wattnow

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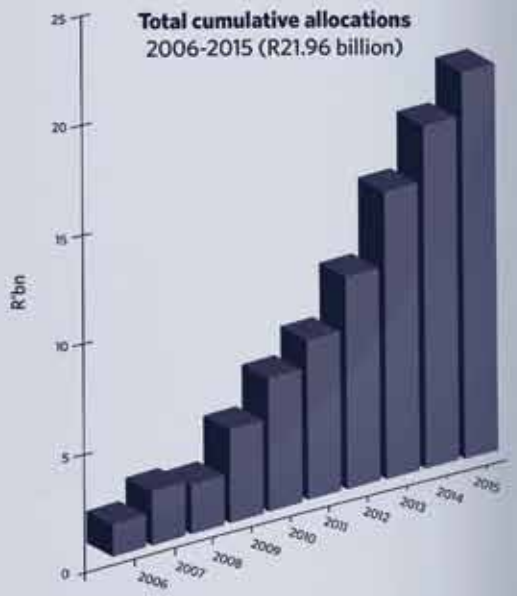
PRESIDENTIAL ISSUE

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | **MAY 2016**

WE'VE SHARED ALMOST R22 BILLION IN PROFITS WITH OUR MEMBERS OVER THE LAST 10 YEARS



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REGULARS

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wattnow

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Immediate Past President	André Hoffmann
Honorary Treasurer	Viv Crone
Honorary Vice President	Chris Ramble
Chief Executive Officer	Stan Bridgens

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5906

May starts with a big **M** – for Mother! We celebrate Mother's Day on the 8th of May, and for those of you, my faithful readers, who might've forgotten, go and get that gift for her! She surely deserves it!

I'm very excited with this issue of **watt**now – not only are we sporting the 107th SAIEE President, Mr TC Madikane, on the cover, but we are talking big science and inventions from South Africa, in this issue! Yes we are Proudly SA!

You will find TC's inaugural address on page 6, which leaves you quite enthused and ready for BIG things – therefore the sub-theme – BIG Science!!

Our first feature article, on page 30, talks about South African inventions, which is quite remarkable. It fills you with pride to know that the world still has a lot to learn from us!

Page 36 sports an article about a Wits Electrical Engineering Graduate and a large South African Cyclotron! This is an extremely interesting, and historical article, to show that our inventions, and intentions, did not just happen recently.

May is jam-packed with events. TC Madikane will be visiting the KZN, Mpumalanga and Bloemfontein centres. See page 61 for more detail and make time to visit and to meet him.

I'll be giving a talk at the Sunflower Fund's Mother's Day Breakfast on the 8th of May, taking place at Fairway Hotel, Spa and Golf in Randburg, JHB. Visit www.sunflowerfund.org.za to book your seat! I hope to see you there.

The Carolinas Energy Associates are hosting a two-day, CPD accredited workshop on the 14-15th of June at our head office in Johannesburg. An early bird discount applies. If you book before the 13th of May, you receive R500 off the registration fee. Book now to avoid disappointment. For more info, visit www.saiee.org.za/events.

Happy Mother's Day - to all my 'mother' readers. YOU - are the pillars of society, enjoy your day off!

Herewith the May issue, enjoy the read!

Minx

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

DYNAMIC REACTIVE POWER COMPENSATION SYSTEMS

Many installations have been done internationally, including a large Wastewater treatment plant in South Africa.

The Equalizer - ST, medium and low voltage motor startup solution

The EQUALIZER - ST is a real-time, dynamic reactive power compensation system that utilises a proven industrial technology to provide an additional solution for the challenges related to large motor startups. The system itself operates at a low voltage and by utilising a step-up transformer, the EQUALIZER - ST is also able to compensate for medium voltage networks.

