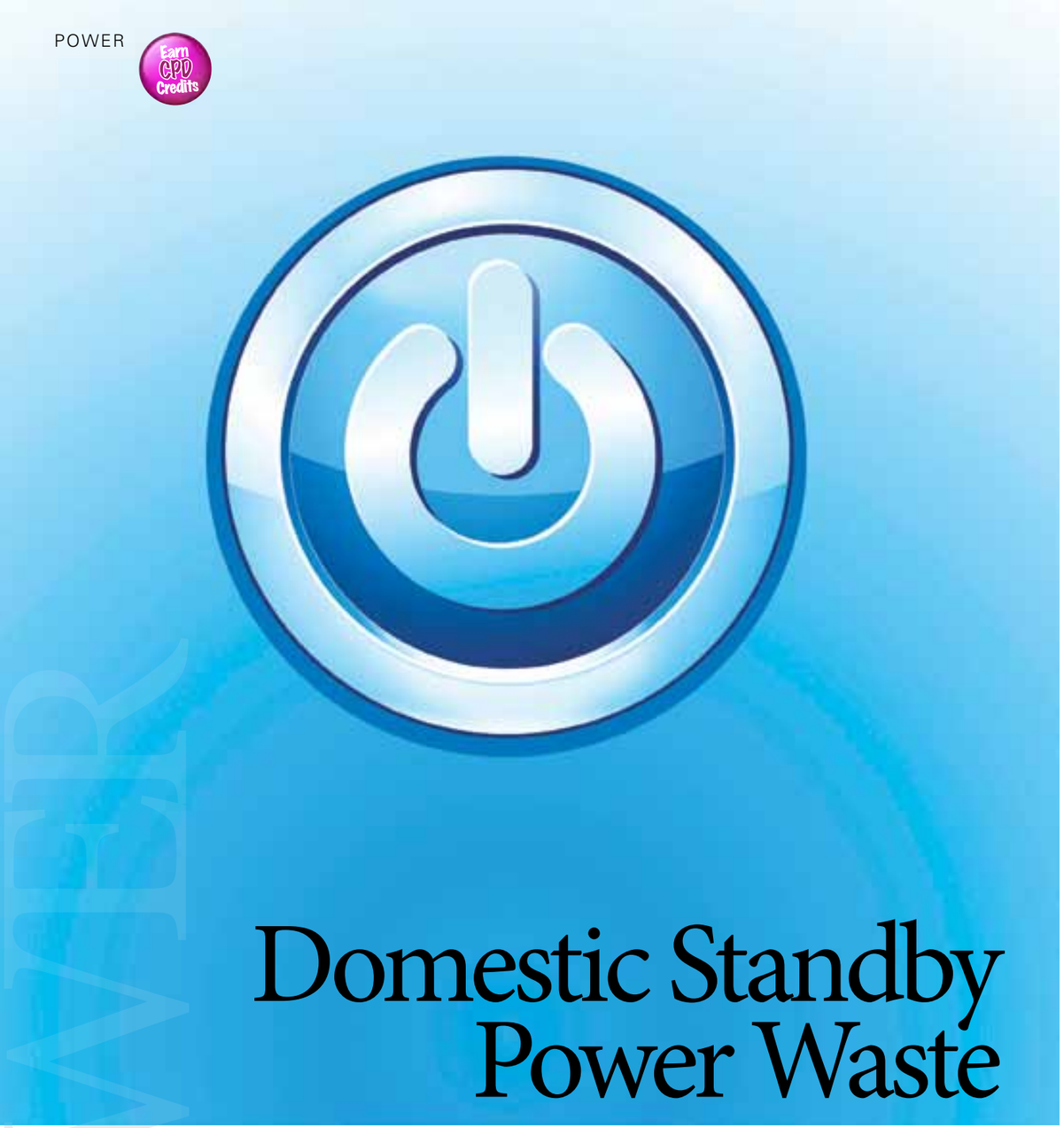

Domestic Standby Power Waste

Standby power, vampire power, vampire draw or phantom loads is the amount of electricity that is consumed by equipment that is on standby mode or turned off. In recent years, with the increasing number of electronic gadgets in households, the amount of standby power consumed has increased to a level where the collective energy waste has actually become a considerable amount.

BY | STUART BATCHELOR
PR.ENG | BSc (HONS) Mechatronic Eng | CEM | CMVP | MSAIEE

Standby power consumption can be found in almost all modern household appliances and is mainly due to the following functions:

- Battery charging
- Instant on or remote control capability
- Poor power supply design
- Memory retention
- Digital clocks
- Displays (LED's/LCD)

In light of the energy crisis that South Africa is experiencing with a very stressed national grid, this article looks at a couple of the common household appliances to see what affect they are having and how much power is actually being wasted. This article is purely a discussion piece and the accuracy of the researched consumption data has not been verified.

COMMON DEVICES STANDBY POWER CONSUMPTION

The Lawrence Berkeley National Laboratory conducted numerous tests on a range of domestic appliances and the following table shows an average of the largest 10 common domestic standby power consumers:

Table 1 shows that many common appliances consume a significant amount of power when not in use. On the positive side, a lot of this wasted power can quite easily be saved with very little effort. Desktop and Laptop computers for example can be set to turn off automatically after a period of no activity. More alarming are the devices which are not usually turned off properly, but rather just switched off using a remote or left to go into an idle/standby state.

This leaves a large amount of power being drawn that actually has no real value. The magnitude of this waste, the associated cost and the effect they collectively have on the National grid are further investigated below:

CELLPHONE CHARGER

One of the most commonly discussed standby power culprits is the cellphone charger. There have been many discussions, comments and requests for users to unplug their cellphone chargers when not in use, but how much power does the unused charger actually use?

In November 2008, the world's five largest mobile phone makers announced a rating system to identify energy efficient chargers. The standby power (no load) consumption rating tool was based on the following:

No star	> 0.5W
1 Star	0.35W – 0.5W
2 Star	0.25W – 035W
3 Star	0.15W – 0.25W
4 Star	0.03W – 0.15W
5 Star	< 0.03W

Product	Mode	Wattage
Computer, desktop	On, idle	73.97
Amplifier	On, not playing	33.99
DSTV PVR decoder	Standby	33.90*
Computer, desktop	Sleep	21.13
DSTV decoder	Standby	20.80**
Computer, laptop	Sleep	15.77
DVD/VCR	On, not playing	13.51
Computer Display, CRT	Sleep	12.14
Computer, laptop	Off	8.9
CD Player	On, not playing	8.62

**DSTV PVR reading from the Multichoice website, model Pace TDS850IMC*
*** DSTV standard decoder results from Mercy Violet Shuma-Iwisi doctorate thesis*

All 5 manufacturers have been actively trying to optimise their chargers to a higher rating and most modern chargers rate 3 stars or better. Mercy Violet Shuma-Iwisi conducted in-depth research into standby power in South Africa in her doctorate thesis and found from a large sample base that the average cellphone charger standby power consumption was only 0.2W. The annual cost of leaving your charger permanently plugged in (at the current City of Cape Town domestic electricity tariff - R1.0743/kWh) is shown below:
0.0002 kW x 24 hours x 365 days x R1.0743/kWh = R 1.88 per year

Although the individual cost and power wastage is very small, there are a huge number of cellphone chargers and their collective wastage could be significant. According to a Wikipedia article citing www.cellular-news.com, the number of active cellphones in South Africa in 2008 was 42,300,000. Assuming these all have chargers left plugged in, the collective wasted power could be as much as 8,46MW. While this may be a significant over estimation, it still provides a good indication of the collective effect.

Although the collective waste of power is significant, it is difficult to convince the public to unplug these devices due to the very small individual costs and savings. If any significant domestic standby savings are to be achieved, it may be better to look at other larger standby power culprits.

COMPUTER EQUIPMENT

As can be seen in Table 1, computer equipment on standby consumes a large amount of power, and given the number of computers currently in the country, this might be the largest culprit. It is very difficult to estimate the number of computers, laptops or screens that are left

Domestic Standby Power Waste

continues from page 31

on standby, but the following calculations show the wasted power cost for each piece of equipment if left permanently on standby:

Table 2 clearly shows that computer equipment left in standby or idle mode consumes a large amount of power, and that the extra little bit of effort in turning un-used devices off daily will eventually add up to real cash savings.

All devices with automatic shut down should be correctly programmed and users should always try to remember to turn off after use rather than leaving devices to fall into standby/idle mode.

Product	Mode	Watt	Annual Cost left permanently on standby
Computer Display, CRT	Sleep	12.14	R 114.25
Computer Display, LCD	Sleep	1.38	R 12.99
Computer, desktop	On, idle	73.97	R 696.12
Computer, desktop	Sleep	21.13	R 198.85
Computer, laptop	Sleep	15.77	R 148.41
Computer, laptop	Power supply only	4.42	R 41.60
Modem, DSL	Off	1.37	R 12.89
Multi-function Device, inkjet	Off	5.26	R 49.50
Multi-function Device, laser	Off	3.12	R 29.36
Printer, inkjet	Off	1.26	R 11.86
Printer, laser	Off	1.58	R 14.87
Speakers, computer	On, no sound	4.12	R 38.77
Speakers, computer	Off	1.79	R 16.85

DSTV DECODER

Another large culprit listed in Table 1 is the DSTV decoder. Typically these devices are left on and the TV is turned off, but in some cases they too are switched off with a remote into standby mode. Assuming each subscriber watches on average up to 6 hours of TV a day, and then turns the decoder onto standby (realistically this is often not the case), this leaves all of these devices on for at least 18 hours of wasted standby per day. The annual individual cost of this wasted power consumption can be seen below:

Standard DSTV: 20.8 W x 18 hours x 365 days x R1.0743/kWh = R 146.81 per year

PVR DSTV: 33.9 W x 18 hours x 365 days x R1.0743/kWh = R 239.27 per year

It is easy to calculate the collective waste as the number of subscribers at any point is known. According to the DSTV financial statements from September 2011, there are a total of 3 697 000 paid subscribers, 571 098 of which are PVR subscribers. The national energy wastage would then be as follows:

20.8 W x 3,125,902 DSTV decoders	*= 65.02 MW*
33.9 W x 571,098 PVR decoders	*= 19.36 MW*
TOTAL	*= 84.37 MW*

To put that number in context, it is roughly equivalent to the power draw of 21 Cavendish shopping centres, just wasted in households around the country!

The reasons for the high standby power for the PVR may be attributed to the hard drive within the device and the method in which it is powered down, however this doesn't explain the high power readings taken on standard DSTV decoders. Multichoice has responded to a query on their web forum regarding the abnormally high standby power of their devices by saying the following: *"The power consumption of the PVR does indeed vary between 30 and 37W from standby to fully active. Currently standby is not "real" as coming back from a "real" standby currently takes about 90 seconds which is deemed too much for the patience of the normal person. Methods to remedy this are being investigated. MCA is however very conscious of the power situation and aims to bring the standby power down to less than 1W in future decoders."*

If 90 seconds is too much time for the 'patience of a normal person', then perhaps this massive waste is a cost we have to pay. However, if DSTV were to install a much higher quality power supply with better standby controls, the cost of this additional equipment should easily be paid off by the savings (R146 – R239 saving per year) over the lifespan of the decoder.

The customer and the national grid would then reap the energy saving benefits, as well as Multichoice reaping the rewards for having a 'greener' product.

