W W

THE SAIEE CHANGING

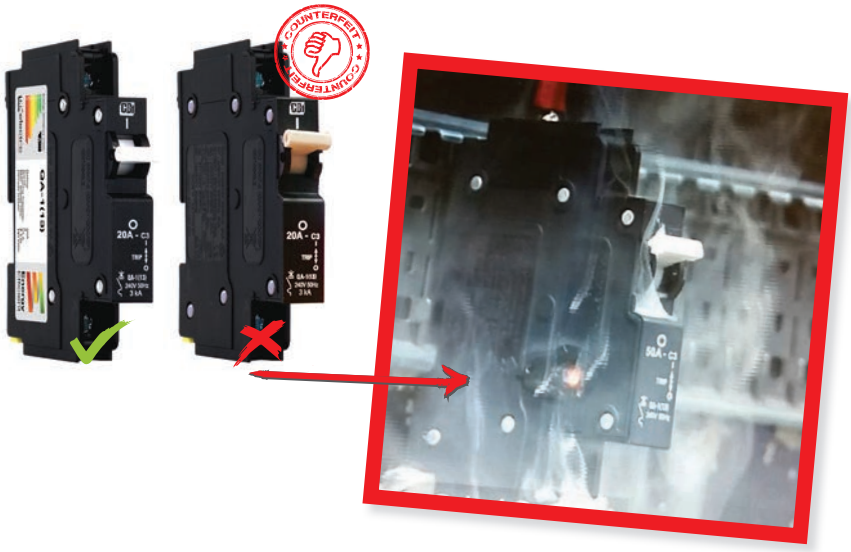
RSA | R30.00 incl. VAT

PRESIDENTIAL

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | May 2018

These are safety devices

WARNING: Which one can you trust?



These are typical miniature circuit breakers (MCBs), very similar in appearance. They are installed in your distribution board. Their purpose is to protect you and your assets from faults in your electrical system. Faults can and do result in **fires**, **destruction of possessions**, **injury** and **death**.

But one of them **WILL NOT COMPLY** with safety regulations and will not do the job.

ALL OVER SOUTH AFRICA THERE ARE MILLIONS OF UNSAFE ELECTRICAL PRODUCTS ON OFFER & IN USE. WHAT TO DO?

- Buy from **reputable distributors** and outlets.
- Beware of **copies** of prominent brands.
- Be suspicious of **prices** lower than for other, similar products/services.
- Be suspicious of **lack of information** on or with the product packaging.
- Ask the supplier for **references** to other users – and contact them.
- When dealing with an electrical contractor, ask for proof of registration and about its membership of the **ECA** (Electrical Contractors Association). Call the ECA in your region to check credentials.
- Be critical of a suspect installation or a **Certificate of Compliance** (COC) that is issued too easily.
- Ask the supplier to prove **compliance with regulations**.
- Look for **certification marks** such as **SABS, VDE and UL**. (Note that the SABS mark is not necessarily a substitute for the LOA).
- Beware of **fraudulent use** of well-known certification emblems, such as the SABS mark.
- A **"CE" mark** is not proof of independent testing and not necessarily proof of conformity.

SAFEhouse members have signed a code of conduct: Your assurance of commitment to offer only safe electrical products and services.

SAFEhouse membership is suppliers' assurance to customers of responsible behaviour and of customers' safety as a priority. SAFEhouse members regulate themselves. SAFEhouse is primarily a communications association that informs customers of safety requirements and occurrences of non-compliance with such requirements.

SAFE HOUSE™
Suppliers you can trust

As at 14/03/2016

The SAFEhouse Association is a non-profit, industry organisation committed to the fight against sub-standard, unsafe electrical products and services.

For more information contact:

Barry O'Leary: Tel: 011 396 8251 | Email: barry.oleary@safehousesa.co.za

Pierre Nothard: Tel: 011 396 8140 | Email: pierren@safehousesa.co.za

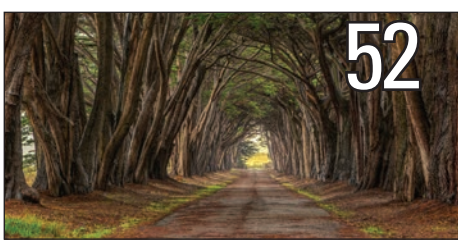
www.safehousesa.co.za

contents

FEATURES

GENERAL

REGULARS



SAIEE @saiee

wattnow

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

TECHNICAL EDITORS
Jane-Anne Buisson-Street

CONTRIBUTORS
Q Louw
B Dewachter
D Basson
B Penzhorn
W Adams
J Buisson-Street

EVENTS
Gerda Geyer I geyerg@saiee.org.za

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

MEMBERSHIP & TECHNOLOGY LEADERSHIP
Connie Makhalemele Maseko I connie@saiee.org.za

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

PUBLISHER
South African Institute of Electrical Engineers

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

ISSN: 1991-0452

2018 Q1 - 15 527

May has arrived, and we are gearing up for what the month will bring.

You would've noticed in the April issue of **watt**now that the SAIEE has inaugurated a new president, Dr Hendri Geldenhuys. I share with you his inaugural speech on page 6, which focusses on the SAIEE Challenge: The world is Changing.

On page 26 you will find the first feature article discussing mitigating strategies to address damage to electrical supply networks.

We discuss Electrical Energy Storage on page 36. The industry has massive expectations, but we need a breakthrough to make this work.

Page 40 sports another article from Dudley Basson, where he tells us more about "X-Ray and Gamma-Ray Astronomy".

I have started a new section in this issue "Down Memory Lane". The first article was penned by Mr Bruno Penzhorn, who shares anecdotes of his former years as an electrical apprentice. Please share your stories with me in sending an article with AT LEAST 2000 words in a word format to my email address: minx@saiee.org.za with "Memory Lane" in the subject field.

We will be taking part at the African Utility Week, running from 15 – 17 May 2018 at the Cape Town Convention Centre. Please come and visit us at our stand.

Herewith the May issue, enjoy the read.

Minx

Visit www.saiee.org.za to answer the questions related to these articles to earn your CPD points.

COMING SOON!

4.5KA MINIATURE CIRCUIT BREAKERS

Our new range of MBT63E 4.5KA MCBs will be launching in April, giving you substantial reliability with up to 14 000 operations and RoHS compliance.

- Available in 1-pole to 4-pole
- 1A to 63A
- C and D curve for overcurrent and short circuit protection on all distribution and motor applications
- Wide range of accessories available – shunt trip, alarm trip, auxiliaries and under/over voltage protection for maximum efficiency

For more information please contact your local Voltex branch.

facebook.com/VoltexSA
twitter.com/voltexsa
info@voltex.co.za
www.voltex.co.za

voltex®
LS IS

SAFE HOUSE
Suppliers you can trust

Proudly Bidvest

DR HENDRI GELDENHUYS
2018 SAIEE PRESIDENT

2018 sees the SAIEE celebrating its 109th year, which means that the members of this proud institution did something right! To ensure the prosperity of the SAIEE for the next century, we need to understand our current situation and plan for the legacy of being still a valid institute for the engineers of tomorrow!

"THERE IS NO STRENGTH WITHOUT KNOWLEDGE"

President Ramaphosa has challenged South Africa - **"Now is the time…"** Now is the time for South Africans to strengthen, update and modernise "ship South Africa". Electrical Engineering and its derivatives are part of the critical industries required to drive South Africa into a prosperous future. Steering Southern Africa to be a region of milk and honey for all its people rests on our shoulders.

Back in the 1980's, Prof Louis van Biljon inspired many of the young and upcoming engineers at Pretoria University; he had the view that his primary job was to "*ignite the fire of engineering*" in the hearts of his students. It is the work of the SAIEE to feed and oxygenate this flame in the hearts of our members throughout their careers. When I see the torch flame in the claw of the lion on the SAIEE Coat of Arms, I can only imagine that our forefathers had a similar idealism in mind when they designed it.

We live in challenging times:
We are at a point in South Africa's history where the spearheads of electrical engineering service delivery (energy and telecommunication) are in a critical state of ailment. The embryonic grounds of our profession (Universities, Universities of Technology, Colleges and Schools) are equally challenged and in the state of flux. Worldwide electrical engineering and its derivatives continue to bring new technologies to the world, bringing new value and enhancing existing value. New organisations usually carry these new technologies into society, and it is imperative that the SAIEE grasp these changes and seize the opportunities that arises.

The older (electrical) technology organisations are in their midlife, even though some may argue it is of a vintage stage. Organisational-competitive edge no longer lies in technology, but lies in efficiently managing its resources, while it applies good governance. For these reasons, these organisations are often lead by financial professionals.

Information Technology is increasingly changing the playing field of engagement and learning; this erodes traditional needs and means of engagement and education. These "new technology" organisations access high-value space and are top risk organisations of which some have rather short lifespans.

The SAIEE Challenge: The world is changing

On our economic-socio-political front lies the promise of a new dawn, not only in South Africa, but also in southern Africa.

The South African choice: we can be inward focussed, like pirates on a ship, fighting for survival amongst ourselves, or have the vision to be like a modern ocean liner, with the clarity of where we are going and how to get there. We can transform southern Africa, to be an effective holistic-community capable of sailing the world's oceans of economic challenges to the benefit of all its people.

The Electrical, Telecommunication, Electronic and Information Engineering community has a pivotal role to play.

It, in fact, is indispensable on this "ship".

The environment the SAIEE (Voluntary Associations) operate in is changing on all fronts. The operations and business of the SAIEE cannot be the same as it was in the past 109 years. It is up to us to adjust the trajectory of this organisation to ensure its vibrancy, vitality, growth and good health in the years to come. Yes, it has to be FUN to be a member!

Changes are taking place in the VA-statutory arena. The SAIEE are keen and capable of playing its role here and would respond positively to increasing its contribution in this regard.

The SAIEE Challenge...

continues from page 7

The most important changes the SAIEE faces are in its members:
Traditionally Universities and Technicons (at the time) fed "Engineers" into the formal sectors of engineering. Voluntary Associations, like the SAIEE, guided these individuals through their careers. These were the days when Engineers were "born as Engineers". These were the days where BEng degree individuals were at the helm of large engineering companies, where technology dominated engineering organisations.

WHO ARE OUR MEMBERS?

2018 brings us to the point where the last of the Baby Boomer generation are still practising. Senior Engineers, Technologists and Technicians draw from Generation X, and the core of our membership is Millennials, and we are on the verge of bringing Generation Z on board. The Silent Generation and the Baby Boomer Generation is mainly leading the SAIEE.

South Africa's political history brings a further dimension to a changing landscape of colour(ful) demographics to the picture. The increasing number of woman in engineering brings exciting opportunities as well as different needs into the profession and workplace.

ENGINEERING – A VERY SPECIAL CALLING

What makes engineering an extraordinary career (in the view of engineers)? It is the notion that engineering is the pinnacle of MAN's civilisation.

Engineering is based on Science, BUT ENGINEERING IS AN ART:
It is the art of creating the technology environment in which we live.

NON-TECHNICAL SKILLS NEEDING CONSIDERATION

- Values and ethics
- Emotional Intelligence
- Team dynamics, development and management
- Human understanding and communication
- Public speaking and public communication
- Physical health and fitness
- Demands of family and community commitment
- Changing demands on gender roles and contribution in the work place

Table 1

For me the words of Chris de Burg's ballad, *"The Hands of Man"*, conveys this role of engineers beautifully:

The Hands of Man
These are the hands that build cathedrals
These are the hands that feed the world...
These are the dreams that take us forward
These are the dreams that walked the moon
These are the dreams that make us
what we are
These are the dreams... of Man!

And we have crossed the oceans
We have followed the stars
We have learned to reason
And we have studied the heart
We can build cathedrals
We can sail the skies
We have energy hostage
Turning day into night...
We are MAN!

Yes, Engineers are people. As we discuss all of these in-depth technical and organisational matters, **we sometimes forget that we are (WO)MAN.**

For the ENGINEER-MAN to work practically, we need to be complete people. The world's engineers live in (as much as we often are not the extrovert, flamboyant types) depends on Man's social skills. The ability to communicate complex and complicated concepts to others and make it work in Our World. The ability to inspire others with the vision and focus of the task at hand, the ability to energise our fellow men to contribute their best effort to the common objective.

Engineer career development, therefore, needs to include the "other" (soft) skills of MAN such as depicted in Table 1.

These are areas of opportunity for the SAIEE to see how it can better serve its members.

A HEALTHY COMMUNITY

South Africa needs healthy communities that care for itself and raises the next generation to take SA forward in a flourishing-meaningful way. South Africa has the most challenging environment one can think of and requires a miracle to balance all the complexity and change its experience.

I wish to focus on just one aspect here, namely the changing gender roles in society and families. Both male and female

roles are changing. We have to consider and understand these changing roles carefully, and how we can make sure that the next generation does not pay the price for these changes.

Once more these challenges are not specific to SAIEE members and synergy between VA's should be exploited in addressing these challenges.

MENTORING

The SAIEE have the objective to give guidance to our members, to help engineers, technologists and technicians to perform optimally throughout their careers and being able to make well-considered choices in career progression.

The SAIEE has been instrumental in defining electrical engineering as a career and is doing sterling work in the mentoring of newly qualified Engineers and Technicians, assisting them to register as Professionals. The "Career Development" block below reflects some of these career aspects. The green shaded area, depicts the start of our careers, and this is where the SAIEE is excelling, but there exists a few gaps in the latter part of career progression, and this is where the SAIEE should focus.

When we look further down the career of our members, and in respect of demands of the evolving environment in southern Africa, guidance beyond Professional Registration is becoming more and more critical.

LEADERSHIP IN BIG ORGANISATIONS

I sometimes hear engineers discussing the question why engineers are no longer the leaders of broad public and private organisations?

The world of large corporate executive teams, in most cases, no longer revolves around their competitive technical edge, but their operational efficiency and corporate compliance requirements.

It, therefore, stands to reason that if we do not guide young members to have an interest in, and master these disciplines, it will be up to other better (but not necessarily more suitable) candidates to fill these positions. (Note our Immediate Past President Jacob Machinjike's Presidential address in 2017- the Role of The Engineering Professional in Today's Complex Decision Making in this regard.)

It is, therefore, critical that we sensitise, nurture and develop members from an early stage of their careers, to enable them to improve their skills.

ENGINEERING-ENTREPRENEURS FOR BUSINESS DEVELOPMENT AND GROWTH IN SOUTHERN AFRICA

The early evolution of southern Africa focussed on infrastructure, and at the time little local development expertise existed, with engineering development taking place elsewhere in the world. It was quite challenging to develop world-class engineering businesses because of limited knowledge, resources and markets.

What redefines the new world is national-boundaries, time, space and even currencies. Bitcoin conveys this point elegantly. The environment for business development is changing. It no longer matters where you are on the globe, the boundaries in particular in electronic and information engineering no longer exists. South Africa has moved far beyond the old arena and the engineers bred on our turf is taking on the best talent in the world.

Several prominent South African born engineering entrepreneurs come to mind, such as Mark Shuttleworth, Elon Musk and others. The southern African market is on our doorstep; we are ideally placed to

The SAIEE Challenge...

continues from page 9

understand these markets and to develop products for these markets.

Are we exploiting these opportunities to the fullest?

It is the task of the SAIEE to sensitise our members and equip them to take full advantage of these evolving opportunities.

By coaching our young members in having a business mindset, we aide them in developing technologies and to grow them to maturity to be skilled business owners.

6000+ MEMBERS TO SUPPORT ONE ANOTHER?

Is there an opportunity for the SAIEE with its 6 000 members to mobilise its members in this regard?

Would it be possible to facilitate the process to link Senior Engineers to less experienced engineers to assist in reflecting on their careers, what they are doing and where they are going and how to get there?

The modern-world-electronic-media are invading many of the traditional roles of Voluntary Associations. The SAIEE are no longer the only custodian of Electrical Engineering knowledge. The internet gives access to education around the world, and even language barriers are being broken down.

How we approach this challenge is very important for the future of the SAIEE.

The space of personalised engagement (coaching and mentoring) is an arena that electronic media can not easily invade, but it will still play an essential role for Voluntary Associations.

How best we can mobilise our members to be coaches and mentors to one another is a challenge the SAIEE needs to consider carefully. It is a space where the SAIEE must develop unique support and services to its members. It is also an arena for synergy between the SAIEE and other VA's in South Africa.

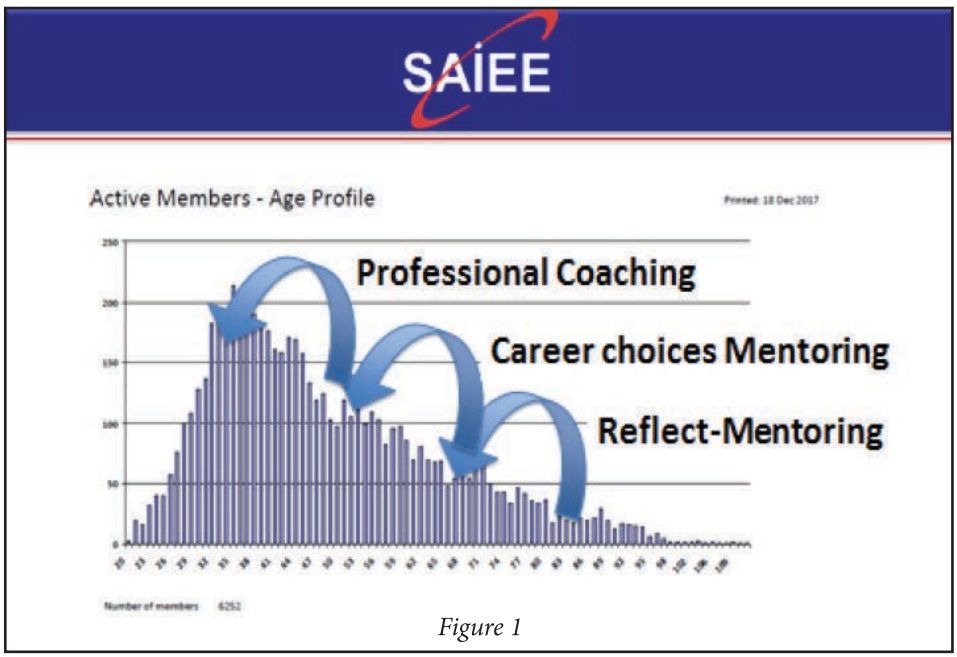


Figure 1

Figure 1 showcases the current age demographics of the SAIEE membership. It envisages that more experienced members can become coaches and mentors to members in the way illustrated.

For this to become a reality, we would need a system that would facilitate such coaching-and mentoring-pairing. Let's assume that a member wishing to receive coaching or mentorship in a particular technology will access the SAIEE database of member-mentors.

This platform will have relevant information (CV's) of our members in a standardised form that will make it possible for a mentee to identify suitable mentors, which they can approach for assistance. Information such as location, work experience, management experience, technical expertise and education will be typically in such a database.

SAIEE STRATEGY

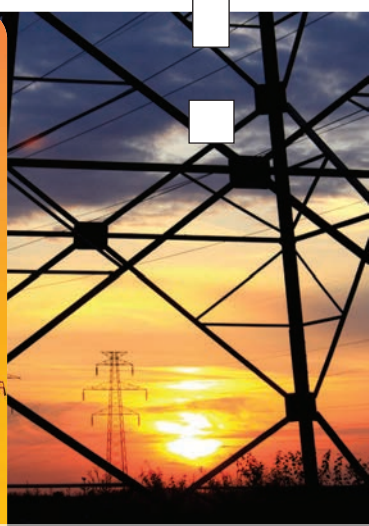
Given the changing environment, the SAIEE Council spend the 3rd of February discussing and considering it's strategy going forward under the guidance of Tony Manning – a very experienced and widely recognised strategy specialist.

The SAIEE Council Members had the opportunity to give their inputs into the strategy discussion and the following crystalised from the talks:

THE SAIEE PURPOSE

- Enhance the practice of Electrical Engineering in SA; and
- Enhance the stature of SAIEE members through knowledge, networking, influence, education and communication;

Why become a SAIEE Member?



what's in it for me?

SAIEE OFFERS:

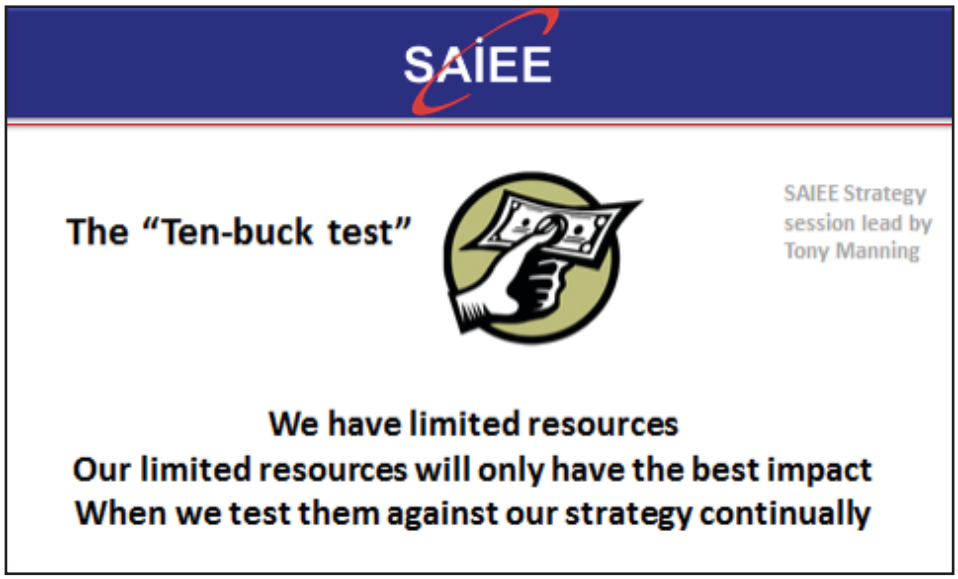
- All members in the Electrical Industry are welcome
- You do not have to belong to ECSA to be an SAIEE Member
- Receive 11 issues of the wattnow magazine online
- Access to the peer-reviewed Africa Research Journal
- Access to Monthly Lectures
- Qualify for discounted insurance as an SAIEE Member
- Generous discounts on CPD Training Courses
- Access to monthly CPD accredited Site Visits
- Be part of an SAIEE Centre in your area
- Networking Opportunities
- We offer a Mentorship Programme
- Receive a weekly SAIEE Newsletter
- Access to the Electrical Engineering Library at SAIEE House
- Free access to the SAIEE Museum
- 2nd Year & onwards Engineering Students welcome
- Claim 1 (category 3) CPD credit for being an SAIEE Member
- Receive a certificate of Membership to hang in your office

SAIEE

011 487 3003 | www.saiee.org.za

The SAIEE Challenge...

continues from page 10



WE CAN ACHIEVE THIS THROUGH:

1. Continually and actively improve our member value proposition to ensure retention and growth, and energise promotion of membership;
2. Focus on Head Office activities, providing the right people with right jobs and facilitate the ongoing personal development;
3. Help Regional Centres and special interest groups to make the maximum impact, and by
4. Aggressive stakeholder outreach to raise SAIEE's profile and gain influence.