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- Significantly Reduces the Startup Current, thus Securing a Safe & Succesful Motor Startup;
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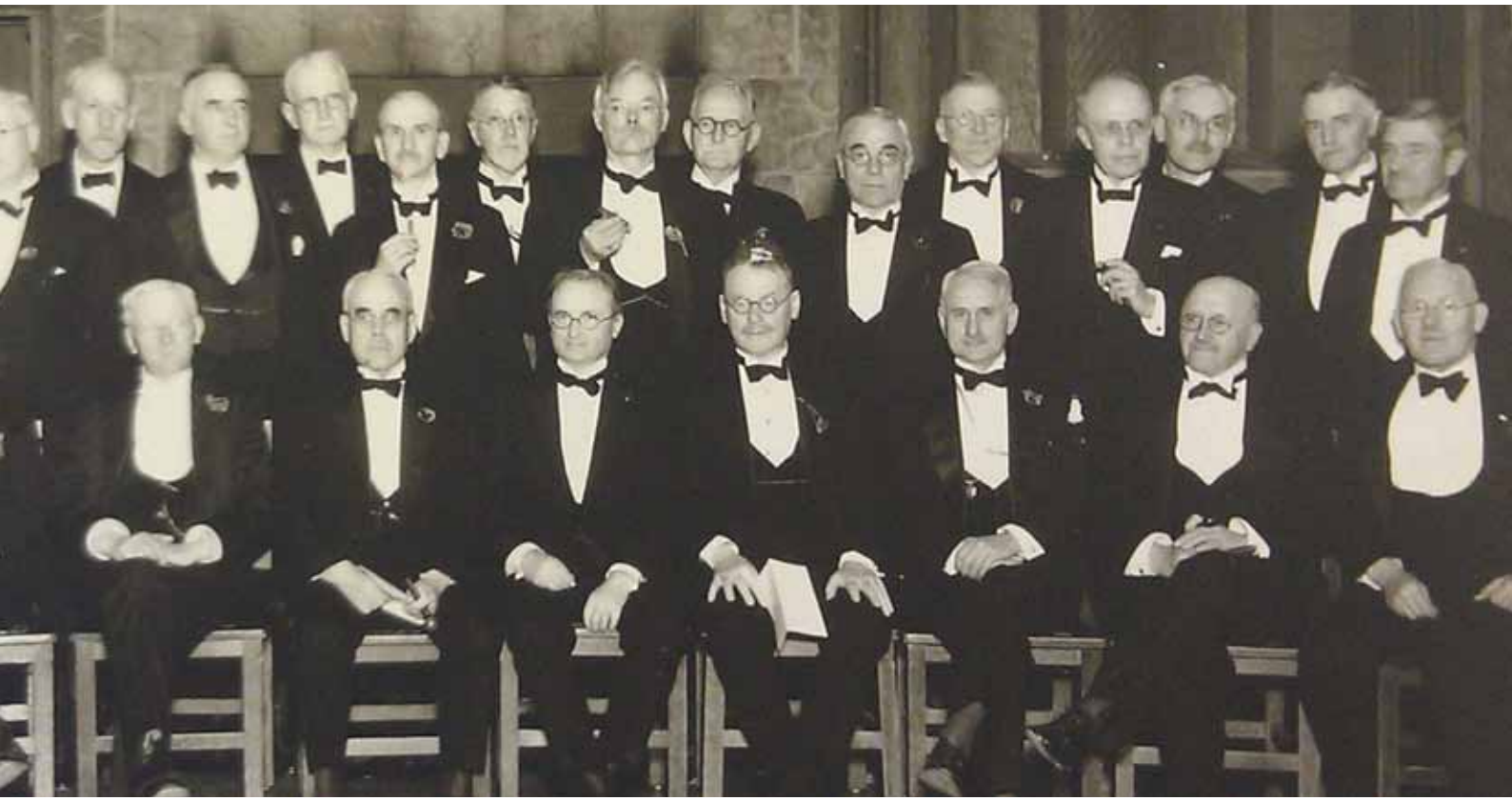
TC MADIKANE
2016 SAIEE PRESIDENT

It is a great honour and pleasure to have been elected as the 107th President of this prestigious institute, the South African Institute of Electrical Engineers (SAIEE).

Are Voluntary Associations still relevant or are they Old Boys' Clubs?

I am humbled to be given an opportunity to lead this esteemed organization, taking the reins after so many successful leaders that have shaped our institute to what it has become today. Very importantly, I would like to thank my family and Igoda Projects, my company, for allowing me to participate in the activities of the institute. A special thanks also goes to the immediate Past President, André Hoffmann, for the remarkable contribution he has made to the SAIEE.



It is important that, as an institute, we reflect on a role played by Voluntary Associations (VAs) in particular, as there are varying perceptions around their relevance in this day and age.

According to Wikipedia, VAs are defined as "a group of individuals who enter into an agreement as Volunteers to form a body to accomplish a specific purpose". An example of such groupings with common interests includes, but is not limited to, trade unions, learned society, environmental groupings, etc. In 1909, a group of Electrical Engineers had a common interest to promote electrical engineering and its application. We salute the vision of our founding members.

In the early 90's, I joined SAIEE as a student member. I was attracted to free dinners provided after the monthly meeting in G01 at University of Natal - Durban Campus. Soon I was in a student leadership role within the institute, and I haven't yet found one reason to terminate my membership.
In 2007, I became part of the SAIEE council and participated in Sub Committees and, to my amazement, I discovered that the dedication of Council Members who were prepared to meet every first Friday of the month, to deliberate on matters that add enormous value to members, and to the Electrical Engineering fraternity! I was really inspired.

I then served the institute as the KZN Centre chairperson in 2011 and 2012 - that was an eye opener for me. One cannot put any price on the lessons learnt from members all over the country, and the networking opportunities available through direct participation in the different structures of the organization.

Now, this brings us to the relevance of VAs and their role. Maybe the first place to start would be to compare South Africa to other developing economies in the BRICS (Brazil, Russia, India, China and South Africa) group of countries. Focusing on BRICS countries would give us an appropriate impetus, considering that all the BRICS countries fall within the so-called developmental states. What role is played by Engineering Councils and VAs in these similar countries? Is there something we can gain from such a comparison?

The critical role played by South Africa globally, in the engineering fraternity, is clearly indicated in Figures 1-4, which reflect the contributions made by our country in the global space. The pictures depict the role of the different countries in the signing of the education accords and competency agreements. Regarding education accords, signatories have full rights of participation in the Accord, qualification accredited or recognized by each signatory as being substantially equivalent to accredited or recognized qualification within its own jurisdiction.