At least they say it is a priority for future decoders, but alarming that this wasn't thought of in the past?!

CONCLUSIONS

The above simple calculations and estimations show that standby power waste does actually have a real effect on the average user, and that there are savings to be made with relatively simple cost effective measures.

The results from the surveys, questionnaires and statistical sampling in Mercy Violet Shuma-Iwisi's doctorate thesis show that the sample standby power losses are estimated to be 73.5 W per household. This may seem like a fairly high number, but by adding up the small standby power of all electronic devices within your own house, it easily adds up to that, perhaps even more.

Think about every little appliance you have plugged in and add them up:

- Television sets
- DSTV decoders
- PC's
- DVD players
- Hi-Fi sets
- Microwave Ovens
- VCR's
- PC monitors
- Mobile phone battery chargers
- Laptops

The cost of all this standby waste is also a real factor that should be considered.

The average of 73.5 Watts of standby power waste is equivalent to R691.69 per year at the current domestic tariff. The electricity tariff is increasing again this month by around 16% and then the MYPD3 (Eskom's third Multi-Year Price Determination), which is due to start in April 2013 will likely see above inflation increases continuing for the foreseeable future.

With that in mind, the cutting down of standby power is going to become a consideration and customers are not likely to continue buying inefficient, power hungry technologies. Manufacturers will be forced to design their equipment properly or risk losing customers.

Devices like timer plugs and auto shut off adapters are also likely to become key components in saving this wasted power. Hopefully people are going to start realising that every little bit counts!

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THE NEW ELECTRIC TRAIN APPEARS TO THE POWER UTILITY AS A GIANT CAPACITOR - ATTRACTING PENALTY FOR LOW POWER FACTOR.

Correcting Capacitive Power Factor

Eskisehir, a city in the Anatolia region of Turkey is located in an area inhabited since at least 3500 BCE- the copper age. Today Eskisehir is known not only as a region steeped in history, but as an industrial centre were the use of copper is still quite prevalent; though not in a way even the most imaginative of the earliest Anatolians would have ever dreamed. The ubiquitous use of copper in electrical systems in general and for the transmission of power to light rail systems in particular is a fact of life for designers of electrical distribution systems.

BY I EPHRAIM KADEC

The Public Utility Company must supply all customers in the city with ample power and stable voltage because they have a vested interest in encouraging customers to conserve energy. Their goal of energy conservation is by keeping the power factoring as low as possible, and this is usually enforced with a surcharge for poor power usage to customers.

The inauguration of a new efficient light train system in the city of Eskisehir, running on non-polluting electricity, surely contributed much to the general transportation system, but creating a challenge to the power company. The burden of compensating for low power factoring is passed on by the Power Company to the customer by levying a penalty if the customer does not improve his power factoring. The utility company is compensated monetarily for the necessary infrastructure upgrades required to supply this customer with more electric current than he actually needs.

For the purpose of graphing, the power factor ranges from 0, for a purely inductive load to 1, for a "perfect" load where current is drawn in phase with the voltage, and up to 2 where the load is purely capacitive.

The challenge to the utility, and the operator of the light train, is that the poor power factor created by the light train's distribution system, is capacitive and not the usual inductive power factor associated with the operation of motors and discharge-lighting. The distribution system, with a positive catenary (upper rail) and a negative track, is in fact a giant capacitor connected to a 750VDC power source.

Capacitive power factoring is not just a matter of wasted current; the capacitance increases the voltage of the feeder, creating a serious voltage instability problem.

THE PROBLEM

The light train's electrical distribution

Correcting Capacitive Power Factor

continues from page 35

No industrial concern operates without some form of power factor correction.

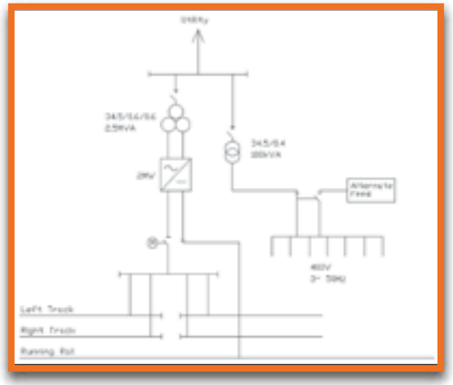


Figure 1: *The Electrical Distribution System Feeding the Train Station*

Figure 2: *Capacitive Power Factor at PCC with Utility*

system begins with medium voltage 34.5kV utility lines feeding double secondary 2.5MVA transformers 34.5/0.6/0.6 kV. As can be seen in Figure 1, these transformers feed 3 phase 2MW rectifiers. The rectifiers feed a positive catenary and a negative track for the trains. The operating voltage between catenary and track is 750VDC.

When measured from the utility point of common coupling, the power factor reached over 1.9 (0.1 capacitive) when few trains were running, averaging 1.5 (0.5 capacitive), and seldom dropping below 1.1 (0.9 capacitive) when many trains were running. A high capacitive power factor in and of itself is not necessarily a problem when little power is being used, however these values translate into an average of 400 kVAR capacitive, as can be seen from the simultaneous sampling of power factor and power in Figure 2. The power utility levied penalties of tens of thousands of dollars as per their defined rates of service.

Another aspect of the problem is that of voltage stability. All instances of poor power factor have negative impact on voltage stability. In the usual instance of poor power factor, the reactive power is inductive; any impact on voltage would be a drop in voltage value. In our system, the impact on voltage is a raise in voltage value when the capacitance is high. This high voltage creates a power quality problem that is potentially more destructive to parallel consumers than the problem created for the utility by increased current.

THE SOLUTION

Simply put, the solution is to connect inductive loads in parallel to the capacitive system. No industrial concern operates without some form of power factor correction. As stated previously, the overwhelming majority of installations requiring power factor correction are dealing with an inductive system corrected by the addition of capacitors. In our case, the system is capacitive, requiring the addition of inductors.

Most systems employ automatic power factor correction, sensing the power factor by constantly monitoring the current and voltage, calculating the power factor and switching capacitor banks as required. As seen in Figure 2, the power factor is quite dynamic, ranging from 1.1 to 1.9. Automatic switching of inductors is most definitely called for. However, at this point, our analogy to inductive systems must be analysed more carefully. When switching capacitor banks, care must be taken in designing the switchgear due to the high inrush current experienced when switching a capacitor. These switching events create high wear on the switchgear and the capacitors.

The switching of inductors is no easier; the high inrush currents of a coil are of a substantially different nature than those created by capacitors. Industrial concerns the world over has turned to Elspec for advanced solutions for correcting the "standard" inductive power factor. For over a decade, Elspec has led the world in power factor correction of inductive systems with the invention of the Equalizer power factor correction unit. The Equalizer solves the problem of switching capacitor banks by switching the banks on zero crossing of the voltage sine wave, typically completing the circuit within half a cycle.

No wonder then, when the engineers looking for a solution to the highly capacitive power problem turned to Elspec to design a similar system for this application.

The solution entailed the installation of an Elspec Equalizer power factor correction unit equipped with iron core reactors instead of the usual capacitors. Based on measurements taken from the site, it was decided to install two Equalizer units with iron core reactors –one 450kVAR the other 550kVAR- on each of two of the three utility feeder stations. Figure 3 displays the method of installation.

The Equalizer, with its iron core reactors, is installed on the low voltage side, correcting the power factor through a 1000 kVA transformer in parallel to the station low voltage distribution panel. The current measuring sensors are connected to the medium voltage side, close to the point of common coupling with the utility. The voltage sensors are connected on the low voltage side of the transformer. By correcting on the low voltage side, the Equalizer takes advantage of the inherently simpler requirements for switchgear. Measuring current on the medium voltage side ensures that the correction will be accurate.

Correcting on the low voltage saves money on switchgear, but does require special

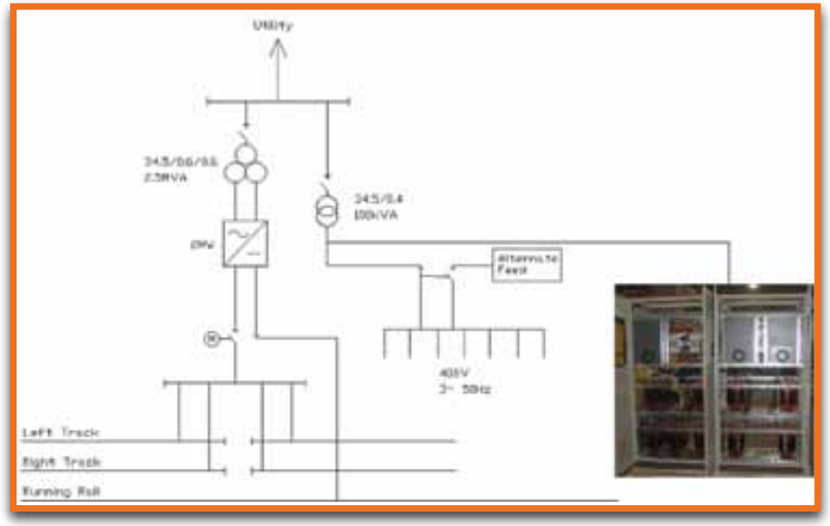


Figure 3: *Elspec Equalizer added to the Train Station*

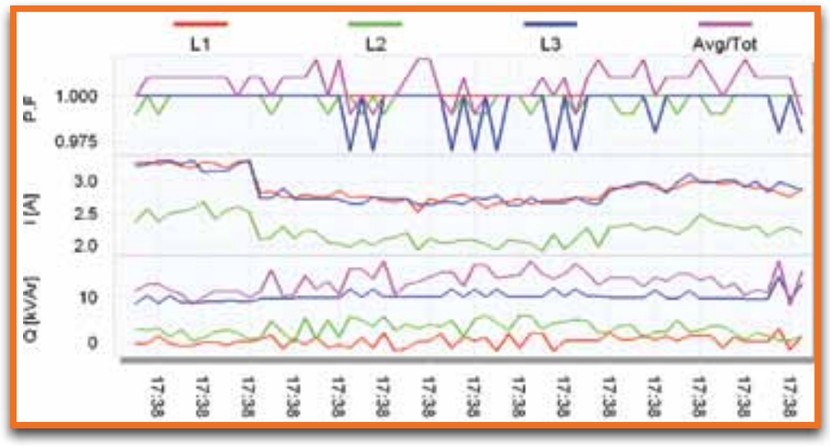


Figure 4: *Measurements after Installation of the Elspec Equalizer*

Correcting Capacitive Power Factor

continues from page 37

consideration. The transformer installed by the train company for the Equalizer was of type Delta\Wye 11, meaning that the primary and secondary are out of phase by 30 degrees. Elspec overcomes this problem, by utilizing their proprietary firmware that calculates the corrections necessary to inject the reactive correction on line in phase with the medium voltage point of common coupling.

The switching of iron core reactors instead of capacitors for correcting capacitive instead of inductive power factor is not just a matter of mirroring the technology, as alluded to earlier. The switching characteristics of capacitors and reactors are very different, and the reaction of the grid to the two types of corrective loads is different. The Equalizer is capable of cycle-by-cycle correction, with switching on zero crossing. This capability allows the engineers to program the equalizer to optimize switching in every situation from pure capacitance to pure inductance, keeping power factor at the required level while ensuring long life to all switch gear and panel elements.