FOCUS RESOURCES: THE "TEN BUCKS" REALITY

Are we doing the right things effectively?

The SAIEE has limited resources - limited budgets, limited staff, limited voluntary contributions etc. These critical resources must be optimally applied to achieve the Purpose of the SAIEE.

We need to critically examine our activities to ensure it meets the "Purpose of the SAIEE" in the best way possible and how we need to change our approach to achieve optimal efficiency.

The resources could be applied more effective by the "Gearing" of activities.

INTERNAL GEARING

We can find "internal gearing" in the activities of the SAIEE, where two currently unrelated activities in support of the "SAIEE Purpose" can be reorganised to become one more useful activity. We need to be always on the lookout for such opportunities. An example is when the SAIEE run a conference which in turn provide publication material for the Africa Research Journal or the **watt**now.

EXTERNAL GEARING

Where synergy exists between the SAIEE and other organisations, and this coalition is beneficial to both organisations, then we are moving in the right direction.

Examples of external gearing are where the SAIEE and other Voluntary Associations (VA's) are working together for the good of their respective Purposes.

External Gearing can be achieved by the synergy between SAIEE and private commercial entities such as Universities, the CSIR, etc. in arranging events such as conferences or seminars more effectively. This will be successful by working with like-minded international organisations such as the IET, IEEE and others.

The SAIEE has a proud history;
The SAIEE have substantial assets, an active administration;
The SAIEE have 6 000 members to mobilise:
My wish is that we use 2018 as a time to reflect on how best the SAIEE can engage with its members at all phases of career progression.

May the ENGINEERING FLAME burn brightly in your hearts
"Now is the time..."

H Geldenhuys | SAIEE President 2018
Pr. Eng | FSAIEE

SAIEE

Why use us for Mentorship?

what's in it for me?

FOR THE MENTOR

- The SAIEE Member is a senior experienced professional
- The SAIEE Member is a:
  - Professional Engineer, or
  - Professional Engineering Technologist, or
  - Professional Engineering Technician or
  - Professional Certificated Engineer
- A mentor is a trusted advisor whose role is to guide and facilitate the professional development of the candidate
- The SAIEE Mentor is able to Manage a candidate by developing skills and competence in the work place

SAIEE OFFERS:

FOR THE MENTOREE

- Work Integrated Learning (WIL) for University of Technology and Comprehensive University Student Technicians
- Development in various engineering arenas
- Comprehensive work related mentorship aimed at Professional Registration with ECSA
- Supplementary training to enhance technical and soft skills
- The scope of Mentorship covers four sub-disciplines:
  - Power
  - Electronics (Control & Instrumentation)
  - Telecommunications
  - Computer and Software

SAIEE

011 487 3003 | www.saiee.org.za

WATTSUP

EDEN GREEN ENERGY SUMMIT SPONSORED BY SOUTHERN CAPE CENTRE

From left: Eden DM Municipal Manager, Mr Monde Stratu; SAIEE Southern Cape Centre (SCC) Chairman, Johann Swanepoel and Eden DM Executive Mayor Cllr Memory Booysen.

Each speaker at the Conference received a complimentary bottle of wine sponsored by SAIEE SCC.

Eden District Municipality (Eden DM) hosted a Green Energy Summit on 11 and 12 April 2018 at Fancourt in George, which was themed "Promoting Green Energy initiatives towards an even Greener Eden District".

More than 200 delegates from the seven local municipalities in Eden, the Western Cape Government's Energy Security Game Changer initiative, the CSIR Energy Centre, Green Cape, USAID-SALED, Green Building Council SA, SALGA, University of Stellenbosch's Centre of Renewable & Sustainable Energy Studies and private sectors attended the summit.

All actively participated in discussions about the region's transition to a collective, sustainable and renewable energy model. The concept of Green Energy also forms part of the critical priorities of the Eden DM Council and is now well reflected in its new Spatial Development Framework which was adopted and approved by the Eden DM Council on 5 December 2017.

The SAIEE Southern Cape Centre co-sponsored the summit, with the Chairman, Mr Johann Swanepoel, congratulating each speaker with an SAIEE gift. Mr Swanepoel said that he is proud to have been associated with such a well organised and professional Summit. The highlights of the two days were the importance of suitable qualified electrical engineers to drive the transition to green energy and the maintaining of the existing municipal electrical infrastructure. The Southern Cape Centre aims to play a leading role in assisting the district engineers with training and workshops.

THE OUTCOMES OF THE SUMMIT SUMMARISED

On the second day of the Summit, the public and private sector delegates voted to pursue the following government-driven 'green' initiatives over the short-, medium and long-term (in order of priority):

1. To develop an "Eden Integrated Energy Plan" aligned with local raw water sources in Eden District SDF's, IDP's, Sector Plans and to then integrate such a plan into the planned "Eden Growth and Development Plan";
2. To implement at least one (1) new green energy project per municipality in the Eden District and to collectively pursue such projects under a new Eden Energy Forum that will aim to meet on a bi-monthly basis;
3. Explore and implement alternative transport fuel strategies, including the conversion of municipal fleets and alternative fuel charging/filling networks / PV charge stations throughout the Eden district;
4. Ensure the implementation of existing, planned IPPs, and to attract new IPPs to the District by creating an enabling environment;
5. Ensure the reflection of "green" planning elements in each Municipality's SDF, IDP and Sector Plan implementation framework; and
6. Establish a local Biomimicry Research Centre and Discovery Park at an appropriate location in the Eden District.

DEHNacademy empowers Wits students

Front row from left: Hano Oelofse (DEHN Africa Technical Director); Thulisile Masangu; Lena Mabaso; Nikita Kanjee; Galaletsang Makhene; Fezile Masanabo; Tatenda Gora (DEHN Africa Sales Engineer) Second row from left: Kgadile Masemola; Thabo Nobela; Thebe Dikobo; Johan John.

Lightning and surge protection specialist DEHN Africa, has recently finished a nine-month training course in lightning and surge protection for a group of Wits students.

As part of its latest efforts, DEHNacademy has just ended an almost year-long period of hands-on training for a group of nine second-year students from Wits, who took a gap year at DEHN Africa during 2017 before returning to study again this year.

DEHN Africa Sales Engineer, Tatenda Gora, says, *"The DEHNacademy internship programme was started partly because of the perceived need for a course on lightning protection for undergraduate electrical engineers. From our experience in the industry, we found that there is a gap in the undergraduate electrical engineering curriculum when it comes to lightning and surge protection."*

DEHNacademy offers practical knowledge and skills in the fields of lightning protection, surge protection and safety equipment, providing a 2-point CPD accredited seminar entitled 'A comprehensive approach to lightning protection' for engineers and consultants. The workshops are both industry and application specific.

Last year's extended training period for the nine second-year intern students was a new evolution for the DEHNacademy. They began with training at DEHN Africa, starting with theoretical learning via DEHN's 'Red Bible' Lightning Protection Guide. They completed various assignments and then continued their training at various DEHN partners for the field experiments.

"During our course, we gave the students real hands-on training, in conjunction with our partner companies, planting the seeds of lightning protection knowledge and instilling the fundamentals of lightning protection, general engineering experience and exposure to the workplace. The course was additionally ratified via Wits University and merSETA, which allowed the students to receive a stipend. We are pleased to realise that the students will take this knowledge back to their peers at university when they return to their studies," concludes Gora.

DEHN Africa would like to thank local partners, Universal Lightning Protection Services, Advanced Lightning Protection, SME Earthing and Lightning Protection Company and Elektromechanica, for their assistance in this practical training.

WATTSUP

SAIEE visits rural school

From left: Mr Qamata, Nyanga High Principal; Monde Soni SAIEE Council member and the Student Governing Body Chairperson.

Monde Soni with a few of the matric maths and science students.

On the 4th April 2018, Monde Soni, SAIEE Council Member and member of the Education & Training Committee, visited the Nyanga High School near Engcobo town in the Eastern Cape. The visit was to inform the students about the SAIEE and electrical engineering as a career.

The school is situated a few kilometres out of Engcobo town, which is a typical rural town in the Eastern Cape. It is far from active commercial areas as the closest larger town (Mthatha) is about an hour away. Most of the students attending there are from the surrounding villages with very little information about career opportunities post matric.

Monde chose this school because it is the school where he completed high school. As an Alumni of the school, he went to motivate the matriculants regardless of the career path they may have in mind. He informed the students about Electrical Engineering as a career – what it takes to be an electrical engineer and what ideal job opportunities exist. Very importantly, he advised the students about SAIEE, the existence of Student Chapters that offer access to mentors. He said: *"As soon as you register at a tertiary establishment as an electrical engineering student, you must register to become a member of the SAIEE, which will offer great guidance throughout your student life".*

The Engineering & Built Environment Faculty of the University of Pretoria sent some marketing material and goodies for the students. We certainly hope that they will receive applications from the matriculants for 2019!

The school really enjoyed the visit, with the Principal, School Governing Body and the students all in attendance.

SAIEE President visits Western Cape

The 2018 SAIEE President, Dr Hendri Geldenhuys kicked off his Presidency with his first visit to the SAIEE Western Cape Centre during April 2018. The Centre Chairperson, Joyce Mtimkulu hosted the Head Office Delegation, which included George Debbo, Deputy President; and Stan Bridgens, SAIEE CEO.

At the event, Mr Emile Kleyn, a student from Stellenbosch University received The SAIEE-International High Voltage Symposium (ISH) Grant Certificate for a postgraduate scholarship for research in High Voltage Engineering.

From left: Dr Hendri Geldenhuys (SAIEE President), Joyce Mtimkulu (Western Cape Centre Chairperson) and Emile Kleyn (Stellenbosch University).

African Distribution Network Places Cummins In A League Of Its Own

With Cummins being one of the largest genset manufacturers worldwide, it is able to provide customers with a broad range of power solutions. Moreover, it differentiates itself from many of its competitors due to its robust distribution network.

Cummins owns its distribution channels in many key African markets, or has very strong joint venture (JV) partners. What this means for customers is a 'one-stop shop' not just for products, but also for service provision, Cummins Africa Distribution Sales and Business Development Director Vivek Malapati explains. *"Many of our competitors mostly use independent dealers, meaning customers often have to deal with multiple companies, even for the smallest issue, which adds red tape and slows down turnaround times,"* he points out.

Cummins' distribution network is extremely well-run, comprising highly-skilled staff, allowing it to cater for all customer needs, from acquiring a 17 kVA unit to installing a 20 MW power station. *"We are not only able to provide upfront application engineering support, but project execution from start to finish, in addition to aftermarket service,"* Malapati notes.

Cummins manufactures all key components of its gensets, unlike other companies that focus solely on assembly, sourcing components from various suppliers. This provides for a completely different customer experience, particularly in terms of warranty and service support, as it allows for a single point of contact, known as 'The Power of One'.

Cummins is currently investing significantly in its African distribution network. *"If you look not only at power generation, but many of our other end markets, one of our key strengths has been our investment in tooling, technicians, and stockholding, both for products and spare parts,"* Malapati highlights.

Nigeria, Senegal, Côte d'Ivoire, Ghana, Angola and East Africa are focus countries at present for Cummins. *"We invest to ensure we have sufficient capacity to meet our customers' needs throughout the continent. In addition, we strive to provide our technicians with the latest training and equipment,"* Malapati concludes.

Vivek Malapati
Business Development Director | Cummins

New F'SASEC Lab at VUT gives students competitive edge

Schneider Electric, a global specialist in energy management and automation, has supported the launch of a new, state of the art automation laboratory at the French South African Schneider Electric Education Centre (F'SASEC), based at the Vaal University of Technology (VUT).

The first of its kind for F'SASEC VUT, the laboratory highlights the latest Schneider Electric technology and affords students the opportunity to advance as they are introduced to automation equipment such as programmable logic controllers (PLCs) and variable speed drives (VSDs).

Officially opened by Albert FUCHET, Cluster President for Schneider Electric Anglophone Africa and Prof. Gordon Zide, VUT Vice-Chancellor and Principal, the newly equipped lab was made possible following a generous donation of more than R1.6 million to the centre from Schneider Electric South Africa last year.

From left: Jason Ullbricht (Schneider Electric), Dr Joe Molefe (VUT), Wiseman Jack (VUT), Dr Véronique Briquet-Laugier (French Embassy), Albert Fuchet (Schneider Electric), Zanelle Dalglish (Schneider Electric) and Professor Alexandre Sebastiani (FSASEC).

WATTSUP

SAIEE Central Gauteng Centre AGM

2017-2018 SAIEE CGC committee with H.E Mmamoloko Kubayi-Ngubane, Minister of Science and Technology.

From left: CGC Chairperson, Lehlohonolo Mashego, SAIEE President, Dr Hendri Geldenhuys and Immediate Chairperson, Tshego Cornelius.

From left: Dr Lufuno Marwala, Dr Hendri Geldenhuys, Ms Tshego Cornelius, Minister Mmamoloko Kubayi-Ngubane, Mr Stan Bridgens and Prof Pat Naidoo.

Having been established only three years ago, the SAIEE Central Gauteng Centre (CGC) has made great strides in marketing the SAIEE in Gauteng and ensuring its relevance amongst the youth and potential members, by its various social media campaigns.

The culmination of the CGC's 2017/2018 Program was its Annual General Meeting (AGM). The Centre aptly titled the theme of the AGM (and that of its next financial year), *"Moving Forward: A Challenge to the Young, Radical and Disruptive Engineer."*

In support of the Institute's strategic objectives, the Centre invited Her Excellency Mrs Mmamoloko Kubayi-Ngubane, the newly appointed Minister of Science and Technology (and Former Minister of Energy and Communications), to deliver the keynote address. The minister lamented on the need for the SAIEE to become visible and relevant, as well as play a contributory role (as an Institute and Centre) to discussions and debates on the Fourth Industrial Revolution, a disruptive digital revolution influenced by the electrical engineering profession.

The Minister also reminded engineers to develop transdisciplinary solutions, taking into account Humanities and Ethics. She cautioned that *"Engineers can no longer restrict themselves to hard technical matters; the boundary between professions is becoming a blur. Therein lies the challenge to the young, radical and disruptive engineer. Engineers should be more mindful that Science and Technology are about the people (out there) and making their lives more prosperous and their conditions more liveable."*

The Central Gauteng Centre assured the Minister that the Centre has indeed heard President Cyril Ramaphosa's call, *#ThumaMina*, and will step up its efforts to reach younger people and women to contribute to the Digital Revolution.

A talking point at the AGM was the newly designed SAIEE Central Gauteng blazer. Another tool, which will be used to market the SAIEE.

The AGM saw the election and inauguration of a new chairperson, Mr Lehlohonolo Mashego treasurer, Ms Matshediso Phoshoko and new members for the 2018/2019 Committee: Ms Sibongile Chawe, Ms Mapula Majola, Ms Makgola Makololo, Mr Seetsele Seetswane.

In the real spirit of Central Gauteng Centre's innovation and disruptive nature, the AGM was broadcast live as a Webinar (thanks to the efforts of Mr Mike Barker) and video recorded by Varsity TV.

Members can view the video recording on the SAIEE Central Gauteng Centre's YouTube channel.

A new anti-cable theft device launced...

Rugged Croc is a unique cable theft prevention system designed and manufactured in South-Africa. It comes in three different sizes (25mm, 50mm and 95mm) to accommodate most existing cables.

The Rugged Croc is designed to anchor cables in the ground. The combined mechanical resistance of the cable and the Rugged Croc System makes it virtually impossible for the cable to be pulled from the ground. The secret lies in the combined resistance of each Rugged Croc over the length of the cable. Dependant on the type of soil, the average resistance one Rugged Croc will deliver is estimated one ton per croc, e.g. when fitting 10m of a cable with ten Rugged Crocs, the combined strength to be pulled is 10 tons.

The installation of the rugged croc is swift and straightforward and requires no specialised skills. The correct size unit merely is strapped to the cable by using four industrial strength cable ties at one-metre intervals and is then placed in the prepared trench covered with soil and compacted.

Cable Theft is not new in South Africa and is steadily on the increase. The South African Chamber of Commerce and Industry (SACCI) views cable theft as very serious and describes it as economic sabotage and treason against business.

Business Against Crime South Africa (BACSA) states that the indirect cost to the South African economy is ten times higher than the expenditure required for the replacement value of the cables lost. Therefore law enforcement agencies have been granted an extension of power to assist in the fight against cable theft. The Criminal Matters Amendment Act has also been signed into law to ensure severe sentences for cable thieves to combat this serious crime.

The result of these new measures is that cable thieves are now even more organised and cable theft is on the increase.

The Rugged Croc could well be the answer to prevent cable theft. Cable theft also influences all sectors of the market whether it be direct power suppliers, railways, agricultural etc., indirectly affecting financial institutions, manufacturing retailers and more.

For more info, visit www.vermontsales.co.za

THE FIRST ELECTRICAL CONNECTOR THAT MAKES YOU GREEN

With the rising price of energy, and the global cost of carbon emissions, the trend is increasingly moving to explore the ways in which our total consumption can be reduced to result in less energy-intensive industrial operations.

Industry accounts for more than 30% of global energy consumption which is likely to increase by 50% in the next 30 years. The way we produce, consume and manage energy today is by no means sustainable with electric power being the leading CO^2 emissions culprit.

Marechal Electric recently undertook laboratory testing in France to benchmark traditional industrial socket-outlets against Marechal's patented butt contact technology in terms of energy efficiency.

The tests were performed on brand new 32A socket-outlets (1st year of life) as well as 32A socket-outlets (1 year +) showing signs of contact oxidation. Test results were catagorised according to:

- Contact Resistance
- Thermal Dissipation
- Thermal Loss

Measurements taken at maximum consumption of 32A constant.

The results show that Marechal Electric offers up to 5.7 times less resistance on oxidized contacts than a standard pin and sleeve product. Thanks to Marechal's Dual Voltage design, we can offer two voltages supplied by the same socket-outlet which significantly reduces the socket-outlet installation base and therein constituting a real-time cost saving for the user.

For more info, email, j.henriques@marechal.com

WATTSUP

On-Site Oil Treatment Saves Transformers

WTA mobile oil regeneration plant.

With what is claimed to be the largest mobile oil regeneration plant in Africa, WEG Transformers Africa plays a vital role in extending the life of South Africa's transformer population and preventing unplanned downtime within electricity transmission systems.

"Ageing transformer oil introduces a number of risks into the performance and longevity of oil cooled transformers," according to Ronaldo Bertoldi, Engineering Manager at WEG Transformers Africa. *"Moisture and impurities reduce the intended insulating effect that oil has within the windings and produces acid, making it more likely for breakdowns to occur, with potentially severe damage to the transformer itself."*

WEG Transformers Africa (WTA) is able to conduct an oil regeneration service on-site for large transformers – those with at least 5 000 of oil in their tanks. This is done by transporting the regeneration plant by road and setting it up at the location required by the customer. Once linked up to the transformer, the unit circulates the oil through a process which involves filtering it through Fuller's earth to remove impurities.

Careful sampling of the oil is first conducted – in accordance with ISO and SANS sampling procedures – by the company's field teams, so that oil testing can establish the severity of the contamination. Laboratory tests, also conducted by WTA, are able to pick up the extent of cellulose breakdown from the insulation around the windings, oil decomposition and any moisture ingress.

"The regeneration process removes acids, as well as absorbing moisture and oil decaying products through a hot oil circulation process through Fullers earth and inline oil purification in a closed loop path," Bertoldi says.

The process of purification only is shorter, and uses inline micro filters to remove water, alcohol, dissolved gasses, oxides and solid impurities. This is also a hot oil circulation process conducted in a closed loop path, and can usually be conducted in less than a day, depending on the condition of the oil.

The number of 'passes' that the oil requires through the system is based on the laboratory tests that indicate the level of contamination.

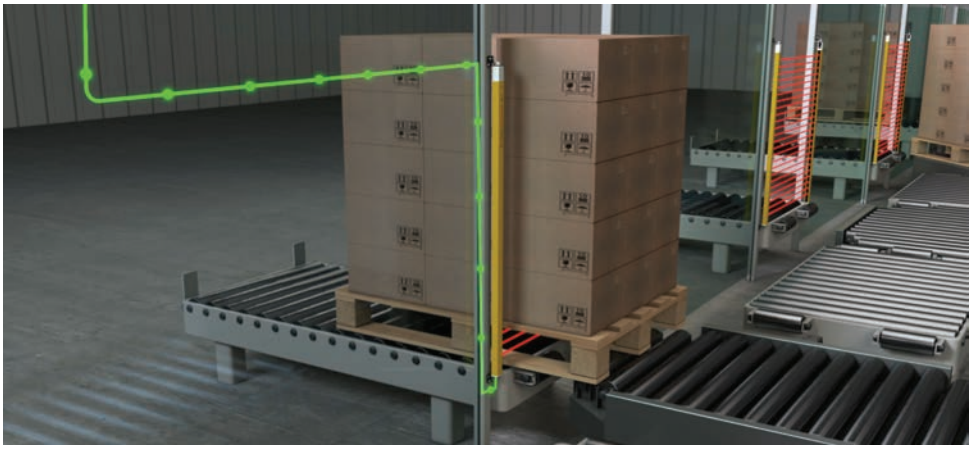
FLIR Systems Completes Strategic Investment in DroneSense

FLIR Systems, Inc. and DroneSense, Inc. announced today that FLIR had completed a strategic investment in DroneSense, makers of a unique software platform that serves the growing needs of public safety organisations in utilising unmanned aircraft systems (UAS) to perform their missions better.

The minority investment by FLIR in DroneSense will create opportunities for the companies to collaborate and share their respective expertise and customer relationships to develop and bring to market advanced UAS operating, management, and reporting systems. FLIR's advanced thermal imaging payloads for UAS platforms provide first responders with a new sense of awareness by imaging heat, seeing through smoke, and seeing at night. DroneSense's comprehensive solution will enable first responders of all types to build and scale their UAS programs with full accountability and transparency. Together, the FLIR and DroneSense offerings will enhance situational awareness, act as a force multiplier, and ultimately save more lives as organisations continue to integrate UAS into daily missions.