Regarding the competency agreements, Members have full rights of participation in the agreement and each member operates a national section of the International register. Registrants on these national

Figure 1: Washington Accord

Figure 2: International Agreement Engineers Agreement

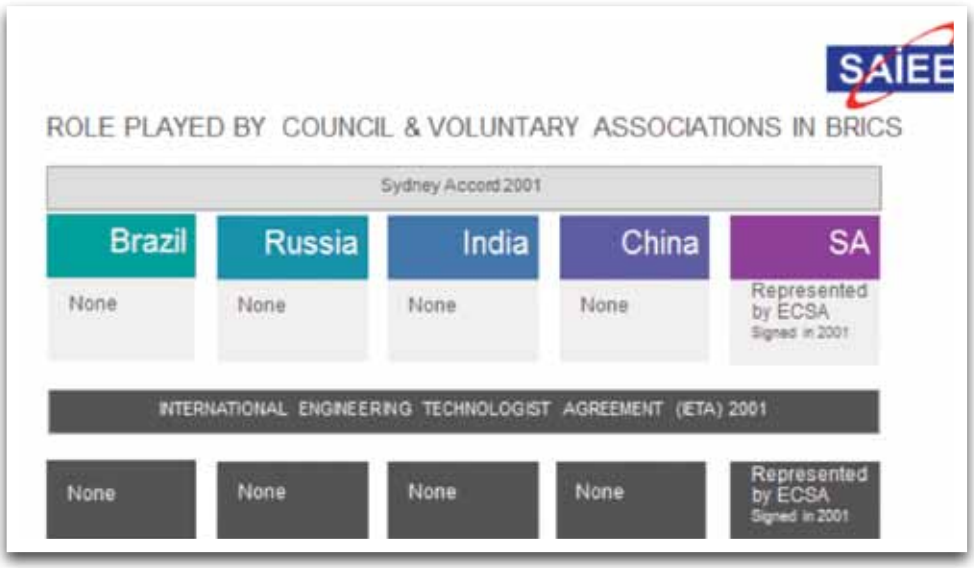


Figure 3: Sydney Accord and International Engineering Technologist Agreement

sections may receive credit when seeking registration in the jurisdiction of another member.

It is important to note that South Africa is the only country within the BRICS that was either an original Signatory, or the first ones to sign accords. That is also applicable to the competency agreement membership. In South Africa, the Engineering Council of South Africa (ECSA) handles both the education accords and competency agreements, as opposed to other countries, where they are represented by the different bodies. In India for example, for the Washington Accord, they are represented by the National Board of Association and, for the International Professional Engineers Agreement, are represented by Institute of Engineers India. The Institute of Engineers India has 15 engineering divisions that falls under them, and it plays the role of VAs.

The point to be noted, is that South Africa has done well in the international space, due to the involvement of VAs assisting ECSA to maintain its status over the years. Definitely the VAs are still relevant, and are playing a major role in the engineering fraternity. At the International Engineering Alliance Meeting last year in Istanbul, Turkey, South Africa made an impact where an Agreement for International Engineering Technicians (AIET) was signed. Dr K Jacobs from South Africa was elected as the first Chair of the AIET and the other countries that signed the agreement were Australia, Canada, Ireland, New Zealand, and the United Kingdom.

Now let us zoom into the relationship that exists between ECSA and VAs in South Africa. Firstly, VAs apply for recognition in terms of section 36(1) of the Engineering Profession Act, 2000, and are recognized by the council in terms of Section 23(3) of the Act.

A great benefit to all VA's for recognition by ECSA, is the fact that registered members of a Recognized VAs (category A and B

only) enjoy partial exemption of payment of their ECSA annual fees. There are currently 48 VAs recognized by ECSA and the recognition is valid for 5 years. It is also important to differentiate the important roles played by both parties, namely;

ECSA is a statutory body, with the primary role of regulating the engineering profession. Its core functions include accreditation of engineering programmes, registration of professional professions, and regulation of the practice of registered persons.

VAs, on the other side, provide a networking vehicle for engineers, technologists and technicians. Members are provided with various means of assessing information, including seminars, symposia, workshops and more. VAs further provide members with platforms for publication of technical papers and research in industry magazines.

I would, however, like to stress that the important relationship that exists between ECSA and VAs should continue to be nurtured and developed.

SAIEE: A GOOD STORY TO TELL.

Coming closer to home, I believe SAIEE has a good story to tell. Since its establishment in 1909, our Institute has built a strong reputation, and is well-respected by VAs internationally. An insurmountable work and effort has been put in place to make this institute the success it has become. The question to ask though, is whether the SAIEE has embraced transformation and aligned itself with the socio-economic environment within which it operates? I believe the answer is a bold yes, although there is much still to be done.

