wattnow

SAIEE SUPPORTS ENERGY EFFICIENCY AND THE ENVIRONMENT

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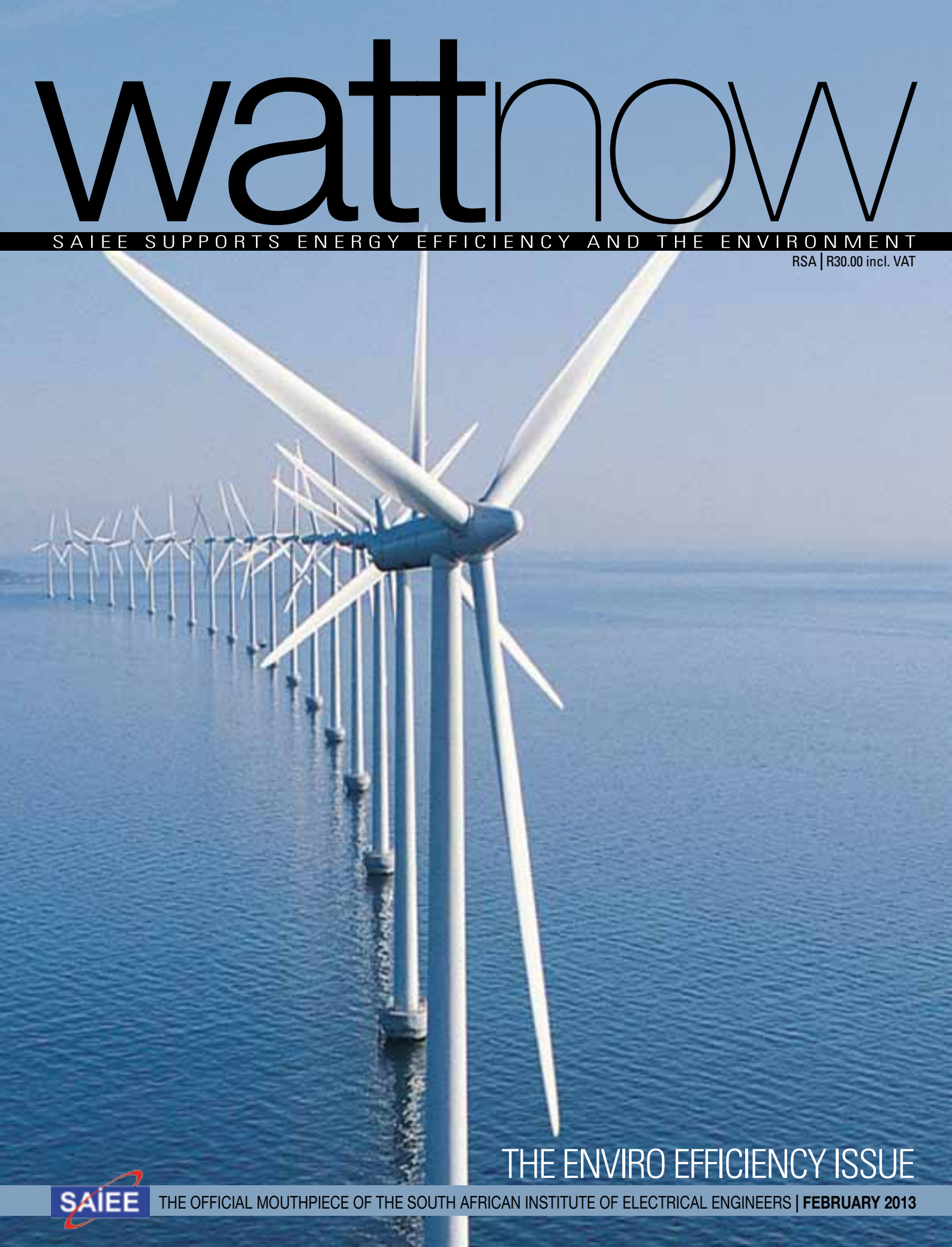

THE ENVIRO EFFICIENCY ISSUE

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

contents

LETTERS

6 Letter from the SAIEE President
- Mr Mike Cary.

REGULARS

8 **watts**hot
We showcase gadgets & gizmo's for everyone!

12 **watts**up
Showcasing social functions & events.

58 Membership
61 Crossword - win R1000!
62 SAIEE Calendar of Events

FEATURE

18 Wind Generator Technology
This article gives an overview of the expected evolutions in the wind market.

ENVIRO EFFICIENCY

32 The answer to effecive irrigation?
Irrigation is a manmade process which applies water to soil to sustain plant growth. Plants, their growth and health, are imperative in the agricultural industry.

36 Rooftop solar PV nears grid parity in SA
Renewable energy will undoubtedly play a key role in South Africa's eventual transition to a sustainable energy economy, with all its citizens having access to a reliable source of electricity.

TECHNOLOGY

38 Increasing concerns for all Engineers in South Africa
In recent years the cost of electricity combined with a greater need for South African companies to compete internationally is placing a lot of pressure on engineers and financial managers.

42 Is Smart Metering smart enough for Africa?
Smart Metering (SM) systems can support various aspects of electricity distribution management and are generally recommended internationally as the way to enhance the services and financial viability of electricity utilities.

OPINION

46 Say Watt?
Do you know how much electricity is costing your household?

HISTORY

48 The Education & Training of Engineers
Excerpt from the transactions Vol 1 - 1913

MEMORIES

50 Reminiscing on an Electrical Engineering career
From the pen of Bill Bergman concludes the 2 part biography.

54 Looking back on Apprentice days... and beyond.
“The time has come” ... Ed Grobler says ... “to talk of many things - of telegrams - teenagers and roller-skates”

wattnow magazine

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With the New Year's eve celebrations a vague memory, we've hit the road running in 2013 - and everyone seems to be getting on with it. So are we all at the SAIEE Head Office. I'm elated in the fact that all my colleagues returned to the office in one piece.

We are gearing up for the Annual General Meeting, which will take place on the 27th of March at the War Museum in Saxonwold, JHB. Contact Gerda on geyerg@saiee.org.za to book your seat.

In this issue of wattnow, we take a look at Energy Generation and Enviro Efficiency, and feature an article on Wind Generator Technology on page 18 and an article on Irrigation - does South Africa have the answer? Read more on page 32.

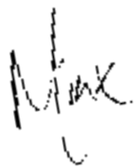
Rapidly increasing concerns for all Engineers in South Africa are the cost of electricity to companies combined with a need to compete internationally. Read more on page 38.

On page 50, Bill Bergman concludes his anecdotal trip down memory lane with us. On page 54, Mr Edwin Grobler looks back on his apprenticeship days and beyond. Both a must read.

On page 57 and 63, I'm giving away two titles to the first entries I receive. Answer the easy question and email your entry to reach me before 28 February. Our winner of the "Oblivion" book is Mr. Graham Fourie of Edgemead, Cape Town. Congratulations! Your book is on its way.
The winner of the November crossword is Mr. Terence Dean of Pretoria. Congratulations.

Herewith another issue filled with lip-smacking content.

Enjoy the read.



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

ELECTRICAL ENGINEERING BURSARIES

Due to SAIEE member's contributions and the prudent investments of erstwhile Office Bearers, we are able to give something back to the Electrical Engineering fraternity in the form of our long-standing SAIEE Bursary programme.

We have a proud record of assisting school leavers and students to become graduate electrical engineers. Over the last 50 years, the SAIEE has spent in the region of R3 million in awarded bursaries to approximately 100 candidates.

Every SAIEE Member should be aware that their contributions have been put to good use in giving back to the electrical engineering fraternity in a significant way to address the skills shortage in South Africa.

The rigorous selection and administration process of the SAIEE ensures that funds are channelled and awarded to worthy candidates because this is high-risk investment with fruitful returns.

OUR 2012 BURSARS OBTAINED THE FOLLOWING RESULTS:

1. Rudolf Byker has obtained outstanding results with 9 distinctions in his first year at the University of Stellenbosch.
2. Pranell Reddy has successfully completed her 3rd year at the University of Natal. She will complete her degree in 2013.
3. Our other first year BSc student needs to repeat 1st year. The existing bursary has been suspended but will be re-instated after successful completion of his first year.

During the last few months of 2012, the Bursary Committee worked through 286 Bursary applications. Unfortunately, more than 50% of the applications were rejected due to incomplete information and lack of supportive documentation not being received. This is a matter of concern and needs to be addressed as this wastes time and also rejects or excludes applicants who may have potential.

The Bursary Committee is considering awarding 10 SAIEE bursaries for 2013. The remaining 33 applications on the short list are available to the industry or any other interested party who would like to sponsor these candidates.

In addition to our current two bursars who will be continuing their studies at Stellenbosch and UKZN, the remaining 8 bursaries will be awarded to students to be enrolled at the following tertiary institutions:-

University of Stellenbosch
Nelson Mandela Metropolitan University
Potchefstroom University
Mangosuthu University of Technology
University of Pretoria

Members are asked to also consider donating an additional amount to their annual subscriptions for 2013 to augment the SAIEE Bursary Fund. These donations have contributed significantly to this designated fund over many years.

2013 sees a year for TEN bursaries offered to students who have applied to study electrical engineering. This is the SAIEE Members' contribution to address the skills shortage in SA - funded from the SAIEE Education and Bursary Fund.

Please contact Dudu Madondo, SAIEE Bursary Secretary at dudum@saiee.org.za or Stan Bridgens on 011 487 3003 to find out more about this exciting initiative for corporate participation in growing the Electrical Engineering industry.

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Greetings to All.

One of the biggest challengers facing our Country today is the development of skills. As technology advances, we require increasing numbers of suitably skilled people to operate and maintain the sophisticated equipment which is in operation today and in the future. We, as the Institute, have to play a part in this development process.

The new year brings new beginnings in all walks of life. Pupils start their school life, students start their tertiary education, and graduates start their new careers. Once one has graduated either at a University or a University of Technology, it is necessary to get the requisite experience in order to register as a Professional Engineer or Technician.

It is difficult for newly qualified engineers and technicians to know what to do in the process of registration, and the use of a mentor makes this so much easier. Our membership currently numbers around 6000, and there exists a vast amount of experience in all spheres of electrical engineering. We have many engineers who are moving towards the end of their formal careers, or that have retired. These engineers are located all over the country, and their knowledge and experience are available to mentor the new generation.

Council is currently investigating how the Institute can best facilitate the mentorship programme, which will be fully compliant with the requirements of the Engineering Council of South Africa. We are currently drawing up a data-base of our members who wish to be included on the mentors' data list. Remember, you do not have to be a pensioner to be a mentor – if you can spare a half day a month, you can make a valuable contribution.

We have already been approached by two large organizations to provide mentors for their engineers, and would welcome enquiries from all the companies in the electrical industry.

In a previous letter, I reported on the project to develop Innes House into a museum for electrical engineering. I am pleased to report that the renovation work commenced in November, and is due to be completed at the end of February. Thereafter, the Historical Section will furnish and equip the museum. Once completed, we will be able to use the museum to encourage school pupils to consider a career in electrical engineering. This will be another contribution to skills development by the Institute.

In conclusion, an early notification of the Institute's Annual General Meeting. Please diarise Wednesday the 27th of March 2013, final details to be announced.

Mike Cary | SAIEE President 2012

WATTSHOT

14 February - Valentine's Day is around the corner and we showcase a few gift ideas for the special one in your life .....

Aqua Phone Case

Place your phone and seal. With this form-fitting waterproof case, you can safeguard your smart phones from the elements!

As well as protecting your handset from water, the Aqua Phone Case also guards against sand, dust and snow. What's more, the case's touch-sensitive skin means that your device is still fully functional when it's sealed away. Plus, you can take super clear underwater video footage as long as you start recording before you dip under the waves and stop recording when you come up for air - perfect for filming your scuba trip in the shallows!

Film underwater

Let's face it, water and smart phones just don't mix, but seeing as around 71% of the earth's surface is made up of H_2O, it's unlikely you're going to be able to keep them apart forever... that's where this 100% waterproof case comes to the rescue! **PRICE** - R350.00.

Car Key DVR Spy Recorder

The Car Key Spy Recorder use a micro-SD card (sold seperately) so you will never miss a scene again. You can use this undercover gadget to record hours of business meetings or interesting events. With the easy one button recording you can easily capture video on a moments notice, anytime anyplace.
This device can also be used as a standard Mini DV recorder for candid shots, but in a highly convenient keychain form factor. In addition, you can easily connect the Car Key Spy Recorder to your computer via USB to use as a USB storage drive.
Retail Price: R995.00

Davidoff Cool Water After Shave 75ml

Launched by the design house of Davidoff in 1988, COOL WATER is a men's fragrance that possesses a blend of lavender, jasmine, oakmoss, musk and sandalwood. It is recommended for daytime wear. Retail Price: R400.00

Armour Watch

The unique armour style watch has no face - instead, concealed LED lights appear within the chinks of the bracelet to reveal the time at the touch of a button. The sleek, high gloss gun-metal finish gives the timepiece the appearance of a stylish bracelet. Simply press the button at the side once to see the time, twice to see the date or 3 times to see the seconds appear in cool blue LEDs!

Features:

- Armour chink bracelet watch
- Press button to see time, date or seconds
- Bright blue LEDs
- 12 or 24hr format
- 1 x CR2016 battery included

Retail Price: R525.00

House of Marley Get Up Stand Up Harvest

Stylish. Powerful. Earth-friendly. Get Up Stand Up delivers breathtaking sound from a truly unique design. Large woofers fill even big spaces with loud, clear, and crisp sound. Get Up Stand Up includes an infrared remote and a built-in compartment behind the top-mounted controls for easy operation from a distance.

Features:

- Dual 4.5" Speakers: Two 4.5-inch woofers, two 1–inch dome tweeters, a speaker output of 25 watts times two and DSP sound processing enhances sound and produces superior bass and treble.
- Marley Sound: Twin 1" tweeters, twin 4.5" high-definition woofers in a ported enclosure and a powerful amplifier deliver amazing output with crisp detail and deep, powerful bass.
- Compatibility: Dock is compatible with iPod™, iPhone™ and iPad™ and works as a charging station.
- Smart Power Supply: International power supply can be connected to power sources from 100-240VAC.
- Aux-In Connector: 3.5mm auxiliary input and integrated RCA input allow flexibility for connecting hundreds of other devices.

Retail Price: R3,499.00

All products featured on pages 8 & 9 is available online at www.mantality.co.za

Wind Up Charger

This wind-up phone charger and torch is the end result of an extensive search for the best mini emergency phone charging gadget that we could find. A twist of the wrist means you'll always be able to charge your mobile in an emergency and there's a handy light whenever you need it to!

There are other emergency chargers and wind-up torches on the market, but we're convinced that this represents the very best combination and balance between size, toughness and functionality.

It's small enough to keep in your glovebox, handbag or manbag, or even a jacket pocket if you're out hiking or camping and it means that you'll never be caught in a sticky situation with a flat mobile phone battery. Adaptors for virtually all modern mobile phones are included, and it can even charge iPods too.

Environmentally friendly and money saving, it's both compact and tough. A solid ergonomic design and powerful internal dynamo make this is an essential gadget for anyone travelling, camping or heading to festivals.

Whenever there's even the slightest risk you could be out of reach of a power socket this mini wind-up charger is the perfect solution.
Retail Price: R250.00

NEW GADGETS ON THE MARKET

WATTSHOT

... gifts especially for her.

LOVE DIAMOND ANNIVERSARY RING

Channel set princess cut diamonds set in 18ct white gold. R9,499

YELLOW GOLD ANNIVERSARY RING

A dose of glam! 9ct yellow gold anniversary ring set with 0.5ct diamonds. Also available in white gold. R9 999

PEAR SHAPED DROP EARRINGS

Indulge in timeless glamour with these alluring pear shaped cubic zirconia drop earrings. (Matching ring & pendant available) R229

AS WOMAN PERFUME

AS Woman is a fresh, sensual blend of peony, magnolia blossoms and pomegranate with notes of citrus, white musk and hints of sandalwood. It comes in 100ml. R399

PENDANT & JEWELLERY BOX

Without a doubt, the gift to give this Valentines Day! A lovely sterling silver and cubic zirconia heart shaped pendant with a matching jewellery box. R499

HEART PENDANT & MINX GIFT SET

Show your heart this Valentine's Day with this circular cubic zirconia heart pendant and Minx watch on a white leather strap. WAS R798 - NOW R599

Alll the featured products on this page is available on www.americanswiss.co.za

WATTSUP

Call for More Dialogue to Advance Africa's Power Infrastructure

Africa is a market of untapped opportunities with demand for electrical transmission and distribution infrastructure and equipment set to increase significantly as the global economy recovers and electricity consumption is expected to grow at a rate of 3.4% per year up until 2020. Currently the biggest exporters of power on the continent include South Africa, Ghana and Zambia.

The newly appointed Chair of the DistribuTECH Africa Advisory Board and recognised leader in the Transmission and Distribution (T&D) industry Dr. Willem de Beer, comments: *"It is widely acknowledged that a reliable and sustainable electricity supply infrastructure is critical to ensure amongst others, economic growth, business sustainability and job creation. Africa presents various business opportunities within the electricity generation, transmission and distribution sector. South Africa, Nigeria, Rwanda and Tanzania are a few examples of countries where significant infrastructure investment will take place over the next few years."*

De Beer adds that *"effective asset and resource management requires a great deal of focus while the introduction of renewable energy options and smart grids presents new and untapped opportunities.*

While the generation sector is receiving significant attention, it is generally acknowledged that there is an urgent need for a well-structured convention to debate and explore opportunities within the T&D sector. A well-managed transmission and distribution business must be financially sustainable. In addition to the focus on assets, infrastructure and resources, it is also critical to effectively manage the customer interface and aspects such as revenue collection."

De Beer urges fellow professionals to share views about the significant opportunities for growth through effective management of 21st century challenges related to electricity supply infrastructure by submitting an abstract for consideration as a speaker at the upcoming DistribuTECH Africa 2013 conference.

The inaugural DistribuTECH Africa 2013 conference and exhibition, to be held from 30 October – 1 November 2013 at Sandton Convention in Johannesburg, South Africa will bring African nations together to share experiences and to explore solutions regarding the potential to be a prime mover in developing smart energy systems from scratch.

For further information on the DistribuTECH Africa 2013 Conference & Exhibition and how to submit your abstract for the conference, visit www.distributechafrica.com

Recipients of Certified Energy Manager (CEM®) and Energy Manager In-Training (EMIT) certificates for the 2011/12 year in South Africa.

Recipients of the Certified Measurement and Verification Professional (CMVP®) certificates for the 2011/12 year in South Africa.