"This alliance with DroneSense will help bring to market a truly mission-critical solution needed by first responders to effectively deploy a complete UAS program across their organisations," said James Cannon, President and CEO of FLIR. *"We believe this platform is scalable geographically, across multiple markets, and across multiple FLIR Business Units. While focused today on UAS's, we see a longer-term opportunity for the solution to be extendable to other forms of sensing devices."*

MUTING REINVENTED



The Leuze Smart Process Gating method has completely eliminated the need for signal-emitting sensors making this a far simpler and more reliable solution.

Smart Process Gating, introduced by Leuze, has made muting processes more economical as well as simpler and safer. This technology is available in southern African from leading sensor solutions specialist, Countapulse Controls.

Gerry Bryant, Managing Director of Countapulse Controls, explains that in intralogistics as well as in the automotive and packaging industries, material locks often need to be safeguarded against unauthorised access by means of safety sensors.

Previously, muting processes with muting sensors were required to clearly identify when transported goods were approaching a protective field. These muting sensors were then to bridge the passing of these goods through the protective field at the correct moment.

Significantly, the Leuze Smart Process Gating method has completely eliminated the need for signal-emitting sensors making this a far simpler and more reliable solution in these applications. This solution is based on the Leuze MLC safety light curtains and this means that conveyor systems can be made more compact.

This configuration of the sensing solution has eliminated the risk of misalignment or damage to the sensors, and in addition because it is so simple to install there is a reduction in capital input costs. There is also a considerable reduction in maintenance and servicing requirements which also reduces costs.

Increased reliability and sensing accuracy is a major advantage of the Leuze Smart Process Grating solution, and this will increase not only productivity but also safety in an operation. In the case of typical intralogistics applications, the height of the protective device is entirely dependent on the safety-related requirements and this sensing methodology does not require synchronisation beams to be taken into consideration, again saving on cost and increasing reliability.

With the Leuze Smart Process Gating solution, the first muting signal comes from the Process Controller (PLC), while the second muting signal is generated by the protective field itself. Smart Process Gating requires a detailed knowledge of the process so that the necessary control signals are made available in the expected time window.

Countapulse Controls offers a full technical advisory service that can assess any application, and provide the most appropriate solution using Smart Process Gating technology.

WATTSUP

The Cat® S31 is built to survive the rugged terrain of a construction site

Where trenches are dug and boots get dirty, you are bound to find the CAT logo strapped to a well-used construction vehicle, these are machines that have proven their worth during thousands of hours of hard labour. Any tool that operates on the construction yard must adhere to the toughest certification ratings to be able to serve its purpose.

The smartphone is no exception, since it's even prone to damage in your pocket. Cracked screens are a common occurrence on a construction site and happen because not all phones are designed to absorb the impact of knocks or drops. But there's good news – the new Cat S31 smartphone can. From wet and muddy to even salt corrosion, the new edition to the Cat smartphone family was built to withstand it all. With handling conditions that go where no consumer-grade electronics dare to go, this device is a cut above the rest. The MIL SPEC 810g smartphone has a tough exterior and is packed with features fit for a construction site. Its sealed ports and buttons keep dust and water out; the 3.5mm audio jack tucked away safely protects it from those unwanted elements and the 4000mAh battery capacity makes it an absolute powerhouse. The 4.7-inch screen features Corning Gorilla Glass that's as tough as nails. It's also optimised for outdoor use and remains readable under virtually any light condition. And since weather conditions are always unpredictable, the Cat S31 screen features wet finger and glove support to grip the phone easily and access site information and communicate with your team quickly.

SAIEE takes the lead in supporting its Members and Industry with CPD

The Engineering Council of South Africa (ECSA) in Board Notice 86 of 2017, which was published in the Government Gazette on 19 May 2017, amended its rules covering Renewal of Registration and Continuing Professional Development (CPD).

The categories in which a registered person must obtain CPD credits remain as follows:

- Category 1: Developmental Activities
- Category 2: Work-based Activities
- Category 3: Individual Activities

The amendments, however, relate primarily to the validation of CPD Activities and the auditing of recorded CPD Activities to ensure that they are relevant and appropriate.

During 2017 Treasury changed their policy regarding the cost of attendance of Developmental Activities for State Employees, by limiting it to R2 500-00 / day excluding VAT. Given these changes the SAIEE has taken note of the validation requirements and adjusted the cost of its Category 1: Developmental Activities, such as Workshops and Refresher Courses.

This has resulted in a reduction in the overall cost for its Members and others to remain competent whilst meeting ECSA's Developmental CPD requirements.

To assist its members the SAIEE has produced a comprehensive Brochure which lists its Developmental Activities, the scheduled dates of which are given on the SAIEE website.

Toshiba and Malawi Conclude a MoU on Geothermal Power Generation Business

Toshiba Energy Systems & Solutions Corporation (hereinafter referred to as Toshiba), the world leader in geothermal power systems, and Malawi's Ministry of Natural Resources, Energy and Mining (MNREM) concluded a memorandum of understanding (MOU). The MoU anticipates a comprehensive partnership in geothermal power projects including capacity building programs in relation to the technology.

Under the terms of the MOU, Toshiba will collaborate in the development and supply of major equipment for a geothermal power plant, develop operation and management guidelines, and facilitate capacity building programs. Toshiba aims to contribute to the early construction of the plant, and to supply geothermal power generation equipment, including a 1-10MW type of "Geoportable™," a wellhead geothermal power generation system, in the future.

Almost all of Malawi's current power generation capacity is from hydro. As the country lies to the west of the Great Rift Valley, it has rich geothermal potential. Adding geothermal to the energy mix will increase generation capacity in the country and contribute to the stable supply of clean energy.

"Toshiba is the world's No.1 supplier of geothermal turbines," noted Toyoaki Fujita, Business Development Executive of Toshiba. *"Our record to date covers delivery of 56 systems, with a total capacity of 3,628MW. We are delighted with this opportunity to work with MNREE, and to use our established expertise to contribute to geothermal power supply in Malawi."*

Toyoaki Fujita
Business Development Executive | Toshiba

Toshiba concluded MOUs with geothermal power development companies in Ethiopia in 2014, Tanzania in 2015 and Djibouti and Uganda in 2016 - all covering comprehensive collaboration in the geothermal power generation business. Toshiba will continue to contribute to stable electricity supply and the realization of a low-carbon economy across the globe.

WATTSUP

Solar's time has come – and not a moment too soon

Dominic Wills
CEO | SOLA Future Energy

Reports of a shortage of coal supply at six of Eskom's power stations have sparked concern that load shedding could once again become a reality in South Africa. It's a stark reminder that a heavy reliance on a finite resource such as coal to meet the country's energy demands is not sustainable.

Rolling blackouts also have a negative impact on the economy and GDP growth. The coal crunch currently affecting the state-owned power utility highlights the importance of adopting a strategy that focuses on replacing coal with a low-cost, clean energy alternative.

"No energy economist will argue against the fact that the cost of new solar is around half the cost of new coal," says Dominic Wills, the CEO of SOLA Future Energy.

"New coal production facilities come in at around R1.05 to R1.16 per kWh, while new solar comes in at 50c to 64c per kWh," he explains.

Unlike sunlight, coal is a finite resource. Wills points out that the cost of harnessing solar – and the cost of storing its energy – will decrease in the years to come, while the cost of coal will only increase.

"The country has a gap in which we can start to build solar projects, both on a commercial and municipal scale, to take the strain off the coal-burning grid. As the price of solar batteries begin to reduce -- being driven by the electric car market -- we need to simply add energy storage into the existing infrastructure," says Wills.

He adds that, once batteries are installed, solar power can be deployed whenever it's needed.

Wills says that as things stand, a high penetration of wind and solar energy can be added to the national grid without incurring costly changes to the system's existing infrastructure.

"As renewable energy and storage becomes cheaper, the country needs to use its remaining coal resources to manage the transition to a zero-carbon grid. This will alleviate uncertainty around whether South Africa has capacity to meet its future energy demands."

Wills says that industrial action and global supply shortages will undoubtedly impact the price of coal, so it's almost impossible to project how costly it will be in the years to come.

"However, with solar PV, you pay for everything upfront, and have fixed-price escalation for its lifetime of 25 years, making it not only the cheaper energy option, but the stable alternative."

The Department of Energy is scheduled to release an Integrated Resource Plan outlining where the country's energy will come from over the next thirty years.

Wills says that if this is done purely on logic and mathematical models, with the correct assumptions gas will play a significant role in the transition to renewables – it's cheap to install and despite being expensive to run, the actual running hours are low – and within 20 years, renewables and storage should ideally take over.

"All credible research points to the same conclusion; these studies simply differ in terms of precise time frames and percentages," Wills says.

For this reason, he says that South Africans should support a transition from fossil fuels to renewable energy. *"It's an important thing to do for the certainty of future power generation, economic stability, and the benefit of the planet,"* Wills concludes.

Pitram unlocks full potential of real-time data in the mining industry

Big Data can be applied to mining operations with greater efficiency and accuracy than ever before, thanks to software innovations such as Pitram from MICROMINE, a fleet management and mine control solution.

With the quantity of data collected and its complexity in the mining industry rapidly on the increase, the ability to handle these large, complex data sets is critical. This has highlighted the need in the mining industry for easy-to-use, fast, function-rich, and fit-for-purpose solutions such as Pitram, MICROMINE South Africa Regional Manager Renier Strydom comments.

Pitram is a fully-configurable solution that captures, monitors, and reports on operational and production data. It provides real-time analytical capabilities to enable improved decision-making on critical areas such as safety, development, and asset utilisation.

The major advantage of Pitram is that it is both scalable in its approach and agile by design, providing a world-class customised solution for any mining operation, irrespective of existing systems or infrastructure.

"Data is king, and it's how we interpret, manage, and analyse that data that delivers the real benefit for clients and industry," Strydom comments. In this regard, the latest trend is for intuitive solutions that are not only user-friendly, but that also promote integration among different software solutions. This trend is becoming prominent due to increased Human Machine Interface (HMI) applications in the mining industry.

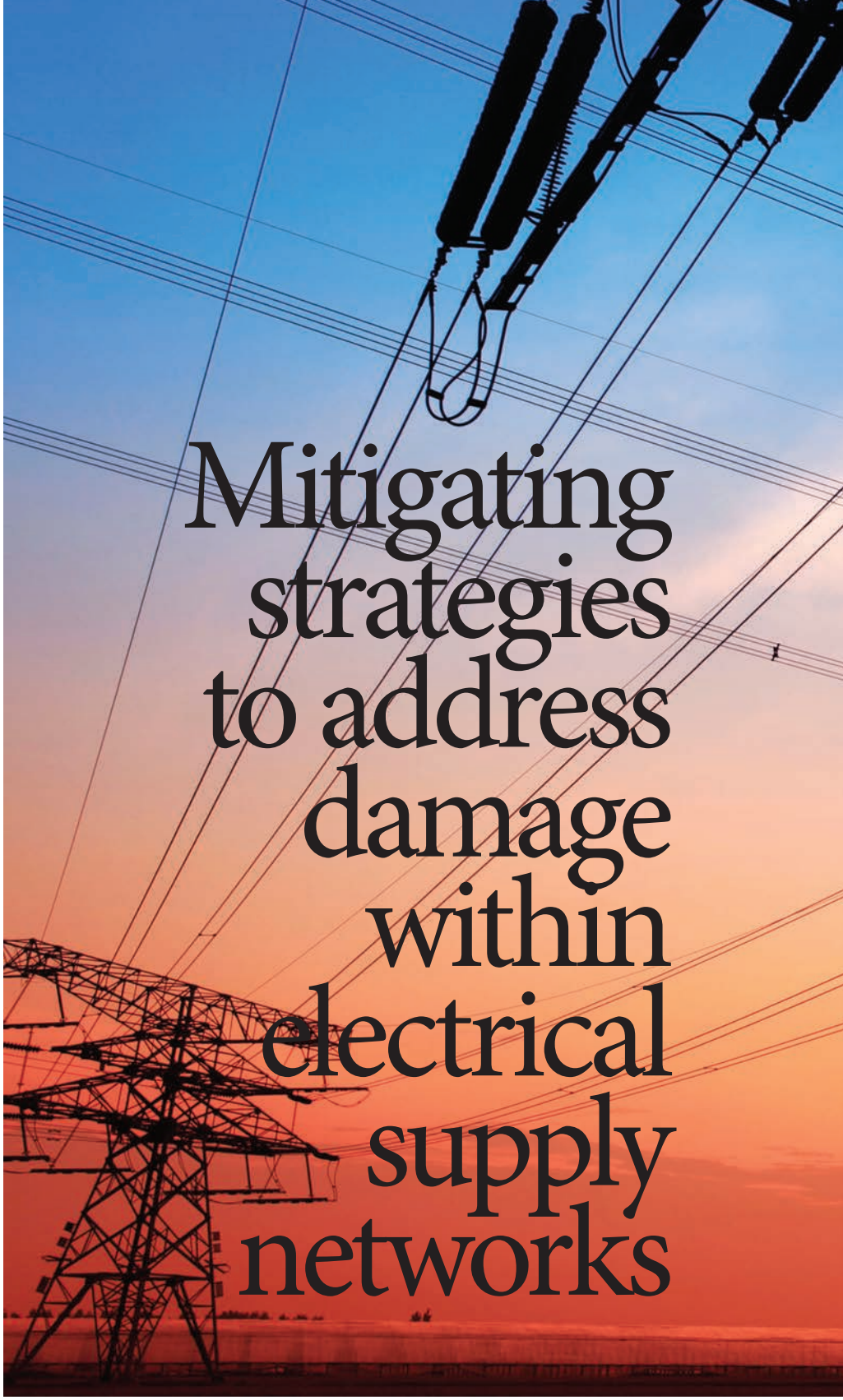
"The use of assisted-control equipment is more and more common, while fully autonomous equipment is common in haulage and drilling operations," Strydom adds. Health and safety is also boosting the need for smarter analytics, with PPE now incorporating sensors to transmit information about potentially hazardous working conditions, for example.

"I believe that ongoing advances in digital technology has the potential to unlock new ways of managing variability and enhancing productivity in the mining industry. Of course, the greatest benefit of this trend will be derived when such technology is integrated across the entire supply chain. This, in turn, will allow for more informed decision-making, as well as more consistent mining operations," Strydom stresses.

With over 20 offices globally, including South Africa, MICROMINE can importantly offer 24/7/365 support. *"Our specialists have the local knowledge to provide solutions that are relevant to your geographic location and operation, maximising the return on your investment,"* Strydom highlights. He adds that Pitram has a 100% deployment success rate in over 60 mine sites globally, including some of the most complex and challenging mines in the world.

Earn CPD Credits

Mitigating strategies to address damage within electrical supply networks



The leading causes of system non-technical losses are due to electricity and cable theft and Infrastructure damage. These losses cost the South African economy anything from 5 to 8 billion rands annually. Historical strategies deployed through the use of generic security applications to combat the problem has not yielded any real economic value to date and in fact, contributes to the overall financial losses suffered within the South Africa context. Different strategies need to be employed with the focus on deploying specific technologies as the first point of departure, and the procedure further requires to adopt an integrated approach to mitigating the problem.

Non-Technical losses are losses which attribute to external factors such as cable theft, illegal connections and infrastructure damage [1]. It is recorded by the South African Revenue Protection Association (SARPA) that these losses account for 5-8 billion rands in the South African economy [1].

Municipalities which act as an intermediary between Eskom and the end user, are highly dependable on the revenue generated from electrical sales, which

BY | Q.E LOUW | PR TECH. ENG | SMSAIEE | MIEE

accounts to be more than 40% [1]. With the advent of the deployment of renewable energies within the electrical distribution sectors, the likelihood of income diminishing under these conditions is due to occur. The management of infrastructure has now become a real concern, and the factors such as cable and conductor theft, illegal connections and infrastructure vandalism are cause for appropriate corrective action to be taken. On the other hand, Transnet and Telkom which do not supply electricity but use copper cable or conductors in their daily execution of their business activities, are subject to the same phenomenon and stand to reason that this further exacerbates the problem to the South African economy.

These losses not just reflects the economy and quality of supply, but more importantly,

Mitigating Strategies

continues from page 27

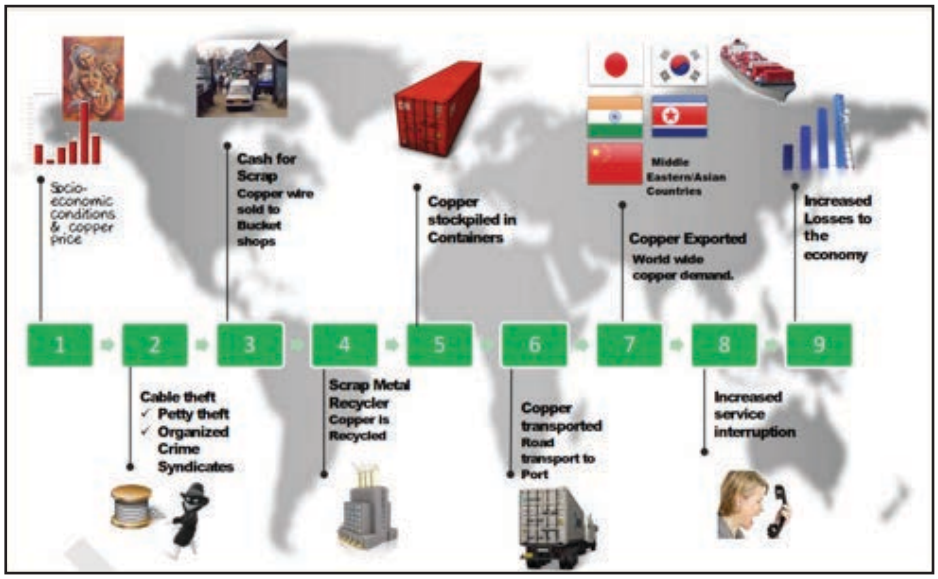


Figure 1 – Value chain for copper demand [2]

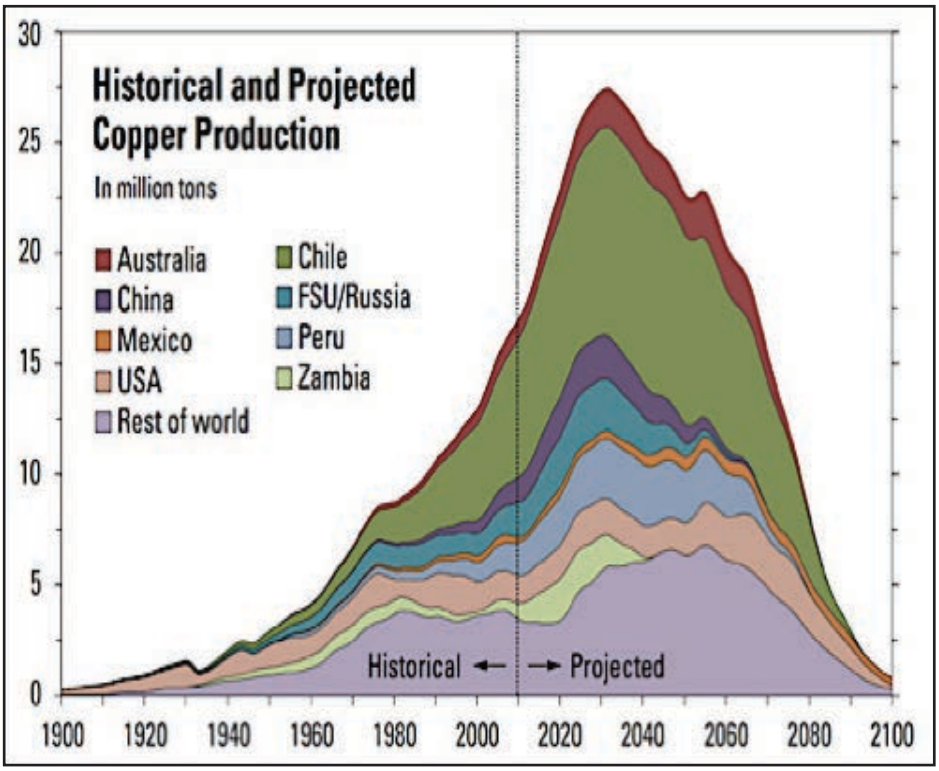


Figure 2 – Historical and Projected Copper production [3]

affects the paying customers. The outcome of this paper is to present current strategies deployed and discuss the economic effects it has, and thus suggest a different approach to mitigate and arrest the problem.

Market demand requirements drive the demands for base metals such as copper, aluminium and lead. Figure 1 represents the criminal value chain, and this illustration highlights the current occurrence found within the South African context. The illegal activities attributed to two factors, namely:

- Socio-economic conditions, and
- Crime syndicate operations.

Without a sense of market demand, one would safely assume that the problem will not be as pervasive as currently reported. However, the need is ever-increasing and is bound to get worse with the development and manufacturing of the new technologies such as the development of the electric vehicle as one example.

Figure 2 [3], illustrates the copper production in millions per ton related to mine production capacity. It is worth noting that the increase from 1980 to 2015 production requirement almost doubled and should be further pointed out that the anticipated peak of production is estimated to peak in 2030, thus showing the anticipated demand for the next ten years.

This is important to note that market demand is ever-increasing, and if mines cannot meet the requirement, the variance in need will be satisfied by the recycling market.

Figure 3 [4], represents the demand versus supply of copper for February 2017. From

this figure, there is a clear indication of need outweighing supply as illustrated from 2017-2020, and the consequential effect it has on the copper price should be noted. This graph indicates the creation of a market environment for the recycling industry. From this graph, the anticipated London Metal Exchange (LME) copper price increase is noted and based on this indicates the lucrative conditions for the sustainability of such businesses.

Morgan Stanley, a commodity research company, estimates the copper demand requirement with regards to a world perspective as indicated in figure 4 [5] and highlights China as the highest commodity user, this being for historical trends as well as for futuristic projections.

As previously indicated the supply of base metals are driven by market demand and as shown figure 5 [6], the anticipated demand for copper in 2022 in China will be 48% of the total world demand, expanding its market for copper even further as compared to previous years.