A world leader in correcting inductive load power factor, Elspec has the answers for dealing with capacitive loads, switching the corrective load at zero since crossing within half a cycle. Switching iron core inductors instead of capacitors, the equalizer is engineered to correct the power factor quietly, with no damaging transients, ensuring long life for all the switch gear involved

Figure 4 demonstrates the success of the Equalizer in correcting the power factor. An analysis of the sampled parameters shows that the power factor is corrected to within a hundredth of unity. The current represented in the graph is from the high voltage side. The reactive capacitive power has dropped from 400kVAR to an average of around 10 kVAR.

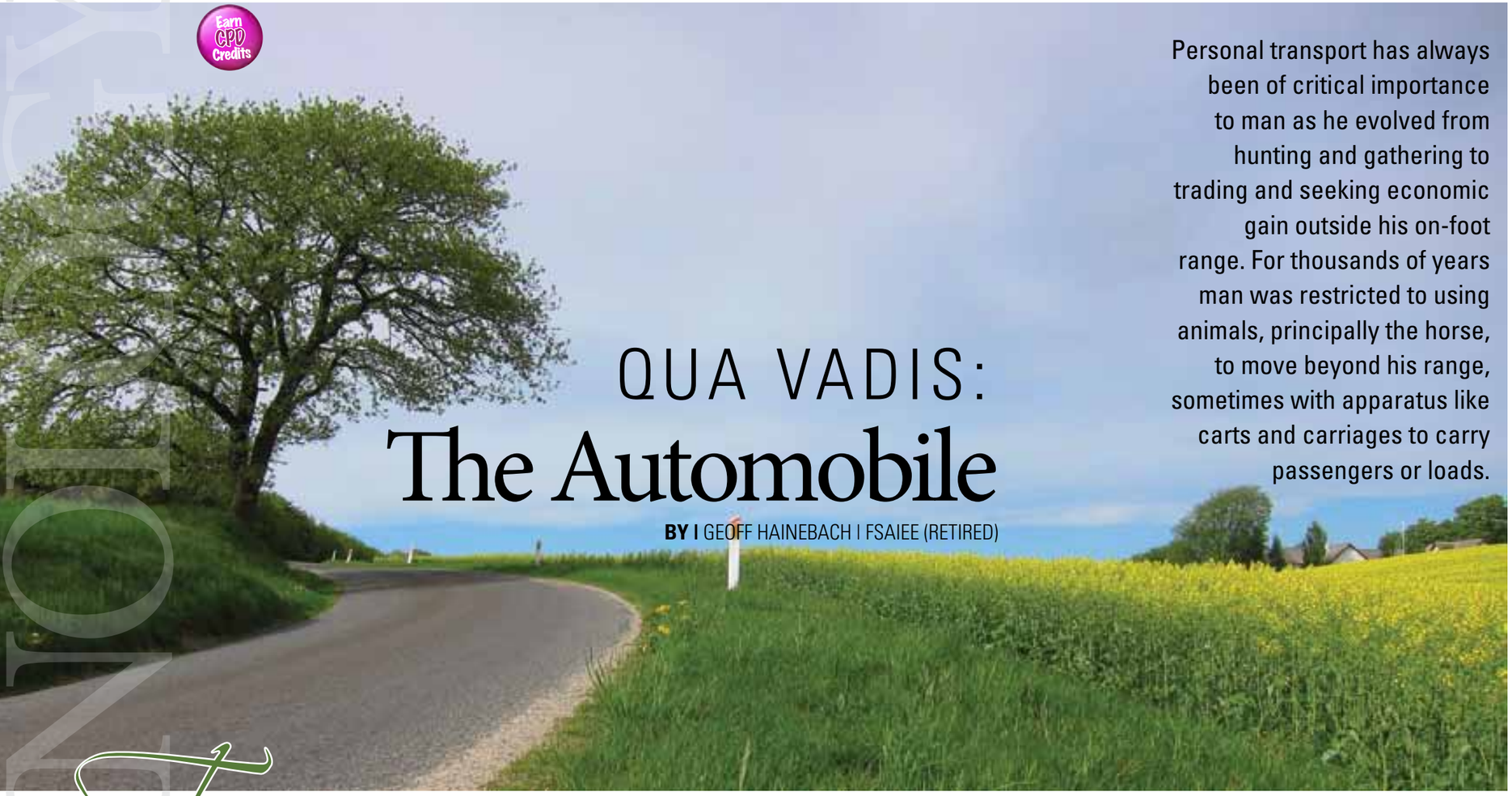
The advanced electronic switching of the inductors ensures long life for all switchgear in the same manner that it increases the life of capacitive correction systems.

MAJOR BENEFITS:

- Power factor correction of a capacitive load system
- Transient free correction
- Correction within half a cycle
- Mitigation of voltage swells due to high capacitance
- The end to paying penalties due to poor power factor.

Power factor is a measure of the phase difference between the current and the voltage; defined as the cosine of the phasor angle between them. In an ideal situation, the current and voltage are in phase, the angle is 0º, and the Power Factor is unity. As a load becomes inductive, the angle increases in the positive direction with the power factor decreasing to 0, as the angle becomes 90º. As a load becomes capacitive, the angle increases in the negative direction, with the PF decreasing negatively until reaching 0 at -90º. These renditions of power factor are used universally in electrical calculations.

When attempting to graph these values, a different rendition of Power Factor is required, since Unity is the axis of divergence, arriving at the value from either side through -0.99 or +0.99. For the purpose of graphing powerfactor, we use a scale that ranges from 0 for a purely inductive load to 1 for a "perfect" load where current is drawn in phase with the voltage, and up to 2 where the load is purely capacitive. wn



QUA VADIS: The Automobile

BY I GEOFF HAINEBACH I FSAIEE (RETIRED)

Personal transport has always been of critical importance to man as he evolved from hunting and gathering to trading and seeking economic gain outside his on-foot range. For thousands of years man was restricted to using animals, principally the horse, to move beyond his range, sometimes with apparatus like carts and carriages to carry passengers or loads.

The first automobile can be traced back to 1770 when Nicolas-Joseph Cugnot demonstrated his “fardier à vapeur” ("steam dray"), an experimental steam-driven artillery tractor.

Today’s automobile industry really began in 1889, when Gottlieb Daimler and Wilhelm Maybach, in Stuttgart, designed an automobile from scratch, rather than a horse-drawn carriage fitted with an engine.

Since then, the automotive industry developed rapidly and its growth has hardly abated, despite concerns about its environmental impact on our planet. People seem to divide into two categories, those who possess an automobile and those who aspire to possess one. This has resulted in the enormous global automotive industry. There were about 806 million cars and light trucks on the road around the world in 2007, consuming over a trillion litres of liquid fuel yearly. While in the developed world, the vehicle population has stabilised, major growth is occurring in the BRICS* countries. China’s automobile market is now the world’s largest and China already produces as many vehicles as the next two largest producers, the US and Japan, together. Other potentially powerful automotive markets are Iran and Indonesia. Emerging automobile markets already buy more cars than established markets. According to a J.D. Power study, emerging markets accounted for 51 percent of the global light-vehicle sales in 2010. The study expects this trend to accelerate.

CURRENT LIMITATIONS

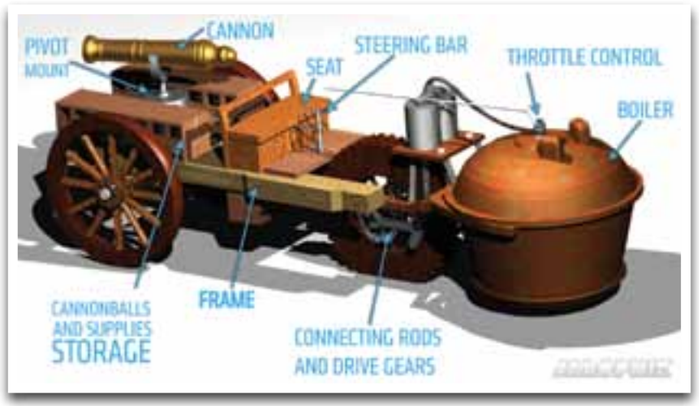
Transportation is a major contributor to air pollution in industrialised nations. According to the American Surface Transportation Policy Project, nearly half of all Americans are breathing unhealthy air. In countries like China, the problem is far worse. The study showed air quality in dozens of metropolitan areas has significantly worsened over the last decade. In the United States the average passenger car emits 5,190 kg of the greenhouse gas, carbon dioxide, annually, along with smaller amounts of carbon monoxide, hydrocarbons, and nitrogen. Animals and plants are often negatively impacted by automobiles via habitat destruction and pollution, which is estimated to be 50.000 m2 per automobile over its lifetime, in terms of "loss of habitat potential". Many animals are also killed on roads by automobiles. This growth in popularity and commuting by private vehicle has led to severe traffic congestion in all large, most medium and even many small cities. In developing countries like India, this growth drastically outpaces the growth of supporting infrastructure which is battling to keep pace.

Oil consumption in the twentieth and twenty-first centuries has been driven largely by automobile growth. Despite the discovery of huge reserves of tar sands and natural gas, this trend has resulted in a very rapid increase of fuel prices.

If we look at the growth of the world’s population, it seems inconceivable that the growth in private transportation can continue in proportion, let alone accelerate to enable populations in the developing economies to enjoy the automobile ownership of the developed economies.

REACTION

The world is caught in a serious dilemma. On the one hand most experts agree that we are now very clearly seeing limitations to growth. Earlier predictions may have been been premature due to the then unknown impact of technology. On the other hand, the global economy, and especially employment, is heavily dependent on the automotive industry and energy from oil. In a time where economies world wide are in recession, or depression, it is difficult to make significant changes,



"fardier à vapeur " - Nicolas-Joseph Cugnot

World’s first automobile designed by Gottlieb Daimler

QUA VADIS: The Automobile

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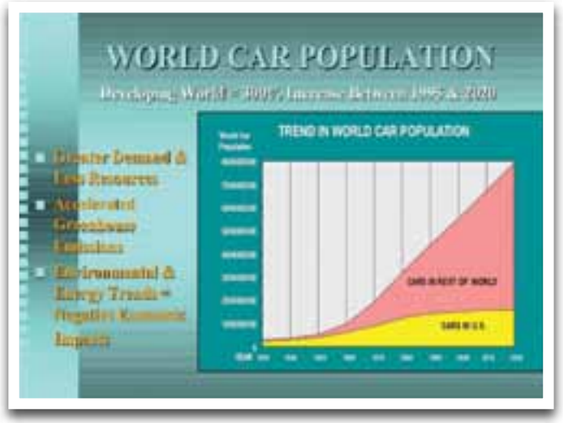
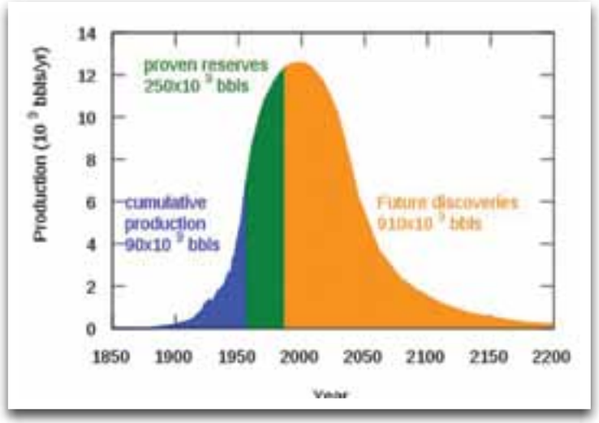
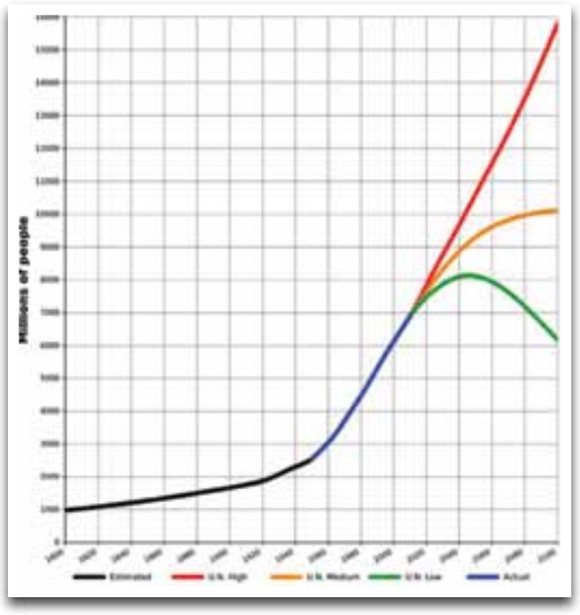