Training recognition ceremony for AEE energy engineers in South Africa

A total of 226 delegates went through the Association of Energy Engineers (AEE) training in 2012 with the AEE's sole training provider for the Southern African region, the Energy Training Foundation (EnTF), the training division of Energy Cybernetics, energy optimisation engineering company.

During the EnTF's AEE Certification recognition evening in November 2012 at Emperors Palace in Gauteng, Prof LJ Grobler, President of the AEE's local chapter the SAEE, welcomed the latest South African professionals to the distinguished group of individuals that are certified internationally. Grobler said, "After an intensive week-long training session and a gruelling 4-hour open book examination you have no doubt earned the respect of your fellow energy engineering professionals that have been through the same processes to attain certification." Not only is a 70% pass mark required for the certification examination, but experiential background within the industry needs to be attained and maintained.

The AEE was the first organization to pioneer energy certification programs and its recognition and credibility has evolved throughout the world to encompass 89 countries that acknowledge its certification programmes. During the last year Australia has joined the long list of countries and started training for AEE Certification. In Southern Africa, the EnTF has made significant inroads already and has trained over 1,700 delegates during the past decade.

First of its kind for South Africa: Gas Desulphurisation Plant sets the precedent for 'environmental friendliness' at Kusile power station

The wet flue gas desulphurisation (WFGD) system being installed at Kusile Power Station by the Cosira Group/Alstom Consortuim, is the first of its kind in South Africa. The WFGD will dramatically reduce the sulphur dioxide (SO_2), content from the power plants flue gases. Sulphur dioxide (SO_2) exists in flue gases as a result of burning fossil flues during power generation and is the foremost contributor towards Acid rain.

"While wet flue gas desulphurisation has been a popular choice for flue gas scrubbing on the international market, South Africa has chosen, until now, to utilise other methods of decreasing sulphur dioxide from gas emission. Although other methodologies exist to reduce (SO_2) from flue gas emissions, advanced proven technology such as Wet flue gas desulphurisation processes are adopted to improve on the limits set by international committees" says John da Silva, Chief Executive Officer of the Cosira Group.

"WFGD has been a popular choice for fossil-fuelled power stations for over 25 years in Europe and the United States. The technology is set to become a standard in developing countries as awareness of its benefits increases. There is no doubt that, the WFGD is the preferred environmentally 'friendly' choice as it removes at minimum 95% of sulphur dioxide gases from the emissions" says Richard De Arruda, Cosira WFGD Project Director.

"We are proud to be a part of the precedent-setting initiative at the Kusile Power Station in terms of reducing greenhouse gases and improving South Africa's carbon footprint. This project clearly mirrors the Cosira Group's own proactive approach towards creating a sustainable environment. We are confident that its success will open the doors for upgrading other industries in addition to power generation in the future," Da Silva concludes.

John da Silva
Chief Executive Officer | Cosira Group

Elquip Solutions: Proud to be associated with environmentally-conscious ABB

Sustainable businesses are based on a number of irrefutable principles. Quality products and services, exemplary customer service, appropriately trained personnel, and a high regard for the health and safety of human life, are all examples of these principles. However, responsible businesses should also consider the impact that their current activities are having on the environment and implement processes to mitigate their carbon footprint.

As a leading local provider of quality capital equipment and consumable products in the electrical, automation and mechanical industries, Elquip Solutions aligns itself with industry leaders, who share the same environmental focus.

"At the end of 2011, Elquip Solutions was appointed as a Third Party Channel for ABB. The partnership is synergistic for a number of reasons, including our customer-centric approach to product distribution. In addition, ABB is a global leader, not only in terms of their products, but also in their energy efficiency solutions," says Mike Cronin MD of Elquip Solutions.

ABB's South African headquarters in Longmeadow, Gauteng are the perfect example of a building designed from the foundations up with environmental consciousness in mind. Careful consideration of energy requirements, rainwater and waste recycling, and 'clean' manufacturing have resulted in a building that, represents an ABB flagship facility. According to Chesney Bradshaw, Head of Sustainability at ABB, "We take a sound approach to sustainability as part of how the company does business taking into account customers, employees and communities. ABB is a world-class performer on the Dow Jones s sustainability index, with 2012 as the fourth consecutive year we have been rated as a world-class performer by the index. The company strives to uphold its sustainability and performance in South Africa."

Mike Cronin
Managing Director | Elquip Solutions.

WATTSUP

The Southern African-German Chamber of Commerce is back on board with the Africa Energy Indaba 2013

The Southern African-German Chamber of Commerce and Industry is pleased to announce its endorsement of The Africa Energy Indaba 2013. The Africa Energy Indaba which is in its 5th year has provided The German Chamber with compelling reasons to continue their association with the event; particularly after the success of The Africa Energy Indaba 2012.

"We feel participation in the Africa Energy Indaba 2013 offers a plethora of valuable information, pulse-point interaction with decision makers and a practical forum to air grievances and debate strategy pertaining to the complex and dynamic Energy Sector" Carryn Todd, HOD, Southern African-German Chamber of Commerce and Industry.

Todd continues, *"Germany was the largest producer of renewable energy within the EU-27 in 2010, with a 19.6 % share of the total; with a Solar power generation world record recently set at 22 gigawatts over 2 days - meeting half of Germany's electricity needs. It is, inarguably, the way of the future, communal knowledge is powerful."*

"The support of Germany demonstrates their commitment to the energy sector in Africa, in finding solutions to the continent's energy challenges. Our aim is to provide ample networking opportunities within the event to showcase German technology and services available to the African market and we encourage interested parties to participate to engage and establish trade relationships with the representatives from German" says Liz Hart, Managing Director of the Africa Energy Indaba.

"The key to joining the wave of momentum is participating from an early stage – SIEMENS South Africa, a member of The German Chamber since 1950, is one of the best examples of an established participation in The African Renewable Energy Sector" says Todd.

Siemens has been actively involved in Africa for over 150 years and employs approximately 3000 people within the African continent. Longevity is crucial in establishing a comfortable foothold in the lucrative Africa Market.

There is no doubt that the energy sector generates a lot of interest – Chancellor Angela Merkel expects renewables to contribute 35% of Germany's electricity by 2020.

The 5th annual Africa Energy Indaba will be the forum for decision-makers and leading role-players developing Africa's energy future and seeking solutions to the challenges facing the continent's energy needs.

Intelligent CXT wire rope hoists increase productivity, safety and service life of cranes

Konecranes frequency converters ASR and ESR: hoisting speeds that adjust automatically according to the current load of the wire rope hoist

When crane drivers have only one or two speeds for lifting and lowering available, the current peaks and numerous changeovers can lead to wear and tear and high energy consumption. Such a situation requires stepless and adjustable hoisting speeds. They provide better operating comfort, increase productivity and the crane's service life even as they reduce energy consumption. There is, however, one problem: conventional frequency converters require an elaborate equipping of the crane leading to high investment costs. To overcome it, Konecranes has developed two converters with ASR (Adaptive Speed Range/Adaptive hoisting speed) and ESR (Extended Speed Range/Extended hoisting speed) that enable advanced solutions for stepless adjustment of the hoisting speed.

Konecranes converter with ESR (Extended Speed Range/ Extended hoisting speed)

Solving South Africa's Energy Crisis: Renewable Energy Projects offer new hope

South Africa's electricity network requires considerable reform over the coming decades if the country is to successfully diversify its generation mix to sources other than coal to meet the increasing demand for power. This view is supported by The Department of Energy's Integrated Resource Plan (IRP) 2010-2030 which anticipates the introduction of 41 346 MW of new generation across various technologies and geographies over the coming 20 years.

In November 2012, 28 renewable energy projects received the impetus they had been waiting for when government signed power purchase, implementation and direct agreements that will enable wind and solar projects identified as preferred bidders under South Africa's Renewable Energy Independent Power Producer Procurement Programme (SA REIPPPP) in December 2011 to move to financial closure. These projects total an installed capacity of 1 415 MW at an approximate investment of R47 billion, with several installations expected to commence commercial operation in 2014.

As a market leader in renewable energy and a trusted advisor for infrastructure engineering, Aurecon is playing a leading role in ensuring the successful realisation of six of these projects, totalling more than 400 MW, in the capacity of Owner's Engineer (OE) and Balance of Plant Design Engineer.

"Aurecon understands the business case for sustainable energy, and we are excited about the role we are playing in shaping South Africa's energy future," comments Blair Walter, Aurecon's Renewable Energy Competency Leader.

Stellenbosch journalism school launches SA's first university-linked app

It is the first time a South African university has launched an app on iTunes – and the bragging rights belong to Stellenbosch University (SU).

SU's Department of Journalism recently launched the SMF2012 app – a digital extension of its well-known final-year magazine, Stellenbosch Media Forum (SMF).

"SMF has been around for over 10 years, but in light of changes in technology and the media, this year's editorial team decided to venture into new territory. We produced an app version of the publication in collaboration with Media24, says" SMF Editor Christa Rohwer.

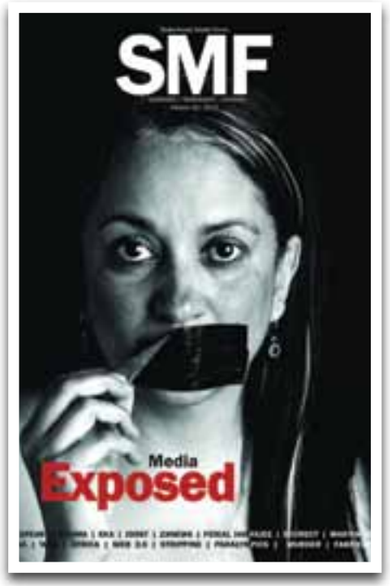
Ryk Benadé, head of digital magazine production at Media24, says the app helps to *"translate the content into another medium."* He and his colleague Luke Edward were responsible for its development of the app.

Dr Gabriël Botma, Head of Journalism at Maties, has welcomed the initiative. *"We are very proud and excited about the app, and congratulate the SMF team and our partners. This project shows that the next generation of journalists is ready and prepared to take on the future of digital publications, which still holds a lot of uncertainty."*

SMF explores trends within the media. This year's theme is "exposed" with all the content covering a wide range of topics – from China and Africa to the Square Kilometre Array, satire and "The Spear" painting.

The latest issue also features profiles of the cover personality, City Press editor Ferial Haffajee, and Noseweek editor Martin Welz.

Journalist Willemien Brümmer, who supervised the production of this year's



SMF in her capacity as the current Rykie van Reenen fellow at the Department of Journalism, considers it *"one of the most sensational editions ever."*

"The magazine is controversial, cuts deep and does what good journalism should do – it scratches where there isn't necessarily an itch," she said.

The SMF2012 app includes all the original content featured in the magazine, plus extra features such as a behind-the-scenes video of the cover shoot, other exclusive videos and numerous photo galleries.

Benadé says the *"digital realm is definitely a massive part of our future"*. Botma agrees.

"If there is one thing the last few decades have shown us, it is that technology makes jumps that no-one can foresee. But what is sure is that journalists and educators will have to stay ahead of the game – and apps are the way to go."

Having notched up South Africa's first university-linked app on a leading platform, it seems that SU's Department of Journalism is leading the pack.

WATTSUP

Zest Weg Group achieves Energy Savings at Mozambique Sugar Mill

Leading electrical equipment supplier Zest WEG Group recently commissioned an installation at a sugar mill in Mozambique that has not only led to robust improvements in centrifuge performance, but has also achieved significant energy savings.

The scope of supply included three 132 kW squirrel cage electric motors from WEG`s W22 range and three WEG AFW11 variable speed drives with an active front end to drive the mill's centrifuges.

The drives supplied are equipped with a regenerative unit that regenerates energy back to the supply under braking conditions and the design of the motors was also customised to avoid any change on the existing installation.

The mill's existing motor also had external cooling and additional 18.5 kW motors were used to draw clean air in from the outside atmosphere for this purpose. The solution provided by Zest WEG Group completely eliminated the need for this external cooling system, saving energy.

In addition to a 30% improvement in productivity, the quality of the sugar from the new centrifuges also improved at the mill. The existing system had taken too long to slow down and the sugar had dried out more, creating a caking effect. With the new system, the mill operating team now has more flexibility and control over the drying times.

"I believe this order was placed with us amid stiff competition based predominantly on our track record of supplying custom designed electrical solutions to sugar operations in remote areas of Africa," Edson Cristofolini, Zest WEG Group product and projects manager, says. *"Our team spent a lot of time researching and engineering a solution that would suit this particular application, working in close consultation with the mill's technical team and drawing from our extensive experience in the African sugar sector. We also tapped into the international knowledge of our holding company, WEG, a leading supplier of electrical solutions to the sugar industry in Brazil and other parts of the world."*

The new blue WEG electric motor installed at a sugar mill has provided energy savings.

The installation, fully customised to integrate with existing technology, was installed and commissioned within a week to ensure minimum downtime on the production process.

Powertech Transformers launches R&D project together with CSIR, DST and University of Pretoria

Powertech Transformers, a subsidiary of Powertech and the JSE listed Altron Group, announced a collaborative research and development project with the Department of Mechanical Engineering at the University of Pretoria, through funding received from the Department of Science and Technology's (DST) Technology Localisation Programme.

Beeuwen Gerryts, Chief Director: Technology Localisation and Advanced Manufacturing stated that the DST's goal for their Technology Localisation Programme is to help increase the competitiveness and capability of local companies by providing increased access to new technologies, skills and innovations – in the form of Technology Assistance Packages (TAPs) - to qualifying South African companies. These companies are then able to increase the level of local components and services provided to South Africa's state-owned companies (SOCs). Ultimately, the aim is to increase the level of local manufacturing capabilities and activities, and thereby reducing the reliance on imports, resulting in increased skills development and sustainable work opportunities.

Powertech Transformers (PTT) is one of the companies who qualified to benefit from this programme. Their first major R&D project with TLIU assistance relates to the short-circuit withstand ability of transformers.

Bernard Meyer, CEO Powertech Transformers says, *"for PTT to prosper and grow it must do more than keep up with its competitors. Getting ahead means innovation which hinges on R&D. The collaborative R&D opportunities through the CSIR, DST and University of Pretoria provide us with a sound platform to excel and at the same time boost local transformer engineering design and manufacturing capabilities."*

Powertech Transformers manufactures power and distribution transformers for Sub Saharan Africa at its operations in Pretoria West, Cape Town and Johannesburg.

This article gives an overview of the expected evolutions in the wind market. The initial boom in the global onshore wind market lies behind us, with a growth rate of 31% between 2005 and 2010. That said, the market is expected to continue its growth in the subsequent three years, with a projected growth rate of 12%. The strongest growth for onshore wind power is predicted for countries outside of Europe.

BY I FERNANDO NUÑO, BRUNO DE WACHTER
ECLAREON

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The size of the turbines will continue to grow steadily, with 95% of all new wind turbines having a power of 1.5 MW or more in the following three years. The market of the offshore wind power tells a different story. The boom in this market in the forthcoming years will be less significant than originally expected, with growth rates that have recently been adjusted downward from 49% to 37%. This market will continue to be largely dominated by Europe. After 2015, the growth is predicted to moderate significantly to a figure around 10%. The average size of new offshore wind turbines has been following an upward trend in recent years and has surpassed 3.5 MW. Turbines of above 5 MW have already been installed.

This article is dedicated to an analysis of the overall trends in wind turbine technology and the related market projections. A key-influencing factor is the increasingly stringent grid code requirements imposed by the Transmission System Operators (TSO). Those requirements follow the rapidly growing penetration of renewables connected to the public grid and the related concerns of the TSOs regarding the management of this type of energy. This factor speaks in favour of the Permanent Magnet Synchronous Generator (PMSG), whose power output is controllable and through which even the most stringent grid codes can be met. This is in contrast to the Doubly-Fed Asynchronous Generator (DFAG), which may need external reactive power compensation. Despite this fact, DFAGs continue to dominate the market and give up market share in favour of the PMSG only at a relatively slow speed. The growth of PMSG is mainly hampered by the fact that the price of permanent magnets remains high and its production volumes are therefore lower than those of the DFAG.

The choice of a particular wind turbine technology has to be studied on a case-by-case basis. For instance, locations with high wind speeds and significant turbulence speak in favour of the PMSG, since their full-scale power converter can offer greater availability and thus a greater energy yield in such conditions. In general, the main driver for the technology choice for onshore applications will be the cost of

Wind Generator Technology

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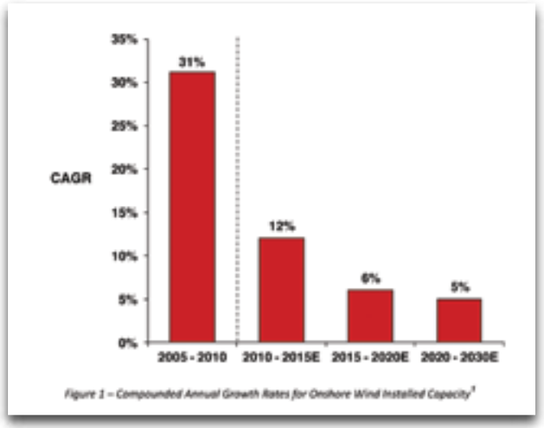

Figure 1 – Compounded Annual Growth Rates for Onshore Wind Installed Capacity[3]

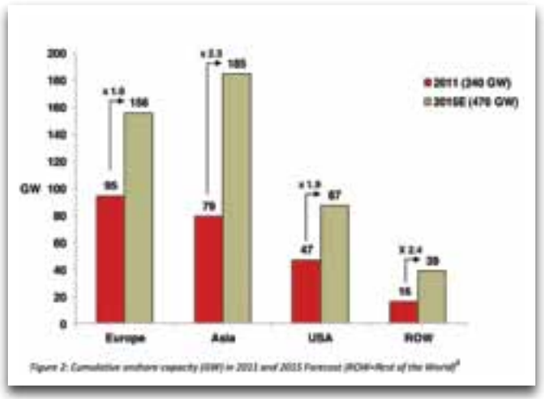

Figure 2: Cumulative onshore capacity (GW) in 2011 and 2015 Forecast (ROW=Rest of the World)[3]

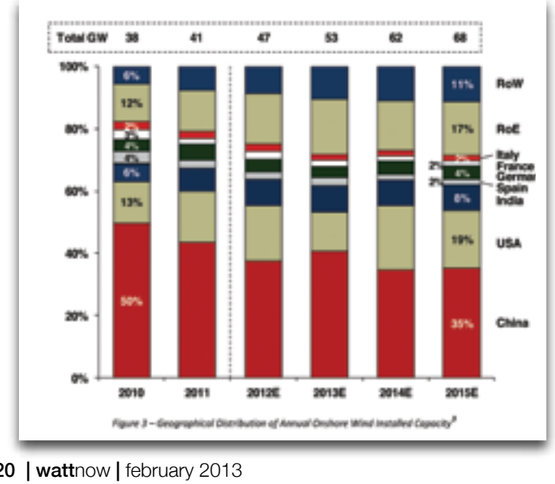

Figure 3 – Geographical Distribution of Annual Onshore Wind Installed Capacity[3]

energy that can be achieved. Wear is more significant, and the cost of maintenance and repair is much higher, for offshore applications. This explains why reliability is usually the principal factor in selecting a given technology for offshore projects, and the reputation of the wind turbine manufacturer will be fundamental.