SAIEE has been at the forefront of transformation! This was clearly demonstrated when the Institute appointed its first female president, Ms Marie Davison in 1995 and ten years later, Professor Beatrys Lacquet became the second female president – and I think this should make us proud. Since then our

Figure 4: Dublin Accord and Agreement for International Technicians

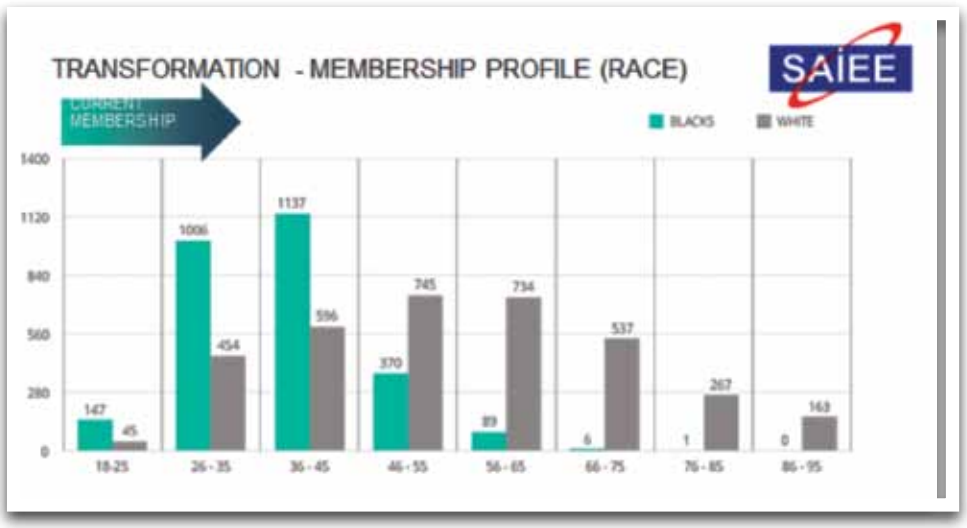


Figure 5: Membership profile by race

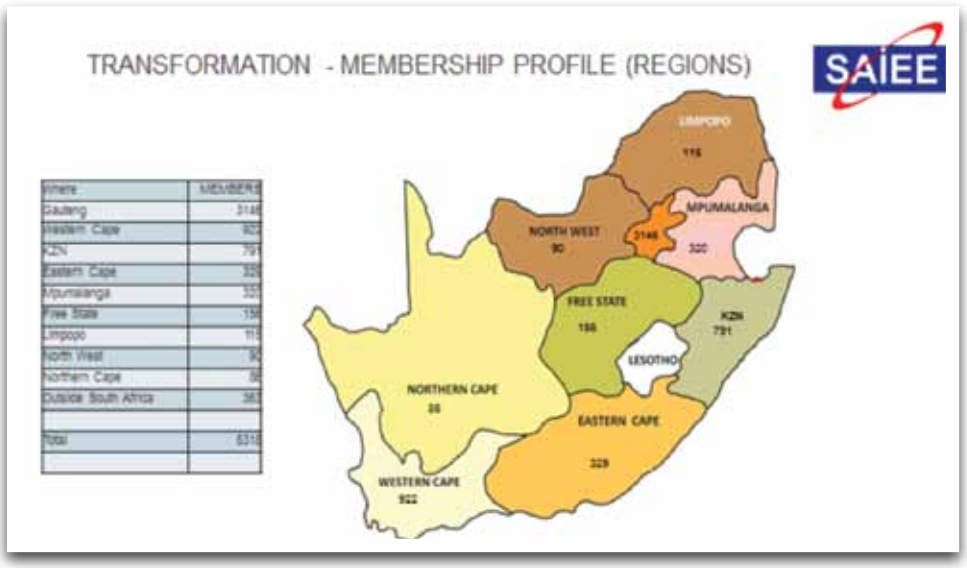


Figure 6: Membership profile per region

Council continues to put transformation of the institute high on their agenda. The current Executive Committee has two females leading strategic sub committees namely, Professional Development and Event & Marketing.

We have since seen an exponential growth in female membership within the institute. Some are actively involved in various committees and subcommittees of the institute. The total number of females in our membership stands at 602, with 215 aged between 26 – 35 years, as of February 2016.

Figure 5 indicates that, as from the age of 66 onwards, there is not much that can be done, and that is history. Of particular interest is that from age 26 to 45 there are more black members joining our institute.

This outlook is positive, and it is my goal to see an increase in SAIEE membership during my tenure as a President. Importantly, Gauteng enjoys over 50% of total membership.

There is a tendency for organizations to have its leadership and all activities centered on Gauteng, but SAIEE has had four Presidents residing outside Gauteng. That started with Rod Harker in 1996, Bob Hayes in 2000, Pat Naidoo in 2014 and in 2016 TC Madikane.

One of the notable change done by SAIEE was an amendment of the constitution to ensure that that the composition of Council accommodates a category of members, not only Fellows and Senior Members. That change was noteworthy in ensuring that young black members are also able to participate on SAIEE's Council.