From "AUTOMOBILE DESIGN Year 2010 and Beyond" by Robert Q. Riley



Hubbert: Peak Oil Plot (Wikipedia Commons)



World population development from 1800 to 2100 (Wikimedia commons)

which will negatively impact the short-term economic well-being and employment of the global economy. It is a dramatic trade-off between current and future economic well-being, and may concern even the survival of life as we know it on the planet.

Given the dire predictions on climate change, its life-threatening consequences and the reducing availability of critical materials and energy, have we done enough to counter its negative effects?

CHANGES IN FUEL

A lot of effort has been invested in alternative, less environmentally harmful, fuels. Converting bio-mass to liquid fuel like ethanol began decades ago. Brazil has built a significant industry making ethanol from sugar cane ("bagasse") and in the US large tracts of maize land for human and animal consumption were converted to using the maize as feedstock for ethanol plants. The amount of land now used for ethanol production is 40% of the total US land under maize cultivation. This has contributed to global shortages of food and consequent increases in food prices, indicating that there are limits to expanding this effort.

Another effort is using hydrogen to power conventional IC engines. Hydrogen fuel does not occur naturally on Earth and thus is not an energy source but an energy carrier. Currently it is most frequently made from methane or other fossil fuels via the electrolysis of water.

However, it can be produced from a wide range of energy sources (such as wind, solar, or nuclear) that are intermittent, too diffuse or too cumbersome to directly propel vehicles. Integrated wind-to-hydrogen plants, using electrolysis of water, is one of the technologies to deliver hydrogen in adequate quantity and affordability to compete with traditional energy sources.

Many companies are now working to develop technologies that might efficiently exploit the potential of hydrogen energy for automobile use. The attraction of using hydrogen as an energy carrier is that, if it is prepared without using fossil fuel inputs, vehicle propulsion would not contribute to carbon dioxide emissions. The drawbacks of hydrogen use are low energy content per unit volume, heavy storage tank weights and inefficient production processes. In addition the logistics require very high storage vessel pressures, difficult transportation and complicated filling of gaseous or liquid hydrogen in vehicles. A huge investment in infrastructure would be required to fuel vehicles across wide geographies.

CHANGES IN PROPULSION

Another response to the, "dependence on oil", syndrome is to change the propulsion system in contemporary vehicles from the current IC engine to something less polluting and oil dependent.

Of these proposed solutions, electric motors seem the most popular and huge efforts are now being made to design vehicles with satisfactory performance for large numbers of motor vehicle users.

The chief problem with electric vehicles is the batteries on which they are dependent. They are expensive and heavy thus reducing affordability, load capacity and range. The best batteries are made from Lithium or its derivatives, which are relatively scarce and would in large quantities, have their own environmental problems. How the demand for much larger quantities of Lithium will be met, is still unknown. Batteries are also just energy carriers and the fuel source will be electrons produced by the grid, using whatever energy sources are available but favouring, renewable energy sources so that the environmental impact of these vehicles will be minimized.

Another electric power solution is to use fuel cells, which combine hydrogen and oxygen to produce an electric current. The principle of the fuel cell was discovered in 1838 by the German scientist, Schönbein, and has been under development since then. There are several different types of fuel cells but the types intended for transportation use are likely to use hydrogen or methane as consumable fuel, requiring a similar type of distribution infrastructure to hydrogen for use in IC engines.

Another propulsion solution being investigated and proposed is air power, where a motor driven by compressed air from a high-pressure container on the vehicle, is used. Again the energy source would be electricity from the grid to power the compressors, which recharge the compressed air container.
While the above approaches may make a big contribution to solve the pollution problem, they won't contribute much to the congestion problem.

CHANGES IN REGULATION

Changes to laws and regulations governing the use of fuels and vehicles have been another response to both the pollution and oil dependency problems where countries without their own source of oil for transportation and electricity generation seek to reduce their dependency on oil from unstable or hostile sources.

The US regulates the allowable consumption for different sizes of motor vehicles and European countries tax motor vehicle emissions. Fuel taxes may also act as an incentive for the production of more efficient, hence less polluting, vehicle designs (e.g. hybrid vehicles) and the development of alternative fuels. High fuel taxes may provide a strong incentive for consumers to purchase lighter, smaller, more fuel-efficient vehicles, or not to drive.

On average, today's automobiles are about 75 percent recyclable, and using recycled steel helps reduce energy use and pollution. The United States Congress, federally mandated fuel efficiency standards have been debated regularly, but passenger car standards have not risen above the 8.55 L/100 km (33 mpg) standard set in 1985. Light truck standards have changed more frequently, and were set at 10.6 L/100 km (26,7 mpg), in 2007.

The South African government has also introduced a sales tax for motor vehicles, based on the theoretical CO2 emissions of different sized vehicles.

In cities like London, authorities have introduced a "congestion tax" to discourage the use of private vehicles in the city.

QUA VADIS: The Automobile

continues from page 43

One anticipates that this type of tax and regulation regime will grow more restrictive in the future as awareness of the problems is increased.

CHANGES IN FORM FACTOR

Two wheeled, self powered vehicles originated at almost the same time as the four-wheeled type. While enjoying a large following, they suffer from the twin disadvantages of weather and safety vulnerability. However developments like the Segway scooter have shown that there is still potential to improve designs to overcome these disadvantages, say by the addition of an enclosure. Since many, if not most private vehicles are occupied by only their driver, a major trend to two wheeled vehicles, at least in cities, would make a big difference. However this would be a relatively small if important contribution to the overall solution, given restrictions on range and safety.

CHANGES IN THE STRUCTURE OF PRIVATE TRANSPORTATION

Since the advent of motor cars and cycles, society has taken for granted that its members have a right to private transportation, if they can afford it and has built the necessary infrastructure to support these vehicles, almost without restraint. The duty cycle of a private vehicle during its life time is very low. No source for this statistic could be found but the average private vehicle duty cycle is estimated to be between 2 and 10%. When a vehicle is not in use, it has to be stored (parked) and a huge amount of resource has been invested in these services in all developed countries.

It would be interesting to know how much of the earth's surface is tied up in parking area for out-of-use vehicles, both on- and off-street. An enormous amount will also have been invested in buildings and garages to house motor vehicles and to support the refuelling and maintenance of private vehicles. A lot of that investment, in terms of real estate and maintenance facilities, is extremely wasteful relative to what could be saved, if the number of vehicles could be restricted to only a small percentage more than those in use.

Paris with its "Vélib" scheme and other cities have introduced a system of bicycle hire where citizens hire bicycles just for a single journey, depositing them at specialised parking areas near their destination, approximately located on a 300m grid. The hire is very cheap and paid for by credit card so that the hirer is always identifiable and any damage can be charged to whomever is responsible.

A similar system could easily be created for cars, possibly electric vehicles which could be recharged at their parking stations. These stations would also indicate the energy capacity in distance or time available on each vehicle so that the hirer would not be embarrassed by running out of energy. Other automatic measures would ensure technical and safety related equipment was in good order. Just like with the Vélib, a management organization would ensure vehicles are kept maintained and in good condition.

In the UK, car clubs have been and are being established, in which members buy shares giving them the right to use club vehicles. Car sharing schemes, are another growing trend where members use on line facilities to get rides to work or another destination. Both schemes are gaining in popularity. Carplus is a promotional organization for these two concepts and more detail can be found on http://www.carplus.org.uk/.

Private vehicles have become so ingrained in our psyche that they have become a de facto expression of our identity. In addition, the private motor vehicle meets a very strong desire for privacy and instant availability. It will be a very long and difficult process to change this mindset to one in which private transport is merely another utility, even one which can be influenced by public policy and taxation.

CONCLUSION

This article was written to stimulate a wider debate on private transport among our members, a highly educated group, focussed on the solving of complex problems. The present private vehicle format is a major problem confronting all mankind and is being generally neglected in government planning, possibly due to a complex web of conflicting narrow interests.

Perhaps some new and very useful ideas will result from a debate on these pages and some of these may even be developed and used in South Africa where pollution and congestion are rapidly reaching crisis proportions in our cities. Investment in private transportation infrastructure, e.g. toll roads, is also competing with other important infrastructure investments for scarce resources, which we can hardly afford.

Most references in this article have been taken from Wikipedia. The author has refrained from using multiple specific references to avoid creating a "reference salad" which would clutter the article.

** BRICS is the title of an association of leading emerging economies, arising out of the inclusion of South Africa into the BRIC group in 2010. As of 2012, the group's five members are Brazil, Russia, India, China and South Africa.* wn

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International Communications

A BRIEF OVERVIEW OF RSA SUBMARINE CABLES AS AT 2012

BY I MIKE CROUCH **I** FSAIEE

Coax (31.75mm) and Optical (17mm) Deep-water Submarine Cables

In 1879 South Africa became connected to the outside world for the first time by a Submarine Telegraph Cable. The cable connected Durban with Lourenco Marques, Zanzibar and Aden where connections were made to existing cables from England to Australia. Previously all communication was by the written word and the international postal sea-mail service. Business correspondence and news took at least two weeks to travel by letter post (Union Castle Mail ships) and answers took equivalent time to return.

The submarine cable network to South Africa grew rapidly as even the painfully slow transmission speeds (one channel at about 50 words per minute!) were able to provide replies within a day or two. Cables were laid up the West coast to England from Cape Town in 1889 and 1899 and from Durban direct to Australia in 1901. These cables carried the overseas telegraph traffic until Wireless Telegraphy commenced in 1927.

Competition was fierce between Cable systems and Wireless systems and in 1928 the two facilities merged into one company called "Cable and Wireless Ltd". Each transmission medium had its disadvantages: Wireless was prone to fading and interference but was faster and carried telephone and telegraph transmission while cable was reliable 24/7 but was very slow. The initial cable transmission was based on Morse code where an operator used two switches to send "dots" and "dashes" by reversing the voltage on the cable and spacing letters with zero voltage. The fact that the cable was in effect a very large capacitor, which had to charge and discharge for each letter, made the maximum transmission speed about 50 words per minute. At this stage overseas communications were really bad! This paper deals with the amazing improvement in Undersea Cable technology that resulted from the use of Coaxial Cables and then Optical Fibres over the past 44 years (1968 to 2012).