A new type of wind turbine technology currently under development is the High Temperature Super- Conductor (HTSG) turbine. This type of turbine is not expected to reach the market before 2016. It will enable the attainment of higher power than with any other type and will be particularly well suited for the niche market of very large offshore wind turbines.

EXPECTED EVOLUTION OF THE ONSHORE WIND MARKET

The size of the market for Wind Turbine Generators (WTGs) is determined by the capacity of new wind power installations[1]. Annual installations of wind power worldwide have consistently increased over the past several decades. It is estimated that the onshore market will continue to grow by more than 10% per year until 2015. From 2015 onwards though, it is expected that market growth will moderate significantly.

Figure 1 shows the estimated evolution of CAGR (Compounded Annual Growth Rate) for the two five-year periods from 2010 to 2020 and the subsequent ten-year period running up to 2030.

As depicted in Figure 1, annual onshore wind power installations are forecast to slow down, growing at a rate of ~5% on the longer term.

In 2011 the cumulative global onshore wind energy market reached a total of 240 GW, with just over 40 GW of that total being newly installed capacity.

It is expected that worldwide cumulative onshore installed capacity will almost double from 2011 to 2015, as illustrated in Figure 2.

In absolute terms, Asia is the region expected to exhibit the most growth, ousting Europe from its leading role. High economic growth in India and China, and the subsequent increase in electricity demand will be the main market drivers.

As for Europe and the USA, the strongest market driver in the past has been governmental regulation. Currently, however, there are some uncertainties about the future of public support.

When we examine the geographical distribution of installed capacity by individual country, we see that European countries trail China, USA, and India in annual onshore wind energy installations. China and the USA account for a combined ~60% of annual global installations. This figure that will remain more or less unchanged in the forecast period.

As Figure 3 illustrates, it is expected that the global onshore wind energy market will be less concentrated in the near future.

On the one hand, China's share of the market will decrease substantially to a more economically sustainable rate of growth. In addition, the contribution of some of the leading European markets will also decrease in the forecast period due in part to financing constraints. In this sense, the Spanish case stands out given its recent suspension of support schemes for renewable energy. This has had an immediate impact on the market.[2]

On the other hand, the onshore wind market will grow in emerging economies such as Brazil and Mexico in Latin America and Romania and Bulgaria in Europe. The increased demand in these markets will more than offset the diminishing demand in developed countries.

After 2015, the onshore wind market will continue to be driven by high economic growth in Asia. It is expected that China and India will account for nearly 42% of cumulative demand over the 2015-2020 period.

Wind power's market expansion will slow down in the mid- and long-term. While not experiencing outstanding growth, it will still exhibit attractive annual growth rates. As wind power capacity continues to increase, the availability of the most desirable locations will drop. But, at the same time, WTGs will become more efficient. This may result in the repowering of older wind farms with new, more efficient WTGs. Some countries will eventually find that wind power electricity will be cheaper than other sources of energy.

EXPECTED EVOLUTION OF ONSHORE WIND TURBINE CAPACITY

The WTG market is shifting toward larger WTGs: those over 1.5 MW nameplate capacity presently dominate the market and it is expected that the share of WTGs over 2.5 MW will increase steadily, though at a very slow pace.

In contrast with the Asian market where smaller turbines are the norm,

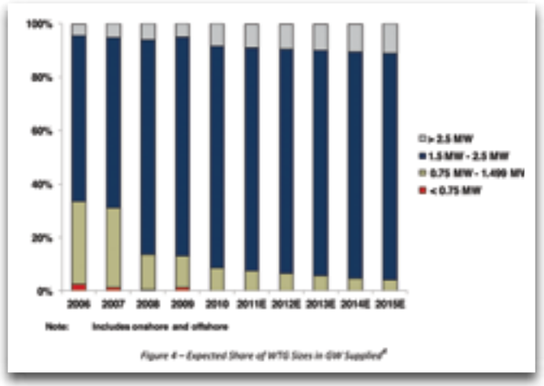

Figure 4 – Expected Share of WTG Sizes in GW Supplied[4]

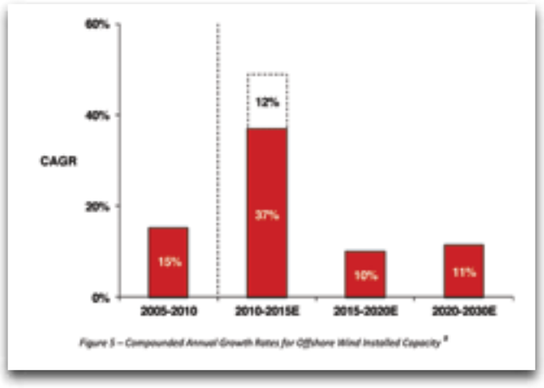

Figure 5 – Compounded Annual Growth Rates for Offshore Wind Installed Capacity [3]

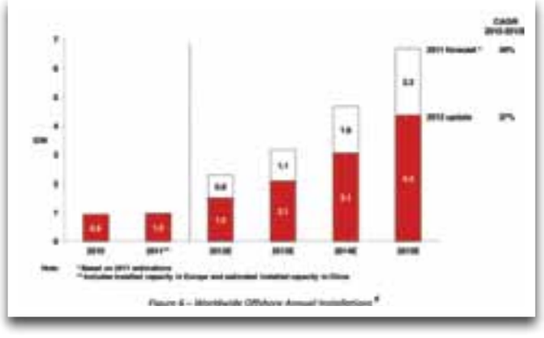

Figure 6 – Worldwide Offshore Annual Installations [3]

Wind Generator Technology

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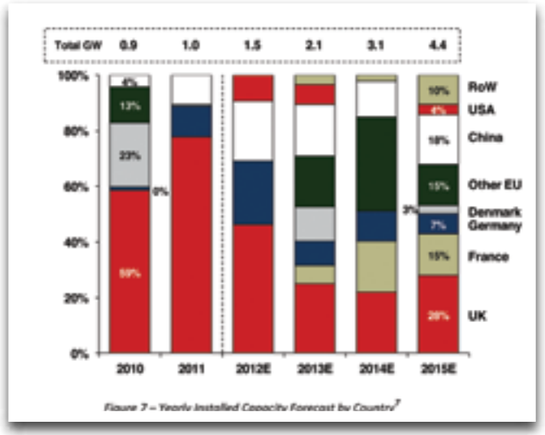

Figure 7 – Yearly Installed Capacity Forecast by Country[7]

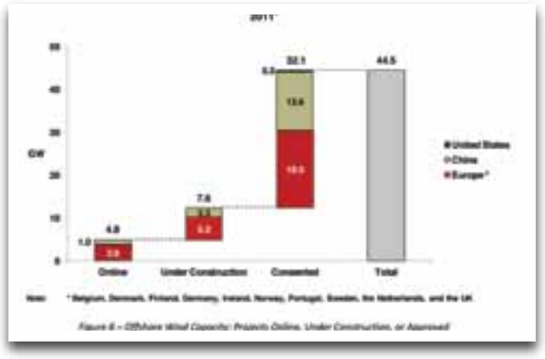

Figure 8 – Offshore Wind Capacity: Projects Online, Under Construction, or Approved

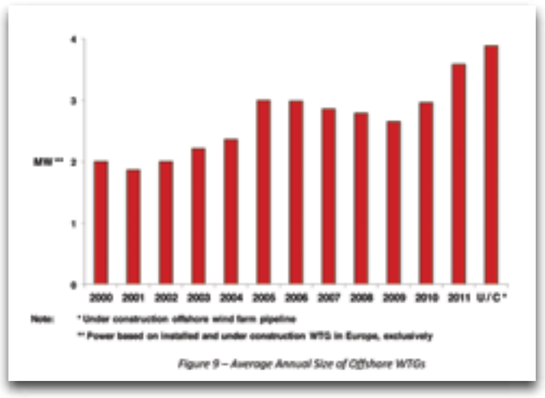

Figure 9 – Average Annual Size of Offshore WTGs

2-3 MW models are popular in Europe[3]. Many of the larger WTG models, which were initially designed for offshore wind farms, are being installed onshore.[4]

Logistics is an important factor, which could limit further growth of turbine size. Many locations which are not easily accessible, are not feasible target markets for larger size WTGs.

Note that larger WTGs (in terms or power and rotor diameter) could compensate for the increasing lack of locations with higher wind speeds and be employed for repowering older sites.

WTG manufacturers have begun to launch next generation WGTs, larger machines which are now being commercialized. Enercon offers a WTG with a 7.5 MW nameplate capacity, the world's largest commercially available onshore WTG.[5]

According to industry experts, even 20 MW WTGs will eventually be developed. What cannot be predicted is whether larger WTGs will reach mass production, because 'it is simply a question of cost of energy,' asserts Henning Kruse, director of governmental affairs at Siemens Wind. The size of the WTGs will be determined by the cost per MWh produced.

EXPECTED EVOLUTION OF THE OFFSHORE WIND MARKET

Currently, the global wind energy market is almost entirely focused on onshore installations. However, it is estimated that the global offshore market will more than triple between 2010 and 2015, experiencing annual growth rates of over 30% and adding up to nearly 10% of total worldwide demand by 2015.

From 2015 to 2020, it is expected that growth will moderate significantly with a compounded annual growth rate of 10%, as indicated in Figure 5.

For the near-term, it has been estimated that the offshore wind market would experience annual growth rates approaching 50% until 2015. However, the most recent figures show that this might have been too optimistic. Given the current market outlook, annual growth rate until 2015 is estimated at no more than 40%.

In 2011, global offshore wind demand amounted to just under 1 GW, a similar level to that reached in the previous year. In 2012 it is expected that the market will reach at least 1.5 GW.[6]

European markets will mostly drive the offshore wind market development in the forecast period. It is also expected that China's share in overall demand will increase considerably from 4% in 2010 to 18% in 2015. Both China and South Korea are regarded as emerging markets.

Figure 7 indicates that in the short-term, the offshore sector will be mainly driven by the UK. This is because the great majority of projects in the pipeline over the next couple of years belong to this market. Currently, the UK represents over half of the worldwide installed offshore capacity with more than 2 GW installed. The UK also accommodates the largest offshore wind farm, a 300 MW project. Germany and France follow the UK in offshore installed capacity potential, and it is estimated that other European countries such as Sweden and the Netherlands will gain significant weight in 2013-2014.

There are nearly 1,400 turbines installed and connected to the grid in Europe, the total sum of which is just over 3.8 GW of cumulative offshore wind capacity. Moreover, there are around 20 projects either under construction or whose preliminary work has been initiated. When all projects under construction or already approved are completed and connected to the grid, the offshore wind installed capacity could total more than 20 GW. China's offshore wind potential is estimated at more than 750 GW[7]. Prior to 2010, it had only installed research and pilot offshore projects. Its first operational offshore WPP was installed in June 2010 and amounted to 102 MW (34 x 3 MW Sinovel WTGs). A public tender for a 1 GW offshore project was announced in October 2010.

The US trails Europe and China in this respect. As indicated in Figure 8, there are currently neither offshore WPPs online nor under construction. Projects with approved permits amount to 500 MW of overall capacity.

However, there are still some obstacles to the development of offshore wind, which need to be solved in order for the market to take off. Among them, are the needs to upgrade grid connections and build new transmission lines, as well as resolve financial and administrative bottlenecks.

EXPECTED EVOLUTION OF OFFSHORE WIND TURBINE CAPACITY

The average size of offshore WTGs has been following an upward trend. The average nameplate capacity has increased from 2 MW in 2000 to more than 3.5 MW in 2011. The first WTGs with a rated capacity above 5 MW have been installed.

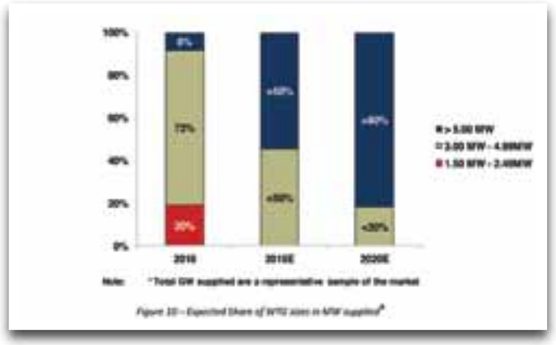

Figure 10 – Expected Share of WTG sizes in MW supplied[8]

Figure 11 – Nacelle, Drivetrain, and Other Components[10]

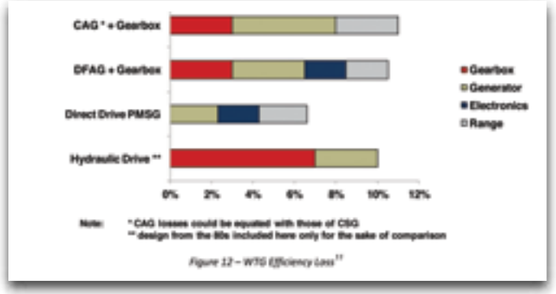

Figure 12 – WTG Efficiency Loss[11]

Figure 13 – Drivetrain Types and Components[12]

Wind Generator Technology

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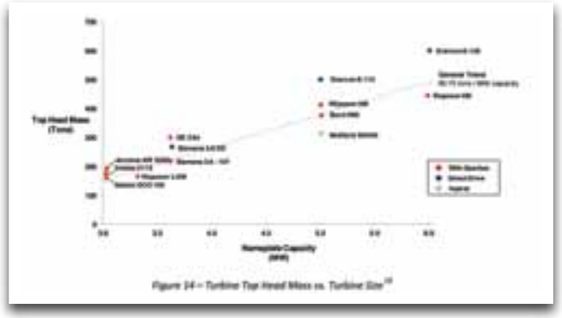

Figure 14 – Turbine Top Head Mass vs. Turbine Size[10]

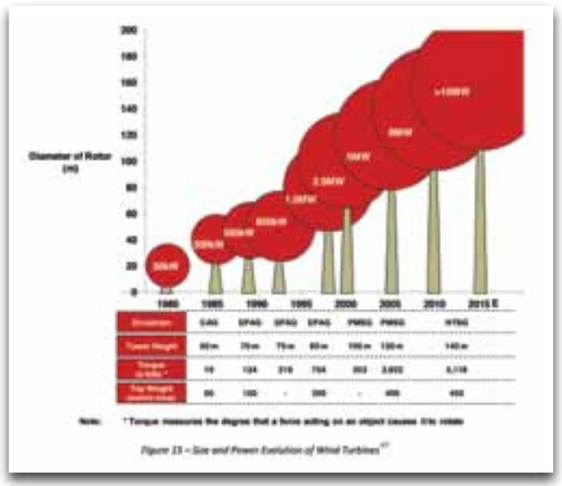

Figure 13 – Size and Power Evolution of Wind Turbines[47]

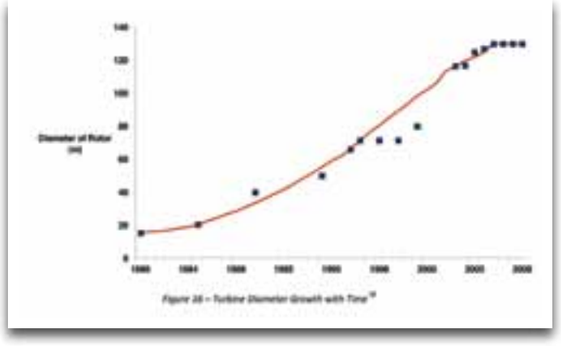

Figure 16 – Turbine Diameter Growth with Time[19]

Although 5 MW WTGs are being mass-produced, 3.6 MW[8] WTGs will continue to dominate the offshore market. Bigger turbines in the range of 5-6 MW that can offer a lower cost of energy because of their lower infrastructure cost, will also be used in offshore WPPs currently under construction. Consequently, the average size of offshore WTGs will soon approach 4 MW.

Market experts claim that the offshore market for very large WTGs is still immature. 'WTGs over 5 MW are not yet bankable. They are now being tested onshore to prove their feasibility. The offshore market will grow significantly five years from now,' asserts the Head of Innovation of a renowned WTG manufacturer.

Some manufacturers, instead of launching larger capacity models, have lengthened the rotor diameter of their existing WTG models[9] in order to achieve a higher number of annual full-load hours.

However, average offshore WTG size will continue its slow rising trend. By 2015 it is expected that WTGs over 5 MW will have more than half of the overall offshore market. By 2020, a majority of all grid connected WTGs could have a nameplate capacity higher than 5 MW.

Manufacturers from both inside and outside Europe have expressed an increased interest in launching offshore-dedicated WTG models. Over 50 new models were announced worldwide in the two-year span between 2010 and 2011.

The trend towards larger turbines is apparent: the great majority of the new offshore WTG models (~70%) are larger than 5 MW. Almost half of these announcements are being made by WTG manufacturers based in Europe, followed by companies in China, USA, South Korea, and Japan.

COMPARATIVE WIND GENERATOR ANALYSIS TECHNICAL ANALYSIS

This section provides a detailed description of WTG technologies[11]:

- First, a description of drivetrain types and their evolution over the years is presented. This is essential in order to identify the relative advantages and disadvantages of each technology and future market trends.
- Second, a definition of the different WTG technologies from an electrical standpoint is provided. Given that every country has a binding grid code, those technologies, which do not comply with minimum standards, will most likely not be able to develop in the future. The higher the RES penetration, the more stringent is the grid code. Thus, an analysis of WTG characteristics is critical in order to project the future evolution of each technology.

INTRODUCTION TO DRIVETRAIN TECHNOLOGY

Drivetrain gearboxes within a WTG increase the rotational speed of the shaft, which feeds into the generator. WTGs, which use direct drive generators, produce electricity at lower revolutions per minute (rpm).

Input from the blades ranges between 15 and 25 rpm. Rpm after the gearbox range between 1,200 and 1,800. The rotor shaft requires such speeds.

Figure 11 shows the components of a WTG with conventional drivetrain (with gearbox). Other drivetrain types include direct drive (gearless) and hybrid (usually with a single-stage or 2-stage gearbox).

Synchronous generators (CSG, PMSG, and HTSG) are compatible with all three drivetrain types.

Fixed-speed CSGs were originally commercialized with a gearbox since this option was generally more economical than direct drive CSGs.