I believe that communicating the successes of our programs should be a priority, and herein below I want to highlight some of what I consider as great interventions presently undertaken by the Institute, and I refer to as a 'Good Story to tell":

- **Mentorship Programme:** There are more than 80 mentors available and willing to assist candidates that desire to register with ECSA.
- **Outreach Programme:** In 2007, the Institute supported the Bergville outreach Programme, and continues to produce excellent results. In 2015, 53% of scholars achieved Bachelor Pass in over 34 schools in Bergville area. We salute Nhlanhla Maphalala, former Council Member, and Viv Crone, Past President, who are Pioneers of this programme, amongst others. We are grateful of contribution done by our Past President, Andries Tshabalala who donated the mobile trailer that is used in the outreach programme.
- **Bursaries:** The institute has issued more than 80 bursaries worth more than R4 million. To address #FeesMustFall, in 2016 SAIEE increased the number of bursaries to 15.
- **Corporate Membership:** SAIEE has eleven Corporate Partners that have signed up as members.
- **Continuing Professional Development (CPD):** In 2015, SAIEE had 30 courses with 400 attendees. 50 CPD ECSA credits were available to be gained by Members.

Below are my key goals as 2016 SAIEE President:

Goal 1: Increase Membership by 20%

- Stronger Collaboration with ECSA: about 55% of professional registered Electrical Engineers, Technologists and Technicians are not members of SAIEE;
- Increase the Student Chapter Program and ensure that they are active, and get support from various stakeholders; and
- Enhance corporate participation by increasing the pool of Corporate Partners, especially companies that are led by Electrical Engineers.

Goal 2: Create an Enabling environment to Plough Back

- Encourage and assist members to register with ECSA. Members who are professional registered are able to be part of registration committees, undertake Professional Reviews, participate in University accreditation and more;
- Inspire members to offer courses within their area of specialization, and encourage members to write technical papers for our wattnow magazine; and
- Ploughing back is a rewarding way to develop interpersonal skills, build interpersonal skill, build new professional relationships, and apply your knowledge to assist others.

Goal 3: Take the lead in energy efficiency initiatives

- Electrical Engineers to become Ambassadors of energy efficiency initiatives;
- Members to take the lead in behavioural change, and save energy in their private space and work environment;
- Enhance Industry Participation through stakeholder engagement on energy matters; and
- Continuous Innovative ways of energy savings by working closely with academic institutions to encourage research.

I would like to conclude by saying that I still believe that Voluntary Associations, such as the SAIEE, are not only just relevant, but they have far more essential roles in the society than the notion of old boys clubs.

SAIEE has evolved, and is embracing the changing environment. It has adapted to the needs of the society, and continues to play an important role, both internationally and locally. It continues to contribute positively to the lives of the community from which its members come. It is against this background I encourage each and every member of the institute to **#ploughback** and **#makeithappen.**

Since my inauguration on the 5th of April 2016 at the AGM, I have been delighted and grateful for the messages of support received via social media, telephonically and formal letters. Letters received from ECSA, NSBE (SA) and MUT ……..

ENGINEERING COUNCIL OF SOUTH AFRICA

ECSA

12 April 2016

SAIEE House,
18a Gill Street,
Observatory,
Johannesburg

Attention: Mr TC Madikane

Dear Mr TC Madikane

RE: CONGRATULATIONS ON YOUR APPOINTMENT AS SAIEE PRESIDENT

On behalf of the President of the Engineering Council of South Africa, the Council and staff, we would like to extend our congratulations on your appointment as President of the ECSA recognised Voluntary Association, South African Institute of Electrical Engineers (SAIEE).

As ECSA, we believe that your appointment as the President of SAIEE will take the organisation to new heights. May I take the liberty to bring to your attention that ECSA has taken a strategic position to strengthen working relationship with its recognised Voluntary Associations.

Best of luck in your new position as we look forward to a fruitful working relationship for the duration of your tenure.

Yours faithfully,

Sipho Madonsela, Pr Eng
Chief Executive Officer

www.ecsa.co.za

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P.O. Box 12363 Jacobs 4026 Durban Tel: 031 907 7348 eMail: MbongwaL@mut.ac.za

08 April 2016

Mr TC Madikane
Managing Director
Igoda Projects
7 Sinembe Crescent
Umhlanga
4319

Dear Mr Madikane

Congratulations on your appointment to lead the South African Institute of Electrical Engineers

Thank you for sharing the good news and I hope it's not too late to congratulate you for this well-deserved strategic role of leading such an esteemed institute.

The Alumni Relations office at Mangosuthu University of Technology, extends hearty congratulations on your election to the position of President for the South African Institute of Electrical Engineers (SAIEE). Commitment, confidence and accomplishment are the things that we have always assumed to be synonymous with your character.

We are very proud of our graduates and would like to share your success with our stakeholders. Lisa Mbongwa, the Alumni Relations Officer will be in contact with your office to schedule an appointment for an interview for a comprehensive profile of your great work to be published in our quarterly newsletter.

Let me once again reiterate my sincere congratulations on your success. Best wishes for continued success in your career.