MITIGATING STRATEGY

An online publication [7], "SA now leading exporter of (cable) copper" highlights that copper theft in Transnet for 2008-2009 equated to 6917 recorded incidents, with an estimated replacement cost of R239m. In 2010-2011 Eskom recorded the estimated replacement cost of cable theft at R265m further highlighting the indirect cost to the economy of R5bn. This includes the "cost of replacement and security; the shutdown of business operations; loss of income; loss of exports; power, communication and transport outages; and negative investor perceptions". The publication further highlights that a total of 72 533 incidents

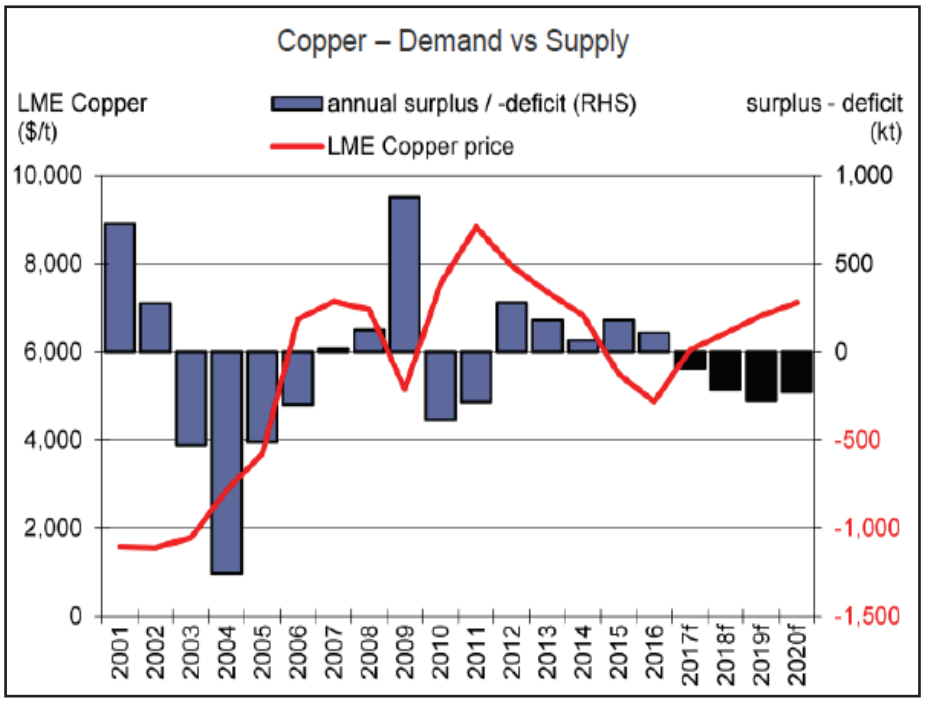


Figure 3 – Copper Demand vs Supply [4]

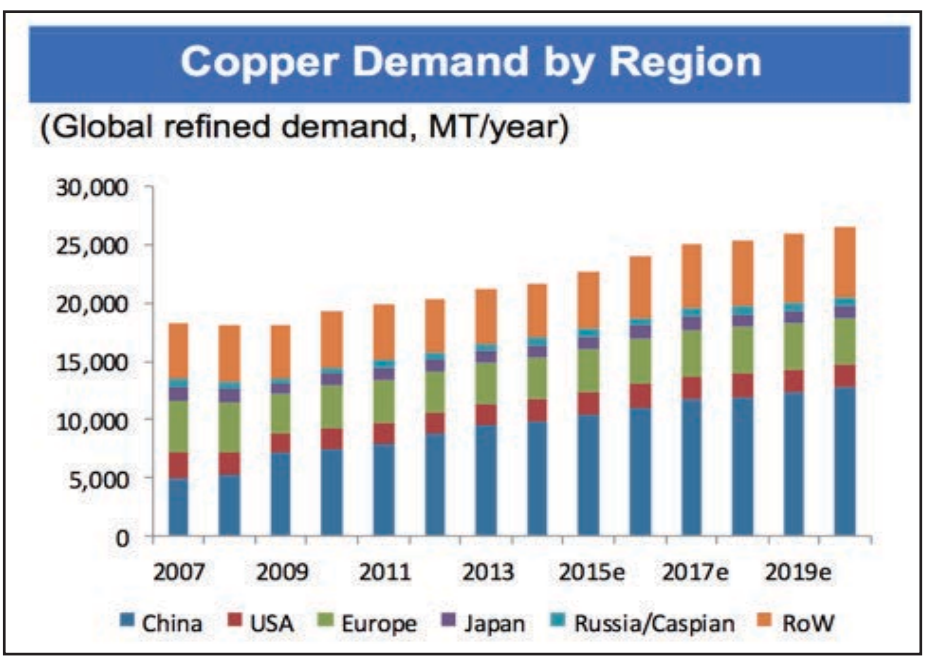


Figure 4 – World demand for Copper [5]

Mitigating Strategies

continues from page 29

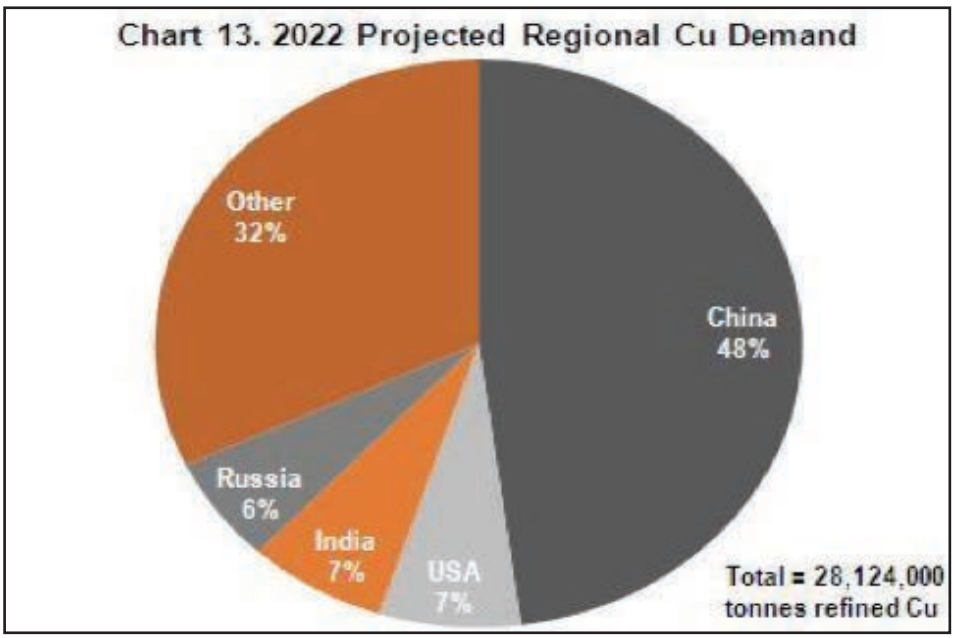


Figure 5 –Projected copper demand for 2022 [6]

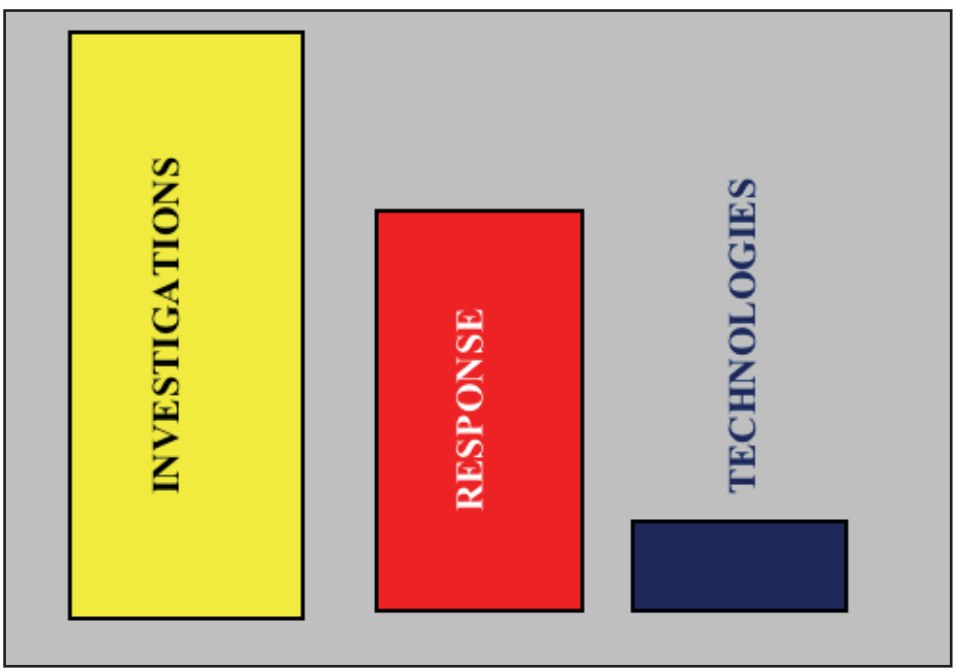


Figure 6 – Current strategy deployed by SOE's

were reported to the South African police services during the previous year and that 10 736 arrests were made during this time. This article fails to present the prosecution conviction success rates associated with these arrests.

Furthermore, in the March 2018 Newsletter of The Association of Municipal Electricity Utilities of South Africa (AMEU)[8], it highlights statistics presented by a leading macro enterprise service provider within the forensic and investigative initiative sphere, which deals explicitly with cable theft and infrastructure damage within state-owned enterprises. The article highlights that an average of 85 arrests are made per month within its customer base and presents a conviction rate of 90%. The report further highlights the deployment of a sophisticated helicopter as part of their operational strategies to combat cable theft and infrastructure damage.

Eskom alone recorded in their annual financial statements for 2016-2017 [9] that the non-technical losses associated with electricity theft and infrastructure damage cost the utility R1.2bn in 2016 and a further R1.3bn in 2017. The notes further highlight that losses of R70m were recorded for 2017 compared to R85m in the previous year, due to cable theft and other related equipment. Associated with this are the arrests made reflecting a total of 235 compared to 229 as per the last year in 2016 reflecting an increase of 6 arrests. The value recovered for both 2016 and 2017 indicates an amount of R5m year-on-year. This clearly illustrates that current initiatives are challenging and that these initiatives, although commendable, are still far from reaching the desired outcome in comparison to the total losses suffered by the economy.

Figure 6 highlights the current strategy deployed by the state-owned enterprises, where the majority of their budgets are spent on forensic investigating task teams or general static security services to address the problem with a limited amount of budget spent on technologies specifically designed to solve the issue.

A question one might ask is how this strategy is problematic?

The assumption made is that the value-adds of the investigate initiatives are implemented to curb the criminal activity within the recycling markets, thus addressing the market where the stolen items are sold. Although various prosecutions have been successful, historically these initiatives have shown limited results, and have not yielded the desired outcome as initially anticipated, and so the unscrupulous element within the recycling market continues to be a problem. It is worth noting that in the mitigation of these recycling markets these investigations usually occur after the fact, which still leaves the customers exposed to the reputational losses.

To address the question further, the answer to this lays within the return on investment expectations.

Using the data provided earlier the assumption is made that an average cost per incident can be calculated as follows:

Case 1 – Transnet incident cost (2008-2009)

Actual replacement cost = R239m
Actual Recorded incidents = 6 917

Cost per incident = R239m/6 917
≈ R 51 000 per incident

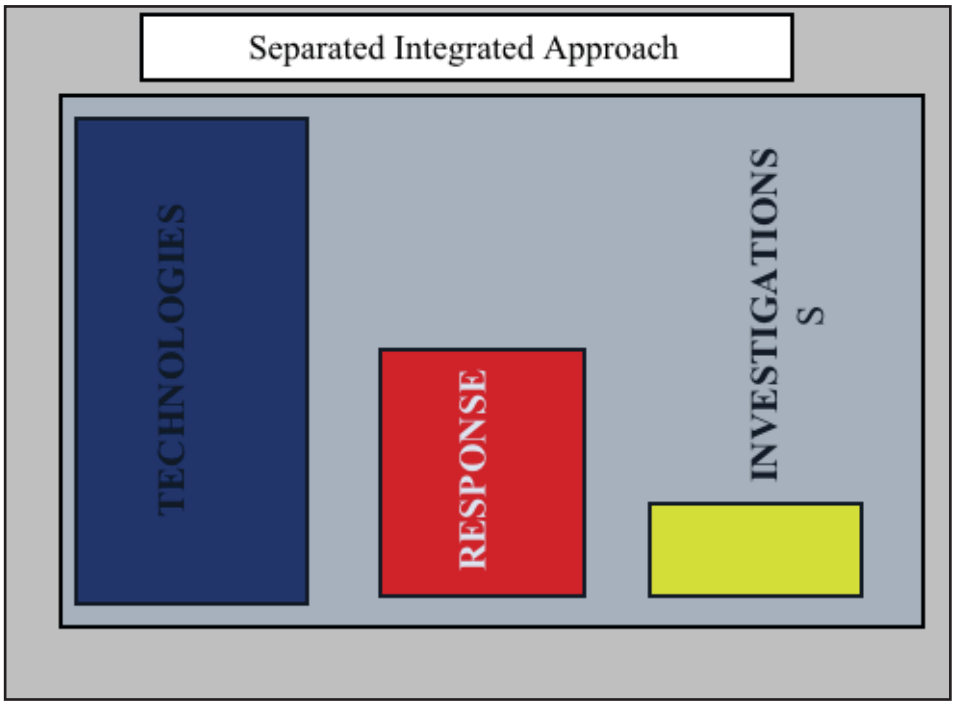
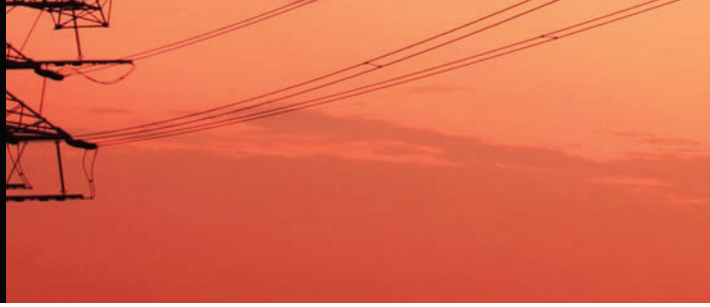


Figure 7 – Proposed Strategy of implementation

Figure 8 – SLA of Technologies deployed

Mitigating Strategies



continues from page 31

Case 2 – Average actual cost to the economy (2010-2011)

Actual cost to the economy = R5bn
Actual Incidents reported = 72 533 (2010)

Cost per incident = R5bn/72 533
≈ R 70 000.00 per incident

Based on the calculated information, the cost per incident can be quantified as anything more than R50k.

Other entities have recorded higher loss per incident values, and these will be highlighted in a presentation of the Ethekwini Metropolitan Municipality case study.

Let's consider the actual loss suffered based on the 85 arrests per month as previously referred to highlight the cost per incident to the economy.

85 arrests @ R70K = R5.95M loss per month (R71.4m p/year).

You should note that the above is not considered as a saving, because the incident and damage has already occurred and losses suffered by the entity. Additionally, please note that this initiative only addresses 1.4% of the total loss of R5bn. It is clear that more needs to be done to protect the assets rather than focus on arrests, as increased damage to the economy is still occurring.

With this analogy presented, the justifications of the budgetary spending patterns are not sustainable and offer very little return on investment. The current contracts employed under these generic security strategies, run more than R150m a year, and the impact these contracts make is questionable, as the measured rate of successes is attributed to the number of arrests, the associated conviction rates and the recovery of the stolen items. Although these initiatives provide for some relief, the problem is not diminishing but in fact, increasing.

The deploying the critical strategy, which is to deter the incident from occurring firstly, failing which detecting the occurrence and dispatching specific task teams to the particular point of conflict as quickly as possible. This strategy lends itself to a significant reduction in losses.

How is this done? By Adopting a strategy around the deployment of specific technologies designed to mitigate the problem and should be the first point of departure in the plan regarding budget expenditure. The complete solution offered, should be a "separated integrated approach" as per figure 7. The entire strategy service model should be provided by individual service providers for technologies, response and investigation.

This strategy will allow for the following:

- More assets are to be protected pro-actively within the total allocated security budget;
- Rapid re-active response to the point of the incident;
- The service provider's accountability for its respective contractual tasks and obligations; and
- Audit trail processes of the complete strategy value chain.

It is further suggested that the various technologies deployed should be rented under a service level agreement with all the associated services of control-room management and maintenance as indicated in figure 8.

This then allows for the following:

- Continuous development of new technologies.
- System upgrade during contract periods, free of charge.
- Continuous system operation and uptime.
- Continuous maintenance and audits.
- System fault management.
- Accountability by the supplier.
- Penalty enforcement by the customer.
- A more extensive range of assets are protected.
- Public and municipal budgetary compliance of financial management acts.
- Financial accounting benefits.
- Not having redundant security products left in-situ.

CASE STUDY

In a paper presented to the South African Revenue Protection Association in 2016 [10], entitled "*The economic benefits of using GSM Pepper Gas Alarm systems in electrical distribution substations: An eThekwini Municipality Case Study*", the economic benefits presented have been summarised and presented hereunder.

Total number of systems deployed:
160 units
Contract duration: 3 years
Ave Cost per incident (as per Ethekwini):
R240k
Incidents per site before deployment: 2
Total number of events per year in subs:
320

The losses Ethekwini Metropolitan Municipality suffered before the deployment of the technologies were:

320 incidents x R240k = R76.8m

AVAILABLE SOON!

Motor control center that performs reliably in the toughest conditions.

TeSys™ GV4 motor circuit breakers - compact design, robust performance

Ensure continuous machine operation, even under the toughest conditions. TeSys GV4 motor circuit breakers are built for efficiency and reliability. User friendly handles allow quick operation and control. Everlink™ creep compensation technology ensures secure and reliable power connections. On-site maintenance is easier with a smart phone and Near Field Communication technology.

Start Smart. Run Smart. Stay Smart.

Scan to discover more >

www.schneider-electric.co.za

Life Is On | Schneider Electric

Mitigating Strategies

continues from page 32

Post the deployment of technologies NO RESPONSE AND INVESTIGATION was included for due to budget constraints within the municipality.

It is noted from figure 9, that only six actual incidents where recorded during the three year period of system deployment within the 160 sub-stations. This mitigating strategy allowed for the following economic indicators to be presented during the three-year cycle.

Before deployment loss: R76.8m
Post 3-year deployment loss: R 1.4m (6 @ R240k)
Contract value over three years: R 10m (over three years)
NET SAVING TO ENTITY: R 65.4m
Loss Reduction ratio: 98.1%
Return on investment ratio: 85.16%

From this case study presented, it is evident that technologies play a significant part in the mitigation of the problem. It proves that it should be the first point of departure in the overall integrated strategy as this allows for less capital to be deployed to affect a higher loss reduction ratio and ultimately affect a higher rate of return on investment.

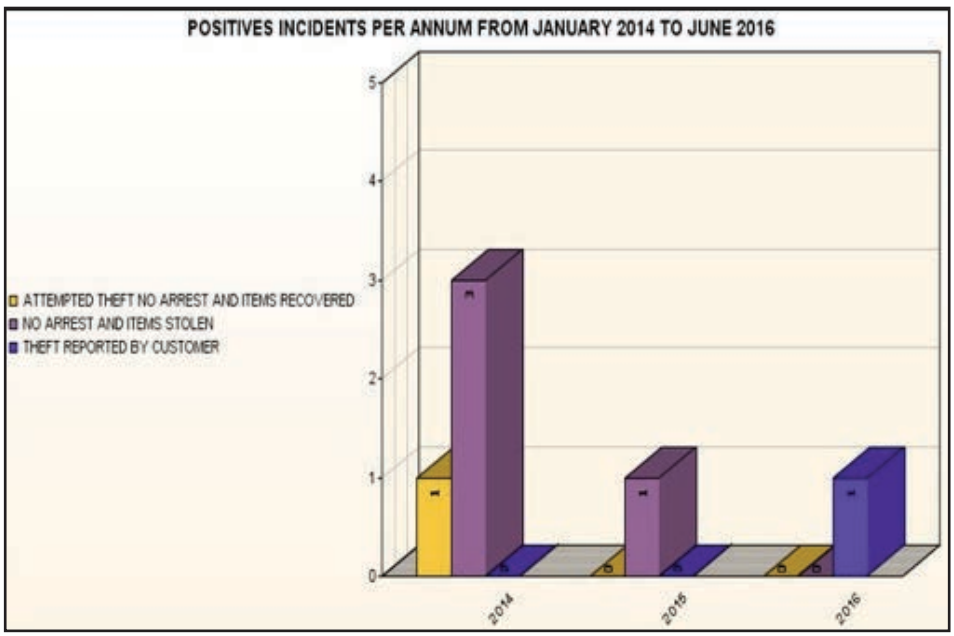


Figure 9 – Positive incidents recorded for 2014-2016 [10]

CONCLUSION

Cable theft and infrastructure damage is a pervasive problem in the South African economy, and it is here to stay as long as the market demand requirements are not satisfied by the production of base metal mining. Although strategies have historically been deployed to address the recycling market criminal activities, not enough has been done to solve the entire problem. The presence of current policy has to be revisited, and new approaches have to be adopted to address the issue holistically. Such a new suggested strategy should the deployment of specific technologies designed around combating the problem as the first point of departure and after that allow for the associated services such as response and investigation to be integrated into the mix.

This will allow for a more prosperous return on investment and more prudent financial management and accountability within the allocated budget and expenditure plan. wn

REFERENCES

[1] Q.E Louw, "Zero-Sequence current-based detection of electricity theft in informal settlements", Masters Dissertation, University of Johannesburg 2017.
[2] J.V Smith, "Cable Theft-The Telkom Experience", South African Revenue Protection Association, Mossel Bay, 2013.
[3] D Batker & R Schmidt, "Environmental and Social Benchmarking Analysis of the Nautilus Minerals Inc. Solwara 1 Project", May 2015, pp 13.
[4] Copper demand vs supply, City Research as at 20 February 2017.
[5] Morgan Stanley, commodity research estimates for copper up to 2020.
[6] Projected regional copper demand for 2022,
[7] Online publication, "SA now leading exporter of (cable) copper", 10http://www.combinedpi.co.za/sa -now-leading-exporter-of-cable-copper, site access April 2018.
[8] AMEU NEWS, The Association of Municipal Electricity Utilities of Southern Africa, Branch News, March 2018 Volume 94, pp 4-5.
[9] ESKOM Annual Financial statements, 31 March 2017, pp 116.
[10] Q.E Louw, "The economic benefits of using GSM Pepper Gas Alarm systems in electrical distribution substations: An eThekwini municipality Case Study", South African Revenue Protection Association, 2016.

Cu

Copper Development Association Africa

Copper Alliance

Training and Education

CDAA recognizes and supports training and education and engages with ECASA (Electrical Contractors Association of South Africa), ECBSA (Electrical Conformance Board of South Africa), OTTC (Open Trade Training Centre) and ACRA (Air Conditioning and Refrigeration Academy) to develop and enhance the skills of artisans in these industries and thereby ensuring that the use and properties of copper is correctly applied.

Copper is the best conductor of heat and electricity of all non-precious metals but the incorrect design and application can create a negative perception of this remarkable material.

The Leonardo Energy website: www.leonardo-energy.org set up in 2004 and managed by the European Copper Institute in Brussels is a global initiative providing sustainable energy professionals with the knowledge to manage energy transition.