In addition, the concept of a direct drive CSG with a full-scale power electronic converter has been developed and commercialized mainly by Enercon[12]. Full converter CSGs are similar to PMSGs but do not require the use of permanent magnets.

PMSG systems are commercialized without a gearbox, or with a single-stage or 2-stage gearbox. Some manufacturers such as Clipper, Multibrid, and Siemens produce hybrid WTGs.

CAG and DFAG always rely on a multi-stage gearbox for their asynchronous generators. The choice between drivetrain technologies is relevant because, among other factors, it defines the extent of efficiency losses.

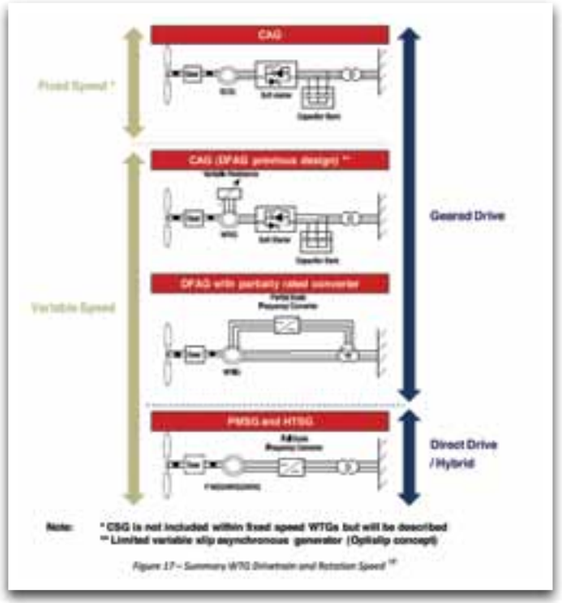

Figure 17 – Summary WTG Drivetrain and Rotation Speed[18]

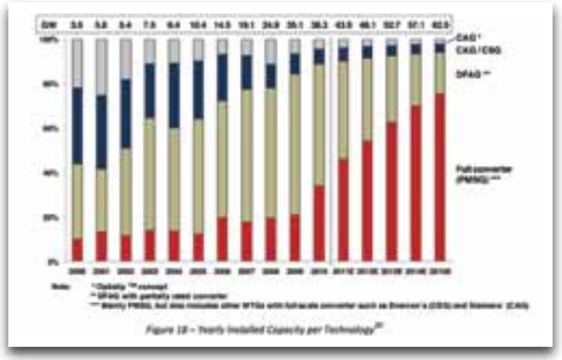

Figure 18 – Yearly Installed Capacity per Technology[20]

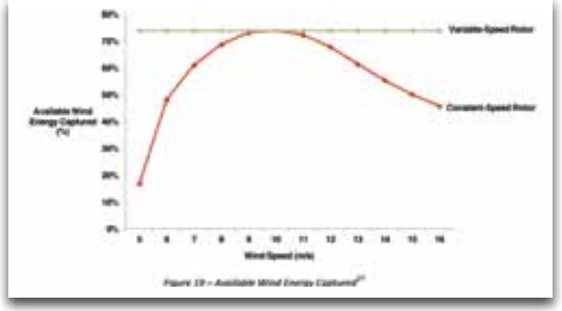

Figure 19 – Available Wind Energy Captured[47]

Wind Generator Technology

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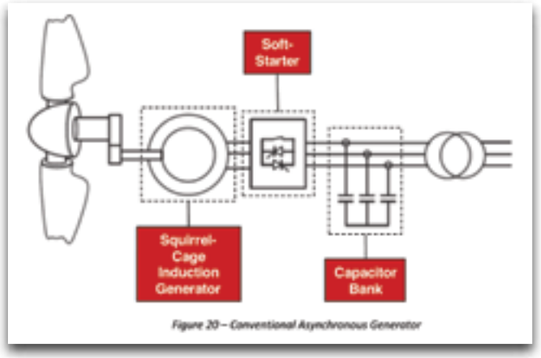

Figure 20 – Conventional Asynchronous Generator

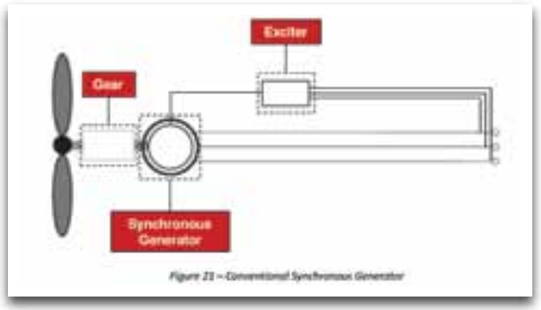

Figure 21 – Conventional Synchronous Generator

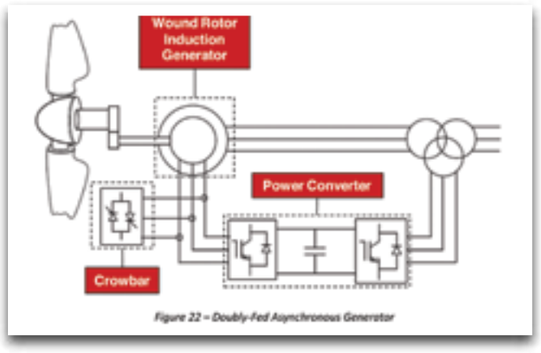

Figure 22 – Doubly-Fed Asynchronous Generator

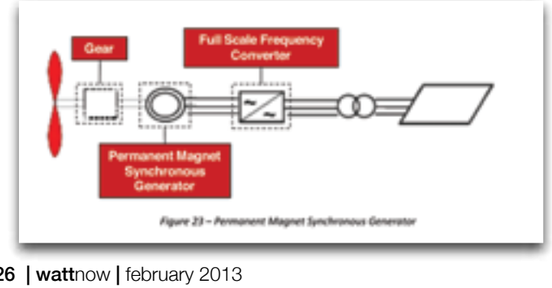

Figure 23 – Permanent Magnet Synchronous Generator

Figure 12 illustrates that gearbox losses represent a considerable portion (3%) to efficiency losses. The fact that direct drive technologies are exempt from gearbox losses is a significant advantage of these machines over conventional WTGs.

DIRECT DRIVE (GEARLESS)

Direct drive WTGs are synchronous generators that usually employ either PMSG or wound rotor technology. Also known as low-speed generators, this machines use a large diameter rotor to compensate for the lack of a gearbox. Enercon is the largest manufacturer of this type of turbine.

Direct drive machines with respect to conventional ones have the following advantages:

- The machine is full converter, making it more compliant with grid codes since it can easily withstand voltage sags and can control active and reactive power, as well as frequency;
- Lower level of harmonics and flicker;
- No need to incur in costs related to the gear such as maintenance, repair, or waste oil treatment;
- Lower maintenance costs are a significant competitive advantage13 particularly for offshore WPPs.

Furthermore, the mechanical system of a direct drive WTG is simple and its efficiency is higher than that of a conventional system since it eliminates mechanical losses.

Gearbox mechanical losses are estimated at an average of 5% for conventional WTGs. Direct drive machines with respect to conventional ones have the following disadvantages:

- A direct drive WTG generally weighs more than its conventional counterpart; It also has larger dimensions, making transportation more expensive;
- Its weight is more poorly distributed, since it is split between the rotor winding and multiple poles. This can generate mechanical stress;
- Although WTG manufacturers such as Enercon and MTorres have always developed direct drive machines, in general, the technology is not particularly mature[14].

CONVENTIONAL DRIVETRAIN (WITH GEARBOX)

As previously explained, the rationale behind WTGs with gearbox is to adapt the rotation speed of the blades to the speed of the rotor in the generator. Usually, this design comes hand in hand with asynchronous generators[15] and is currently the model most widely used.

Conventional machines with respect to direct drive ones have the following advantages:

- It is a very mature technology;
- The nacelle is more compact and lightweight and weight distribution is better. Easier transportation can be a decisive factor in some areas with limited access.

Conventional machines with respect to direct drive ones have the following disadvantages:

- Conventional drivetrain configurations have a higher number of mechanical components;
- These lead to higher mechanical losses. For powers above 1 MW, failures in high-speed mechanical components (especially the gearbox) could prove problematic;
- In some cases, WTGs may need reactive power compensation devices;
- Higher (and regular) maintenance costs;
- Higher level of harmonics and flicker.

HYBRID DRIVETRAIN

In the search for a solution that lies between conventional and direct drive drivetrain, the following characteristics are sought:

- Compact drivetrain;
- Simple, reliable gearbox with less stages than conventional ones;
- Lighter nacelle than that of direct drive WTG, which means cheaper foundation costs Hybrid turbines can be combined with PMSG and can have a gearbox with less than three stages and a generator with two or four poles.

Clipper, for example, introduced a PMSG with a single-stage gearbox. They are currently working on a 10 MW machine for the Brittannia Project, an offshore project currently under development. It is expected that larger offshore turbines will enable lower operating and maintenance costs, as well as lower installation and foundation costs per electric power generating unit.

There are industry experts who maintain that Siemens WTGs are hybrids because the number of stages in the gearbox has been considerably reduced, to decrease the number of components and, consequently, reduce maintenance costs too.

Hybrid machines have the following advantages with respect to direct drive and conventional ones:

- Combined advantages of both conventional and direct drive;
- Simpler logistics.

Hybrid machines with respect to direct drive or conventional ones have the following disadvantages:

- Technology is still immature
- Currently more expensive

Figure 13 illustrates that the lower the number of stages in the gearbox, the lower the rotor speeds. Fewer high-speed resistant materials are needed for lower speeds and there are lower maintenance costs.

Figure 14 shows the relation between turbine size and nacelle weight. The general trend displays a relation of 60 to 75 tons per MW.

However, relevant differences between drivetrain technologies exist, which are highlighted as follows:

- High-power direct drive machines are generally heavier than conventional ones;
- Hybrid turbines optimize weight.

WIND TURBINE EVOLUTION

CONTROL AND DRIVETRAIN

Although wind technology is evolving towards direct drive, major WTG manufacturers have chosen not to do away with gearboxes entirely. For example, Vestas decided to keep the geared drive system in their new 7 MW turbine for the following reasons:

- Direct drive is not fully proven while geared ones are a proven technology;
- Geared drive WTGs offer a lower cost of energy in many locations.

Siemens on the other hand, recently decided to launch a new 2.3 MW hybrid turbine. They justified the choice of a hybrid drive by stating that it would enable high efficiency and reduced maintenance costs.

WTG SIZE EVOLUTION

Figure 15 illustrates the extent to which turbine size (in terms of rated power and hub height[17]) has increased over time and is expected to continue to increase until 2015. As the table beneath the graph shows, permanent magnet technologies allow for a considerable power increase with a relatively lower increase in rotor diameter.

In order to get more power, the area swept by the turbine blades must be greater. However, the length of the blade is limited by the following variables:

- Blades have upper limits to the wind speed they can handle; if the wind speed is too high, they can disintegrate due to the excess kinetic energy at the tip of the blade.
- For mono-block wind turbines, blade length is limited by transportation requirements

Wind Generator Technology

continues from page 27

As Figure 16 shows, blade length has stagnated around 130 metres since 2005.

DESCRIPTION OF WTG TECHNOLOGIES

Basic configurations of WTG technologies, which are schematically segmented in Figure 17, are explained in detail.

We will first explain fixed speed wind technologies, including Conventional Asynchronous Generators (CAGs) and Conventional Synchronous Generators (CSGs). Following that, we will describe variable speed wind technologies, including the Double-Feed Asynchronous Generator (DFAG), the Permanent Magnet Synchronous Generator (PMSG), and High Temperature Synchronous Generator (HTSG).

Constant wind speed regime generators CAG and CSG are currently obsolete technologies for powers over 100 kW. Our main focus will therefore be on analysing DFAG, PMSG, and HTSG and their different types of PMSG and HTSG drivetrain.

Other types of WTGs are sometimes mentioned. These include the limited variable speed concept with a multi-stage gearbox (OptiSlip™ is a registered trademark of Vestas Wind Systems A/S) and are not included in our classification since we only intend to provide an indicative orientation of WTG technologies.

There is more power capacity installed employing DFAG than of any other technology. It was in fact the DFAG technology that facilitated wind sector expansion. The world's largest manufacturers are, in order of installed capacity, Vestas (Denmark), Sinovel (China), GE Wind (US), Goldwind (China), and Enercon (Germany).

Figure 18 shows the evolution of newly installed capacity by WTG technology up to 2010 and the capacity that is expected to be installed annually per technology from 2011 to 2015. It is worth highlighting the expected increase of PMSG installations at the expense of DFAG.

HTSG machines are not expected to be installed before 2015. Grid codes will have to become more stringent and mandatory in order to further increase wind power capacity in countries that already have a high RES penetration. This speaks in favour of WTGs with a full converter (PMSG). Because of the current financial crisis however, the expected growth of PMSG in the near future as shown in Figure 18 could be over-estimated. The crisis could hamper the development of new designs and force WTG manufacturers to opt for proven models with a low investment cost.

In the longer term, however, the evolution towards full converter WTGs will continue, since this is the only technology that enables a smooth integration of WTGs into a grid system with a high penetration of renewables.

CONSTANT-SPEED WIND TURBINES

In contrast with the design of variable-speed wind turbines, the design of constant-speed turbines limits the rotor power that can be captured from the wind. In constant (or fixed) speed wind turbines, the angular velocity of the generator is constant and determined by grid frequency, regardless of wind speed.

To achieve the maximum potential energy yield, rotor speed must reflect wind speed. Wind turbines with a constant rotor speed only achieve this maximum power efficiency at one particular wind speed, namely the one for which it was designed.

Wind speed variations generate flicker on the grid. In order to avoid generating electrical fluctuations and optimize the energy yield, the blade position is adapted with increasing speed (they are turned to the side). Apart from that, wind speed peaks are also absorbed by the mechanical parts, causing mechanical stress. [18]

There are two types of technologies that work in this way:

- Conventional Asynchronous/Induction Generator (CAG/CIG), also known as Squirrel-Cage Induction Generator;
- Conventional Synchronous Generator (CSG), also known as Wound-Rotor Synchronous Generator.

These turbines are currently being used for small WPPs. In contrast, variable-speed wind turbines can achieve optimum rotor power at every wind speed. Figure 19 demonstrates that constant-speed rotors can extract the maximum percentage of available wind power only at a specific wind speed. In contrast, variable-speed rotors can capture the optimum percentage of available wind energy at every wind speed.

CAG (CONVENTIONAL ASYNCHRONOUS GENERATOR)

The CAG was the most widely used constant-speed technology until it evolved into the DFAG.

With respect to other turbine technologies, CAGs have the following advantages:

- Relatively simple design and construction;
- Lower manufacturing and maintenance costs.

On the other hand, CAGs have the following disadvantages:

- Low efficiency
- Consumes reactive power during operation. Capacitor banks should be installed to avoid penalization by the grid operator.
- Consumes a significant amount of reactive power during start. A soft-start is required to compensate for this.
- Wind regime variations cause electrical disturbances (usually flicker) in the network.
- Current WTGs do not meet the grid codes established by Power System Operators (PSOs)[19] in many countries. Installation is allowed if – and only if – additional devices such as FACTS are added, making the Wind Power Plant less economically viable.

Figure 20 illustrates the standard topology of a CAG, with a capacitor bank in parallel for reactive power compensation and a soft-starter to achieve a smoother connection to the electricity grid.

CSG (CONVENTIONAL SYNCHRONOUS GENERATOR)

CSGs are directly connected to the grid and the angular speed is fixed by grid frequency.

CSGs have the following advantages with respect to other turbine technologies:

- Reactive power consumption can be controlled to a certain extent;
- Depending on the design and the number of poles, direct coupling between the hub and the generator shaft could be achieved, thereby eliminating the gearbox.

However, CSGs have the following disadvantages:

- Small wind speed variations generate transients;
- Quality of generated power can be very poor;
- WTG components experience mechanical stress;
- These turbines do not meet the grid codes established by PSOs in many countries;
- The exciter is fed through slip rings. These must be replaced from time to time, increasing maintenance costs.

The stator winding is directly connected to the grid and the rotation speed is set by grid frequency. In the rotor, the poles are fed with direct current, which is varied to match grid frequency.

As with the case for CAG, technical data have been extrapolated from a small wind turbine data to reflect that of 3MW turbine, a turbine size which doesn't currently exist for this technology.

VARIABLE-SPEED WIND TURBINES

This technology was developed jointly with power electronics, which enables blade rotation frequency and grid frequency to be different at all times.

Add to this the fact that it allows turbines to operate at peak rotor power at every wind speed (proper tip speed ratio), thus maximizing rotor efficiency.[22]
Flicker problems caused by wind speed variations can be minimized with this technology.

DFAG (DOUBLY-FED ASYNCHRONOUS GENERATOR)

Unlike in the CAG system, the DFAG rotor winding is not shorted. The rotor is electrically accessible and, apart from being used to magnetize the poles, it may also be used to extract power and to control the rotation speed.

A DFAG is connected to the grid through a bidirectional electronic power converter, converting between 30% and 40% of rated power. This results in economic savings.

However, the DFAG system has some disadvantages; principally, its configuration always includes a gearbox in the drivetrain and a slip ring, both of which require constant maintenance.

A crowbar is used for protection.

PMSG (PERMANENT MAGNET SYNCHRONOUS GENERATOR)

In PMSG, the generator rotor is not connected with the grid. The rotor contains powerful magnets that generate the electromagnetic field without an electric current.

This technology requires that all the generated power pass through a full converter before it is transmitted to the grid.

Using a full converter has the following advantages associated to power electronics:

- The WTG can operate in wide wind ranges, since the rotation speed of the blades is decoupled from grid frequency;
- No reactive power is consumed to start or excite the rotor;
- It complies with grid code requirements;
- It can operate both as direct drive and as geared drive;

Wind Generator Technology

continues from page 29

- It can operate as reactive power compensator even when the blades are still. This is highly valued by PSOs as it contributes to a stabilization of the electrical system;
- The use of slip rings – and related maintenance costs – is avoided

These attributes are increasingly becoming an obligation for new WPPs as wind energy penetration increases and TSOs[25] face greater challenges integrating renewable energy while maintaining security of supply. The ability to control the quality of generated power is even deducted from the electricity tariffs.

- Permanent magnet prices are going down and the technology is becoming more efficient. A PMSG can be smaller and lighter compared to a DFAG of equal power.
- WTG manufacturers such as Multibrid (M5000-135), GE Energy (4.1-113), Vestas (V164-7.0 MW), and Gamesa (G128-4, 5 MW) design PMSG. These turbines have higher power than any other turbine in their product offering.

A drawback of this technology is that alloys of rare earth elements[26] are sometimes used to produce the permanent magnet. One example is high-strength neodymium, a mineral whose supply is controlled by a select group of exporting countries (mainly China) and whose extraction process is regarded as a highly polluting practice.