Yours sincerely

Zama Sishi (Ms)
Director: Stakeholder Relations Management
Contact: 031 907 7161; zama@mut.ac.za

NSBE (SA)

NATIONAL SOCIETY OF BLACK ENGINEERS OF SOUTH AFRICA
"BRIDGING THE ENGINEERING SKILLS GAP"

NSBE SA, No1 Somerset Office Park, 5 Libertas Road, Bryanston, 2191
P O Box 591, Parklands, 2121, SOUTH AFRICA Tel: (011) 463 1222 Fax: (011) 706 5354
Email: admin@nsbe.org.za Website: www.nsbe.org.za

6 April 2016

President
South African Institute of Electrical Engineers (SAIEE)
P O Box 751 253
Gardenview
20147

Dear Mr. Madikane

Subject: Congratulations on your new role as President of the South African Institute of Electrical Engineers (SAIEE).

It gives us great pleasure as the National Society of Black Engineers (NSBE) to see one of our former leaders ascending to the highest office within the ranks of the institute for electrical engineering.

We believe that you will make a meaningful impact to strengthen academic research, manufacturing, electronics, telecommunications, measurement and control, mining, and power infra-structural services in South Africa.

Your contributions to the quality of life in our communities and the advancement of technology and the efforts will be highly acknowledged in many countries of the world. Our existence and that of yours within your role will hopefully strengthen our close co-operation in the sector.

This note serves to confirm our excitement and loyal support in your new role.

Best regards,

Caesar Mtetwa

1

WATTSUP

SAIEE Annual General Meeting

At the recent SAIEE AGM which took place at the Military Museum in Johannesburg on the 5th of April 2016, Mr TC Madikane was inaugurated as the 2016 SAIEE President. The 2016 Office Bearers are: TC Madikane, SAIEE 2016 President; Jacob Machinjike, Deputy President; Dr Hendri Geldenhuys, Senior Vice President; George Debbo, Junior Vice President; Chris Ramble, Honorary Vice President; and Viv Crone, Honorary Treasurer.

This auspicious event saw co-authors Prof Ian Jandrell and Andrew Swanson receiving the Best Paper Award, for their paper titled "Investigation into the Role of Singlet Oxygen in Positive Corona in Air", which was published in the December 2015 issue of the Africa Research Journal.

After the financials were reported on, TC presented his inaugurational speech - which you will find on page 6.

The event ended with networking and a cocktail party.

2016 SAIEE President, TC Madikane

Prof Ian Jandrell, receiving the Best Paper Award from André Hoffmann

AGM guests with Viv Crone, Honorary Treasurer

Mike Little, Mike Crouch and Dr Angus Hay

Thembo Dau and Hope Mashele

Mike Little and Prof Ken Nixon

Michael Etterschank (UJ Robotics) and Mike Barker

Gerda Geyer and Pascal Motsoasele

Mr Sicelo Xulu, CEO, Citypower (middle) - a thorn amongst the roses

Guests

Ele Ndlovu and Max Chauke

Wayne Fisher and Prince Moyo

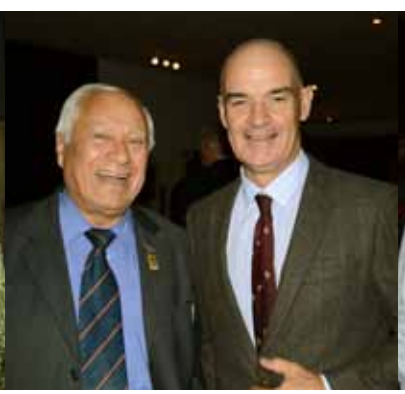
Stephen Koller and William Stucke

TC Madikane, Margaret & Mike Cary

Jack Rowan and Dr Hendri Geldenhuys

Maanda Ramatumbu and Thembo Dau

Liz van Niekerk, André Hoffmann and Janine Meyer-Hoffmann



Stan Bridgens (CEO SAIEE) and Vaughan Rimbault

Nhlanhla Mapalala, Paul van Niekerk and Andries Tshabalala

WATTSUP

Demand for quality cable is growing

Doug Gunneweg
MD | Helukabel

International cable and accessories manufacturer and distributor, Helukabel, is growing beyond bounds in South Africa necessitating a second move to considerably larger premises in just six years since entering the local market.

Escalating demand for its products has once again prompted the company to seek larger warehousing and operations facilities, this time in the more centrally-situated Lazer Park industrial area north of Johannesburg.

The new premises will span more than 6000m² with separate receiving and despatch areas able to facilitate multiple delivery and despatch vehicles simultaneously.

Managing Director, Doug Gunnewegh, ascribes the rapid growth of the local operation to a strong trend towards quality approved cables that meet both local and international standards. Another key to the company's success is its high availability of stock and ability to stock sufficient product to meet customers short and medium term requirements.

"Just like our counterparts in Germany, we have made room to significantly expand our storage capacity and ensure that most items required locally are available ex-stock. On rare occasions that we may not have stock of a particular item, our logistics systems worldwide are able to slash delivery times to us and so ensure our customers get what they want when they need it," says Doug.

GARY
WILLIAMS

MBA Sustainable Business (Renewable Energy)
Certified Master Inspector (CMI) - InterNACHI
Reg. Cert. Eng. (ICMEESA member 55833)
www.carolinasenergy.com

Gary's more than 25 years worth of combined experience in the engineering profession, energy management training, and renewable energy business has built a solid foundation for the establishment of energy efficiency and sustainability consulting company, Carolinas Energy Associates and Sustainability Consultants, LLC. This versatile leadership has been demonstrated with a consistent track record creating value in manufacturing, renewable energy, data management, technology through innovation, process improvement and developing results- orientated organisations.