It provides free education and training through its resource library, e-learning programmes, advice to regulation and standardization bodies and stimulating public debate. The regular webinars and workshops are highly respected.

The CDAA is able to assist with advice and support in the use of copper albeit in electricity, HVAC, plumbing or any other initiative.

The theft of electrical copper cable is particularly concerning and the CDAA is in constant communication with Government to reduce the theft of copper by limiting the export of copper scrap to foreign countries.

Tel +27 11 824 3916
Fax +27 11 824 3120
Email info@copperalliance.org.za
www.copperalliance.org.za

Leonardo ENERGY
www.leonardo-energy.org

Earn CPD Credits

All hope relies on electrical energy storage

BY | BRUNO DEWACHTER | LEONARDO ENERGY PLATFORM

The development of Electrical Energy Storage technology (EES) carries the weight of massive expectations. According to an earlier international Electrotechnical Commission White Paper, many of the medium and long-term renewable energy targets that have been set by governments are impossible to achieve without a fundamental breakthrough in storage technology.

Energy storage systems already exist, but a significant technology shift is required to enable large-scale deployment. The first hopes of the IEC lie with hydrogen stored in the natural gas network and on innovative electrochemical battery technologies. If the expected breakthrough occurs, those storage systems have the potential to improve other aspects of the electricity system as well as compensating the variable output of renewable energy systems.

The International Electrotechnical Commission (IEC) White Paper on EES discusses several renewable energy targets and the corresponding storage capacity they would require. The German goal of 60 to 80% of renewable electricity by 2030 is a good example. This target needs at least 8,400 GWh of storage capacity according to the calculations of the IEC, for more than 200 times the 40 GWh of pumped hydroelectric capacity that Germany currently has operational.

A reinforcement of the grid and interconnecting regions with different weather patterns could be part of the solution, but will never make significant scale storage redundant. If all electricity were to be generated by renewable energy systems with variable output without any backup from fossil fuel power stations, a storage capacity of 1 to 4 weeks of electricity demand would be required. Even though calculations by some other organisations show different results, the end conclusion remains firm: the 100% renewables target, endorsed by the Greenpeace Declaration of Intention, will never be achieved without large-scale energy storage.

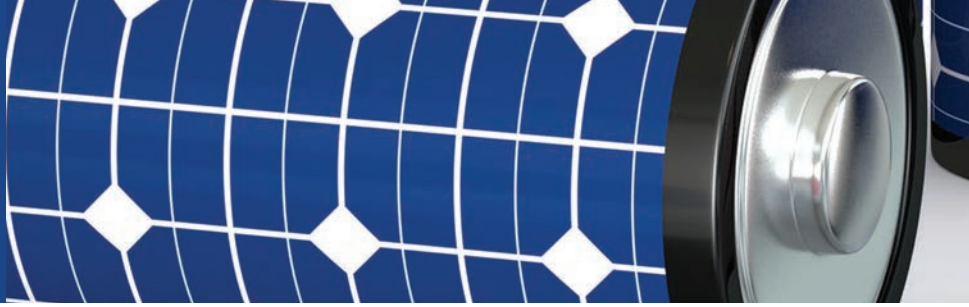
ENERGY STORAGE SYSTEMS TODAY

Energy storage connected to the electricity grid is not a new idea; it is in fact as old as the grid itself. By using various types of storage systems for keeping voltage and frequency between tolerances, flatten the hourly variations in demand, and improve the reliability of supply.

The scale of these storage systems, however, is different from what we need when a significant contribution of renewables comes into play. Today, 99% of the worldwide storage capacity consists of pumped hydroelectric systems, which are used

Energy Storage

continues from page 37



for time shifting. While it is a proven technology, the number of sites that are suitable for building such systems is limited. The remaining 1 % of storage capacity that currently exists consist of:

- Compressed air systems (CAES) for time shifting and power quality (440 MW globally);
- Li-Ion batteries for more efficient use of power network (70 MW globally); and
- Lead acid batteries for emergency supply in power plants (35 MW globally).

It becomes clear that new technologies with better technical performance and better cost efficiency are required.

THE STORAGE TECHNOLOGIES OF THE FUTURE

Which technologies have the most potential to fill in the future needs?

Electrical storage technologies such as the Double Layer Capacitor (DLC) or Superconducting Magnetic Energy Storage (SMES) Coil have the potential to replace flywheels and power station reserve capacity for power quality regulation. They are ideally suited for this because of their short discharge times. However, DLC and SMES systems, at a larger scale, are still under development, and their energy density will always remain too small for the massive, long-term type of storage that is needed for flattening out variations in renewable energy supply.

For the latter function, the IEC sees a primary role for hydrogen and Synthetic Natural Gas (SNG) injected into the natural gas network. By producing both Hydrogen and SNG, electricity and can be used again to generate electricity in combined-cycle gas-fired power plants. The energy efficiency of this cycle is 50 to 75%. While this level may not seem overly impressive, the higher end of this range is reasonable. The natural gas grid can take up to 10% of hydrogen and has ample storage capacity.

For example, the German natural gas grid has an overall storage capacity of 400 TWh. Using 8.4 TWh of this capacity for flattening out long-term supply and demand variations is realistic, it would enable Germany to reach it's 2030 renewable energy target. However, one drawback of this solution is that it restricts countries with an extensive existing natural gas grid.

A renewable energy economy would also require a large number of small-scale, short-term storage systems.

Those systems can ensure that electricity generated by distributed renewables is used primarily locally, in a micro-grid at the scale of a neighbourhood, a street, an industrial even a single house (a so-called smart house). Locally generated electricity will only be supplied from the micro-grid to the main grid when local demand is low, and grid demand is high. Li-ion batteries seem to be the most obvious choice for this kind of task.

NaNiCI batteries become a viable option as well if there is a daily cycle of loading and unloading.

Grid operators will require additional short-term storage capacity as well. They need it to develop a smart grid system, designed to make maximum use of the existing power line capacity and to maintain power quality and reliability standards despite variations in supply and demand. Along with Li-ion batteries, redox flow batteries might become a suitable option for this task, once the technology has matured.

A lot has been written in recent years about the use of Electrical Vehicle (EV) batteries as grid storage systems. It is true that in theory, they can serve as a storage system for the smart house they are connected to, and via demand-side management, they can do the same for the entire electrical grid.

It is an attractive concept since it provides storage capacity without the need to build any additional facilities. However, some simple back of the envelope calculations shows that electric vehicles will be able to supply more than a fraction of what is required for an electricity system that is primarily based on renewables.

For example, if 1 million EVs are in operation in Germany by 2020-an estimation which is becoming increasingly highly optimistic-and if those EVs could provide an average of 20 kWh to the grid; this would total only 6 GWh of additional storage capacity for the whole of Germany.

This is just a small share of the 40 GWh of pumped hydroelectric capacity that is already operational in Germany, and a fraction of the 8,400 GWh that is needed. Electric vehicles alone will not create a renewable energy future.

SUCCESS DEPENDS ON TECHNOLOGICAL BREAKTHROUGHS

All the energy storage technologies mentioned above are realistic options, but their success remains to be seen. They all depend upon technological advances of different importance.

Concerning electrochemical batteries, the primary task for R&D departments is to improve the performance characteristics of existing technological concepts. NaNiCl batteries need higher energy capacity and power density to become a realistic option. Li-ion batteries mainly need a lower cost per kWh and higher safety guarantees.

Developing hydrogen and SNG storage natural gas network requires R&D breakthroughs on many different levels: the physical facilities, the interactions with the gas network, the chemical production processes, the energy efficiency of the cycle, and the reliability of the system. These breakthroughs demand active cooperation between the electricity market players on one side and the gas and hydrogen sectors on the other side. While the IEC report does not categorically state it, the lack of interaction between those sectors is probably one of the reasons why this domain has not yet been explored further up to now.

Along with the actual energy storage units, the management and control of those units also require further development. Conventional Battery Management Systems (BMS) control of the battery by making use of a simple logic based upon local measurements.

The BMS can be made more potent by including remote data (weather forecasts, dynamic market prices, et cetera). When combining several storage systems into a Virtual Power Plant, the centralised control and management system becomes highly complicated. By developing an intelligent SCADA system, you can control vast amounts of dispersed batteries centrally.

GOVERNMENT INCENTIVES AND STANDARDISATION CAN PLAY THEIR PART

If governments genuinely intend to maintain their ambitious renewable energy targets, the development of large-scale, long-term storage systems should receive full support. Policymakers can create incentives for private actors in the field, encourage research, and stimulate interaction between electricity market players and the natural gas and hydrogen sectors.

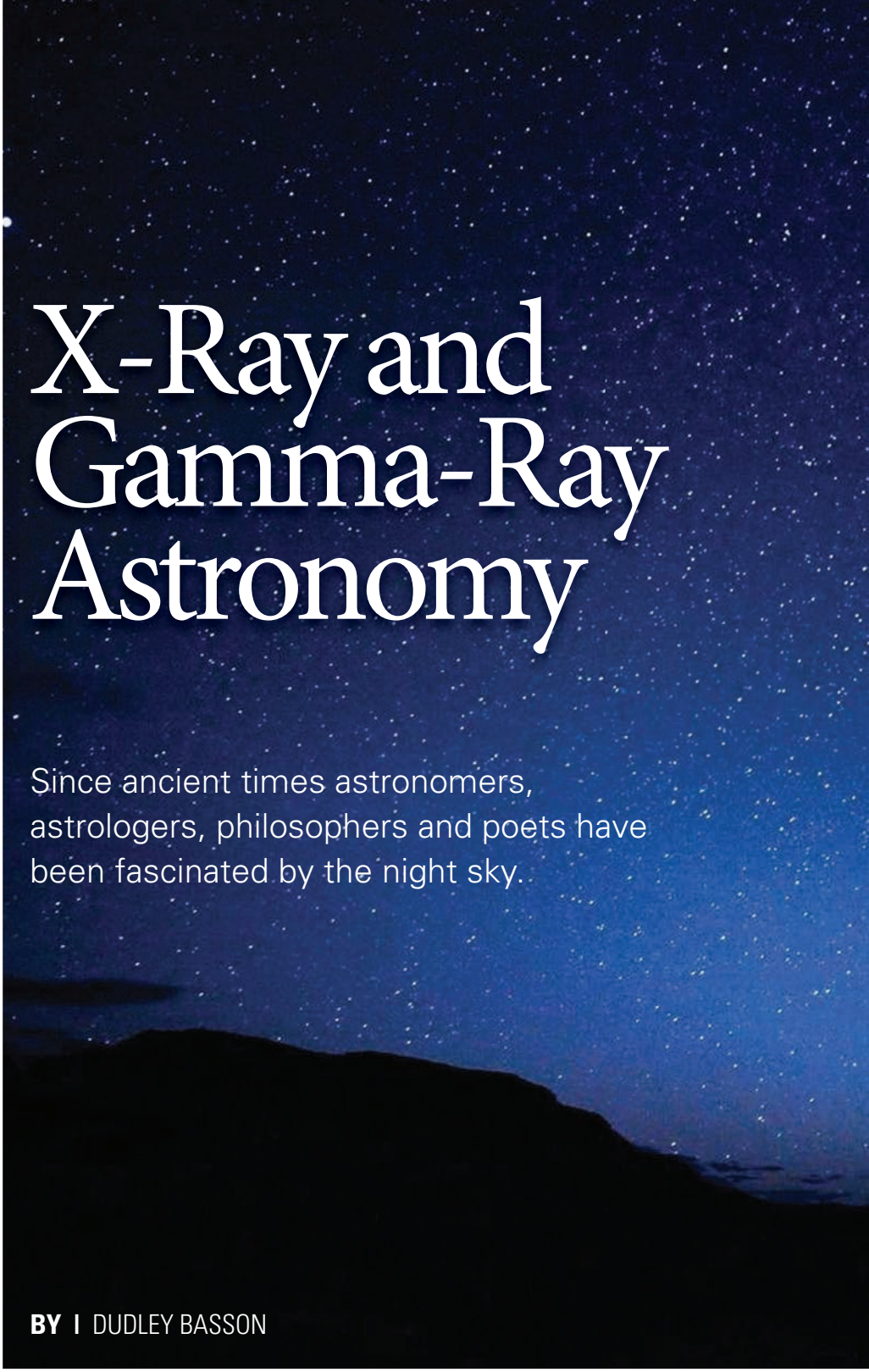
Standardization can also play its part, since it can remove unnecessary regional differences and system incompatibilities, in this way stimulating mass production and cost reduction.

The result of all these efforts might very well go beyond that of a renewable energy society, as improved and low-cost storage capacity may also bring other advantages. It could flatten out the hourly variations in the electricity network even more than is currently possible, leading to more stable electricity prices.

It could also further improve the reliability of electricity supply, making the entire system highly robust against blackouts. It would not be the first time that a fundamental change urged by necessity, in the end, leads to a system that is in many aspects better than its predecessor. wn

First published on www.leonardo-energy.org

Article courtesy of The Copper Development Association Africa.
For more info, visit
www.copperalliance.org.za



X-Ray and Gamma-Ray Astronomy

Since ancient times astronomers, astrologers, philosophers and poets have been fascinated by the night sky.

BY | DUDLEY BASSON

The origins of modern astronomy can be found in ancient Mesopotamia, and all western efforts in the exact sciences are descendants in the direct line from the work of the Babylonian astronomers. They also used a sexagesimal (base 60) place-value number system, which simplified the task of recording very high and very small numbers.

The modern practice of dividing a circle into 360 degrees, of 60 minutes each, began with the Sumerians.

The Ancient Greeks also had advanced astronomical knowledge. The Antikythera mechanism dating from 205 BC shows their astonishing level of understanding of the solar system. This mechanism, containing

37 finely crafted bronze gears of epicyclic and differential gearing could function as an orrery showing the positions of the Moon and inner planets for any desired time frame. The instrument was discovered by a sponge diver who came upon the wreck of a vessel laden with statues, wine and other goods. He came up gasping that he had found a heap of naked women.

The ancient Egyptians also had developed astronomy. They attached particular significance to the constellation Orion.

The arrangement of the three-belt stars of Orion match the positions of the Giza pyramids, and the brightness of the stars are reflected in the sizes of the pyramids.

The ancient Chinese were particularly careful to preserve their astronomical records and can show dates of all visible supernovae going back millennia.

For millennia the only way of observing the sky was by direct observation which limited the view to a few thousand stars in our own Milky Way galaxy. The first

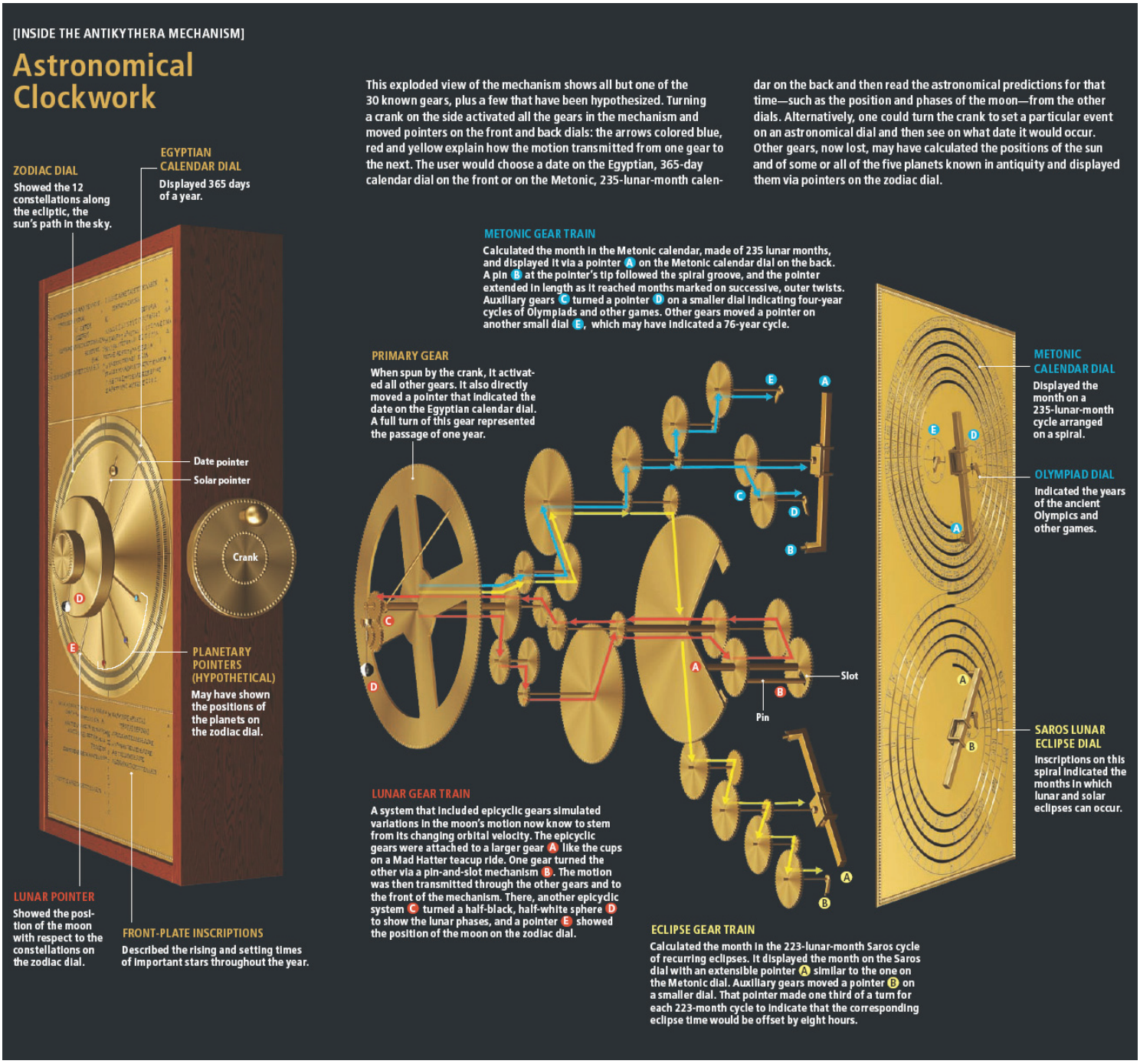
X-Ray & Gamma-Ray Astronomy

continues from page 41

[INSIDE THE ANTIKYTHERA MECHANISM]

Astronomical Clockwork

This exploded view of the mechanism shows all but one of the 30 known gears, plus a few that have been hypothesized. Turning a crank on the side activated all the gears in the mechanism and moved pointers on the front and back dials: the arrows colored blue, red and yellow explain how the motion transmitted from one gear to the next. The user would choose a date on the Egyptian, 365-day calendar dial on the front or on the Metonic, 235-lunar-month calendar on the back and then read the astronomical predictions for that time—such as the position and phases of the moon—from the other dials. Alternatively, one could turn the crank to set a particular event on an astronomical dial and then see on what date it would occur. Other gears, now lost, may have calculated the positions of the sun and of some or all of the five planets known in antiquity and displayed them via pointers on the zodiac dial.



The Antikythera mechanism dating from 205 BC shows their astonishing level of understanding of the solar system.

significant boost to astronomy came with the development of refractive telescopes which vastly increased the number of visible stars. The next significant improvement was the availability of photography and the use of mechanically driven equatorial mounted telescopes which could track the sky to obtain long exposure photographs. The introduction of Newton-type reflector telescopes was delayed by the lack of a satisfactory means of coating the mirrors.

Advances in the 20th century improved astronomy beyond recognition. Precision manufacturing and glass coating made huge mirrors possible. Computer control of altazimuth mounts made large mirrors practical. Advances in computer technology have made considerable improvements to imaging and spectrographic instruments. Increases in active and adaptive optics have revolutionised data quality. The possibility of orbiting space observatories has created even more significant advances possible.

Extending observations by observatories operating in the ultraviolet, infrared, submillimetre, microwave and radio wave parts of the electromagnetic spectrum, find that there are more astronomical objects radiating in the infrared portion of the range than any other. Extending observations to the high energy photons of the electromagnetic spectrum required the use of spacecraft, as X-rays and gamma rays are entirely filtered by the Earth's atmosphere.

A telescope working in the X-ray spectrum presents some unique problems. An ordinary Newton reflector is of no use at all as the X-rays would merely pass straight through. X-rays can be reflected by a mirror but only at a very oblique angle, so that tubular mirrors polished to a slight curvature on the inside or outside are used. A grazing incidence angle of from 10 arc minutes to 2 degrees is used.

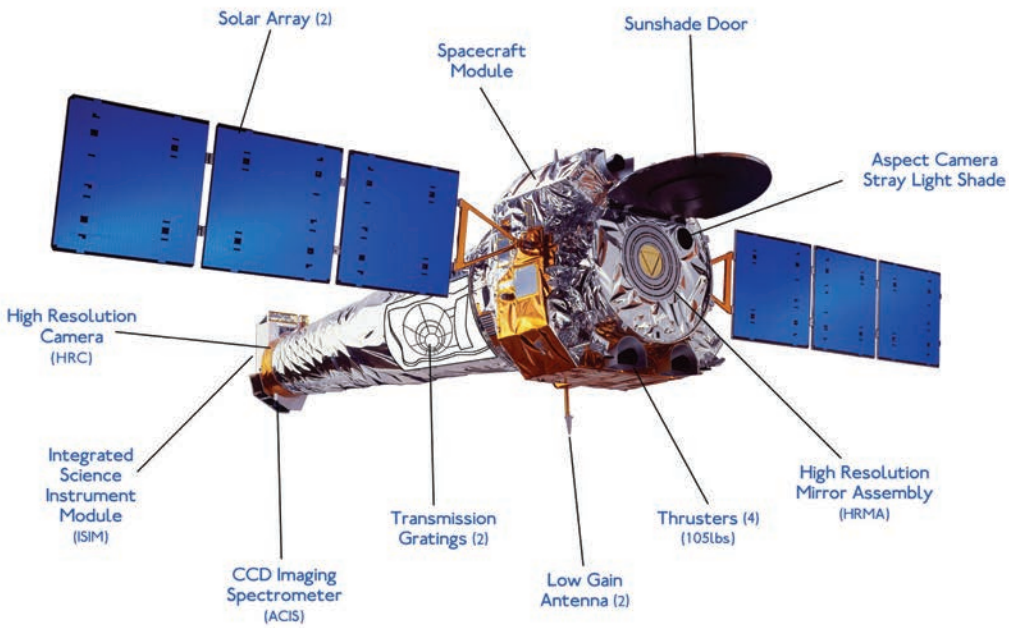
In 1952 Hans Wolter designed three types of low grazing incidence mirrors which use pairs of nested tubular mirrors (paraboloid, hyperboloid and ellipsoid) to give a full field of view and better qualities that could be obtained from a single set of tubular mirrors. The outer mirrors reflect the X-rays to the inner mirrors to give the more comprehensive view.