Figure 23 depicts the scheme of a geared PMSG system, with a three-phase cable connection made through power electronics that transforms the AC produced by the generator to a DC bus and from there to the grid. As opposed to direct drive PMSG, other types of gearless WTGs exist that do not require the use of permanent magnets.

HTSG (HIGH TEMPERATURE SUPERCONDUCTOR)

HTSGs use high-temperature superconducting wire and ceramics and are currently being developed in order to solve one of the main drawbacks present in other technologies, e.g. heavy weight. American Superconductor (AMSC) is planning to launch a 10-MW direct drive turbine with HTS in the rotor winding instead of copper wire.

HTSG advantages over other technologies are as follows:

- Superconductors can carry 100 times more power than conventional wires, without electrical resistance or loosing heat. Materials with semiconducting properties are cooled at very low temperatures until electrons move nearly freely through the material. In order to achieve this effect, the coils are placed in vacuum containers, which are constantly cooled by special gases (similar effect to that used in heat pumps).
- This turbine can extract more wind energy than other types of machines with the same nominal efficiency.
- They are smaller and lighter than conventional WTGs. Size can be reduced to half that of a conventional turbine with the same nominal power and weight can be reduced to one third.
- No other machine reaches >10 MW. Their low weight per MW makes them particularly suitable for off-shore applications.
- This design is associated with direct drive and full converter.

HTSG disadvantages over other technologies are the following:

- Technology still in development phase. Superconducting direct drive technology still has to prove that it has superior reliability compared to more established technologies.
- The cooling process could become problematic.
- HTSGs are not expected to reach commercial development before 2014-2016 and validation of designs will still then be needed, a process which could take a further two or more years, taking us to 2016 as the earliest date by which HTSGs may feasibly reach the market.

CONCLUSION

Wind power technology has evolved significantly during the boom in renewable energy over the past decade. This has spurred the development of numerous novel wind turbine generator technologies. Currently, the rather conventional Doubly-Fed Asynchronous Generator (DFAG) still dominates the market, but innovative concepts such as the Permanent Magnet Synchronous Generator (PMSG) are increasingly seen as attractive alternatives.

As long as the penetration of renewables onto the grid remained low, power quality fluctuations could be compensated for relatively easily by Transmission System Operators (TSOs). Compensating for transients, reactive power consumption, random connections, and harmonics, among other fluctuations, was not problematic. Now that renewable penetration has risen to record levels in many countries, managing the influence of the renewable input on the grid is a major concern for the TSO. Grid codes and operational procedures that were historically not designed for the integration of renewables must now be adapted and many countries are making the requirements for such adaptations mandatory. In order to satisfy those requirements, installations with DFAGs may require external reactive power compensation. In older wind power parks, installing power electronic devices such as STATCOMs, FACTs, and fixed compensators have been necessary to meet the evolving grid codes.

Due to the changing priorities, the market share of DFAGs is slowly declining in favour of full converter wind turbine generators such as PMSGs, which have controllable power output and can therefore more easily meet the increasingly stringent requirements. However, this shift in technology is happening at slow pace, primarily because the cost of permanent magnets is still high. DFAGs on the other hand can offer relevant cost savings because their power converter only has to cover 30 to 40% of the generated power.

Each wind project has different circumstances, so the decision regarding which wind turbine generator technology to use must be taken on a case by case basis.

Comparison of the technologies that are commercially available today reveals that each has a particular niche in which they have the biggest advantage.

Locations with high speed and turbulent winds, for example, are better suited for variable speed wind turbine generators with full-scale power converters, since they offer a higher availability under such conditions. This means that PMSGs will generally be preferred over DFAGs at such locations. In conditions with low wind speed and little turbulence, this technology preference could be reversed.

In general, PMSGs not only deal with grid related faults better, they also offer higher efficiency, reliability, and availability compared to their geared counterparts. This is obviously due to the fact that they contain fewer mechanical components. Nevertheless, geared models have been more thoroughly field-tested and are cheaper due to the greater volumes that are produced. The current trend is moving in the direction of PMSG hybrid solutions, i.e. with a single stage or two-stage gearbox. Vestas' most recent wind turbine generator is a geared drive, while the most recent model of Siemens is a hybrid. The cost of power electronics is expected to further decrease in the medium term and direct drive PMSGs will become more attractive.

The High Temperature Super-Conductor (HTSC) wind turbine generator is currently still in development phase and are not expected to be commercially available before 2016. It is expected to attain a higher power than any other wind turbine technology. If the offshore market continues its evolution towards ever-larger machines, this could become an important niche market for the HTSC. wn

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The answer to effective irrigation?

Irrigation is a manmade process which applies water to soil to sustain plant growth. Plants, their growth and health, are imperative in the agricultural industry.

BY | BAREND SWART
SAIEE NATIONAL STUDENT COMPETITION ENTRANT **|** NMMU

It requires elements such as temperature, light, air, minerals, nutrients and water to be present in an irrigation system to grow and produce effectively.

From this, water is the major resource that can be managed to perfection by the use of several irrigation systems with the Centre Pivot irrigation system being the most popular when it comes to large scale irrigation[3].

Irrigation is the process that applies water to the soil[1]. There are several irrigation systems currently in use[1], each having advantages and disadvantages. Listed below are the most popular irrigation systems with their relative efficiencies[2]:

Surface or Flood Irrigation

Basin	80 - 90%
Border	70 - 85%
Furrow	60 - 75%

Sprinkler Irrigation

Hand Move or Portable	65 - 75%
Traveling Gun	60 - 70%
Centre Pivot & Linear Move	75 - 90%
Solid Set or Permanent	70 - 80%

Trickle Irrigation

With Point Source Emitters	75 - 90%
With Line Source Products	70 - 85%

PROBLEMS

Problem Statement

South African farmers receiving their main income from growing crops like corn, wheat, potatoes, beans, etc. are financially very unstable with harvests of lower than average yields as well as fluctuations in the economy[4]. Thus farmers need to spend large amounts of time and money to secure and improve their yearly crop yields. Commercial farmers often suffer reduced profits resulting from additional water, electricity and human resources required in attempts to maintain a large crop yield of high quality.

A 110% crop yield will result in a successful harvest, whereas a 90% crop yield can result in bankruptcy[5]. Looking at the bigger picture this is not only a large setback for any farmer, but also has a major impact on a country's growing economy[4].

Human Error

The Human error factor refers to employees not taking extra care in adjusting pivot settings correctly or doing routine observations and tasks.

Therefore, when the pivot system is started or stopped with these incorrect procedures it results in the system being less efficient. It also causes damage to hardware over time which in turn leads to additional costs of repair.

Hardware Failure

Additional hardware costs often results from the lack of early warning systems. These costs could include, but are not limited to the replacement of wheels, sprinklers, valves, pipes, motors and gearboxes. If proper equipment inspection and maintenance procedures are followed by a certified technician at regular intervals, some of these problems can be avoided.

Farm workers are generally not capable of doing regular inspections effectively as it falls outside their range of technical expertise. Qualified technicians are not a readily available resource for most farmers, thus resulting in less than satisfactory inspections and in return expensive equipment failure.

Electricity & Water Resources

Extended pivot run times due to incorrect watering settings or inefficient usage of the system, results in higher electricity costs. This also puts a strain on the local electricity grid supplying possibly a hundred farms. When over-watered, soil becomes slushy, causing pivot wheel slippages which in turn increases the water usage tremendiously.

Another factor contributing to higher water consumption is the manual purging of the pivot pipeline, as valves are forced open for longer periods of time than actually required to clean out the dirt from the pipeline.

Labour & Management Resources

All commercial farmers must abide by the labor act which means that all workers must be paid overtime or given time off for additional time worked, including weekend work or public holiday work.

Thus, if a farmer is growing very sensitive crops that need additional watering and care, it will cost on average 1.5 times more than a regular day's labour over weekends and public holidays to sustain that crop. Regular farm workers are seldom available during their time off, replacement laborers have to be arranged.

Care must also be taken that the stand-in laborers will be able to do the work successfully. All of the above mentioned puts management resources under considerable strain which can be avoided.

FULLY AUTOMATED SYSTEM USING PAC SOLUTION

The system will be fully automated and self-adjusting with the use of a weather station to measure humidity, rainfall, temperature, wind speed, wind direction, evapotranspiration and solar radiation.

Soil probes are placed in the field to measure the amount of moisture in the soil. The station will assist in the

The answer to effective irrigation?

continues from page 33

selection of the various recipe enabled programs to run as well as determine run times depending on the weather forecast. It also enables the pivot to irrigate only sections that require irrigation, while skipping the sections that are either blocked or wet enough.

Recipes will be basic as the only control it will have is how to water the soil. Recipes will give the owner customisation to suit any crop. The pivots position will be determined via an absolute encoder system at the pivot base.

This system makes use of approved industrial standard equipment which ensures support, availability, stability, quality, reliability and interchange ability.

Development time, down time and any time required to make upgrades or alterations to the system, will be reduced. On average this system will be warranted to last at least 5 to 10 years by the manufacturers of the individual components.

A PAC (Programmable Automation Controller) will be used to do all the central processing. Remote I/O (Inputs & Outputs) in the field will be of the industrial standard, matching the range and communication protocols of the selected PAC. This system will also utilise a central SCADA (Supervisory Control And Data Acquisition) for control and monitoring of multiple systems. Additional features to this system will also include logging and trending of important variables, and alarm dispatching. Important messages & alarms can be sent directly to selected e-mail addresses. An industrial Ethernet protocol is most likely to be used for communication with the SCADA PC to the remote site. A web client will allow remote devices to connect to the SCADA system via the internet to observe the status of the system or even make any required changes.

A small touch interface display will be used to give control at the Automated Centre Pivot Irrigation System's control panel.

ANALYSIS & DESIGN

Site Evaluation

A thorough site evaluation was done before development on the design of the Automated Centre Pivot Irrigation System.

The site evaluation is required to obtain details regarding the changes that are required to be made on the mechanical and the electrical level of the project. These changes are required to integrate the new with the existing infrastructure.

Mechanical Design

The design of as special angle control cam was done to change the existing angle control system from a start stop system to a drive friendly control system. This was achieved by analyzing the existing system to obtain the angular gain on the control cam. The angular gain is obtained by use of a double lever system that from the pivot pipeline to the rod holding the control cam. Modifications to the pivot enclosure had to be done to house the extra equipment.

Network Design

The network was designed by analyzing the existing network to determine the subnet mask, gateway, DNS (Dynamic Name Service) server and static IPv4 (Internet Protocol version 4) addresses. Using the above information the new devices were assigned strategically selected IPv4 addresses.

SCADA Design

The SCADA design was completed by using a basic layout throughout the complete system. The layout idea was drawn in paint first and then altered in the SCADA IDE (Integrated Development Environment).

The basic layout consists of a buttoned structured menu for screen changing on the left hand side with the current screen button un-clickable in an altered style. The top bar contains the heading of the current page. Below the heading is the alarms banner to display active alarms. Below the alarms banner is the pivot identifier frame or tabbed multiple screen display box. The main screens content is always presented in this section of the screen.

Alarm Dispatching was implemented to provide a feedback system to the Pivot Manager and support an early warning system. The system is at present primarily used as the pump start command for the manager, as there are not a lot of errors to report on the working system.

CONCLUSION

The Automated Centre Pivot Irrigation System is completely built and running in the automatic program cycle. The pivot system has thus far run much less than previously and the weeds have decreased drastically. Growth of the alfalfa has increase in bulk as opposed to previous experience. The pivot manager has since not been to the center as everything is managed remotely.

The SCADA system is easily used by the owner of the Automated Centre Pivot Irrigation System and the lessee of the property. The alarm dispatching operates seamlessly as all the pump start requests are emailed to a designated technician who is responsible for the pump management.

The Automated Centre Pivot Irrigation System designed and implemented above functions, but it is not sellable to the agricultural industry yet as a few marketing aspects needs to be implemented.

RECOMMENDATIONS

The pivot system is quite high in cost for the initial clients to accept the new un-time-proven concept. The price therefore needs to be reduced by designing and manufacturing some of the equipment purchased like the soil probe system and weather station system.

A higher bandwidth wireless backbone system needs to be designed and manufactured with a Modbus RS485 interface gateway used to acquire data from the end nodes on the system. The weather station can be manufactured instead of procured to save at least R 15,000 in cost to build. This can be incorporated on the same backbone system as the soil probe system that is manufactured instead of procured, saving another R 10,000.

A tire pressure system needs to be designed and manufactures to prevent wheel damage. This will cost approximately R5,000.

A pump start/stop system with feedback needs to be designed and manufactured to operate on the same backbone system.

As a marketing aspect the HMI needs to be colored and larger to represent more detail. The SCADA needs to be converted to be available as android running platform on a tablet or web server to be viewed on an android tablet. The control panel will be changed to a single panel costing less than the combined panels. The tower panels need to change to a sleeker design. wn

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Rooftop solar PV nears grid parity in SA

Renewable energy will undoubtedly play a key role in South Africa's eventual transition to a sustainable energy economy, with all its citizens having access to a reliable source of electricity.

BY I JACK WARD **I** MANAGING DIRECTOR
POWERMODE

However, while the world has steadily increased its embrace of renewable/ sustainable energy sources over the last decade, South Africa has lagged behind, hampered by a number of barriers, including high up-front implementation costs of solar, wind and other technologies.

The landscape is changing. Today's renewable power generation technologies are increasingly cost-competitive and they are now seen, from an economic standpoint, as viable options for off-grid electrification in certain circumstances.
Today, renewable power generation technologies account for around half of all new power generation capacity additions worldwide. In 2011 these additions included 28,000 megawatts of solar photovoltaic (PV) power along with wind, hydro, biomass, concentrated solar and geothermal power.

This rapid deployment of these technologies has had a significant impact on costs. For instance, for every doubling of the installed capacity of solar PV systems, module costs decrease by as much as 22%.

In the last two years alone PV module costs fell by around 60% to below one (US) dollar per watt. The price of crystalline silicon (c-Si) renewable modules is marginally higher at just over one dollar per watt.

This evidence is a sure sign that the renewable revolution is underway, gathering momentum and in the process of sustaining a virtuous circle of rapidly declining costs. As more installations spring up, so the price decreases further.

Renewables are becoming increasingly competitive with grid-supplied, utility power prices.In Germany the costs of installed rooftop systems fell by 65% between 2006 and 2012, making solar PV competitive with current residential electricity tariffs in this country.

In South Africa, with its high (and climbing) electricity costs, solar PV installations are rapidly gaining grid parity.

In fact, the levelised cost of electricity (LCOE) of solar PV (the ratio of lifetime costs to lifetime electricity generation, both discounted back to a common year using a rate that reflects the average cost of capital) is declining to a point where it will soon be seen as the most economic solution for off-grid electrification and grid extension in most areas.

There are four major components that largely determine the levelised cost of electricity for renewable power generation technologies – resource quality, equipment cost and performance, the balance of project costs and the cost of capital.

Each can vary significantly between individual projects and countries. And each component can typically make a difference of a factor of two, in some cases even more.

In remote locations in South Africa solar PV is already the best option and its increasing application will help the country meet many of its economic and social development goals. For example, solar PV can be significantly cheaper than (currently common) diesel-fired power generation in areas characterised by poor or even non-existent infrastructure and where lengthy transport routes can increase the cost of diesel by 10% to 100%.

It is also important to note that rooftop solar PV and small wind generating installations can provide new capacity without the need for additional transmission and distribution investments and therefore should not be directly compared with large utility-scale renewable solutions.

If these trends continue, grid parity with residential electricity tariffs will soon be the norm, rather than the exception across South Africa. Solar PV also has the advantage that, once the domestic installation market is developed, solar PV installations can be ramped up rapidly to meet policy goals or electricity sector needs. No other power generation technology shares this flexibility. wn

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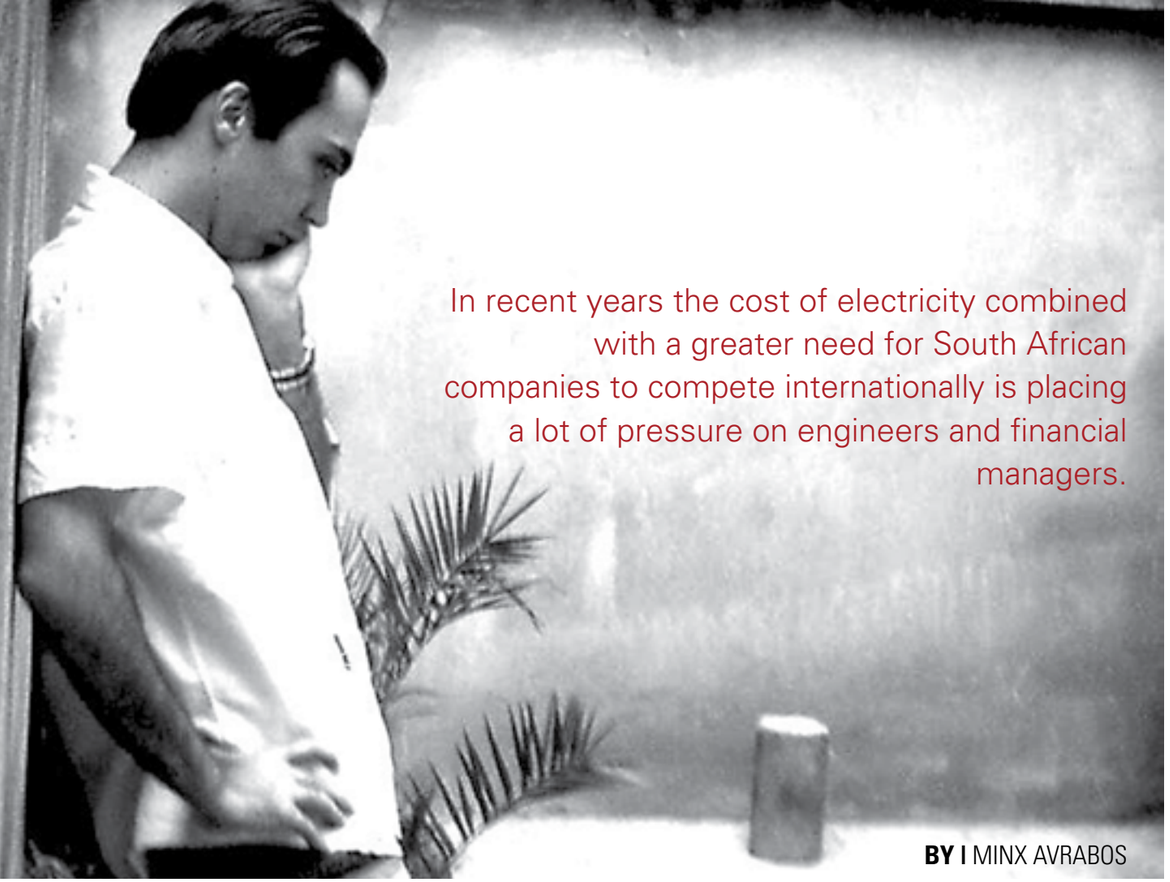
Increasing concerns for all Engineers in South Africa



In recent years the cost of electricity combined with a greater need for South African companies to compete internationally is placing a lot of pressure on engineers and financial managers.