COAXIAL CABLE

SAT1 (1968)

South Africa's first multi-channel undersea cable, named SAT 1 (South Atlantic Telephone 1), used 10906 km of coaxial cable with an outside diameter of 1.25in (31.75mm) to carry the 360 frequency multiplexed 3kHz telephone channels on 3MHz bandwidth. The dc power feed to the 624 repeaters was 15kV at 0.5 Amp. Power feed was from both ends of each cable section with sea return. The repeaters, situated every 17.78km from Melkbosstrand (SA)to Sesimbra (Portugal) via Cape Verde, Sal and Ascension Islands, used vacuum tubes in their amplifiers.(At the time that this system was designed the known reliability of transistors was insufficient to meet the 20 year guarantee period of the system.) In fact the system operated successfully from 1968 to 1993, 5 years over its design life! Most of the land-based terminal and power-feed equipment was assembled and tested at the Boksburg factory of Standard Telephones and Cables (STC SA Ltd). As Manager of this project the author experienced the most exciting and interesting project of his career.

A full description of the SAT1 project is to be found in the SAIEE Transactions Vol 61 Part 8 August 1970 by DPJ Retief of the SA Dept. of Posts and Telegraphs (Telkom).

OPTICAL FIBRE CABLES

SAT 2 South Atlantic Telephone 2 (1993)

Melkbosstrand (RSA), El Medano (Tenerife Island /Spain), Funchal (Madeira Island/ Portugal) . 9500 km, 84 repeaters, 560Mbit/s, capacity 8750 64kb/s telephone channels, downloads 0.11 Movies /s.(Assuming the bandwidth of a movie is 5 Gbit/s)

2002 - SAT3

(WASC - West Africa Submarine Cable)
This cable runs from Melkbosstrand (RSA), Cacuaco (Angola), Libreville (Gabon), Douala (Cameroon), Lagos (Nigeria), Cotonou (Benin), Acra (Ghana), Abidjan (Cote d'Ivoire), Dakar (Senegal), Alta Vista (Canary Islands/Spain),Chipioa (Spain), Sesimbra (Portugal) with 14,350km, 193 repeaters, 340Gbit/s, Capacity 5.312 million 64kb/s telephone channels, downloads 68 movies/s.*

2002 - SAFE (SA to Far East)

This cable runs from Melkbosstrand (RSA), Mtunzini (RSA), St Paul (La Reunion Island), Baie Jaeolet (Mauritius/France), Cochin (India), Penang (Malaysia). It is 13,500km long, has 175 repeaters at 440Gbit/s, Capacity 6.875million 64kb/s telephone channels, downloads 88 movies*.

2010 - EASSy

(East African Submarine Cable System)
This cable runs from Mtunzini (RSA), Maputo (Mozambique), Toliart (Madagascar), Dar es Salaam (Tanzania), Moroni (Comoros), Mombasa (Kenya), Mogadishu (Somalia), Djibouti (Djibouti),Port Sudan (Sudan).
It is 10,000km long, 127 repeaters, 1.4Terabit/s, Capacity 21.88 million 64kb/s telephone channels, downloads 280 movies*.

2012 - WACS

(West Africa Cable System)
This cable runs from Yzerfontein (RSA), Walvis Bay (Namibia), Cacuaco (Angola), Muanda (DRC), Pointe-Noire (Congo), Douala (Cameroon), Lagos (Nigeria), Lome (Togo), Accra (Ghana), Abidjan (Cote d' Ivoire) Cape Verde Islands, Altavista, (Canary Islands), Cape Verde Islands, Sesimbra (Portugal), London (England). It is 14,000km long, has 237 repeaters, 5.12Tbit/s, Capacity 80 Million 64kb/s telephone channels, downloads 1024 movies*.

TECHNICAL NOTES

1. The possible number of 64kbit/s telephone channels given above can be increased up to 8 times by compression techniques!

2. All of the above systems use Wavelength Division Multiplex (WDM) to increase the capacity of each pair of fibres. Each basic block of channels at say 10 Gbit/s is fed to a laser of a specific wavelength. A modern system is capable of using up to 160 different wavelengths on the same fibre. These 160 different laser beams are combined at the transmitter and separated by filters at the receiver resulting in 160x10 Gbit/s which is 1.6 Tbit/s. (A Terabit/s is 1000 Gigabit/s).

3. Optical Amplifiers are necessary to boost the photons along the fibres. Initially this was achieved by converting the photons to electrons and then amplifying the electron stream, after which the electrons

**Assuming the bandwidth of a movie is 5 Gbit/s*

continues from page 47

were converted back to photons by a laser. The amplification of optical signals directly is achieved nowadays in Erbium-Doped Fibre Amplifiers (EDFA). Here the technique is to use a length of Erbium doped optical fibre and using a high powered laser "pump" to stimulate the erbium ions into a high energy level . The original signal is passed into the doped fibre after which the signal absorbs energy from the erbium ions in the form of new photons thus amplifying the original bit-stream.

4. Many other techniques are used to increase the capacity of the latest submarine cable systems. These are discussed in this issue of wattnow in an article from Alcatel-Lucent Submarine Networks titled "New Technologies for High Capacity Submarine Cable Systems" by Vincent Letellier and AliceShelton.

Submarine Cable Systems are indeed a new" Wonder of the World" and South Africa can be very proud of its involvement.

The author acknowledges the assistance of Johan Meyer and Jaques van der Walt of Telkom SA Ltd. wn

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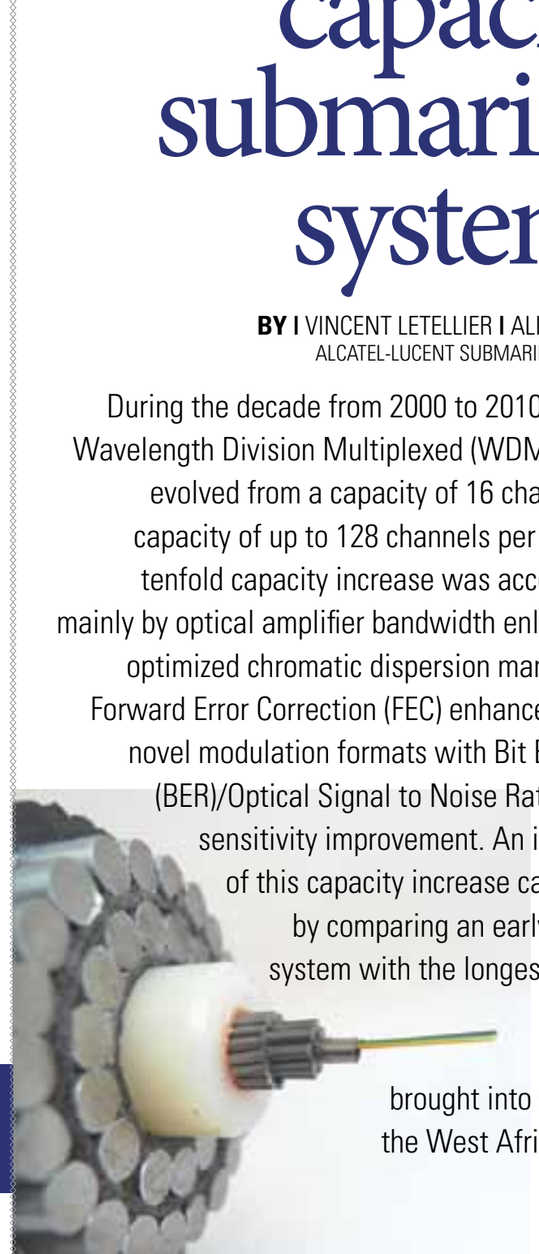
New technologies for high capacity submarine systems

BY | VINCENT LETELLIER | ALICE SHELTON
ALCATEL-LUCENT SUBMARINE NETWORKS

During the decade from 2000 to 2010, 10Gbit/s Wavelength Division Multiplexed (WDM) systems evolved from a capacity of 16 channels to a capacity of up to 128 channels per fibre. This tenfold capacity increase was accomplished mainly by optical amplifier bandwidth enlargement, optimized chromatic dispersion management, Forward Error Correction (FEC) enhancement and novel modulation formats with Bit Error Ratio (BER)/Optical Signal to Noise Ratio (OSNR) sensitivity improvement. An illustration of this capacity increase can be seen by comparing an early 10Gbit/s system with the longest 10Gbit/s system recently brought into service on the West African coast.



The first Alcatel-Lucent designed 10Gbit/s trans-oceanic system, Japan-US, transmitted 16x10Gbit/s over 7000km of Non Zero Dispersion Shifted Fibre (NZDSF) with a Spectral Efficiency (SE) of 0.13bit/s/Hz using On-Off Keying (OOK) modulation format.

To date, the longest Alcatel-Lucent designed 10Gbit/s system is the West Africa Cable System (WACS), spanning 11000km of Dispersion Slope Matched Fibre (DSMF) using Differential Phase Shift Keying (DPSK) modulation format achieving a capacity of 128 channels per fibre corresponding to a Spectral Efficiency of 0.4bit/s/Hz.

The capacity of optical systems has historically been quantified in terms of the number of simultaneous telephone calls that could be carried per channel. This unit of measure has become more or less meaningless today as the percentage of voice data carried over today's trans-oceanic systems is ~1% of the total traffic carried.

One measure of capacity that can be used is the time taken to transmit the contents of a standard DVD, around 4.7Gbytes. On one 10G channel, a DVD can be transmitted in 3.76 seconds, so the capacity of WACS can be considered equivalent to transmitting the contents of 34 DVDs every second or half a million calls handled simoultaneously.

Put another way, the contents of Leo Tolstoy's novel War and Peace can be sent from South Africa to the UK on WACS 400,000 times per second. On a telegraph system in 1870, it would have taken 37 days to transmit one copy of the novel.

Significantly increasing system capacities beyond this achievement has required the development of new technologies. Deployed since 2011, the new technologies open the door to channel bit rates of 40Gbit/s and 100Gbit/s, increased Spectral Efficiency and up to 10Tbit/s capacity per fibre pair. These new technologies; the use of polarization multiplexing at the transmission side and coherent detection at the received side associated with powerful Digital Signal Processing (DSP) mitigating line fibre linear distortions, are described in this paper.

COHERENT RECEIVER TECHNOLOGY

Optical coherent detection was previously proposed as a method of increasing the sensitivity of a system due to the lack of optical amplification. The introduction of Erbium Doped Fibre Amplifiers (EDFAs) meant that coherent detection was no longer of great interest to optical systems. The return of interest in coherent detection in transmission systems comes in conjunction with progress in Digital Signal Processing (DSP) technology. Indeed, coherent detection can combine polarization multiplexing at the transmit side and an optical coherent receiver with a powerful DSP that can compensate for frequency and phase shifts between the received signal and the Local Oscillator (LO), changes in polarization in the transmission path and linear signal distortions due to Chromatic Dispersion (CD) and Polarization Mode Dispersion (PMD) [1].

Phase mismatch between received signal and local oscillator is a fundamental hardware limitation that has been solved by estimating the relative phase of the signal and local oscillator via the algorithm implemented in the DSP.