Type-1 mirror has an outer paraboloid set reflective on the inside and an inner hyperboloid set also reflective on the inside. Type-2 mirror has an outer paraboloid set reflective on the inside, and an inner hyperboloid set reflective on the outside. Type-3 has an outer paraboloid set reflective on the outside, and an inner ellipsoid set reflective on the inside.

Let us take a look at a few significant X-ray and gamma-ray space missions selected from the large number that have been launched.

CHANDRA

The Chandra X-ray Observatory, the third item of NASA's Great Observatories program, was launched on 23 July 1999 by the space shuttle Columbia. This flagship-class mission was completed at the cost of R20 billion. Chandra observes X-ray wavelengths from 0,12 nm to 12 nm (0,1 – 10 keV). Chandra is very long at 13,7 m. Chandra has produced a vast wealth of astronomical data and has been particularly successful in observations of the material surrounding black holes. It has even been discovered that black holes



The Chandra X-ray Observatory.

X-Ray & Gamma-Ray Astronomy

continues from page 43

have a spin which is detectable by its effect on orbiting particles and distortion of space-time. Chandra can observe X-rays from particles up to the last second before they fall into a black hole. Some quasars observed are more than 10 billion light-years away. In April 2006 the Chandra observed the eclipse of the supermassive black hole at the centre of galaxy NGC 1365 by a dense cloud of gas. It allowed the measurement of the size of the material at the event horizon of the black hole.

A spectacular NASA image posted in September 2012, showed an accumulation of 270 hours of operation of the Chandra – the central regions of the Perseus galaxy cluster revealing the turmoil that has wracked the bunch for hundreds of millions of years. One of the most massive objects in the universe, the group contains thousands of galaxies immersed in a vast cloud of multimillion degree gas with the mass equivalent of trillions of suns. This gas is so hot that it glows only in X-rays.

The newly discovered wave of hot gas is being described as a tsunami to indicate its great size spanning about 200 000 light years. Using Chandra, astronomers have also determined that the Milky Way galaxy, including the nearby Magellanic cloud galaxies, is embedded in an enormous cloud of hot gas which extends for hundreds of thousands of light years.

The Chandra discovered the first direct evidence of a superfluid, a bizarre, friction-free state of matter, at the core of neutron star Cassiopeia A. Superfluids containing charged particles are also superconductors, meaning that they act as perfect electrical conductors and never lose energy. The Chandra results strongly suggest that the remaining protons in the star's core are in superfluid state and, because they carry a charge, also form a superconductor.

Superconducting neutron stars are also known as soft gamma repeaters or magnetars. The gamma bursts are so immense that they can release as much energy as the Sun in 1000 years. The magnetar's magnetic field strength is enormous and can be as much as 80 gigatesla. The magnetic field strength used in ordinary electrical machinery is commonly between one and two Tesla. For more information on the many successful observations by Chandra see:
https://en.wikipedia.org/wiki/Chandra_X-ray_Observatory

Chandra was initially intended as a five-year mission, but after more than 18 years it remains fully functional.

The focusing mirror used is a Wolter type-1 design. It consists of four pairs of slightly curved tubes, polished on the inside, and nested one inside the other with a combined mass of a ton of glass. The mirror tubes are from 0,6 m to 1,2 m diameter with a length of 0,8 m. The outer set is of paraboloid curvature and the inner hyperboloid. Due to the extremely short wavelength, the mirrors had to be polished to within a nanometre – the most precisely polished optical surfaces ever produced. The orbit of the observatory is also unusual in that it takes 2,6 days and is highly elliptical going up to a third of the way to the Moon to avoid the Van Allen radiation belt.

This observatory was named in honour of Nobel laureate astrophysicist Subrahmanyan Chandrasekhar (1910-1995). There is an additional astronomical connection here – Chandra is the Sanskrit word for 'moon'.

XMM NEWTON MISSION

(X-ray Multi-Mirror design)
This magnificent addition by ESA to the fleet of space observatories was the most significant scientific satellite ever built in Europe. It is ESA's second 'cornerstone' mission. It has three telescopes which are marvels of precision engineering. Each telescope lens consisted of 58 high precision wafer thin concentric mirror tubes polished to incredible precision on the inside and provided with a gold reflective coating.

A grazing incidence angle of 30 arcminutes is used which would give sufficient reflectivity in 7 keV energy range. The observatory was launched by an Ariane-5 rocket in December 1999 from Kourou, French Guiana. The mission life was extended to 2012 but could technically remain operational until 2018. The observatory carries 3 X-ray imaging cameras, spectrographs and an optical monitoring telescope. The three-axis stabilised spacecraft has a pointing accuracy of one arcminute. The prime contractor, Dornier Sattellitensysteme (A part of Daimler-Chrysler Aerospace) led an industrial consortium involving 46 companies from 14 European countries.

The primary scientific instruments carried aboard the craft are:
The three European Photon Imaging Cameras (EPIC) produced by a consortium of ten institutes in four nations. One of the cameras uses a new type of CCD developed by the Max Planck Institute of extra-terrestrial physics. The optics are designed to cover a spectral range of 12 keV to 0,1 keV.

An assembly of 51 mirrors, carefully sized, formed and nested one inside another, makes XMM-Newton the most sensitive X-ray telescope ever built. ESA's XMM-Newton derives its name from its X-ray multi-mirror design and honours Sir Isaac Newton. This unique X-ray observatory was launched by Ariane 5 from the European spaceport in French Guiana on 10 December 1999.

THE TWO REFLECTION GRATING SPECTROMETERS (RGS)

The Optical Monitor (OM) aligned with the X-ray telescopes gives the mission a multi-wavelength capability. It is a 30 cm aperture Ritchey-Chrétien telescope with a 170-600 nanometer spectral range.

X-ray tests were performed by the PANTER test facility of the Max Planck Institute of extra-terrestrial physics. The spacecraft is in a 48-hour elliptical Earth orbit with an apogee of 114 000 km and a perigee of 7 000 km.

ESA has proposed a new X-ray mission – Advanced Telescope for High Energy Astrophysics (ATHENA) for launch in 2028.

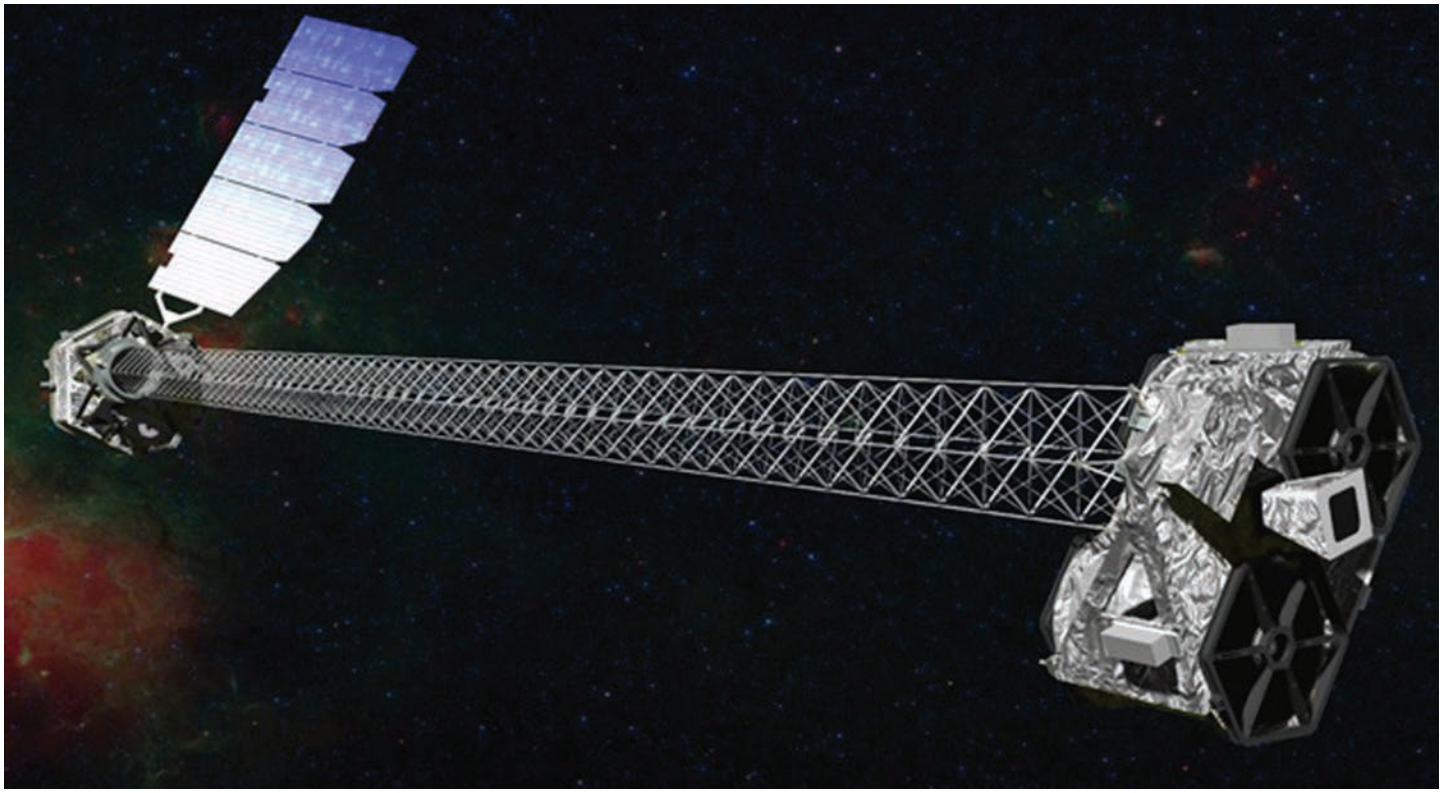
NUSTAR NUCLEAR SPECTROSCOPIC TELESCOPE ARRAY

NuSTAR is the eleventh mission of NASA's Small Explorer satellite program and the first space-based direct-imaging X-ray telescope at energies beyond those of the Chandra and XMM-Newton. It was successfully launched over the Pacific Ocean by aircraft on 13 June 2012 and then boosted into orbit, with a planned mission life of two years, but remains operational. The unique telescope design includes a ten-metre mast with a Wolter type-1 ten metre long telescope consisting of 133 concentric shells working in the 3keV to 79 keV range.

Its primary goals include a broad survey of black holes a billion times more massive than the Sun. To understand how particles accelerate to a fraction of a percent below the speed of light in active galaxies, and also to know how the chemical elements are created in the explosions of massive stars by imaging the supernovae remnants.

X-Ray & Gamma-Ray Astronomy

continues from page 45



NuSTAR Nuclear Spectroscopic Telescope Array

GAMMA RAY OBSERVATORIES

Gamma rays cannot be reflected or refracted at all requiring an entirely different approach to telescope design. Two of the following three methods are commonly used to detect gamma rays coming from a particular target area:

- Collimators,
- Anti-coincidence shields, and
- Coded aperture masks.

Since the flux of cosmic gamma rays is always small, the problem is compounded. At energies of 100 MeV, the most reliable source might give a flux of one photon per minute. Gamma rays refer to a range of photon energy from 100 keV (105 eV) to over 100 EeV (1020 eV). It is a range of 15 decades which is more than the remainder of the electromagnetic spectrum. Gamma-ray observatories in space detect only a small part of the gamma-ray spectrum. Space observatories are at a disadvantage with detecting very high energy gamma rays as they do not have sufficient collecting area to detect enough photons.

There are several designs of gamma-ray recording instruments using scintillation detectors. The well-known Geiger counter is a gamma-ray detection instrument. Gamma rays are easily detected but determining their direction is a complicated matter and cannot be accurately calculated. Angular resolution can at best be from a few arc minutes to a few degrees. Cosmic gamma rays are entirely blocked by the Earth's atmosphere, but the extremely high energy rays can be detected by terrestrial gamma-ray air or water Cherenkov observatories detecting secondary radiation resulting from gamma-ray scintillations in the atmosphere.

The first views of gamma-ray bursts were in the 1960s in the course of military observations, and it was thought that the strength of the bursts ruled out any possibility of them coming from beyond our galaxy. It was subsequently found that the bursts were occurring on a daily basis from all parts of the sky – millions of light years away from other galaxies.

Energy bursts on this scale seemed unbelievable. These are the most powerful explosions in the universe. Stars with a mass of 10 times that of the Sun can produce supernovas at the end of their life cycles. Stars with a mass of 40 Suns can follow the supernova with a hypernova with an energy output of 100 times that of the supernova

ELPA
EARTHING AND LIGHTNING PROTECTION ASSOCIATION

CERTAINTY through CERTIFICATION and COMPLIANCE

A registered non-profit organisation of voluntary membership

ELPA Guarantees Installations

Benefits of specifying ELPA

- All ELPA certificates are guaranteed by ELPA in accordance with the SANS 62305 series of standards.
- All lightning protection systems are carried out by trained & accredited designers, installers and inspectors.
- Expected inspection rate of 100% on all registered projects.
- Peace of mind that projects comply with the SANS standards.

ELPA specifications for engineers

ELPA will assist all engineers and engineering companies who wish to specify ELPA on their projects by providing an up-to-date earthing and lightning protection specification - FREE OF CHARGE.

ELPA also offers project-specific specifications and drawing approval services.

For more details contact ELPA.

Specify ELPA for your projects

Telephone: 010 534 6186 E-mail: info@elpasa.org.za Web: www.elpasa.org.za

X-Ray & Gamma-Ray Astronomy

continues from page 46

This illustration of the Compton Gamma Ray Observatory shows the locations of its four instruments, the Burst And Transient Source Experiment (BATSE), the Oriented Scintillation Spectrometer Experiment (OSSE), the Imaging Compton Telescope (COMPTEL), and the Energetic Gamma Ray Experiment Telescope (EGRET).

and can produce a GRB. The hypernova burst radiates more energy than the Sun in its entire life cycle. The visible afterglow can remain for up to several months.

Gamma-ray bursts are also produced in kilonovas by the collision of two neutron stars or a neutron star and a black hole, which orbit each other and finally inspiral to collide in a cataclysmic explosion and end up as a black hole.

COMPTON

The Compton Gamma Ray Observatory was the second of NASA's Great Observatories program. It was named in honour of Dr Arthur Holly Compton (1892-1962). At 17 tons this was the most substantial astrophysical payload ever flown at the time. The observatory was deployed by space shuttle Atlantis on 5 April 1991. The four instruments on board could detect more than six decades of the electromagnetic spectrum from 20 keV to 30 GeV.

The Observatory detected some 2600 gamma ray bursts while in orbit. Some 2000 scientific papers have been written from the vast amount of data gathered.

Due to malfunctioning of one of the three gyros, it was decided in June 2000, for safety reasons, to de-orbit the observatory and allow it to plunge into the Pacific Ocean rather than risk an uncontrolled descent.

INTEGRAL INTERNATIONAL GAMMA-RAY ASTROPHYSICS LABORATORY

Launched from Baikonur spaceport in Kazakhstan on 17 October 2002, INTEGRAL remains operational. It is an international mission with the participation of all member states of ESA plus the United States, Russia, Czech Republic, and Poland.

The European Space Operations Centre - ESOC in Germany is responsible for satellite control. The INTEGRAL Science Operations Centre (ISOC) at Noordwijk, the Netherlands, is providing the observation plan, and Switzerland hosts the centre for the scientific data.

INTEGRAL International Gamma-Ray Astrophysics Laboratory

The observatory has a payload of four co-aligned instruments:

- IBIB – Imager observer from 15 keV to 10 MeV with 12 arcminutes resolution.
- SPI – Primary spectrometer observes from 20 keV to 8 MeV.
- ACS – Anti-Coincidence shield.
- JEM-X – Observes soft and hard X-rays from 3 keV to 35 kV.

FERMI GAMMA-RAY SPACE TELESCOPE

Formerly: GLAST – Gamma-ray Large Area Space Telescope

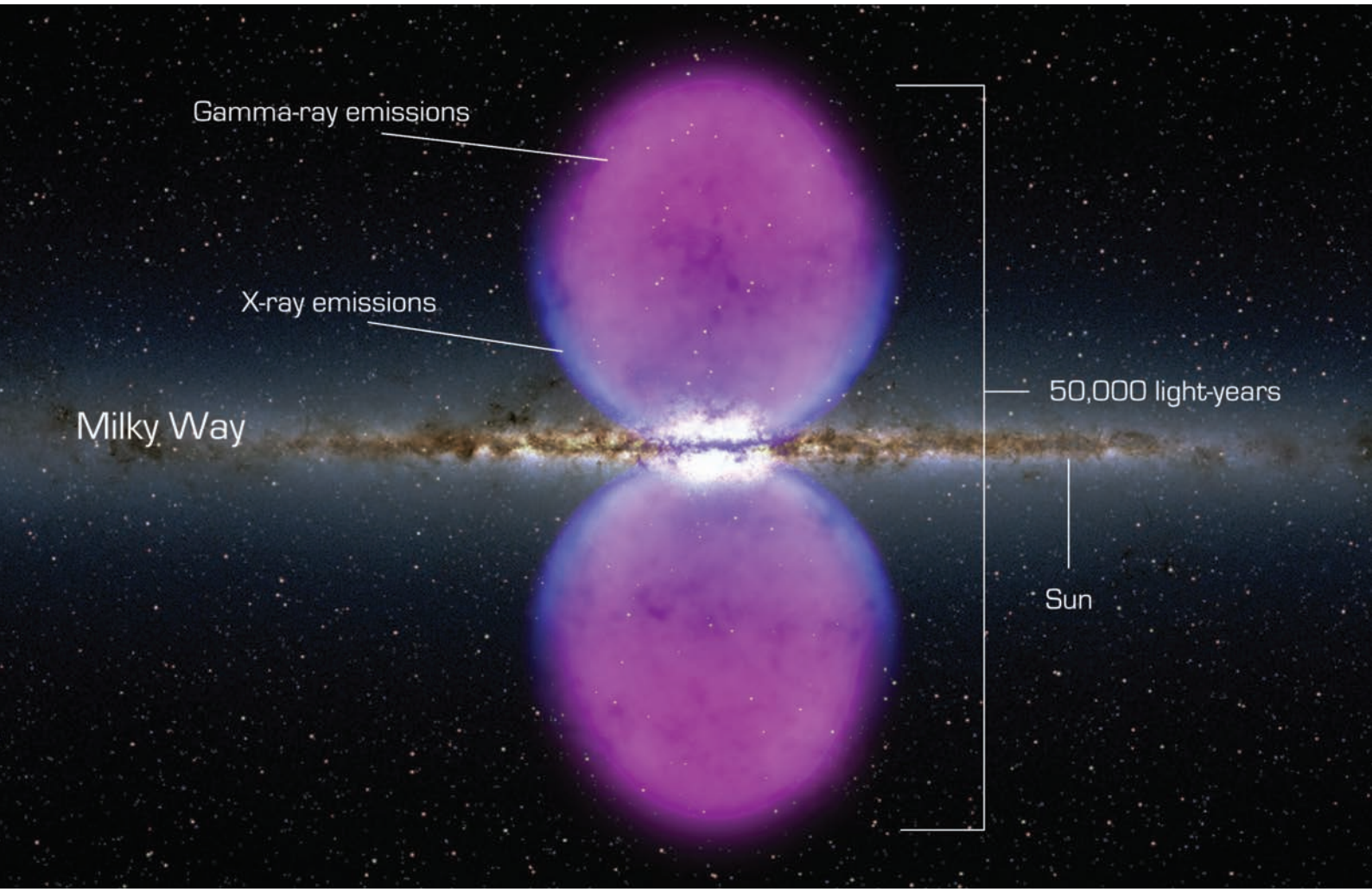
This primary mission, built by General Dynamics, was launched by NASA on 11 June 2008 on a five-year mission with a goal of 10 years operation. For this mission, NASA teamed up with the US Department of energy and a large number of institutions in France, Germany, Japan, Italy, Spain and Sweden. The entire project has a budget of $690 million.

The Fermi Large Area Telescope (LAT) has a massive field of view of more than 2,5 steradians. Its limit for source detection in an all-sky survey is 1,6 x 10-9 photons cm-2 s-1 at energies over 100 MeV. The LAT is an imaging gamma-ray detector which detects photons with power from 30 MeV to 300 GeV. Gama ray bursts will be identified by the GBM (GLAST Burst Monitor). The GBM consists of 14 scintillation detectors, twelve with sensitivity for the eight keV to 1 MeV range and two for the 150 keV to 30 MeV range. Fermi was designed to explore the most extreme environments of the universe and explain how black holes accelerate immense jets of material at nearly the speed of light. Within 40 days of launch, to the delight of all concerned, Fermi detected 12 powerful GRBs.

Fermi has also discovered a gamma-only pulsar which pulses three times per second and radiates 1000 times the power of the

X-Ray & Gamma-Ray Astronomy

continues from page 49



"Bubbles" above and below the Milky Way galaxy emitting X-rays and gamma rays.

Sun. In September of 2008 fermi recorded a notable GRB in constellation Carina with the power of 9000 ordinary supernovae. In November 2010 a most astonishing discovery was made – two 'bubbles' above and below the centre of the Milky Way galaxy.