BY I MINX AVRABOS

Reliability, efficiency and cost are a factory's biggest concerns. One of the major costs to industry is electric motors, both in their maintenance and their cost of electrical consumption. One of the solutions has been to introduce Variable Speed Drives (VSDs) into factories, thereby reducing motor failures as well as electrical consumption costs.

VSDs protect and increase electric motor reliability, as well as reduce energy consumption but have a huge side effect in the form of capacitive currents and high shaft voltages, which damage electric motor bearings. This stops companies from realizing the full benefits of their Variable Speed Drives (VSDs).

VSDs are the largest single source of bearing failures in the world today. There is a 57% increase in bearing failures worldwide, which is due to the introduction of Insulated Gate Bipolar Transistors (IGBT) Variable Speed Drives.

Older VSDs operated at a lower switching frequency and did not create many bearing problems, with the advent of the newer IGBT VSDs, the higher switching frequencies have created more unbalance and thereby creating higher shaft currents that increase motor failure.

Variable Speed Drive problems, as a scenario, are very similar to vehicle problems. When you own 4 or 5 vehicles, you believe they are quite reliable and you do not experience many problems. But as soon as you have a fleet of 200 vehicles, you start to experience an increase in problems, which is logical, but like VSDs; you also start to experience problems you never knew even existed. This is the same as our scenario in South Africa, whereby factories are starting to experience problems they never knew existed, and in most cases factories are not even aware that these new problems exist.

These problems are often disguised as standard industry failures such as contaminated grease, low grease levels and normal bearing failures and the true cause of failure is never identified.

VFD INDUCED SHAFT CURRENTS

So what are these high shaft currents and how do they damage bearings? Damaging voltages are induced on the shafts of AC and DC motors controlled by Variable Frequency Drives (VFD). The extremely high on/off switching speeds of the Pulse Width Modulation (PWM), generated by the Insulated Gate Bipolar Transistors (IGBT), induce damaging voltages onto the motor shaft through parasitic capacitive coupling between the stator and rotor. This common mode shaft voltage seeks a path to ground, usually through the motor's bearings.

Damaging currents arc through the di-electric oil film between the rolling elements and the bearing race. This is known as Electrical Discharge Machining (EDM) effect.

EDM causes fusion craters, severe pitting, and eventually bearing fluting (a washboard-like pattern in the bearing race) which results in premature bearing failure.

One of the most frequently asked question is, *"Will electrical bearing damage always occur in a VSD application?"* The answer is *"Yes - with no alternate path to discharge shaft current, pitting of the motor bearing will take place during VSD operation. These discharges will continue and will always seek the path of least resistance - usually through the motor bearings"*.

Yes, many motors still last for some time on a VSD application but bearing life is drastically reduced by up to 50 percent, even when the problem is not critical.

Bearing current problems are nothing new to engineers, but it is the alarming rate of increase in this problem that is becoming a worry to factories and mines.

SGS, a company in the USA, undertook a survey on 1000 AC motors on Variable Speed Drives. 250 of the motors monitored had bearing faults appearing by month 18, and of motors averaging 24 months production time, 65% had electrical bearing faults appearing.

This problem is termed by many as "The Ghost" as you never know when or how damaging its effects will be, there are many cases in KZN (where the initial research has taken place) where AC and DC motors have been effected within 2 to 6 months of the motors installation, thereby creating huge and expensive down times. South African companies are going to experience increasingly more of this scenario, unless they protect their motors against this growing problem.

SOLUTIONS TO HIGH SHAFT CURRENTS AND EDM

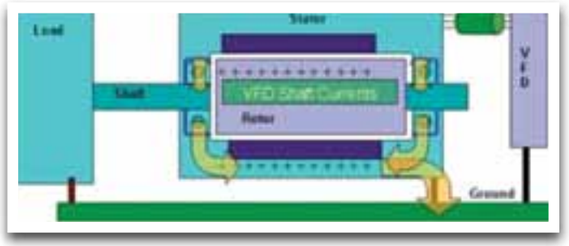
(Electrical discharge machining)

So what are the solutions to this problem? As EDM is brought about by high shaft currents, the most effective way is to reduce these shaft currents. This has been assisted by the use of filters for variable speed drives. This has had mixed results and the research in not conclusive, therefore the filter manufacturers will not guarantee the products solves electrical bearing damage. The next solution is to make sure that the high electrical currents and voltages that

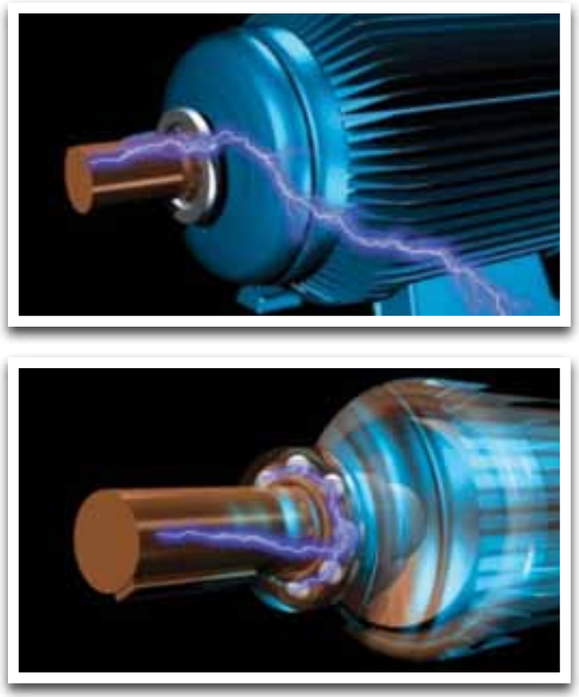
Increasing concerns for all Engineers in South Africa

continues from page 39

Damaged Grease & Bearing fluting, "washboard" pattern on bearing race



EDM Currents Damage Bearings



Damaging shaft voltages going through bearings on the way to earth.

are passing the bearings on their way to ground, are redirected so that they do not pass through the bearings. This is the most effective solution, and there are many systems that have been in place over the years that try to solve this problem (mainly in relation to the old Eddy-current problem). None have been 100% effective, and have performance (and/or high cost) problems of their own.

The most popular solutions South African companies have used in solving Eddy-current problems, which are similar, but are not the same as VSD capacitive currents are the following:

- Insulated bearings
- Insulated bearing housings
- Carbon block brushes
- Copper or bronze metal brushes

INSULATED BEARINGS: These are effective but are not guaranteed against EDM by the bearing manufacturers. They also do not stop the bearing currents going into the driven equipment machinery (gearboxes, pump casings etc.), which can transfer the problems to other areas in which problems had not previously been experienced. With shaft voltages unable to escape through the motor bearings, there is a massive increase of current through the motor shaft. This can lead to the higher risk of ionization in hazardous areas. The initial, and on-going cost of ownership of insulated bearings in South Africa is also very high.

INSULATED BEARING HOUSINGS: Since normally only one insulated end shield is fitted, this solution is not 100% effective when used to protect the motors bearings against VSDs'. In addition the capacitive currents differ from Eddy-currents, and the use of only one insulated housing would just increase the shaft currents in the other bearings. This method, of using two insulated housings per motor, is also very expensive as well as increasing the currents diverted to the driven equipment, and the associated risks involved.

CARBON BLOCK HOUSINGS: Conventional shaft grounding brushes need frequent maintenance and become less effective over time. They rely on the spring tension to press the brush against the rotating shaft. This causes the brush material to wear - sometimes in as little as 3 months as it rubs on the shaft. In addition, oil, grease, dirt or oxidation will break the conductive path which will prevent conventional brushes from discharging shaft currents and will not protect the bearing adequately.

COPPER OR BRONZE METAL BRUSHES: These brushes are very abrasive, wear out faster, and are therefore not maintenance free. These need constant monitoring to prevent the build up of contaminants.

THE SOLUTION FOR SOUTH AFRICA

With the advent of more and more VSDs becoming used in South Africa, what is the most effective and economical solution?

The answer is earthing rings, or Bearing Protection rings. These rings consist of very thin micro-fiber that redirects shaft currents and provides a reliable, very-low-impedance path from shaft to frame, which by-passes the motor bearings entirely. The earthing ring is attached to the electric motors bearing housings. Once installed, the earthing rings require no maintenance. Unlike conventional shaft grounding brushes, its conductive microfibers work with virtually no friction or wear. They are unaffected by dirt, grease, or other contaminants, and last for the life of the motor, regardless of motor speed. In overseas trials the results show surface wear of less than 0.001 in. per 10,000 hr of continuous operation, and no fiber breakage after 25 million direction reversals.

For almost a decade these earthing rings have been extensively used in USA, UK and more recently Australia. There are thousands of case studies that show the positive effects of using these rings. The rings are seen as a solution to these problems, as well as an insurance against unforeseen problems. During changes in load conditions and during adjustments to their drive parameters it was found in KZN that many motors exhibited increased shaft currents after their most recent repair.

This is why it is termed "The Ghost", since it can never be determined when its effects will drastically increase and rapidly destroy bearings. It is of utmost importance that industry protects itself against this so called "Ghost", especially in regard to their critical motors.

You may wonder, "if these earthing rings are so effective and popular, why are they not extensively used and sold in South Africa". There are a number of reasons for this: - (1) High costs, due to high patent costs as well as the exchange rate in South Africa. (2) Lack of support and education to factories, (as these newer EDM faults disguised as old standard industry bearing problems) (3) Long Delays in supply time (especially for older or non standard motor shaft sizes, of which SA has a lot.).

These problems have been solved with the launch of South Africa's very own manufacturer in KZN. Due to local patenting costs and no ill effects of exchange rates the cost of the product has been reduced and is in line with the SA market. All Support is local, combined with education and training.

Earthing rings of both standard and custom designed sizes, can be manufactured and supplied anywhere in the country within 24 to 48 hours. Due to extensive research this South African company will also be the first company in the world to manufacture this product for approval in motors in flammable (E/x) locations.

Due to the massive increase in the use of Variable Speed Drives (VSDs), shaft current bearing failures are one of the fastest growing problems on electrical motors in the world. wn

Earthrings Combo

" Two of the largest factories in South Africa have just specified the earthing ring, as a requirement on all new motors purchased."

"The first Earthrings received the thumbs up from the South African Government and have been successfully installed."

For more information, contact Wyko Industrial on Tel: 031 461 4411 | Fax: 031 461 4450

Earn CPD Credits

Is Smart Metering smart enough for Africa?

BY I KOBUS VAN DEN BERG (PRENG), BENG (ELEC). MMEDSC, MBA.

Smart Metering (SM) systems can support various aspects of electricity distribution management and are generally recommended internationally as the way to enhance the services and financial viability of electricity utilities.

It is important to understand the additional functionality of a SM system and see if it meets the specific requirements of Africa.

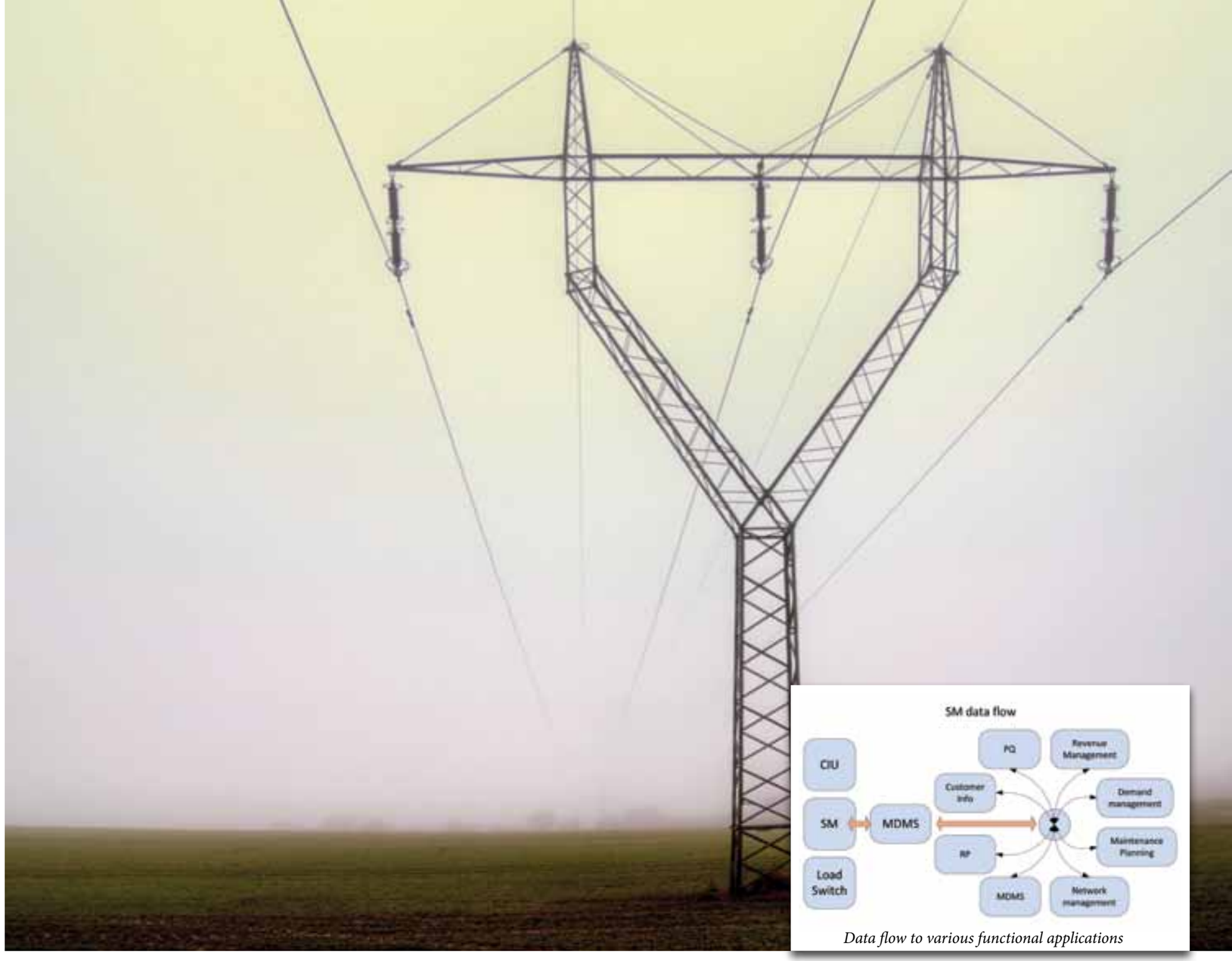
The extensive functionality of a Smart Metering system is not always fully appreciated. However, collecting vast amounts of system data is in itself pointless: the value is in the management of the data. The solution lies in the integration with a highly effective Meter Data Management System (MDMS) and being able to demonstrate benefits for the consumer.

THE METERING SYSTEM

A typical SM system will have a smart meter at the customer's premises with a load switch and in-house display. These devices communicate via various communications media and the data is transferred to a MDMS (Meter Data Management System) for storage and processing.

In the metering mode, the system provides the measurement and recording functions to enable effective measurement of consumption data for billing purposes. It records data at 30-minute intervals, which enables the utility to determine when and where energy has been used.

The meters can be switched between credit mode and pre-payment mode remotely. Credit tokens purchased at vending outlets or online via the internet or cell phone can be transferred to the meter directly or manually through the keypad on the Customer Interface Unit (CIU, display and keyboard installed in a customer's residence). The meter also allows the implementation of complex tariffs. The use of TOU (Time of Use) tariffs allows the utility to offer new energy products to the customers, as well as use pricing signals to manipulate the consumption pattern of consumers to enhance energy efficiency.



Data flow to various functional applications

The 'smartness' of the metering system comes from being flexible and multifunctional, able to enhance the management of distribution systems and improve energy efficiency.

ADVANTAGES OF A SMART METERING SYSTEM

- Revenue management

The SM system can provide accurate meter readings, timeous billing, pre-processed readings with VEE (Validation, Estimation and Editing), and remote connect/disconnect.

One of the most important challenges municipalities face in South Africa is to read meters and produce accurate bills to enable customers to pay their dues. It is not always possible for meter readers to get access to a customer's premises, resulting in 'no reads' or 'estimated' readings on a customer bill. In the case of SM, the consumption data will be validated and any inconsistencies corrected in the MDMS before it reaches the billing system,

Is Smart Metering smart enough for Africa?

continues from page 43

ensuring much higher quality billing. The VEE (Validation, Estimation and Editing) functions allow the utility to effectively manage consumption levels, missing readings due to meter failure and energy theft due to bypassing of meters.

The SM system supports functionalities such as remote connection/disconnection. If the customer does not pay their bill, a warning can be sent to the CIU. If no reaction from the customer occurs, the supply can be switched off remotely.

As soon as payment takes place, the supply can be restored immediately. An especially important benefit is that accurate meter reading and billing will restore customer confidence in the utility and result in an improved payment performance.

- Revenue protection (RP)

Most utilities employ RP officials or contract meter auditors to visit and inspect meter installations for safety and especially tampering issues. SM systems can be this 'guard dog' to monitor meters 24/7 and provide reading VEE to detect anomalies, tamper detection, alarm generation, energy balancing and loss detection, and non-payment/tamper disconnection.

While the visibility of meter officials motivates customers not to tamper with meters, the main challenge is the time and cost to maintain this visibility.

Soon after a meter audit, customers tend to revert back to their old tampering habits or pay 'contractors' to 'adjust' their metering system! The SM system can provide a focused, enhanced and more cost-effective RP service for the utility.

- Maintenance and planning

Data collected from the SM system can be used to identify maintenance actions as well as network extension and upgrade planning. Applications include distribution system loading and power flow, fault log system, power quality (PQ) information, system loss measurement, parameter trending facilities, maintenance alert, job scheduling, and meter error detection.

Meter failures can be detected immediately and the necessary maintenance and repair teams activated. Customer service will improve due to prompt reaction to failures in the distribution network.

Capital and maintenance budgets can now be based on operational information from the SM systems rather than ad hoc measurements in the network.