The fibre CD is determined by the relative speed of the light versus wavelength and leads to a phase shift between the spectral components of the transmitted signal. The fibre PMD is determined by the relative speed of the light versus polarization. In direct detection receivers, the phase of the optical electrical field is lost, whereas in coherent receivers the absolute phase of the transmitted signal is recovered and the fibre induced distortions can be compensated by DSP.

M-PSK AND M-QAM MODULATION FORMATS

Coherent reception techniques open the way to a full range of new modulation formats known as M-PSK (Multi-Phase Shift Keying) and M-QAM (Multi-Quadrature Amplitude Modulation. Constellation diagrams of such modulation formats are presented in Figure 1.

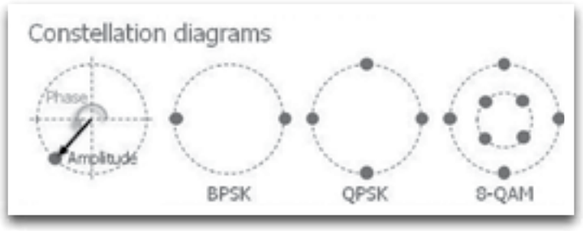


Figure 1: M-PSK and M-QAM modulation formats

M-PSK uses a finite number (M) of phases to code the signal with constant amplitude. M-QAM uses a combination of both Phase Shift Keying (PSK) and On-Off Keying (OOK) to code the signal.

The higher the order of M in M-PSK and M-QAM formats, the higher the spectral efficiency as it increases the number of bits per symbol, as presented in Figure 2 for Binary PSK (BPSK) and Quadrature PSK (QPSK) modulation formats.

PDM-PSK AND PDM-QPSK MODULATION FORMATS

In addition, in order to fully exploit the advantage of a coherent reception, Polarization Division Multiplexing (PDM) is used to increase the spectral efficiency as shown in Figure 3.

New technologies for high capacity submarine systems

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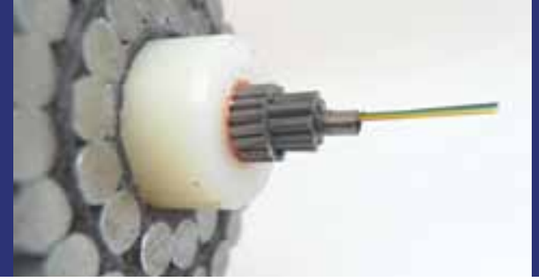

BPSK Symbol	Amplitude	Phase
0	1	0
1	1	π

QPSK Symbol	Amplitude	Phase
00	1	0
01	1	π/2
10	1	π
11	1	3π/2

Figure 2: Example of bit/symbol coding for BPSK and QPSK

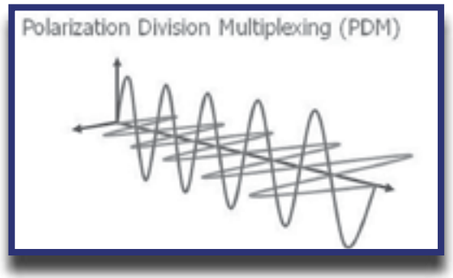

Figure 3: PDM: Signal carried on the two polarizations of a single laser source

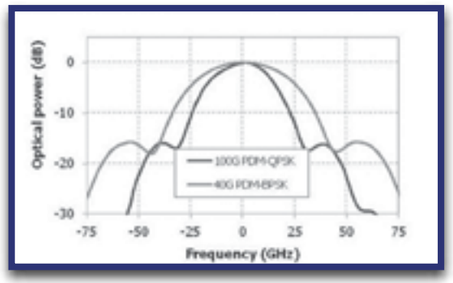

Figure 5: 7%FEC encoded 40Gbit/s RZ-PDM-BPSK and 25%FEC encoded 100Gbit/s NRZ-PDM-QPSK spectra

The scheme in principle of a PDM-BPSK or PDM-QPSK transmitter-receiver is shown in Figure 4. The transmitter laser signal is split into two orthogonal polarizations and each polarization is B(Q)PSK modulated with a signal data rate before being recombined. Such a PDM technique allows to build a 40Gbit/s PDM-BPSK signal using a 20Gbaud rate per polarization (baud = symbols/sec) or a 100Gbit/s PDM-QPSK signal using a 25Gbaud rate per polarization. Further optimization of the signal consisting of the addition of Return to Zero (RZ) carving may be done on the transmit side to improve the robustness of the signal to non-linear effects.

The received signal is mixed with a local oscillator using two 90° hybrids in order to recover the phase and amplitude of the signal on both orthogonal polarizations. The four received electrical signals are then digitalized and processed by the DSP before Bit Error Ratio (BER) decision.

Optical spectra of a 7% overhead FEC encoded 40Gbit/s PDM-BPSK and 25% overhead FEC encoded 100Gbit/s PDM-QPSK channels are presented in Figure 5. These compact spectra permit to obtain high spectral efficiencies: 1.2bit/s/Hz at 40Gbit/s with 33GHz channel spacing and 2.5bit/s/Hz at 100Gbit/s with 40GHz channel spacing.

It is worth remembering that DSP implemented in ASIC technology is the key enabler for the emergence of 40Gbit/s and 100Gbit/s coherent products as it allows real-time signal processing for mitigation of linear CD and PMD distortions.

COHERENT SUBMARINE SYSTEMS

In addition to PMD mitigation, a coherent reception technique enables in-line Chromatic Dispersion mitigation which gives the opportunity to simplify the submarine line fibre mapping by use of a single type of ultra low loss and high effective area fibre; its high Chromatic Dispersion (20ps/nm/km) being no longer a limitation. Such fibre, known as Coherent Submarine Fibre (CSF), is fully qualified and available and offers a loss lower than 0.17dB/km and an effective area larger than 100mm² permitting to design systems with longer spans and higher power optical amplifiers. Early research lab experiments have demonstrated the potential of Binary Phase Shift Keying (BPSK) and Quaternary Phase Shift Keying (QPSK) associated with Coherent Submarine Fibre for long haul submarine transmission [2][3][4].

PDM-BPSK and PDM-QPSK modulation formats are associated with a wet plant composed of Coherent Submarine Fibre (CSF) and conventional wide band Erbium Doped Fibre Amplifiers (EDFA) to design Coherent Submarine Systems.

40GBIT/S & 100GBIT/S COHERENT SUBMARINE SYSTEMS

Submarine systems can be designed for a capacity of 10Tbit/s per fibre over trans-oceanic distances using 100Gbit/s PDM-QPSK format associated with CSF and a channel spacing of 40GHz. Figure 6 presents the received spectrum of 100 channels at 100Gbit/s PDM-QPSK with a 40GHz channel spacing after 7000km transmission over CSF. Such a capacity has been demonstrated in Alcatel-Lucent's laboratories [5]. The reported results demonstrate industrial margins for system reach up to 8000km when using Soft Decision (SD) FEC. Soft Decision FEC is bringing 2dB of additional margin on the FEC limit compared to Hard Decision (HD) FEC [6].

Early designed CSF systems have been first equipped with 40Gbit/s PDM-QPSK channels using HD FEC which are market available. However these systems are guaranteed by design to carry 100Gbit/s channels when SD-FEC is available.

SYSTEMS UPGRADE TO 40GBIT/S & 100GBIT/S

The upgradability with 40Gbit/s and 100Gbit/s channels on already installed systems designed for 10Gbit/s WDM has been deeply investigated as they represent a large number of systems installed on all major submarine routes. Oldest WDM legacy systems use NZDSF fibre mapping as depicted in Figure 7.

This mapping was optimized for 10Gbit/s OOK modulation format; two types of line fibre with -3ps/nm/km and +18ps/nm/km chromatic dispersion are combined to periodically bring the cumulated CD back to zero at central wavelength. To demonstrate the upgradability of such systems, a 40Gbit/s PDM-BPSK field trial was performed on Apollo's north cable over a distance of 6221 km. 72 channels at 40Gbit/s per fibre were carried over the NZDSF mapped system across the Atlantic Ocean. This field trial demonstrated a twofold increase of the ultimate capacity by using 40Gbit/s channels instead of 10Gbit/s channels.

Recent legacy WDM systems use DSMF fibre mapping. In such a fibre mapping (Figure 8), which was optimized for 10Gbit/s DPSK modulation format, two types of line fibre with chromatic dispersion of -40ps/nm/km and +20ps/nm/km are mixed. The almost perfect fibre matching of the fibre CD slope makes the CD almost independent of the channel wavelength. In addition, the cumulated CD is never brought back to zero for an optimum transmission performance of DPSK channels.

This chromatic dispersion map, optimized for 10Gbit/s DPSK modulation format, is also well suited for PDM-B(Q)PSK formats as the local CD is high and the CD is never brought back to zero thus limiting the non linear interactions between channels. Experiments carried out over a DSMF 5000km long testbed have demonstrated the transmission of 128 channels at 40Gbit/s using PDM-BPSK modulation format (Figure 9).

The recorded transmission performance of the 125x40Gbit/s PDM-BPSK channels is reduced by 2dB compared to the transmission of the 125x10Gbit/s OOK channels, demonstrating a fourfold increase of the ultimate system capacity with slightly reduced system margin. For both CD mappings, the reach of 100Gbit/s PDM-QPSK transmission compared to 40Gbit/s PDM-BPSK has been demonstrated to be reduced by a factor 3. This limitation in transmission reach roughly corresponds to the ratio of the line bit rates. Although the longest legacy systems might not carry 100Gbit/s per wavelength, 100Gbit/s client interfaces will be available through inverse multiplexing technique using lower line bit rate.