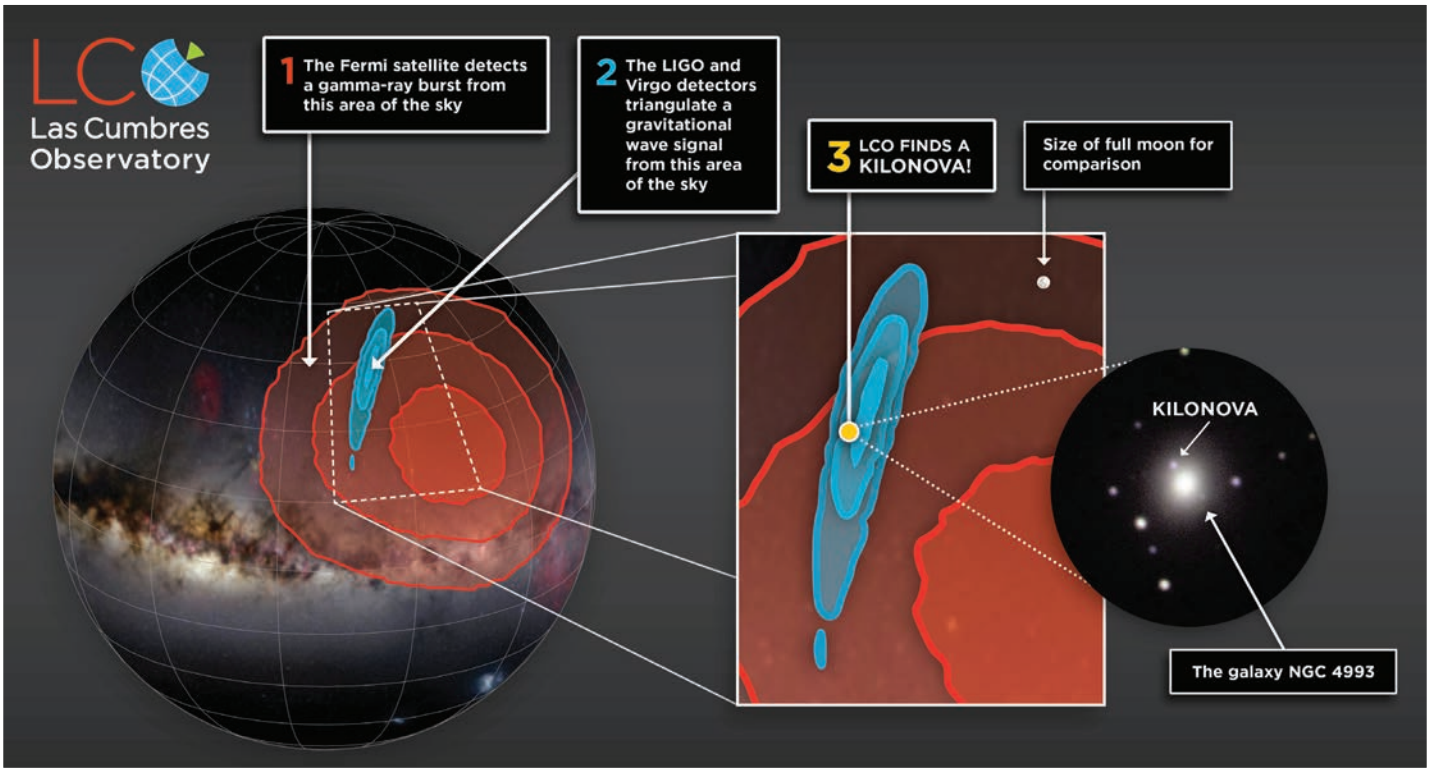
These bubbles emit X-rays and gamma rays and extend 25 000 light years. In early 2012 the Fermi detected the highest energy light ever seen from the Sun. At its peak, the solar flare emitted gamma rays with an energy of 4 GeV.

SWIFT

The Swift Gamma-Ray Burst Explorer is now called the Neil Gehrels Swift Observatory in honour of Neil Gehrels who helped develop Swift as its principal investigator until his death in Feb 2017. The SWIFT mission is specially designed for the study of Gamma Ray Bursts (GRBs). SWIFT was launched on 20 November 2004 and is controlled by the Goddard Space Flight Centre. SWIFT is not an acronym – it was named Swift as it can detect gamma-ray bursts and then swiftly alert other instruments to study the afterglow in longer wavelengths.

The problem of observing the afterglow of a GRB is a matter of timing. The burst could last from a few seconds to a few minutes, and the visual afterglow may only remain visible for a few hours. SWIFT can deploy its instruments and also alert Earth-based observatories and other space missions to study the afterglow in different wavelengths. SWIFT was the first instrument to detect a kilonova.

SWIFT has a payload of three instruments: BAT – the Burst Alert Telescope. It is a very wide angle gamma-ray detector with the



Kilonova brightness graph explained.

function of detecting the bursts and their approximate location in the sky. Within ten seconds the burst detector will transmit the information to ground-based agencies for further action and also slew the observatory so that the narrow-angle instruments on board can make observations of the afterglow within 90 seconds of the burst observation.

XRT – the X-ray telescope will then make detailed observations of the afterglow in the X-ray spectrum. The XRT uses a Wolter type-1 telescope with 12 nested tubular mirrors.

UVOT – this is the UltraViolet and Optical telescope which will also make detailed observations of the afterglow.

SWIFT has over the years made a large number of notable detections including more than 1000 GRBs. For more information refer to https://en.wikipedia.org/wiki/Neil_Gehrels_Swift_Observatory

MASTER

(Mobile Astronomical System of Telescopic Robots)

It is a Russian system of robotic telescopes of which the Moscow State University, under the leadership of Professor Vladimir Lipunov, started development in 2002. The robotic telescopes were installed in five Russian cities as well as South Africa, Argentina and the Canary Islands. The telescopes can compare sky images with archival data to detect the appearance of new astronomical objects, in particular, GRBs. MASTER has in recent years discovered 1500 new celestial objects.

A SCIENTIFIC BREAKTHROUGH

A significant scientific milestone was achieved on 17 August 2017 when the three gravitational observatories, the two LIGO observatories in the US and VIRGO in Italy, detected gravitational waves, and the approximate source position determined. Telescopes were alerted worldwide as well as in space, in the greatest ever target of opportunity observing campaign. The GRB afterglow was detected in galaxy NGC 4993 by telescopes worldwide including MASTER. In all, some 70 telescopes watched the event in gamma-ray, X-ray and optical wavelengths. It was also confirmed that this was a kilonova event in which heavy elements such as gold, platinum, uranium etc. are produced.

A single neutron-star merger can generate an amount of gold equal to the mass of Jupiter and that neutron star mergers can account for about half of all the elements heavier than iron in the universe.

It was the first time that the gravitational waves of a kilonova and its electromagnetic counterpart were observed together, confirming Einstein's theory of General Relativity claim that gravitational and electromagnetic waves propagate at precisely the same velocity; in this case, arriving together after travelling for 130 million years. Resounding proof indeed. WN

Down Memory Lane

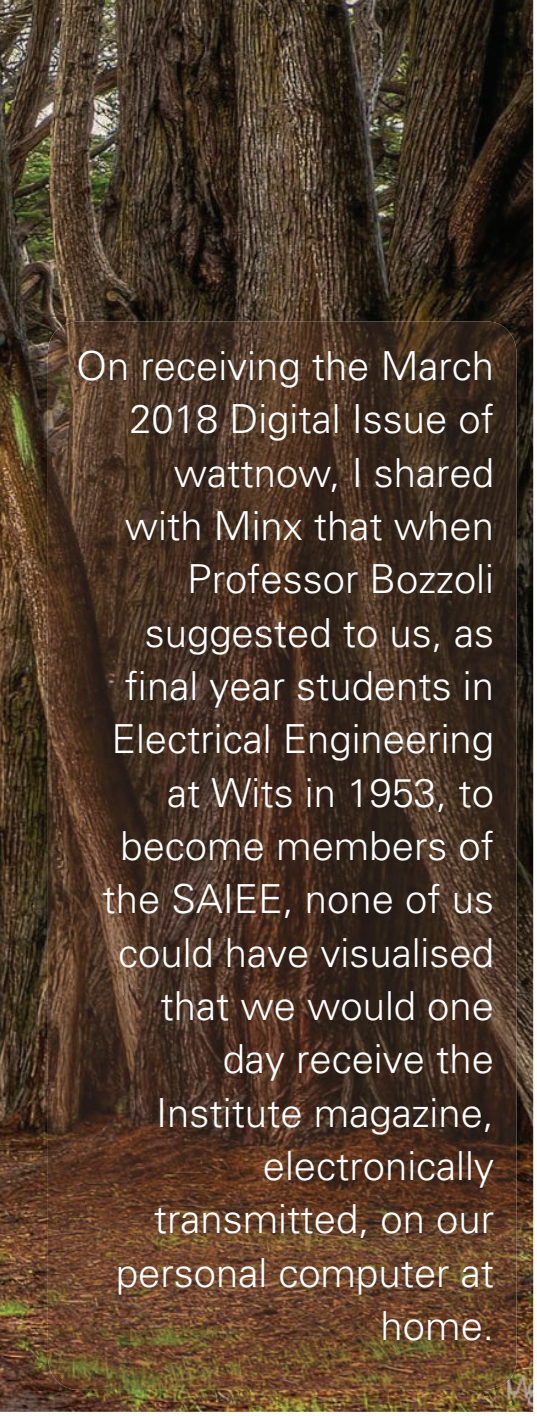
BY | BRUNO PENZHORN | SMSAIEE | PR.ENG., BSC.(ENG)

I also shared with her the narrative of the first installed computer at Wits (IBM) in the Electrical Engineering building next to the High Voltage Lab. As part of my post-graduate work in HV, I had built a van der Graaff high voltage generator using a flowing dust-laden air stream as a charge carrier. When I finally got my machine to work, it produced a spectacular electric spark which extended its electromagnetic waves far beyond the HV lab into the computer room and erased its memory. This led to the boffins from the Physics Department, who were using the computer at the time, to rush out and display great displeasure with my activities. In consequence, we had to agree to 'research' in shifts to avoid further interference.

Minx was amused by this story and asked whether I would be prepared to contribute under the abovementioned heading for our journal. I hesitantly accepted, given my inexperience in journalistic endeavours and the potential for inaccuracies when reminiscing about daily activities over a time span of well over half a century.

EARLY YEARS AND TRAINING

I hail from Kroondal the little German farming community near Rustenburg. My grandfather and great-grandfather served as missionaries amongst the Royal Bafokeng nation in Phokeng for a joint period of 75 years. I received my first steps in primary education at a little German private school in Kroondal near



Rustenburg followed by an Afrikaans medium High School in Rustenburg and after that qualified as an Electrical Engineer at Wits University under Professor Bozzoli & Professor Cormack. This time in English.

BROWN BOVERI & CIE –BBC

In those early days the large electrical groups from the UK, including names like GEC, English Electric, Metropolitan Vickers, Reyrolle & BTH were strongly represented in South Africa. Most engineering graduates went across to England for training and to serve their two years pupillage before coming back to South Africa to join the local offices. One of our lecturers told me about a Swiss company called Brown Boveri & Cie (BBC) who were leaders in electric traction and locomotives. This exciting direction immediately appealed to me and through the facilitation of their local office, I went for training at their works in Baden, Switzerland where I arrived in the summer of 1954. What followed was a pleasant experience, with skiing in winter and mountaineering in summer. What a beautiful country, with 'clockwork' systems in place notwithstanding the challenge of four official languages.

Two years later I returned to South Africa to join the local office. It was the beginning of a 28 years association with the company, the last eight as Managing Director of Brown Boveri South Africa. Given the entrenched relationship with British firms in South Africa, BBC faced a real challenge to enter the market in traditional fields of engineering but finally made substantial inroads into the power generation market.

The first breakthrough came with an order for the 6 x 60/66 turbo generators for the new MW Highveld power station in the Free State. The 6 x 200 MW generators followed this for Grootvlei (turbines from MAN), the 6 x 350 MW turbo generators for Arnot power station and the 6 X 500 MW turbo generators for Kriel. BBC's success was due to the outstanding capability in power generation equipment developed by the Swiss engineers as well as attractive low-interest loans that became available from Switzerland.

By now Eskom , and with its extremely competent New Works Department became the world leader in what they called 'six-pack' thermal power stations. For the next round of power stations, other turbo generator suppliers took the lead including GEC for Duvha, Siemens / KWU for Kendall and MAN / Alstom for Matla, Matimba and Lethabo. *(In modern times Eskom's latest Titanics, Medupi and Kusili, have lifted the six-pack concept to lofty levels at 800 MW per machine and 4'800 MW per station. However, most of us could not believe the media reports about the ongoing severe cost increases and delays at Medupi. Whereas Union interventions can be categorised as Force Majeure, experienced on looking contract engineers found it difficult to understand what mechanisms were used to justify such colossal cost increases over and above the firmly agreed levels at the time of signing the contract.)*

In early 1980, the shortage of power station contracts at BBC put heavy cash flow strains on the company which led to the merger with Asea from Sweden to form ABB and finally the sale of the power generation Division to Alstom.
On the electrical side some interesting BBC projects included:

- An order for the innovative mechanical contact-rectifiers for an electrolysis installation;
- Mercury-arc rectifiers for DC traction at the SA Railways and a wire mill at the Iscor Works in Pretoria;
- The electrical drives and control installations for the Saldanha Bay iron ore export terminal;
- Generator switchgear at Kariba & the Drakensberg pump storage scheme;
- A large number of HV air blast and SF6 substations in South Africa;
- The built of substations on the Central African Power Corporation interconnection between Southern Rhodesia and the Copper belt in Zambia.

We were also heavily involved as part of the HVDC partnership comprising Siemens, AEG & BBC on the Cabora Bassa 1,920 MW HV DC link and its terminal stations in Songo Mozambique and Apollo in RSA.

In 1969, in preparation for taking over the leadership of the company, I was delegated to attend a Programme for Management Development – PMD at Harvard University in Boston, USA. It was an exciting experience with the aim of broadening once technical capabilities into the field of finance and management techniques.

Down Memory Lane with Bruno...

continues from page 53

In 1980/81, based on a major order for locally manufactured motors, we build a BBC factory for large HV motors in Alrode which later became a Centre of Excellence in the ABB Group.

POWERTECH

In 1982 I left Brown Boveri South Africa to join Bill Venter's Altron Group as Managing Director of Powertech for a period of five years until 1987. It was truly amazing to see how Bill and his team of keen young South African entrepreneurs build up such a huge organisation in a relatively short time with an emphasis on local manufacture both in the telecommunication and power field. I think the Group benefitted from the fact that many overseas principals found it difficult to manage their operations in South Africa at that time and were happy to disinvest to a hands-on local organisation. Whereas my involvement at BBC was almost exclusively in engineering and project management, the Powertech approach was to build the organisation through acquisitions and the effective control and performance of newly acquired subsidiaries and to service the public relations demands associated with the listing of both Altron as the holding company and its subsidiaries on the JSE. It was a steep learning curve for me especially the evaluation of companies and merger discussions under the able management of the financial gurus in the Group.

ROTEK INDUSTRIES (PTY) LTD

During our contractual contacts with Eskom while at BBC, I developed severe respect for the vast engineering capability build up by Eskom at Rosherville over many decades with the intent to ensure complete independence in the maintenance of their power generation and distribution networks countrywide. However, despite the undisputed technical excellence and a backup complement of 3000 people the workshop lacked commercial acumen and displayed great under-recoveries under the Central Maintenance Services (CMS) umbrella where it operated as a dedicated in-house service organisation in a parastatal operation. At the time CMS was in a strong position to do the power station maintenance work of all the utilities in Southern Africa and beyond but this would contractually not have been possible under the Eskom umbrella. After many meetings to share a commercialisation concept with Eskom, I was invited to join Eskom on a consulting basis in 1987 to explore the viability of the broader utilisation of CMS services together with a particular task team of Eskom managers. After a two year period, the decision was taken to convert CMS into a separate entity to be called Rotek Industries (Pty) Ltd. I was appointed CEO, with four subsidiaries to give focused attention to the diverse capabilities in heavy engineering & power station maintenance, civil engineering, abnormal transport and property management.

Establishing the service hours available, the utilisation thereof, the overheads and the base cost for contractual agreements with our clients was a huge task. It highlighted both the loss-making units that needed attention and the possible expanding of profit leaders. The whole process had to be accompanied by an intensive HR involvement to take the employees and the unions with us on our journey. We played open cards in all respects and published a Rotek Group House Journal on a monthly basis as well as a detailed and informative Annual Report each year. I believe that in overall terms the project was a success and led the way for Eskom's noncore activities to become corporatised and increasingly commercially aware and capable. The concept also included the possibility of an employee share participation scheme for all, but I believe we were ahead of our time in this regard. But who knows, with the present support for broad-based equity participation in commercial enterprises it could, even now, pick up the threads and become a trailblazer for other non-core parastatal units to follow. I stayed with the Rotek Group until my retirement in 2000 at the age of 68 years.

MY OPINION ON ESKOM AND THE POWER INDUSTRY

Eskom is the pulsating heart of "Body SA"! When the heart rate increases, it might lead to the body to get seriously ill and die. For large electricity consumers, industrial undertakings, mining and the engineering fraternity, Eskom stood out like a monolith of pride and performance. In years gone by we all loved and admired Eskom, its professionalism, its management, its operators and its functionality.

At present Eskom plays the role of our sizeable one-stop utility that owns and controls all power stations, the full transmission system and a relatively large section of the distribution network. In the latter case, it shares the market and the supply to end-consumers with the municipalities. Over the past two decades, ongoing developments have increasingly highlighted the fact that Eskom in its present form is no longer fit-for-purpose. Also that the solutions to Eskom's current predicament are not to be found in the better management of the monolith as it stands, but in the restructuring thereof into task-orientated, manageable and focussed entities.

Two specific new off-shoots need to be considered and analysed in some detail:
Firstly - for decades now Eskom's mantra has been "electricity for all" in an endeavour to provide equity, fairness and quality of life for all. But the reality of non-payment and illegal connections has reached such proportions that many municipalities cannot pay their bills for water and electricity and the providers have been forced to disconnect the supplies. Of the defaulters, many are unemployed and not in a position to pay while others maintain that water and electricity is a fundamental human right. They pose the question: if others do not pay why should I? With the state of our economy as at present, we should not underestimate the potentially crippling effect of this problem. It could grow to such an extent that it could seriously affect the viability of all municipalities as well as Eskom itself.

But be that as it may, it is not rational for this complex distribution issue to be on the daily list of problems to be solved by the top management of Eskom. Eskom as the generator of power, needs to attend to its own specific needs to remain a going concern, i.e. tariff agreements, financing & loan agreements, coal supplies to its power stations, maintenance of its asset base, competent staff and the effective management of the utility.

Secondly - in the early days, the municipalities generated their power and were allowed to do so if they could prove that they could do this more effectively than buying electricity from Eskom. Nowadays Eskom is the sole survivor as the provider of electricity except for Kelvin power station in Johannesburg.

However, with the advent of renewable power from wind & solar, industrial excess process heat generation and budding IPPs in coal and gas, the game has changed putting Eskom in the uncomfortable position whereby government decrees it has to source power from its competition at the expense of its performance and its excess capacity. Furthermore, on buying energy from renewable sources, Eskom like many other utilities worldwide, will have to live with the problem that the demand for its sound energy as generated by its 'anchor power stations' will vary up-and-down in line with IPPs swinging ability to produce power.

But again, be that as it may, nobody can expect Eskom to be impartial when agreeing to the connection of renewable power sources and not to show bias when buying power from these new sources.

It poses a direct and severe conflict of interests!

The above two considerations tell us that the time has come to thoughtfully respond to the logic that Eskom and with it the electricity supply industry as a whole, need to be restructured into service orientated, independent components as follows:

- GENCO. The generator of firm bulk power
- TRANSCO. Responsible for:
  - Energy broker, buying power from Eskom and all IPPs
  - Bulk power transmission countrywide
  - Sells power to all consumers
  - Negotiates both buying & selling prices of electricity
  - Balances supply & demand
- THE REDS - Regional Electricity Distributor:
  - Combines present Eskom & Municipal Distribution into one entity
  - Buys power from Transco and sells to end users
  - Operates all regional units under one umbrella body
  - Find solutions with the government to the socio-economic non-payment problems at a municipal level
  - Ends present and prevents ongoing illegal electricity connections
  - Note: The creation of the REDs reached an advanced stage 10 years ago. Discontinued when the municipality objected to losing a lucrative source of revenue. Part of this 'lucrative' market has now turned into an expensive and crippling Albatross.

In summary. Appointing competent and clean management at Eskom will not solve its problems. We have to drill deeper! The individual tasks and challenges in each link of the supply chain are beyond being managed in a combined entity! We the users need to present a solution with format and structure to the government for consideration, approval and implementation. wn

If you have an anecdote to share with our readers, please send an email to minx@saiee.org.za with "Memory Lane" in the subject field. The story should ***not be shorter*** than 2000 words - ***ED***

IN MY OPINION - WALDO ADAMS

Liberate economic development for renewable energy companies

With government refreshing its drive to build renewable energy capacity, it's time for these respective companies in the industry to renew their focus on economic development outputs. Since issuing the first licences in 2011, communities around these plants are growing. By revitalising this sector, now is the time to review lessons learnt and make some strategic decisions where necessary.

BY | WALDO ADAMS

In May 2011, the Department of Energy (DoE) gazetted the Electricity Regulations on New Generation Capacity under the Electricity Regulation Act (ERA). We subsequently saw the first Independent Power Producers (IPPs) appointed.

Over the past seven years, renewable energy generations plants have been established in rural areas of South Africa to meet the goals of the National Development Plan (NDP) - namely creating 10,000 megawatts (MW) of additional electricity capacity by 2025 against the 2013 baseline of 44,000 MWs.

To date, three IPP Bid Windows has reached full operation phase. Last week saw the signing of the Bid Window 4 Power Purchase Agreements (PPAs) and projects are in the process of achieving financial close. Besides, the country still awaits the announcement of the Expedited Window, Bid Window 4.5 preferred suppliers. These companies submitted their bids on time, but there are no decisions on the outcome yet.

Much effort was put into the sustainability and transformation opportunities that these projects created. By establishing numerous renewal energy plants, it creates economic benefit, and this leads to some questions such as:

- Are the levels of monitoring and evaluation of these initiatives sufficient to ensure success in the long-term?
- Are the local construction employees still gainfully employed, and have they become more employable within other industries or found employment at different renewable energy plants?
- Have local businesses indeed benefitted from the procurement of their goods and services as part of the commitments made to the DoE? What was the impact of these contracts?

When circumstances change, as they did for renewable energy companies in 2015 when government delayed the issuing of PPAs on Bid Window 4, business expenses get cut to the bone to ensure the organisation's sustainability. One of the measures taken was bringing the execution of economic development plans in-house.

With expertise and focus on in-house teams diluted, so are the potential impact of these economic development investments and programmes. A pressed in-house team often does not have the time, skill or motivation to maximise outputs that specialised independent economic development teams do.

Renewable energy companies usually take 18 to thirty months (technology dependent) to get the infrastructure implemented. Post construction and commissioning revenue generation starts (Operations), which will begin to allow for inputs to the economic development programmes that assist in uplifting the community. Building sustainability into these projects from the beginning is vital.

By addressing the elements of the economic development scorecard need to include management control, preferential procurement, local content, job creation, socio-economic development and enterprise development. The 20-year power purchase agreement awarded to these companies by the government also include clauses that compel the energy company to apply a minimum of 2,1% of their turnover to improve and uplift the community.

Independent economic development service providers can provide dedicated expert resources not just to oversee the design of these plans, however, to engage and negotiate best outcomes with all stakeholders. These outcomes include:
Key players such as municipalities, whose IDP provide insight into the needs of the community.

Impacted Government Departments such as Social Services, Health and Basic Education.

Other companies and SEOs investing in similar projects where collaboration can help increase the positive impact of efforts.
Community stakeholders – community and labour leaders.