- Keeping customers informed

Customers can either accept and use the SM facilities or view it as a method to 'spy' on them and force them to pay for services. Whatever the case may be, the customer should be persuaded and shown that the SM provides essential and useful information, such as consumption feedback, cost and tariff information, outage warnings, bill payment information, remote disconnection/reconnection, and pre-payment options.

For successful implementation of SM, it must be to the advantage of the customer in terms of energy management, as well as the improvement of services. The SM system opens a new communication channel to customers to inform them of the actions and intentions of the utility without reverting to call centres and the media.

- Demand control

Many African countries are in the predicament that the demand for electricity is at times very close to or exceeds the supply capability. The SM system provides methods of managing the demand for electricity on the consumer side of the supply network direct control of devices such as geysers, air conditioners and pool pumps, load limiting during high demand/supply shortage crisis situations, and indirect load and energy efficiency control via TOU (Time of Use) tariff structures.

The first method enables the utility to switch off the supply to non-critical appliances such as air conditioners, pool pumps and hot water geysers, as well as other residential loads or, motivate customers to disconnect loads themselves.

The second method is to use TOU tariff structures to reflect the actual cost of energy at a particular moment and also send a strong price signal to the customer. This information enables the customer to reschedule certain loads and save electricity cost, as well as improve energy efficiency.

IN CONCLUSION

SM has a place in African utilities to meet the needs and particular characteristics of Africa's electricity consumers. SM is only really smart if it is carefully integrated into the distribution system with a specialised MDMS, and the system used to improve business processes, utility operations and particularly, customer services. wn

This article is based on the paper titled 'When is Smart Metering really smart?' presented at the 63rd AMEU Convention, 15-17 October, Ekurhuleni.

Say watt?

Do you know how much electricity is costing your household? When I received my November account for electricity I did some analysis of the actual cost per KWh, and I was dumfounded.

BY I FREAKIN OUT

Now, it's true to say that I, as an electrical engineer who should know watt, sorry, what goes into making one kilowatt hour of electrical energy available, I have been somewhat sympathetic with the whole scenario and outcry of price increases, and the capacity shortage and all.

But when I look at my own household account I am not only dumfounded, but the cold sweat I experience almost makes me want to put on the electric heater! Fortunately common sense prevails and I put on another layer of clothing - not to get warmer - but to absorb the moisture from my overexcited body.

The latest account says I used 950 KWh of electricity - not bad I think - since we have a pool and two geysers. We could use less if my wife could use one fridge instead of the two plus the freezer. And, if I took up the Eskom subsidy of about R4000 and installed a solar geysers on the roof.

We could also change all the lamps to energy efficient LED lamps plus only use the town gas and not the electric stove. We could also fill up the pool and grow vegetables instead of endlessly filtering the huge pool all year that only serves during the summer to cool the 3 dogs we have and maybe the grandkids when they visit. Yes, there are a lot of things we could do to save on our consumption of electrical energy, but we are only two pensioners using a fraction of the big family house since the kids left, and we think we do not waste anything.

The reason we are not doing all these things is that we are trying to save our pennies to do what we should be doing - and that is downsizing into a smaller flat, in a more secure complex with no pool or no dogs or big garden etc.

You see - it's a matter of one's pressing priorities. Our priority at this point is not to spend money on schemes that give payback within 3 years when we may not even be here/there at that time but somewhere else maybe. Either in an old age complex or in heaven – hopefully?

What is not high on our priority list is using less electricity – paying less of course! But hereunder I will show that it is not the authorities aim to incentivise people like us. On my latest account this is clearly why!

We used 950 kWh in October 2012 and here is a breakdown:-
Just for the electricity on an inclined block tariff we are paying R0.90 per kWh.
Add to this a service charge, the demand charge and the Network charge: R1.44 per kWh.
Now add VAT - R1.61 per kWh

So we are paying some 79% more for the service delivery of the commodity – scandalous - or should I say highway robbery!

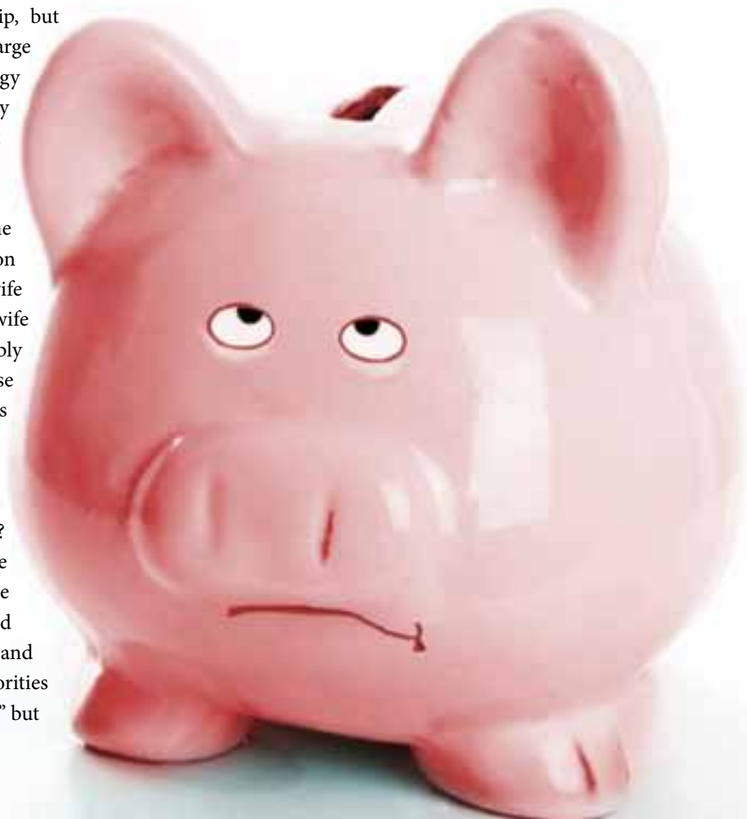
(It's like buying these computer gadgets - the wrapping – which is discarded - costs more that the actual computer gadget. Don't forget the instruction booklet that is about 3 times the size of the gadget!)

The question remains, why are we paying so much for the poor service (by any standards) and here I refer to the national billing problem for electricity. The above figures do not reflect the cost of the frustration, time and travel costs of going to the service centre or billing department without any satisfaction except "we will log your call/query and get back to you and here is your reference number" – getting back to the customer is unheard of, and running out of reference numbers are the next thing to happen!

I don't wish to upset your **watt**now readership, but compare the cost of R1.61 per kWh to what large industrial consumers pay for their electrical energy – by all accounts it is 10 to 16 times less. Some say this is below the cost of production but I can't believe that - surely?

So if the authorities place such a low value on the actual commodity price, and such a high value on service delivery, then the only incentive for my wife and me is to refrain from using the services. My wife argues that even if we do that, we will still probably have to pay and be charged a service fee, because we stay in the municipal area and the service is available not withstanding we don't use it. She's got a point!

So given the scenario above what do we do? I think we just have to sit tight and wait for the winds of change to blow. How things are done administratively, and the way tariffs are structured to support the poor competency and productivity, and save as much as possible to address the higher priorities of on our list. I do not want to call it a "bucket list" but it's not far from the truth – in our case! wn



The Education & Training of Engineers

At the present time the various engineering businesses are expanding at a very rapid rate, and the question of providing the engineers of the future is one of considerable importance.

WRITTEN BY I MR N. HARRISON (MEMBER - 1913)
COMPILED BY I ALAN MEYER I FSAIEE

It is time this country became self-contained: that the policy of importing our engineers should cease, and that suitable methods of training should be generally introduced in South African colleges and technical schools, with a view to instilling in the South African youth that general education which is so very necessary if he is to be fitted for the engineering profession.

The strength of any company or department where engineering is involved depends entirely upon the officers holding the responsible positions. At the present time, one has only to look round to find how rarely the engineer takes his proper place, namely: at the head of the business; it is usually found that he is there purely in the capacity of technical adviser, whilst some other officers controls who has no technical knowledge whatsoever.

There is some sound reason or this, and when one comes to argue the matter dispassionately, it is found that wherever this happens to be the case, the engineer is lacking in business capacity – in other words, he is lacking in the commercial application of scientific knowledge.

As I am more closely concerned with the development of telephony than with other maters, I will instance the area of study where the question of opening a telephone exchange in a large town has to be considered. In the first instance, the census figures are very closely examined to ascertain the growth of the population over a given number of years, and the population is then estimated on a conservative basis for a period ahead.

The class of dwelling houses, business and the number of charitable institutions, government and Municipal Offices are then enquired into, and data carefully noted.

For instance, the residential subscriber would not use his telephone more than two or three times a day; the small business man about a dozen or twenty times a day; but the larger user night never have the telephone idle.

How many engineers are there today, who are technically expert, but who find the compilation of a report a most difficult and laborious matter? Some of them find it an impossibility to perform and do not hesitate to say so.

The engineers must be an exceptionally good judge of character, and know how he can most effectively use a man for a purpose. Whatever the type of man, he must be able to recognise it and act accordingly. Tact will do more towards obtaining the maximum amount of work for a minimum outlay than any other quality known, and I have no doubt that many of those here tonight can readily draw their won comparisons without being necessary for me to belabour the point.

The best type of engineer is the man who combines a thorough knowledge of his work with the broader and more general knowledge of commercial application and administration, who is sympathetic with the men and at the same time firm, commanding respect, a strict disciplinarian, ready to assist the smallest members of the staff either with constructive suggestions or encouragement, a good organiser, tactful in the greatest degree, with an imperturbable calm both with the staff and the public, and who places responsibility down the line so that even the office box has his own little pet scheme to tend, care for and improve.

Summing up the various points that I have mentioned, it will be seen that an engineer is required to have a thorough commercial and financial training; an all-round knowledge; able to compile reports in clear and simple language; to be an excellent judge of men; a good organiser; tactful and human.

For practical training, it was recommended that for all classes of engineers there should be one year in a mechanical engineer's workshop, to familiarise the student with the handling of machines, tools and metals; three years in a technical college, the first course the cover the theoretical principles of all branches of engineering, to be followed by specialisation in the particular branch which the student proposes to take up; finally three years apprenticeship on actual works or in workshops in the actual profession in which he is about to enter.

When I was in America during 1911 enquiring into various matters, it was made known to me that the method adopted by many of the large companies to recruit their engineers was to send agents to the various universities, who made it their business to find out which men were likely to prove most suitable. The agent then got in touch with the under-graduates a year or so prior to their graduation, and invited them to serve a short period with the company, so that their capabilities could be ascertained.

There is nothing being done at the present time in the direction of educating the South African youth to fit him in the higher engineering appointments of any profession. Students in electrical and mechanical schools may gain a good knowledge of electrical and mechanical laws, and a fair acquaintance with machinery, but this is insufficient. There is something more wanted than that, namely Commercial Training, and until the various Engineering Societies take the matter seriously, genuinely supported by the Government, nothing effective will eventuate.

In my capacity as a member of the Engineering Committee of the South African College, and in conjunction with Professors Bohle and Snape of the same college, I went closely into the matter, and eventually it was agreed that, having regard to the various exigencies, the following would be the best arrangement possible to meet the Post Office requirements for engineering students:

1. School education
2. Training in South African universities
3. Training in offices, workshops and on works.
4. Training in factories and other places in America and Europe.

With regard to the course of study to be proposed, I cannot too strongly urge the necessity for providing a suitable course of commercial training, so that the youths will be in a position to acquire the knowledge necessary for commercially applying their technical knowledge. Too much cannot be done in this direction if the boys are to be fitted for the higher positions.

Again, in forwarding the proposals to the Government, it should be strongly urged that the curriculum put forward should be introduced in at least one college in Natal and the Free State, and two in the Transvaal and Cape Colony, and more if it can possibly be arranged.

Earn CPD Credits

Reminiscing on an Electrical Engineering Career

BY | LT COL BILL BERGMAN (RTD) MMM **|** PR TECH(ENG) **|** F SAIEE

When I started my military career I was posted to the Quarter Master General's (QMG) office in the Terrain Development Section as Staff Officer Electrical Services (SOES).

Within two months I was in the operational area on to the "Border" because I had to design the buildings and reticulation for five major military bases. This meant travelling to and fro to these bases by means of the "Flossie", which was the name given to the C130 Lockheed Hercules aircraft used for the shuttle service from Waterkloof Air Force Base in Pretoria to the Border operational areas.

A number of these bases had an electrical supply from the grid but each had to have a standby generating capacity in case of power failures. In those bases where no electricity was available, we had to design and install a base load power plant. These had to have back-up facilities as well so that when one generating set was being serviced the other had to run to keep the military base operating. In some cases we had to run two sets in parallel and these had to be synchronised. In case where 2 sets had to run together on occasions, there were three sets installed. At the base camp at M'Pacha, we installed 3 x 500kVA sets. Each alternator set was driven by a M.A.N. marine engine which turned a 500kVA alternator which operated at 500 r.pm! The 3 sets were flown up to the Caprivi Strip by the SA Air Force (SAAF) in C130's (Flossie) but each complete set was so big and heavy, we had to split the engine from the alternators at the coupling and the SAAF flew each piece up separately. This meant 6 trips!

The "Flossie"

When all were assembled and installed, and when required by the load, the diesel alternators used to start up and synchronise automatically. One must keep in mind that the power station was run and maintained by national servicemen who had no experience in running a power station of this sort! Their main duty was to ensure that there was always sufficient fuel.

During the national service days, I had the newly qualified electrical engineers from the Universities and the Technikons posted to my section. I used these National Service Men (NSM) to assist me in design and in supervision roles on the various projects. These National Service Men were the salt of the earth and to this day I have the utmost respect for them because they gave their best. In all the years that I had National Service Men on my staff, I had no complaints from them. I had a policy that when a new design had to be implemented that I used to tell the young engineers what I wanted and how I wanted it done. However, my policy was that if they had a better idea,

Reminiscing on an Electrical Engineering Career

continues from page 51

they were always welcome to discuss this with me and to convince me that their idea was better than mine. If they managed to do this, I had no qualms about accepting their design ideas. By the same token, if I did not like their idea, then I would have to convince them why I thought my design ideas where better! When it came to engineering design and ideas, my door was always open as we strived to present the best possible electrical installation solution for the military base camps and in the long run for the soldiers who occupied these bases.

Many times I had to post the NSMs on my staff to do a three month stint at a border base to supervise the maintenance of electrical installations and the power plant. They went willingly and many times came back and thanked me for the experience gained as they were thrown into the deep end and had to deal with soldiers of higher rank.

Because they were the technical boffins, the others of higher rank had to take their advice when the need arose. One of the funny incidences was when the mixer valve on the water system at an ablution block went faulty. Hot water somehow was piped into the toilets! I was on an inspection visit to this camp and a young 2nd Lieutenant came to me and quipped, *"Is this what is known as a hot flush?"*. One must realise that a military base camp is like a small town. It has sleeping accommodation, ablution blocks, kitchens, water purification plant, sewerage disposal, offices, dining halls, recreation facilities, medical facilities, etc. In the kitchens we had electric frying pans that could cook 90 eggs at a time!

As SOES, I not only looked after the bases on the Border but also had to design specific projects across the length and breadth of South Africa. These included a rehabilitation centre at No 2 Military Hospital in Wynberg, Cape Town, an automatic water pumping plant at Upington, security lighting along perimeter fences, security detection systems, and water purification systems. When QMG was disbanded, I was transferred to the SA Engineering Corps Formation headquarters and one of the interesting projects that my section designed was electrical installation of the military printing works. One of the printing presses installed was a 5 colour Heidelberg press which had to be put into operation urgently to print additional ballot papers when the first democratic elections took place. These ballot papers were printed overnight then taken to Swartkops Air Force Base to be flown the next day to outlying election centres where ballot papers had gone missing.

The power plant at M'Pacha Military Base

On the military side, I had to attend military training courses. One of the most interesting was a Military Law Course at the Military Academy in Saldanha. Once I qualified in this course, I was called upon to sit as one of the assessors on Military Courts Marshall. This was quite an intellectual challenge to interpret the Military Disciplinary Code (MDC), which I enjoyed but did not enjoy having to sentence soldiers for their misdemeanours.

I was also called upon to preside as the Chairman on a number of Boards of Enquiry. Here one has to take evidence and then give a conclusion who is to blame or what was the cause leading up to a Board of Enquiry being established. One must understand that military personnel are subject to two laws. These being the civilian laws of the State and the Military Disciplinary Code.

During this time I was elected President of the SA Institute of Electrical Technician Engineers (SAIETE). I was already a member of SAIEE but felt that there were too many smaller electrical engineering institutes which fragmented the discipline.

The Three Presidents: seen at the SAIEE Annual Banquet held on 28 October 1994 were from left - Bill Calder (Pres. SAIEE), Lt. Col Bill Bergman (Pres. SAIETE) and Thys Uys (Pres. ICMEE)

After consulting with SAIETE members and SAIEE Council, it was decided that SAIETE would disband and its members become members of SAIEE. This was successfully achieved and the finances of SAIETE were transferred into a bursary fund for Technicians called the Jack Yelland Bursary Fund and administrated by the SAIEE.

After 25 years' service in the SADF and the SANDF, and there are many more stories that I could relate, I retired from the Defence Force and received personal letters of thanks from the then Minister of Defence, Joe Modisa and the then Chief of the SANDF, General George Meiring.

I had served under some of the finest Generals and Commanding Officers. In my time in uniform, I wrote a number of papers, some of which were published in the SADF magazine, Paratus. Others were used in-house for training in both the electrical engineering discipline and others concerning military matters.

On retiring, I went into electrical consulting where I am still busy today as a partner in the firm Bergman Fisher and Associates in partnership with Wayne Fisher (MSAIEE). I had an interesting career in the SA Defence Force and now pursue an interest career as a consultant. Many people asked me why I became a soldier. My answer to them was that I knew what I had to wear every day!

I am still involved with military veteran affairs and as a Field Officer, retain my rank. The highlights of my working career are, being awarded the Military Merit Medal decoration (MMM), becoming a Fellow of the SAIEE, receiving the SAIEE Engineer of the Year Award in 2011, and meeting the most interesting people at the SAIEE as a Council member.

My philosophy in life is to respect others no matter who they are or what they do as we all have a role to play in this world. wn

Looking back on Apprentice days ... and beyond!

"The time has come" ... Ed Groblersays ... "to talk of many things - of telegrams - teenagers and roller-skates"*

REFLECTIONS BY | EDWIN F. GROBLER | PRENG | FSAIEE

(Apologies to Lewis Carroll)

As part of the apprentice training program set by the Government Telephone Company in the late 40's, I was placed in the Central Telegraph Office (CTO) in Cape Town to learn about the practical aspects of telegram telecommunication. This was the centre from which all messages were processed from local sources and duly routed to/from all other destinations.