As previous Chairman of the Eastern Cape Branch of ICMEESA (Institution of the Certificated Mechanical and Electrical Engineers of South Africa), Gary inspired and engaged engineers to deliver measurable results in the engineering and energy eficiency sectors. This passion led to his appointment to establish and manage Eskom's Industrelek Energy Test and Demonstration Centre in Port Elizabeth, South Africa. Since moving to the USA in 2001, he has worked closely with many industrial and commercial organisations to improve their production efficiencies in the usage of energy significantly.

Notably, Gary worked with Continental Tyres, both within South Africa and the USA, to improve the company's energy ef ciency and clean up the environment by reducing CO2 emissions, resulting in huge savings for the business. His ENERGY STAR partnership and consulting work continues to guide organisations to deliver excellence in creating, enhancing and sustaining their "triple bottom line"; people, planet, and profit.

Collaboration in South Africa's first hydrogen fuel cell forklift and refuelling station

In partnership with the University of the Western Cape (UWC), Implats unveiled its prototype hydrogen fuel cell forklift and refuelling station at its Impala Refining Services in Springs.

The three-year project commenced in 2012 and was a collaborative effort between Impala Refining Services, Hydrogen South Africa (HySA) Systems (hosted by the University of the Western Cape) and the Department of Science and Technology, Over the last three years, Implats funded HySA Systems a total of R6 million towards the development of a fuel cell-powered prototype forklift and refuelling station.

A fuel cell forklift prototype has been in operation since October 2015 within the dispatch area at the Base Metals Refinery (BMR) situated at Impala Refining Services in Springs. Implats plans to use hydrogen fuel cell technology as its main source of energy for material handling and underground mining equipment. The initiative involves building local skills in the development of hydrogen and fuel cell products and co-funding the development of the prototype forklift and refuelling station.

Fuel cells are a family of technologies that use electro-chemical processes rather than combustion to produce power. The technology will significantly enhance ventilation requirements, and reduce heat, noise levels, and noxious and sulphide emissions underground.

The metal hydride system brings with it significant benefits. It allows for the forklift to operate at lower pressures of 180 Bar, improving vehicle safety and costs (the cost of the local refuelling station is around R 2 million vs € 500 000 for an international system). The forklift also has lower noise levels, and longer operational times between refuelling, ensuring increased productivity – there is sufficient fuel for two to four days before hydrogen refuelling is required, and the refuelling itself takes only seven minutes. This investment is a result of over a decade of continuous discussions and negotiations between various parties who saw the energy potential and safety in this new technology.

WATTSUP

DEHNcheck camera enables technicians to see the hidden

Tracing electrical wiring in walls or anywhere else can be a tricky task, one that involves more than just looking for the visible and non-visible wires. To figure out exactly where the wires are, one would also have to look for the outlets and appliances to which each wire connects.

Furthermore, you would need to figure out which circuit breaker applies to which section of the building wiring. Fortunately, with the right tools and techniques, you can effectively and safely trace wiring without causing any damage.

The DEHNcheck camera brings the invisible to light, and thus allows for safe inspections and easy handling, via a radio link, to smartphones or tablets. The portable inspection camera can be used for regular visual inspections and for documenting the state of electrical installations up to 36 kV / 15 to 60 Hz. The device can easily and safely be operated by electrically skilled workers through the use of WiFi, and practically controlled via an application on smartphones or tablets.

Photos are wirelessly transmitted via a WiFi connection and, when is used in combination with the extendable insulating sticks from DEHN, the camera maintains the required safety distance. The flexible operating head is able to reach and document areas of the installation that are difficult to access.

The DEHNcheck camera comes as a complete set supplied in a case. It consists of a camera with battery, USB cable and smartphone attachment, housing, adapter with gear coupling and transport case and can be used for visual inspections of electrical installations with nominal voltages up to 36 kV / 15 to 60 Hz.

For more info, visit www.dehn-africa.com

POWER-GEN & DistribuTECH Africa

19-21 July 2016
Sandton Convention Centre
Johannesburg, RSA

POWER-GEN & DistribuTECH Africa conference & exhibition will be held from 19-21 July 2016 at Sandton Convention Centre, Johannesburg, Republic of South Africa.

Under the theme "Creating Power for Sustainable Growth", this premier event will cover all aspects of power from conventional and renewable generation to supply and delivery.

Energy professionals will have the chance to partake in world-class conferences sessions, guided technical tours of Eskom communication and plant facilities and comprehensive exhibition floor showcasing the latest technological developments by leading African and international companies. Student and young professionals will also be showcasing their entrepreneurial ideas at the EON GEXX Theatre sponsored by EON Consulting.

The complimentary B2B Matchmaking service with a highly targeted approach as well as the Opening Reception sponsored by Amec Foster Wheeler, Networking Reception sponsored by EPK and Closing Reception & Best Paper Awards sponsored by Edison Power Group, will provide outstanding opportunities for all attendees to interact and network with peers, colleagues and high-level industry professionals.