With full insight, the ability to collaborate, and the processes in place to drive outcomes for reporting, the returns on the socio-economic development investment are improved for the community and the investing company.

WATT? is a forum related specifically to the industrial and commercial electrical sector.

Do you have any burning questions, topical issues or points of interest about the electrical industry, from the perspective of a contractor, supplier or professional service provider? Submit your comments, thoughts, ideas, suggestions or questions for the attention of our industry experts, and these will be addressed in a future issue of the magazine. This is your forum, and we would like to hear from you!

WATT? is an opportunity for people on the ground to engage with each other and related professionals in an informative and friendly manner. This is a platform for you to discuss anything related to your particular sector, to highlight anything new, or to ask a specific question related to a technical topic or to engage in general industry issues. . Please note that we will not be considering anything related to the domestic sector, such as residential wiring.

We hope that this section of the magazine not only becomes a regular feature, but that it is widely read and distributed among your peers. Remember, it can only become a success with the full participation of our readers! Send your burning questions to minx@saiee.org.za - subject 'WATT?'.

We look forward to hearing from you.
- Ed

QUESTION ONE
What is oil regeneration?

ANSWER ONE
Oil regeneration is the process of restoring the original properties of transformer insulation oil by removing contaminants from the oil. These contaminants could be due to the standard ageing of the insulation fluid as a result of physical and chemical breakdown or from external contamination such as water, dust or even metal particles.

The former is mainly caused by exposure to high temperatures and contact with air that leads to oxidation, decomposition, polymerisation and condensation of hydrocarbons. The accumulation of the mentioned contaminants leads to build up of sludge, acids and various salts.

QUESTION TWO
What does the process involve?

ANSWER TWO
The process starts with in-depth oil analysis to determine the exact level of contamination within the oil. Based on the oil results, the amount of contact time with the filtration medium can be determined.

The oil is then heated to the desired temperature, to enhance the filtration process, and pumped into the filter columns housing the Fullers Earth filtration media. Here the oil is stripped from by-products caused by ageing and impurities.

The oil is then fed through a degasification chamber for dehydration and degasification.

At this stage, the remaining oil will be drained from the filtration chambers and vacuum applied. The columns will be heated, and the vacuum will force the heat energy to pass through the sediment to clean all the contaminants. The exhaust gases are then processed using carbon scrubbers.

QUESTION THREE
Can this process be harmful to my transformer?

ANSWER THREE
The simple answer is no. However, it is essential to follow a due-process and that well trained and qualified staff uses high-quality equipment and then the process is safe.

There is, however, the risk of contaminating transformers on-site if the plant used is not certified as clean and fit for use. The

operator needs to take extreme care in monitoring the oil levels, and safe operation is essential to prevent any environmental impact.

QUESTION FOUR

Can the process be done online (live)?

ANSWER FOUR

By conducting oil regeneration within a closed loop system, and maintaining transformer oil levels through controlled oil flow. It is vital to account for the increased flow rate of the heated oil in relation to the oil retrieved from the transformer at the bottom main tank valve.

Although not uncommon practice, off-load oil regeneration will always be the preferred method due to the high volumes of oil withdrawn from the main tank

QUESTION FIVE

Is there a real cost saving?

ANSWER FIVE

Yes, there is. Transformer oil is highly refined mineral oil, and expensive to purchase. Regeneration can yield the same properties as new oil at 25% of the cost of replacement. It is important to note that regeneration needs to be conducted near the end of the insulating fluid life.

Information provided by Zest WEG Group

If the process is applied too early, it will not be cost-effective, and if used too late it will have only limited benefit.

A further point worth mentioning is the benefit of a two-stage process (or even more) to allow for the natural migration of moisture from the core to the paper covering the windings. Research has shown that as much as 95% of all the moisture held within the transformer active part is trapped in the insulation paper covering the windings.

QUESTION SIX

What is the difference between oil purification and regeneration?

ANSWER SIX

Oil purification is a process that eliminates and reduces contamination in the oil through a means of filtration, dehydration, degasification or some other methods that essentially clean the oil of water, gases, and particulate matter. The typical process involves mechanical filtration and vacuum degassing. It can be performed with the transformer online or offline. Current purification methods are for the removal of gases, particulate matter (down to 0.2 microns) and some, but not all, of the water/moisture found in the used oil.

Typical oil purification methods are usually sufficient to correct "electrical voltage breakdown" caused by a combination of particulate matter and water in the oil which is a prevalent condition found in transformers in service for more than a couple of years.

Oil regeneration is a process that not only wholly purifies used transformer oil; it also improves the oil colour and removes substances such as acids, aldehydes and ketones that the standard purification processes cannot remove. Oil regeneration, therefore, performs all the purification processes and goes beyond the purification process by removing the water and other acids, contaminates and particulate matter from the oil and the rest of the transformer including the paper.

When placing the "regenerated oil" back into the transformer, it is in the same condition as it was when new and unused. Additionally, the Kraft Insulating Paper has been dried, and the acids, particulate matter, water and other contaminants are removed efficiently thereby extending the service life of the paper. wn

May

Movers, shakers and history makers

COMPILED BY | JANE BUISSON-STREET
FSAIEE | PMIITPSA | FMIITSPA

1 MAY

2000 The U.S. government removes Selective Availability from its Global Positioning System, improving the accuracy of civilian GPS devices from 100 metres to 20 metres.

2 MAY

1918 General Motors acquired Chevrolet in a deal that put GM founder, Billy Durant, back in charge of the automotive giant.

3 MAY

1715 A total solar eclipse was visible across northern Europe and northern Asia, as predicted by Edmond Halley to within 4 minutes accuracy

4 MAY

1892 Thomas L. Wilson developed a method for the commercial production of acetylene, which is used in welding applications, quite by accident.

5 MAY

1994 Nelspruit, South Africa produced the world's most massive milkshake containing 7 555 litres of chocolate. This title held for six years.

6 MAY

1949 EDSAC (Electronic Delay Storage Automatic Calculator) the first full-size stored-program computer, built at the University of Cambridge's Mathematical Laboratory, England, ran its early programs. The result was a table of square numbers and a list of prime numbers. EDSAC 1 was finally shut down on 11 July 1958, when it was superseded by EDSAC 2, which remained in operation until 1965.

7 MAY

1952 Geoffrey Dummer read a paper at the US Electronic Components Symposium. At the end of the presentation he made the statement: *"With the advent of the transistor and the work on semiconductors generally, it now seems possible to envisage electronic equipment in a solid block with no connecting wires. The block may consist of layers of insulating, conducting, rectifying and amplifying materials, the electronic functions being connected directly by cutting out areas of the various layers"*. It was the first public description of an integrated circuit.

8 MAY

1847 Robert W. Thomson of Adelphi, Middlesex, England was issued the first U.S. patent for Rubber Tyres (No. 5104). His *"improvement in carriage wheels"* was the application of elastic bearings around the rims of carriage wheels, which was based on his British patent that had been issued 10 Jun 1846.

9 MAY

1962 A laser beam was bounced off the moon from the earth by Massachusetts Institute of Technology. The approximate area of the light beam on the surface was at a diameter of 6.4 kilometres.

10 MAY

1904 August Horch founded the Horch & Cir. Motorwagenwerke AG. After troubles with the Horch chief financial officer, August Horch founded a second company in 1909, the August Horch Automobilwerke GmbH in Zwickau.

11 MAY

1997 Garry Kasparov, the world's best chess player, beat IBM's Deep Blue in the first match of what many considered a test of artificial intelligence.

12 MAY

1941 Konrad Zuse completed his Z3 computer, the first program-controlled electromechanical digital computer. It followed in the footsteps of the Z1 - the world's first binary digital computer - which Zuse had developed in 1938.

13 MAY

1912 The Royal Flying Corps (RFC), was established in the United Kingdom. It was the air arm of the British Army before and during the First World War until it merged with the Royal Naval Air Service on 1 April 1918 to form the Royal Air Force.

14 MAY

1878 The name Vaseline register as a trademark for the petroleum jelly developed by an English-born chemist Robert Augustus Chesebrough.

15 MAY

2001 Apple Computer announced plans to open a chain of retail stores specifically for Apple products. The aim was to open twenty-five stores in the United States by the end of the year. At the time, Apple's plan was 'doomed to failure' by experts. Nowadays Apple's retail stores are now considered one of the catalysts for Apple's tremendous growth.

16 MAY

1960 Physicist Theodore Maiman created the first laser light, using a synthetic-ruby crystal device. He was the first to create an operating laser device.

17 MAY

1792 The New York Stock Exchange was formed under the Buttonwood Agreement, because that is where the agreement was signed - under a buttonwood tree - by 24 stockbrokers, outside of 68 Wall Street, New York.

18 MAY

1952 Prof. Willard F. Libby determined the date of Stonehenge on Salisbury Plain, England, at about 1848 BC (+/- 275 years) through analysis of the carbon-14 radioisotope in charcoal remains excavated there.

19 MAY

2001 Apple Computer opened the first two locations of their new retail stores in McLean, Virginia and Washington, D.C, USA. In the first weekend of opening, the stores attracted 7,700 shoppers, and the sales totalled $599,000.

20 MAY

2015 Aducanumab, a new drug developed by Biogen to treat Alzheimer's, was, and still is, showing success in reducing toxic brain plaque and decreasing the rate of mental impairment in trials; if successful in further testing, the drug may be available by 2020.

21 MAY

1952 At IBM's AGM President Thomas J. Watson, Jr., informed the shareholders that IBM was building the Defence Calculator. This machine signalled a significant moment in IBM's history because they were moving into the computer business.

MAY

continues from page 61

22 MAY

1987 The first ever Rugby World Cup kicks off with New Zealand playing Italy at Eden Park in Auckland, New Zealand.

23 MAY

It seems to have been a good day for Thomas A. Edison:

1905 Edison patented a "Process of Duplicating Phonographic Records" (U.S. 790351).

1911 Thomas A. Edison has issued a patent for "Device for Feeding Pulverulent Material" (U.S. No. 993,294). Pulverulent refers to a consistency of fine powder.

1916 He received three patents for his "Phonograph or Talking Machine." The original patent applications were made 7 Dec 1910, 17 Feb 1911, and 12 Aug 1912.

1922 This time Edison has issued a patent for "Production of Thin Metal Sheets or Foils" (U.S. No. 1,417,464).

24 MAY

2002 Queen Elizabeth II officially opened the Falkirk Wheel - the world's first rotating boat lift.

25 MAY

1994 The first international World Wide Web Conference, hosted by CERN, started. For the first time, Tim Berners-Lee's concept of a single storage facility for a variety of information was discussed in one room.

26 MAY

1927 **The last Ford Model T motor car rolled off the assembly line,** watched by its inventor, Henry Ford at his factory in Highland Park, Michigan, USA. Ford built 15 million vehicles over the last 19 years.

27 MAY

1988 Microsoft released two versions of Windows 2.1. Not many were aware of these as it wasn't until the release of version 3 that Windows had any substantial user-base.

28 MAY

1932 In the Netherlands, construction of the Afsluitdijk is completed, and the conversion of Zuiderzee bay to the freshwater IJsselmeer.

29 MAY

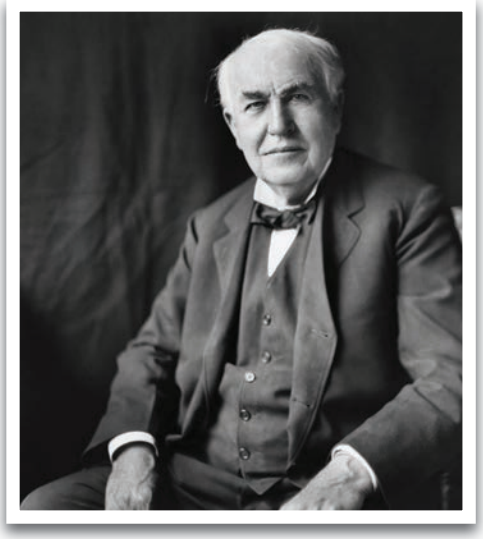
1999 The Space Shuttle Discovery completed the first docking with the International Space Station.

30 MAY

1896 The first auto accident on record occurred in New York City when a Duryea Motor Wagon driven by Henry Wells collides with a bicycle ridden by Evelyn Thomas.

31 MAY

1991 Sega released their video game Zero Wing for the Sega Mega Drive system in Europe. The game was relatively unknown until years later when the poorly translated opening scene became popular on the Internet. The most famous mistranslation is the phrase "All your base are belong to us!" wn



= Earn CPD Credits

calendar

MAY | JUNE | JULY 2018

MAY 2018

6 - 9	2018 IEEE Rural Electric Power Conference (REPC)	Mephis, USA	www.ieee.org
9 - 10	Collaborative Teams In Engineering	Johannesburg	roberto@saiee.org.za
10	Debate on the Restructuring of Eskom	Johannesburg	www.saiee.org.za
15 - 17	Africa Utility Week	Cape Town	www.african-utility-week.com
16 - 19	Planning Strategic Feasibility Studies	Johannesburg	roberto@saiee.org.za
20 - 24	IEEE ICC 2018	Kansas City, USA	www.icc2018.ieee-icc.org
21	Fluke Seminar Western Cape Centre	Western Cape	www.saiee.org.za
22	Fluke Seminar - Eastern Cape Centre	Port Elizabeth	www.saiee.org.za
22 - 23	Transformer Design, Protection, Testing And Maintenance	Johannesburg	roberto@saiee.org.za
22 - 25	2018 IEEE 22nd Workshop on Signal and Power Integrity (SPI)	Brest, France	www.ieee.org.za
24 - 25	High Voltage Testing And Measurement	Johannesburg	roberto@saiee.org.za
25 - 26	2018 Power, Energy, Signals and Automation	Chennai, India	www.ieee.org.za
27	2018 IEEE/ACM Symposium on Software Engineering in Africa	Sweden	www.ieee.org.za
29 - 30	Fundamentals of LTE Mobile Communications	Johannesburg	roberto@saiee.org.za
29	2018 Smart Grid and Clean Energy Technologies (ICSGCE)	Malaysia	www.ieee.org

JUNE 2018

3 - 7	2018 Power Modulator and High Voltage Conference (IPMHVC)	Wyoming, USA	www.ieee.org
5 - 7	Fundamentals of Medium Voltage Protection	Johannesburg	roberto@saiee.org.za
6 - 7	Photovoltaic Solar Systems	Johannesburg	roberto@saiee.org.za
10 - 15	2018 IEEE 45th Photovoltaic Specialists Conference (PVSC)	Hilton, USA	www.ieee.org
12 - 13	AfricaRail 2018	Johannesburg	www.terrapin.com
13 - 14	SANS 10142-Part 1 & OHS Act	Johannesburg	roberto@saiee.org.za
13 - 15	2018 IEEE Transportation Electrification Conference and Expo (ITEC)	California, USA	www.ieee.org
19 - 20	Core Financial Management	Johannesburg	roberto@saiee.org.za
20 - 21	Network Frequency Controls	Johannesburg	roberto@saiee.org.za
24 - 27	Water Institute of SA Annual Conference & Expo	Western Cape	www.wisa.org.za
26	2018 PES-IAS PowerAfrica Conference	Western Cape	www.ieee.org
27 - 28	Carrier Ethernet 2.0 Fundamentals	Johannesburg	www.saiee.org.za
27 - 29	2018 15th Conference on the European Energy Market (EEM)	Lodz, Poland	www.ieee.org

JULY 2018

17 - 18	Smart Procurement World Natal	Durban	www.smartprocurementworld.com
17 - 19	PowerGen Africa & DistribuTech	Johannesburg	www.powergenafrica.com

SAIEE COUNCIL MEMBERS

GRADE	NAME & SURNAME	CONTACT DETAILS	EMAIL ADDRESS
President	Dr Hendri Geldenhuys	084 625 5522	GeldenHJ@eskom.co.za
Deputy President	George Debbo	012 991 3748	george.debbo@gdtelecom.co.za
Senior Vice President	Sy Gourrah	083 321 5526	sgourrah@gmail.com
Junior Vice President	Prof Sunil Maharaj	012 420 4636	Sunil.maharaj@up.ac.za
Immediate Past President	Jacob Machinjike	082 805 5436	jacob.machinjike@eskom.co.za
Honorary Treasurer	Viv Crone		vivcrone@gmail.com
Honorary Vice President	Veer Ramnarain		ramnarainv@elec.durban.gov.za
Past President	Stan Bridgens	011 487 9048	s.bridgens@saiee.org.za
Past President	Ron Coney	083 800 2057	rongconey@gmail.com
Past President	Viv Crone		vivcrone@gmail.com
Past President	Mike Crouch	011 440 7944	michaelc@telkomsa.net
Past President	John Gosling	011 487 3003	gosling@worldonline.co.za
Past President	Rod Harker	021 553 2632	rharker@telkomsa.net
Past President	Dr. Angus Hay	011 585 0490	angus.hay@liquidtelecom.co.za
Past President	André Hoffmann	011 783 9330	andreleohoffmann@gmail.com
Past President	T.C. Madikane	031 536 7300	tc@igoda.co.za
Past President	Ian McKechnie	012 663 4804	ianmac@gafrica.com
Past President	Paul van Niekerk		paulvn@telkomsa.net
Past President	Andries Mthethwa	011 820 5094	andries.mthethwa@actom.co.za
Fellow	Jane-Anne Buisson-Street		buisson@mweb.co.za
Fellow	Max Clarke	011 285 0940	mppc@mweb.co.za
Fellow	Willie Cronje	011 717 7224	willie.cronje@wits.ac.za
Fellow	Prof Jan de Kock	018 299 1970	Jan.Dekock@nwu.ac.za
Fellow	Collin Matlala	011 997 8900	matlalac@global.co.za
Fellow	Prof Johan Meyer	011 559 3845	johanm@uj.ac.za
Fellow	Marius Mostert	011 966 7731	marius@mcorp.co.za
Fellow	Prince Moyo	011 800 4659	prince.moyo@eskom.co.za
Fellow	Prof Jan-Harm Pretorius	011 559 3377	jhcpretorius@uj.ac.za

SAIEE COUNCIL MEMBERS

GRADE	NAME & SURNAME	CONTACT DETAILS	EMAIL ADDRESS
Senior Member	Mike Barker	083 627 7673	mike@mikebarker.co.za
Senior Member	Andreas Beutel	072 267 1650	BeutelAA@eskom.co.za
Senior Member	Refilwe Buthelezi	011 682 0972	rbuthele@randwater.co.za
Senior Member	Max Chauke	082 802 0668	max.chauke@xahumba.co.za
Senior Member	Tshego Cornelius	011 871 3063	corneltg@eskom.co.za
Senior Member	Prudence Madiba	011 800 4212	Prudence.madiba@eskom.co.za
Senior Member	Nishal Mahatho	011 629 5341	mahathN@eskom.co.za
Senior Member	Lehlohonolo Mashego	074 110 9657	mashegol@gmail.com
Senior Member	Zwelendile Mbebe	011 871 2116	mbebez@eskom.co.za
Senior Member	Pascal Motsoasele	083 642 5921	pascal.motsoasele@gmail.com
Senior Member	Amelia Mtshali	011 871 2625	MtshalHA@eskom.co.za
Senior Member	Thandiwe Nkambule	083 560 8381	thandiwe.nkambule@eskom.co.za
Senior Member	Patrick O'Halloran	011 490 7485	pohalloran@citypower.co.za
Senior Member	Kgomotso Setlhapelo	011 871 2228	SetlhaK@eskom.co.za
Senior Member	Dr. Nicholas West	012 656 1266	njwplasma@gmail.com
Member	Clinton Carter-Brown	083 630 0626	clintoncarterbrown@gmail.com
Member	Tom Eichbaum	011 652 2226	thomas.eichbaum@siemens.co
Member	Wayne Fisher	011 679 3481	wayne@bergmanfisher.co.za
Member	Thavenesen Govender	011 629 5738	thavenesen.govender@eskom.co.za
Member	Mluleki Hlatshwayo	073 546 1715	Mhlatshwayo@csir.co.za
Member	Kusakana Kanzumba	078 269 6060	kkusakana@cut.ac.za
Member	James Motladiile	011 629 5172	james.motladiile@eskom.co.za
Member	Fulufhelo Nelwamondo	083 978 1988	fnelwamon@gmail.com
Member	Elekhanyani Ndlovu	083 750 7962	ele.ndlovu@gmail.com
Member	Maanda Ramatumbu	011 800 6356	RamatuM@eskom.co.za
Member	Monde Soni	012 421 4743	sonim@eskom.co.za

Bloemfontein Centre

Chairman | Dr Kanzumba Kusakana

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

Eastern Cape Centre

Chairman | Jacques van der Heide

T|041 404 3326 **E**|vdheidj@eskom.co.za

Gauteng Central Centre

Chairman | Lehlohonolo Mashego

E|mashegol@gmail.com

Kwa-Zulu Natal Centre

Chairman | Zola Ntsahngase

T|(033) 347-0000 **E**| zola@zmlafrica.co.za

Mpumalanga Centre

Chairman | Louis Kok

T|017 619 2607 **E**| louis.kok2@sasol.com

Southern Cape Centre

Chairman | Johann Swanepoel

T| 0448714925 **E**|jgfswanepoel@gmail.com

Vaal Centre

Chairman | Martinus Beumer

T|083 256 7177 **E**|martinus.beumer@proconics.co.za

Western Cape Centre

Chairman | Joyce Mtimkulu

T| 087 820 3555 **E**|joymtimkulu@yahoo.com

Since 2006, we have been involved as consulting electrical engineers across a broad spectrum of projects. These include housing estate reticulation, office buildings, warehousing, shopping centres, automobile dealerships, training facilities, and emergency generating systems, to name a few.

DEDICATED TO DESIGNING YOU A SAFER GREENER ENERGY EFFICIENT FUTURE

With a combined 60 years experience, we have developed a niche in various key projects in the electrical and construction industry. We are dedicated to provide the technical skill and service you deserve.

T 011 679 3481 **F** 086 537 3589 **E** wayne@bergmanfisher.co.za

www.bergmanfisher.com

BERGMAN FISHER ASSOCIATES (BFA)
CONSULTING ELECTRICAL ENGINEERS

OUR SOLUTION

CONSULTING SERVICES
PROGRAMME & PROJECT MANAGEMENT
OPERATIONS CENTRE SERVICES (NOCDESK)
NETWORK INFRASTRUCTURE DEPLOYMENT

MCORP
COMMUNICATIONS

BUSINESS AND PROFESSIONAL COMMUNICATION SERVICES

T | 011 477 5600 | marius@mcorp.co.za | warren@mcorp.co.za | pierre@mcorp.co.za | www.mcorp.co.za