The scene was thus: in a large room, telegram forms were processed by teleprinter operators and then by a conveyer belt routing them to six destination bins from which several guys and gals on roller-skates, (to speed things up), redistributed them to the next stage of zone processing.

Now: I fancied myself as a pretty skilled skater so you can imagine my teenage excitement when I viewed this incredible scene. I was a 'regular skater' twice a week at the local skating rink. I could do this job. *"Kid"*, I thought, *"you've arrived"*!

But it was not to be. My verbal application was turned down by the "Powers-that-be" and I was wisely pointed in the direction of honing my skills (whatever those were!) on one of the 20 operational teleprinters at the site.

Swallowing my disappointment, I settled into learning to type. Each telegraphist had to type at a speed as fast as the system would allow and also use the morse code key and sounder in the event that the teleprinter failing.

This also involved such curiosities such as *"please daddy don't go down the mine, there is enough coal in the cellar"* and *"too wise, you are too wise you be I see you are too wise for me"* The latter was abbreviated to "2 Y's U R 2 Y's U B I C U R 2 Y's 4 ME".
The speed of typing was 50 Words per minute or 50 BAUD in digital format. Many competent typists can exceed this rate of typing. The printers were designed for this maximum speed.

Each day I had to listen out for the noon "boom" from the gun on Signal Hill and then check that the master clock in the CTO was correct, thus controlling all the clocks and the Blicks in the Post Office building and maintaining the correct time for the next 24 hours. The "Blicks" were manually operated machines used to stamp the time and date on each telegram as it passed through the system.

This "how-to" telegram episode took exactly one week and, after a last, yearning look at the other teens skating on their jobs, I embarked on the next stage of my Appy journey - an outside job assisting in telephone-line construction.

THE TALE (AND TAIL) OF A GEITJIE ...

This memorable (for me) "Appy action story" occurred, when in Cape Town. I was with the Post Office Telecommunications Division. I joined an outdoor/indoor telephone team to install a phone for a new subscriber in Tamboerskloof.

We had the use of a truck which carried all the necessary gear: the phone, outdoor bridle wire, indoor wire, staples, long ladder, six-foot survey pole, etc. - plus the ever-trusty blowlamp for making tea. The team comprised the electrician-in-charge, one young apprentice (yours truly) and two assistants.

The "external" part of the job went like this: there was an overhead suspender wire between six steel poles in the backyards of local residents. The bridle wire had to be fed through some clips on the suspender, spaced about eighteen inches or so apart. This we did by tying one end of the bridle wire to a six-foot survey pole and then feeding this through the clips. There were already other circuits connected on other bridle wire loops inside the clips and we had to make sure we did not interfere with them.

Still with me? Feeling the excitement building? Good!

We had to move the ladder along the suspender wire every 10 feet. With the two assistants holding it, I, as the apprentice, was appointed to climb up and down each time.

When the electrician and one of the assistants went into the house to finalise the indoor connection, the other man and I would have to connect the new external wire to the chosen circuit in the Cantop at the top of the telephone pole. This meant my climbing up the ladder again and making the connection to this new circuit.

With the remaining assistant holding the ladder, I donned a safety-belt (as per Standard Technical Instructions) and headed for the top, secured the belt round the pole and suspender wire and tested that it was safe holding my full weight on it.

It was just as well I did that because as I removed the cover on the Cantop, "something" jumped out of the cover and hit me on the chest. I didn't know what it was - and now, yikes! there were TWO things inside my shirt - wriggling. I feared snakes!

I let out a yell which resounded throughout the whole neighbourhood... lost my foothold... the ladder fell sideways over some bushes... and I was left hanging in the safetybelt!

Our team came to the rescue: the electrician and the two assistants replaced the ladder and I was able to remove my shirt and, hopefully, "release" the two critters wriggling inside. Turns out one was a geitjie (alias Gecko) which had jumped into my clothing and in its panic shed its tail, a clever distraction by these little creatures to avoid serious attack on themselves.

Happily, the geitjie fell on soft grass and would live to grow another tail!

Well, I finished the connection, still without my shirt which had fallen to the ground.
The telephone circuit worked well.

Looking back on Apprentice days ... and beyond!

continues from page 55

Overview: Forget the geitjie for a moment. This job took four men and many hours to install one telephone in a neighbourhood house. By comparison, in the present technological era a prescribed fee and contract is all it takes to have online cell-phone service in about 10 minutes to any part of the world!

RADIO...

and now I am a Qualified Electrician

In early 1950 after being chosen to study "radio" in all its aspects, I was stationed for six months at Klipheuwel, North-East of Cape Town.

It was the Transmitting Station for overseas radio communication, and local ship-to-shore transmission, whilst the receiving channels were based in Milnerton, just north of Cape Town.

During my posting at that base, I helped install various pieces of radio equipment, and learned a lot about transmitters and aerials.

Radio Transmission Equipment was fraught with danger as the voltages were at the level of 10,000 to 15,000 volts. It was high powered stuff and it generated powerful signals which were conveyed by overhead wires or coaxial cable to an array of aerials some of which were mounted on towers 300 feet above ground. Beaming information to London in the 300ft aerial case was considered "State of the Art"!

The actual transmitter was a SWB One unit (Short Wave Broadcast #1) - the earliest type of transmitter.

Earlier, on the same site, were aerials 800 feet high to carry much lower frequency channels in the same direction. After many amateur radio experimenters found that by going to higher frequencies, it was possible to transmit and receive the signals with smaller aerials.

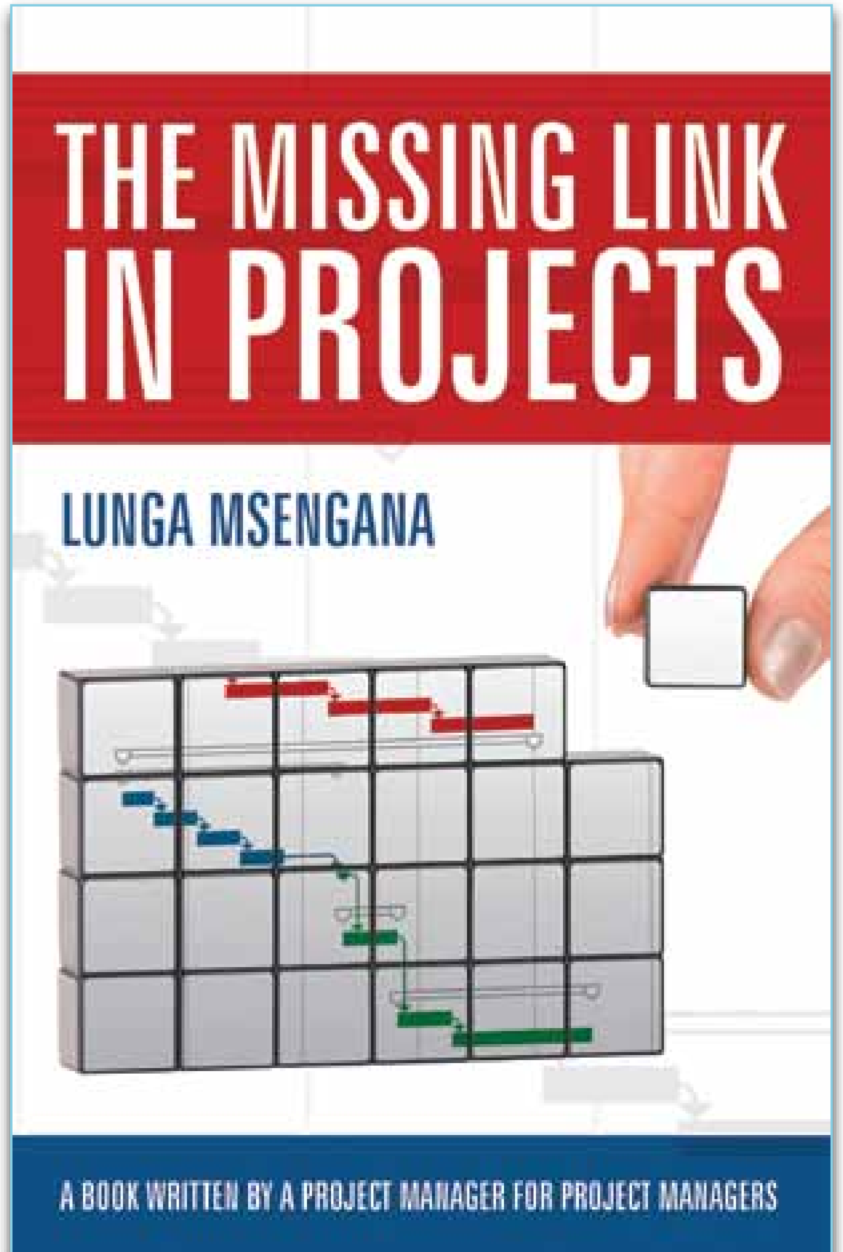
So the Industry followed suit and dismantled (or rather 'blew up') the stays of the 800 foot aerials which were becoming expensive to maintain. I have seen 800 foot aerial arrays in Rugby, in U.K. energised at 16.2 Khz giving communication to destinations around the world, including submarines under water! These are still in use today!

A "FELINE" ERROR

One of our First Grade Electricians, at Klipheuvel, had a cat, which would come looking for him in the station house when it wanted a titbit. This was usually a successful venture except on this one occasion when (regrettably) it walked under the fence inside the building (a six inch gap!). This fence surrounding the high voltage rectifiers and the cat's back touched the 10,000 volt live terminal whilst its feet were on a concrete slab indirectly connected to the station and system's "ground".

Needless to say the poor animal's paws were badly burnt and for months it was incapacitated. We all wondered - how many of it's "9 lives" had that cat lost? wn

BOOK GIVE AWAY



Just when we thought that everything that needed to be researched in project management had already been done, the author comes up with this captivating book that makes us re-evaluate our thinking. Indeed, the human aspect is the missing link in projects. If organisations deny this fact, they do so at their own peril. Project managers who fail to understand the 'people side' of projects or to collaborate with key project stakeholders and beneficiaries, will soon found themselves irrelevant and inadequate in their roles. Similarly, organisations can no longer afford to focus solely on the scientific aspects of running projects, as this is not sustainable. Sustainable results can only be achieved when there is a balance between the science and the art of project management, which the author clearly elaborates on.

Vuyani Jarana
Head of Enterprise Business Unit
at (Vodacom South Africa)

"The missing link in Projects" written by Lunga Msenga retails for R239 and is published by Knowledge Resources. Lunga gives full credit to the human factor in project management by acknowledging the vital role people play in the unfolding of projects. Project management has two main streams: the technical and the personal component. The personal component plays a greater role as it involves people, and people are the key to project success.

STAND A CHANCE TO WIN YOUR VERY OWN COPY OF "THE MISSING LINK IN PROJECTS" ANSWER THIS EASY QUESTION:

Project management has two main streams. Name the two components.

Send your answer to minx@saiee.org.za to reach me by no later than 28 February 2013.

SAIEE Membership Benefits

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

You simply cannot afford not to be a member!

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

APPLICATION REQUIREMENTS FOR SAIEE MEMBERSHIP

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

Many applicants do not read the list of requirements.

WE REQUIRE THE FOLLOWING DOCUMENTS:

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

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

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

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

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

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

2013 Membership fees

Rates as from 1st January 2013

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

NOTE

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

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

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

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

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

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

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www.saiee.org.za

Mentorship

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

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

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

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

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

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

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

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

SAIEE

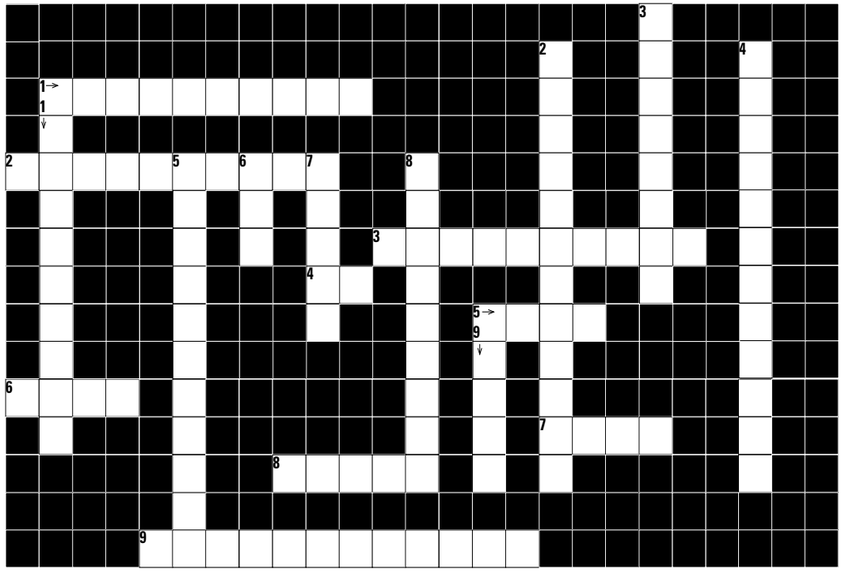
PROSPECTIVE SAIEE MENTORS

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

Have some fun and stand a chance to win R1000. Complete the February issue crossword puzzle and send it with your name, surname and contact details to: *Managing Editor, February 2013 Crossword Puzzle, P.O. Box 751253, Gardenview, 2047* or email it to *minx@saiee.org.za*. The completed crossword puzzle should reach us by no later than **28 February 2013**. The winner of R1000 will be announced in the April 2013 issue of the **watt**now magazine.

win R1000

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



ACROSS

1. What is coal, natural gas or petroleum also known as? (10)
2. Who installed the first electricity-generating wind turbine battery charging machine in July 1887? (5,5)
3. Electricity generated by dry steam power plants. (10)
4. Which windwheel is known as the first wind powering machine in history? (5,2,9)
5. Another name for a Giromill (4)
6. Vertical-axis wind turbines (abbr.)
7. Ocean Thermal Energy Conversion (abbr.)
8. Nuclear Energy Corporation of South Africa (abbr.)
9. A type of solid-state power generator which produces electrcity from radio-active decay. (12)

DOWN

1. Name 3 different power station types.
2. The practice of using exhaust or extracted steam from a turbine for heating purposess, such as rying paper, distilling petroleum in a refinery or for building heat. (12)
3. See 1 down.
4. A type of solid-state power generator which produces electricity from radioactive decay (12)
5. See 1 down.
6. Not no. (3)
7. See 4 across.
8. See 4 across.
9. A greeting.

November issue answers:
WINNER: TERENCE DEAN

ACROSS 1 Resistive **2** Surface Acoustic Wave **3** CRT **4** PDA **5** Haptic **6** Smartphones **7** ITO **8** Surface **9** Newton PDA

DOWN 1 Infrared **2** Fairlight CMI **3** Capacitive **4** EA Johnson **5** Samhurst **6** iPhones **7** Stylus **8** Elograph **9** SAW

Calendar of events

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

FEBRUARY 2013

4-5	CSP South Africa 2013	Pretoria, RSA	www.csptoday.com
4-7	African Mining Indaba	Cape Town International Convention Centre	www.miningindaba.com
19-21	Africa Energy Indaba	Sandton Convention Centre	www.energyindaba.co.za
21-26	16th Biennial International Symposium on Toxicity Assessment	MSC Opera, Cape Town	www.naturalscience.co.za
25-28	2013 IEEE International Conference on Industrial Technology	Cape Town International Convention Centre	www.icit2013.org

MARCH 2013

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

APRIL 2013

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

MAY 2013

4-6	Led Expo Mumbai	Mumbai, India	www.biztradeshows.com
8-9	Electrical Manufacturing and Coil Winding Expo	Frontier Airlines Center, Milwaukee, USA	www.biztradeshows.com
14-15	African Utility Week	Cape Town International Convention Centre	www.african-utility-week.com

ADVERTISER LISTING

PAGE	COMPANY NAME	CONTACT DETAILS	WEBSITE
2	Technology Integrated Solutions (TIS)	011 635 8000	www.tis-sa.com
7	CSP Today South Africa		www.csptoday.com/africa
11	Ana-digi Systems	011 658 1337	www.anadigi.co.za
17	Cummins	011 321 8700	www.cumminspower.com
35	Nynas	010 590 1052	www.nynas.com
45	Reliable Transformers	011 421 2333	www.reltrans.co.za
45	Electrogreen	011 249 5000	www.em.co.za
56	Comtest	011 608 8520	www.comtest.co.za
61	Bergman Fisher Associates	011 679 3481	www.bergmanfisher.co.za
68	Earthrings	031 461 4411	www.wykosa.co.za

BOOK GIVE AWAY

FIFTY SHEDS OF GREY: A PARODY

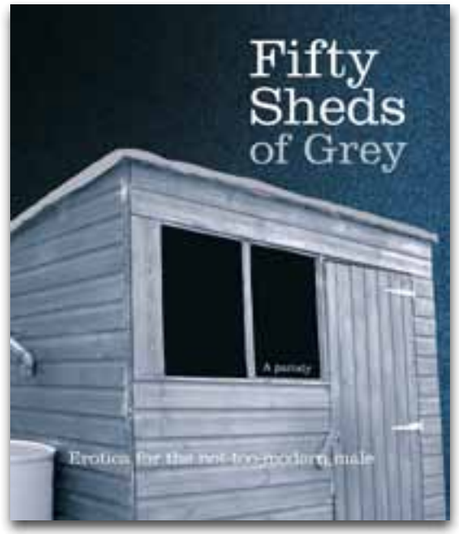
Written by C.T. Grey

A compilation of shed erotica for the not-so-modern man.

'Hurt me!' she begged, raising her skirt as she bent over the workbench.
'Very well,' I replied, 'You've got fat ankles and no dress sense.'

Colin Grey's life was happy and simple until the day everything changed - the day his wife read THAT book. Suddenly, he was thrust head-first into a dark, illicit world of pleasure and pain. This is the story of one man's struggle againsta tide of tempestuous, erotic desire and of the greatest love of all: the love between a man and his shed.

WARNING:This book contains graphic shed-based images. Please don't look if you are easily offended.



STAND A CHANCE TO WIN YOUR VERY OWN COPY OF "FIFTY SHEDS OF GREY" ANSWER THIS EASY QUESTION:
WHICH BOOK IS THE AUTHOR REFERRING TO WHEN HE SPEAKS OF 'THAT' BOOK?
Send your answer to minx@saiee.org.za to reach me by no later than 28 February 2013.

SAIEE COUNCIL MEMBERS

SAIEE COUNCIL MEMBERS

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Chairperson - Power Section	Thandiwe Nkambule	011 629 5158	thandiwe.nkambule@eskom.co.za
Chairman - Historical Section	Max Clarke	011 476 5925	mppc@mweb.co.za
IEEE Representative	Prof Willie Cronje	011 717 7224	willie.cronje@wits.ac.za
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Chairman | T.C. Madikane

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