FORWARD LOOKING TECHNOLOGIES

In order to further increase the spectral efficiency, higher level modulation

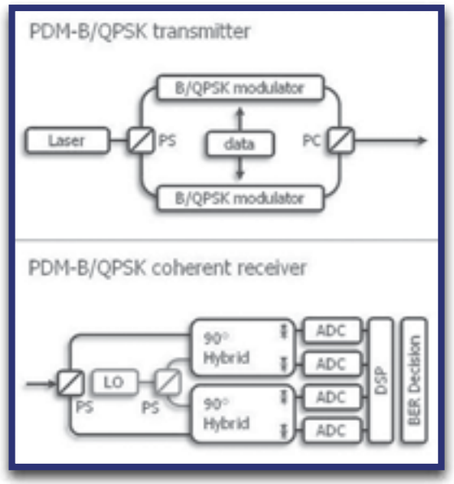

Figure 4: PDM-B/QPSK Transmitter and receiver

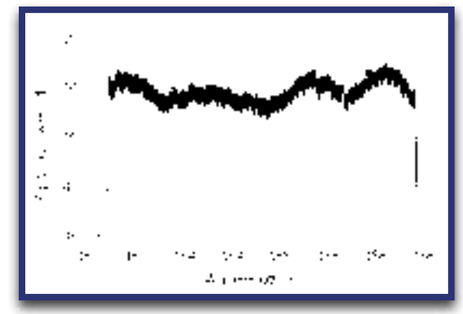

Figure 6: Received Optical spectrum after CSF 7000km - 100x100Gbit/s PDM-QPSK with 40GHz spacing

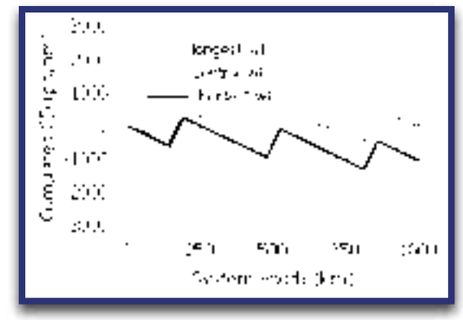

Figure 7: NZDSF Chromatic Dispersion map

New technologies for high capacity submarine systems

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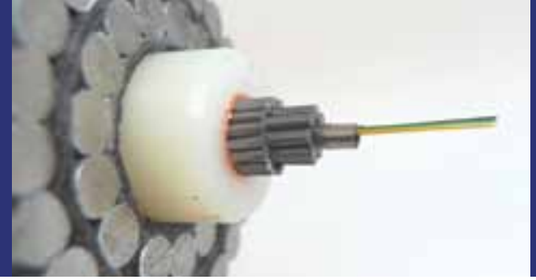

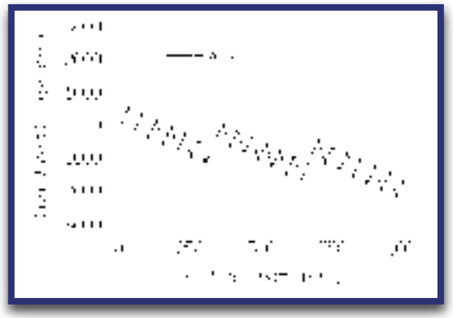

Figure 8: DSMF Chromatic Dispersion map

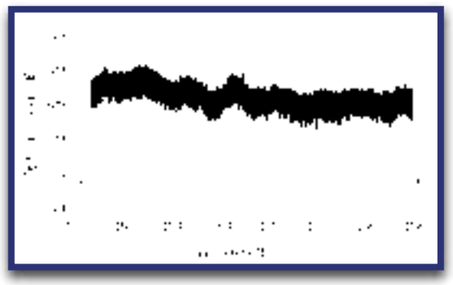

Figure 9: Received Optical spectrum after DSMF 5000km - 125x40Gbit/s PDM-BPSK with 33GHz spacing

schemes are mandatory. Advanced transmission experiments with 50GHz spaced channels modulated with 200Gbit/s PDM 16-QAM which corresponds to spectral efficiency of 4bit/s/Hz were performed by Alcatel-Lucent Bell Labs [7]. The reported results demonstrate 15.4Tbit/s error free transmission over 2000km of CSF before industrial margin. This strong limitation in system reach will have to be overcome before use in long distance trans-oceanic submarine systems.

CONCLUSION

New 40Gbit/s PDM-BPSK and 100Gbit/s PDM-QPSK formats associated with a coherent receiver and used in conjunction with CSF increase spectral efficiency from 0.4bit/s/Hz to 2.5bit/s/Hz allowing to design submarine systems with an ultimate capacity of 10Tbit/s per fibre pair. Compared to the already phenomenal capacity as described in the introduction on WACS , this is close to an additional ten-fold increase; a 10Tbit/s system has the capacity to transmit the equivalent of 340 DVDs per second. A new measure of capacity will be needed soon.

10Gbit/s legacy systems based on NZDSF and DSMF fibre mapping can also take advantage of these new coherent formats to increase their ultimate capacity.

The experiments reported in this paper demonstrate that submarine systems are ready to provide the emergent 100Gbit/s based global network with necessary submarine inter-connections.

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[5] Transmission of 96x100Gb/s with 23% super FEC overhead over 11680km, using optical spectral engineering, M. Salsi et al, OFC 2011.

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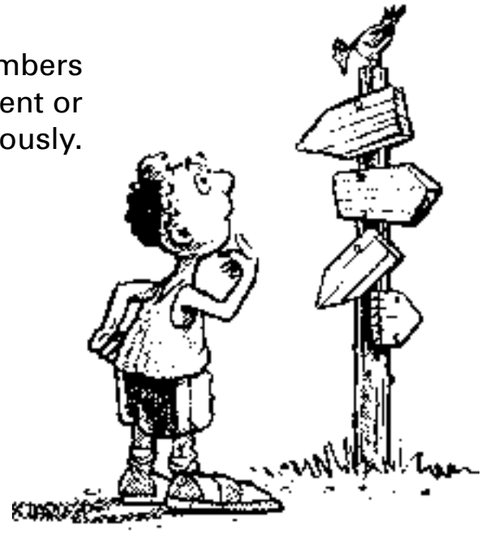
This page is dedicated to members who would like to comment or opinionate anonymously.

Say watt?



ARE OUR YOUNGSTERS IN TRAINING BEING SET-UP TO FAIL? ARE WE DISILLUTIONING THEM WITH FALSE PROMISES?

Can you imagine the frustration of a young person completing the 3-year theoretical course and not getting a diploma because they cannot get the practical experiential training – so called P1 and P2!

I am talking about many young people who have chosen and completed a technical technicians course at a University of Technology and are now sitting around doing nothing.

Well it is happening here and now in South Africa. Unbelievable but true! There are many cases that the SAIEE is aware of and just look at the social media where our young technicians in training have been sitting around without a job and no diploma. They are disillusioned and ask themselves "what is all the fuss about a skills shortage when I cannot find a job to get the P1 & P2 experience and finally get my diploma?"

University of Johannesburg has tried to address this catch 22 situation by compiling a list of about 200 firms that they approach to give the P1 and P2 training and manage to place about 95 % of their output of 'semi-graduates'.

The bottom line is – not only applicable to engineering - how does one get experience if you cannot get a job??

Is the perception that companies who are compelled to contribute 1% of their salary budget saying that this is all they are prepared to contribute to the skills shortage and nothing more? The other thought that may be in the minds of the employer decision makers is that with the competitiveness in acquiring contracts there is no place to carry the financial and accountability burden of using inexperienced labour. The preference may be to pay more for skilled resources and load the tender price accordingly. These perceptions could be far off the mark of truth but the fact remains our young people are not being employed and are seriously looking at undesirable alternatives to surviving.

The SAIEE should be concerned, as I am sure it is, about this totally unacceptable situation and must address it at the highest levels possible - because it is a situation that cannot be allowed to continue for a moment longer!

FREA KINOUT

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SAIEE

Request for SAIEE members to serve on SABS Technical Committees and the associated mirror committees of the National Committee of the International Electrotechnical Commission (IEC)

The Technology & Knowledge Leadership committee (TKL Com) of the SAIEE would like to call for responses from institute members to offer their technical know-how by participating in SABS Technical Committees as representatives of the Institute.

The main function of each committee is to make recommendations to the SABS on the need for new and revised South African Standards within the committees filed of expertise. Often the work requires the review of International standards, such as those from the IEC, to deliberate on their suitability for adoption or adaptation for publication as South African National Standards.

The SAIEE representatives in SABS technical committees are expected to provide sound, unbiased engineering judgment and advice when participating in these committees, thus adding value to the consensus process that leads to the publication of National Standards. The representative then reports back to the Institute on the progress of the SABS committees through the

For a list of the SABS technical committees, go to https://www.sabs.co.za/Standardss/standards_tech.asp

SAIEE members of SABS and other technical committees are expected to abide by a set of guidelines that are available from the Institute.

Should you be interested in representing the SAIEE on any SABS technical committee, please send your name and contact details to the Secretary of the Technology and Knowledge Leadership Committee, Ms Ansie Smith, email: smitha@saiee.org.za

South Africa is a member of the IEC, participating in the development of IEC standards through its 'mirror committees' – these are teams of local experts, who generally work by correspondence to comment and vote on draft international standards under development by IEC technical committees.

Each local IEC mirror committee liaises with a parent SABS technical committee. In the case of mirror committees, the members act in the personal expert capacity.

Many SAIEE members have technical expertise in the fields covered by IEC standards, and it is important that knowledgeable local technical experts take part in developing international technical standards in their fields.

BENEFITS

Besides honing their expert knowledge and keeping abreast with international developments, members will get an opportunity to protect the local industry by influencing standards that may eventually apply to the country.

SAIEE members are therefore encouraged to be active members of the IEC mirror committees. Active participation can sometimes lead to individuals being nominated to serve on international working groups of the IEC, providing further opportunities to develop their expertise and to contribute to international standards when in their initial stage of development.

Please contact the National Secretary of the SA National Committee, Paul Johnson, email: paul.johnson@sabs.co.za to find out more about the IEC activities and where you might get involved.

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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 R650, an annual membership fee of R840 for Members, and between R1027 and R1113 for Senior members depending on age. Most of this will be recovered through the ECSA discount.
- SAIEE members receive 11 issues of the **watt**now 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 ***CV***;
- The completed ***application form***;
- ***Proof of payment*** for the application fee. Membership fee will be comfirmed on acceptance of membership.

Copies of the above listed documentation should ***accompany the application forms*** but frequently are submitted after the application forms are sent in.

A number of applicants do not fill in every answer to questions asked on the application forms, ***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!!

2012 Membership fees

Rates as from 1st January 2012

Grade of Membership	Annual Subscriptions paid before 31 March 2012		Annual Subscriptions paid after 31 March 2012		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	106	75	118	84	118	84
After 6 yrs study	684	486	760	540	760	540
Associate	684	486	760	540	760	540
Member	756	537	840	596	840	596
after 6 years	884	627	982	697	n/a	n/a
after 10 years	924	656	1,027	729	n/a	n/a
Senior Member	924	656	1,027	729	1,027	729
after 6yrs/age 40	1,002	711	1,113	790	1,113	790
Fellow	1,002	711	1,113	790	1,113	790
Retired Member (By-law B3.7.1)	423	300	470	334	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 R650 (except Students which is free)
2. Transfer fee to a higher grade is R300.00 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 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.

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 on written application to Council, be exempt from the payment of further 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 July of each year will be struck-off the SAIEE membership role subject to Council decree.

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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 September issue crossword puzzle and send it with your name, surname and contact details to: *Managing Editor, September 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 October 2012**. The winner of R1000 will be announced in the November issue of the **watt**now magazine.

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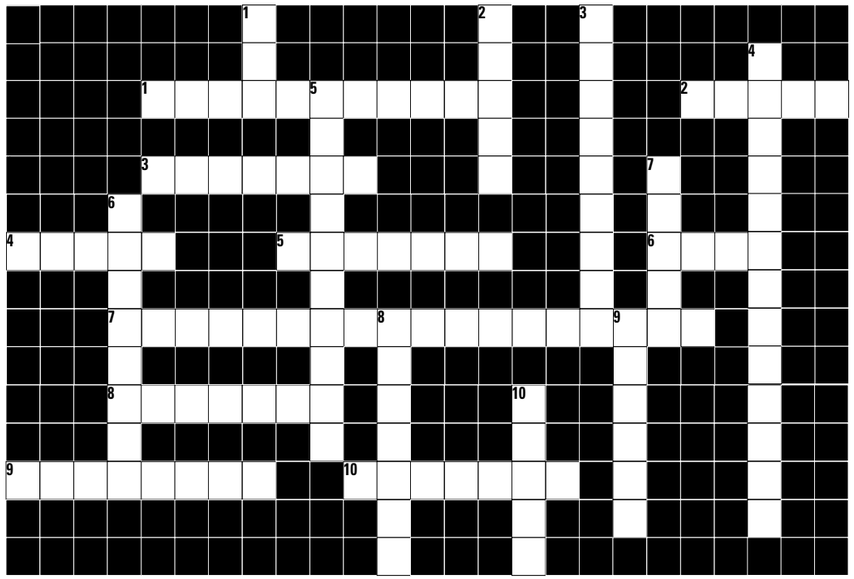
ALGAE-X, THE TANK CLEANING SPECIALISTS, ARE THE PROUD SPONSOR OF OUR CROSSWORD PUZZLE.



ACROSS

1. What do you call a device that transfers electrical energy from one circuit to another through inductively coupled conductors? (11)
2. Supervisory Control and Data Acquisition (abbr.)
3. Which nuclear powerplant in South Africa contributes about 1800 MW to the national grid? (7)
4. South African Institute of Electrical Engineers (abbr.)
5. What was the name of the first steam-powered electric power station on Pearl Street in New York City? (5,6,7)
6. High Voltage Direct Current (abbr.)
7. In 1835, who demonstrated constant electric lightning system using a prototype bulb? (5,6,7)
8. What is the name of the world's biggest dry cooled power station? (7)
9. Who, in 1752, experimented with a kite in a stormy night to understand lightning better? (8,8)
10. In 1831, who discovered that a change in magnetic flux induces an electromotive force in a loop of wire? (7,7)

DOWN

1. According to the Forbes' 100 list, which Utility company ranks the highest?(3)
2. National Energy Regulators of South Africa (abbr.)
3. What is an electrical network that connects a variety of electric generators to the users of electric power? (9)
4. What was the fierce rivalry between Edison, Westinghouse and Tesla known as? (3,2,8)
5. Which company is the world's largest provider of utility scale PV power? (5,5)
6. See 9 across.
7. Federal Power Act and the Public Utility Holding Company Act (abbr.)
8. See 10 across.
9. See 5 across.
10. See 5 across.

July Crossword Answers:

ACROSS 1 Intellectual Property **2** ALU **3** Pixel **4** Guides **5** MB **6** Roberts **7** Flattened **8** Marquee **9** Elk **10** Background **11** Skrenta

DOWN 1 Filter **2** Clipboard **3** Fastening Point **4** Layer **5** Rich **6** GB **7** Bitmap **8** Defringe **9** Steve **10** Cloner **11** Jobs

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 October 2012. 8. The winner will be announced in the November 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

OCTOBER 2012

2-3	MVNO's Industry Summit	Southern Sun Hotel, Cape Town	africa.mvnoindustrysummit.com
4-5	2012 E-LEADERSHIP Conference	University of Pretoria, Pretoria, South Africa	www.e-leadership.org
4-6	Star HRD Expo	Sandton Convention Centre, Johannesburg	www.hrde.co.za
8-9	2nd Annual Smart Grid And Smart Meter Summit	Abu Dhabi, UAE	www.fleminggulf.com
15-17	63rd AMEU Convention	Emperor's Palace, JHB	www.ameu.co.za
16-18	Broadband World Forum 2012	Amsterdam, Netherlands	www.broadbandworldforum.com
19	SAIEE Annual Banquet	Wanderers Club, Illovo, Johannesburg	www.saiee.org.za
23-25	Africa Electricity 2012	Gallagher Convention Centre, Johannesburg	www.africaelectricity.com
28-30	Retirement Expo	Coca-Cola Dome, Johannesburg	www.retirementexpo.co.za

NOVEMBER 2012

6-8	Power-Gen Africa	Sandton Convention Centre, Johannesburg	www.powergenafrica.com
7-8	2012 First National Conference for Engineering Sciences	AL-Nahrain University, Baghdad, Iraq	www.rces-2012.org
7-9	Mine Manager's Show Africa	Riviera on Vaal Hotel & Country Club, Vereeniging	www.terrapinn.com
12-14	2012 International Power System Conference (PSC)	Niroo Research Institute, Tehran, Iran	www.psc-ir.com/en
14-15	2012 Southern African Energy Effciency Convention	Emporer's Palace, Johannesburg	www.saeec2012.org.za
14-17	2012 27th Convention of Electrical & Electronics Engineers	Hilton Hotel, Eilat, Israel	www.eng.tau.ac.il
16	**watt**now Birthday Bash Networking Breakfast	SAIEE House	minx@saiee.org.za
22	SAIEE National Student Project Competition	University of Stellenbosch	www.saiee.org.za
23-25	The Green Expo	International Convention Centre, Cape Town	www.thegreenexpo.co.za
28-30	Solar & Energy Saving Products China Sourcing Fair	Gallagher Convention Centre, Johannesburg	www.tradeshow.globalsources.com

FEBRUARY 2013

25-28	2013 IEEE International Conference on Industrial Technology	Cape Town International Convention Centre	www.icit2013.org

19 September – Cape Town
20 September – Johannesburg
25 September – Port Elizabeth
26 September – East London
27 September – KwaZulu-Natal
8 September - Bloemfontein

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Member	Hope Mashele	011 350 0537	hope.nga.mashele@gmail.com
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Chairman - E&S Section	Shamendran Pillay	012 671 4565	ShamendranP@dlsys.co.za
Chairperson - Power Section	Thandiwe Nkambule	011 629 5158	thandiwe.nkambule@eskom.co.za
Chairman - Historical Section	Max Clarke	011 476 5925	mppc@mweb.co.za
IEEE Representative	Prof Willie Cronje	011 717 7224	willie.cronje@wits.ac.za
RMWG Representative	Mario Kuisis	011 326 2708	mario@martec.co.za

Kwa-Zulu Natal Centre

Chairman | T.C. Madikane

Postal Address | 1st Floor Santoni House, 7 Sinembe Cres, La Lucia Rige, 4051

T| 031 536 7300 **F**| 031 566 3385 **E**| tc@igoda.co.za

Western Cape Centre

Chairman | Marius van Rensburg

Postal Address | Vygieboon Singel 8, Durbanville, 7550

T| 021 980 3777 **E**|marius.Vanrensburg@eskom.co.za

Southern Cape Centre

Chairman | Robbie Evans

Postal Address | P O Box 744, Wilderness, 6560

T| 044 801 2151 **E**|robbie.evans@eskom.co.za

Eastern Cape Centre

Chairman | Sarel Schoombie

Postal Address | Private Bag X6011, Port Elizabeth, 6000

T|041 504 3290 **E**|Sarel.schoombie@nmmu.ac.za

Mpumalanga Centre

Chairman | Elyssa Spreeth

Postal Address | PO Box 432, Secunda, 2302

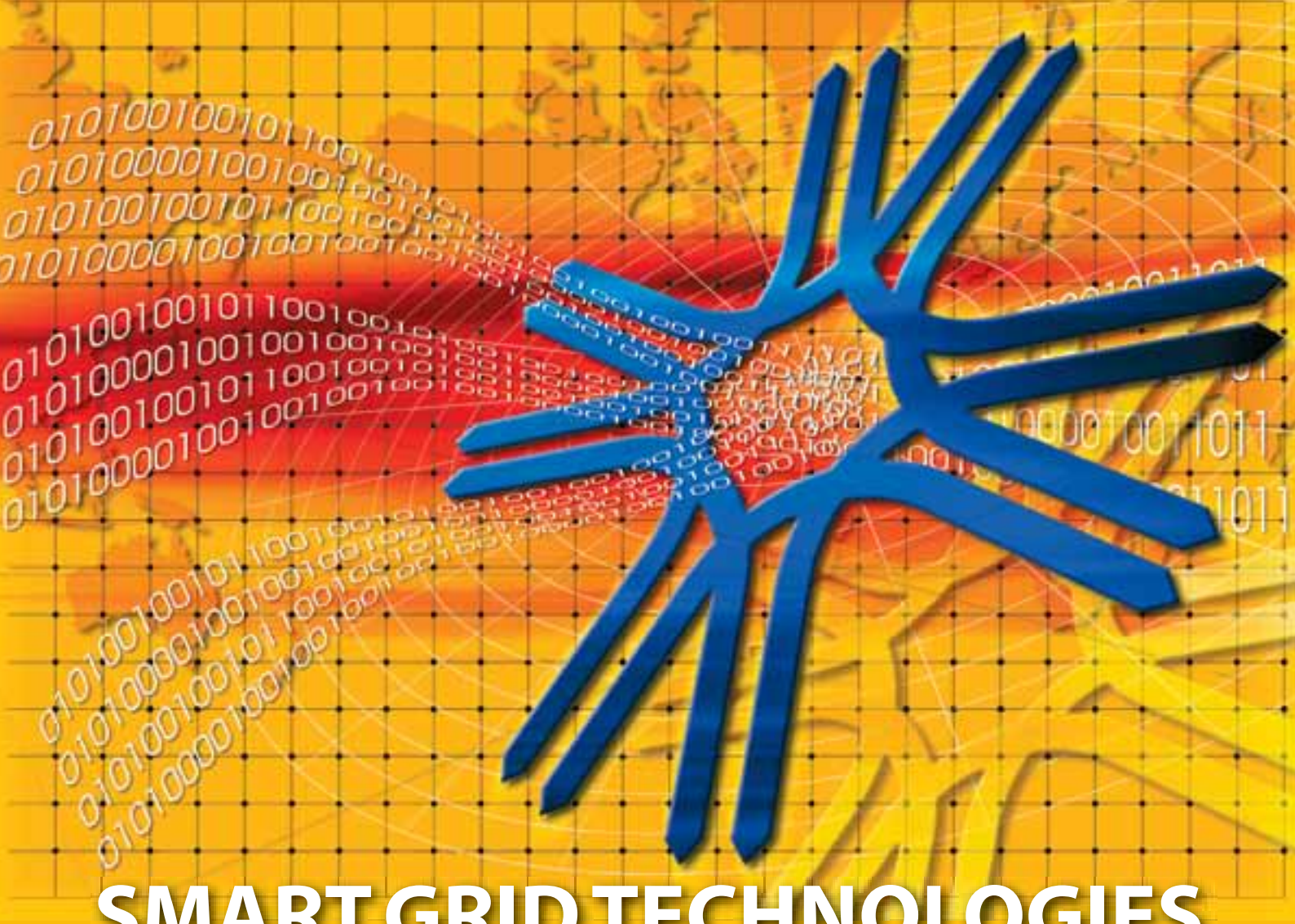
T|017 614 5029 **E**|elyssa.spreeth@gmail.com

Bloemfontein Centre

Convener | Ben Kotze

Postal Address | University of Technology Free State, Private Bag X20539, Bloemfontein, 9300

T|051 507 3088 **E**|b.kotze@cut.ac.za



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TELECOMMUNICATIONS RESEARCH GROUP
Electrical and Electronic Engineering Sciences
Faculty of Engineering and the Built Environment
University of Johannesburg
PO Box 524, Auckland Park 2006
Johannesburg, South Africa
Phone **+27 (0) 11 559 4743**
Fax +27 (0) 11 559 2357
Email **hcferreira@uj.ac.za**
asnyders@uj.ac.za
wendys@uj.ac.za

OUR RESEARCH PARTNERS
University of Duisburg-Essen, Germany
Technical University, Delft
University of California, Davis
Chinese University of Hong Kong
Walter Sisulu University, South Africa
North-West University, South Africa
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