Join us at this highly renowned event for the chance to meet with over 2,500 industry professionals from 80 countries. To register or for further information, visit www.powergenafrica.com

POWER-GEN AFRICA
DISTRIBUTECH AFRICA

An important value-added service offering from WTA is its suite of structured transformer maintenance programmes that allow customers to protect these assets from degradation.

WEG Transformers Africa Growth Continues

WEG Transformers Africa, a division of Zest WEG Manufacturing, is determined to continue growing its share in both the South African and African transformer markets.

Louis Meiring, chief executive officer at Zest WEG Group Africa, says the acquisition last year of Heidelberg-based TSS Transformers facilitated immediate access to additional facilities as well as best-in-class technical skills. "Upskilling ourselves in this critical market sector and increasing our local manufacturing base was a strategic move that will see greater involvement from Zest WEG in this industry," Meiring says.

Zest WEG Group is owned by Brazil-based WEG and this significant investment in local manufacturing highlights WEG's financial commitment to its local operations. Meiring says the acquisition was in line with the international player's intention to expand its global network of businesses and manufacturing plants. The WEG Group aims to increase its sales year-on-year by a minimum of 17% until it reaches an annual turnover of US$ 10 billion in 2020.

WEG Transformer Africa (WTA) operates two major facilities and is poised to reinforce its position as a leading African manufacturer of electrical equipment. The last two years has seen the recapitalisation of the WTA Wadeville operation. Andre Mans, COO of WTA, says that this extensive investment programme has seen the facility undergo a complete makeover with the upgrading of equipment and streamlining of processes. "Today, WTA Wadeville is a modern operation that boasts best-in-class production and manufacturing capabilities," he says.

Developing Southern Africa's Electricity Sector

Promethium Carbon has launched their Independent Power Producers Guideline, together with the Electricity Market Reform in Southern Africa Report.

"The aim of the Guideline is to assist prospective Independent Power Producers (IPPs) navigate through the procedures that are required to license new electricity generation facilities within Southern Africa," said Promethium Carbon director, Robbie Louw.

The Guideline outlines the background policies and regulatory processes for IPPs to obtain generation licences. The guide was formed by interviews with relevant government departments, energy regulators, industry associations, independent power producers, available legislation and published literature.

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

From left: Dr Philip Goyns and Robbie Louw, Promethium Carbon; Sisa Njikelana, chairperson, SA Independent Power Producers Association; Harmke Immink, Promethium Carbon; and Peter Boxer, deputy British High Commissioner.

WATTSUP

Cummins showcases QSK95 at PEWA 2016

Cummins, a global power leader and corporation of complementary business units that design, manufacture, distribute and service diesel and natural gas engines and related technologies, showcased the long-awaited QSK95 Series of high-horsepower generator sets at Africa's highly acclaimed Power & Electricity World Africa (PEWA) Exhibition. PEWA is the annual forum where industry professionals gather to acquire ideas on developing sustainable, clean and bankable world class energy for projects on the continent.

The QSK95 is specifically designed and engineered for critical applications that demand a robust, reliable source of power to ensure uninterrupted operations, for applications such as hospitals, sports stadiums, office buildings, data centers and the like. For operators that seek to maximise uptime, the QSK95 Series of generator sets exceeds industry standards by providing 100 percent, one-step load acceptance in less than 10 seconds. Commenting at the launch, Andre Kuhn, GM of Power Generation for Cummins Southern Africa said, *"This incredible innovative product enjoys ratings of up to 3,500kW and delivers high-horsepower output while achieving installation economies with an innovative small-footprint design. Innovation is about unlocking and unleashing new ways of thinking, doing and delivering against a background of continuous improvement. We are very excited about bringing this product to the Southern African market, especially in light of the current energy situation."*

Andre Kuhn
General Manager
Power Generation
Cummins Southern Africa

Kenneth Gaynor, PowerGen Leader Southern Africa concluded, *"Innovation is more than a word at Cummins, it is also a value that we live by. It is our pledge to our customers that we are committed to bringing them innovative, sustainable and reliable power solutions. More Dependability. It's what we call The Power of More."*

Master Power Technologies establishes a branch in Namibia

Master Power Technologies, power solution and data centre specialist, has recently opened a branch in Windhoek Namibia, as part of its plan for growth in Africa. The operation officially opened on 1 March 2016.

This office will compliment the Master Power branches already successfully operating in Zambia (Kitwe and Lusaka) and Mozambique, with additional African countries earmarked to benefit from a direct Master Power presence.

Master Power's aim is to expand in Africa so clients have easy access to the quality products and technical expertise Master Power has to offer.

"We identified a requirement for a direct presence in Namibia, making solutions and products easily accessible for the many diverse projects we are undertaking in Namibia", says Rory Reid, sales and marketing manager at Master Power Technologies.

The Namibian team will be led by branch manager, Wouter Vermeulen. He is a qualified Mechatronic Engineer, a Namibian citizen and will bring 7 years Master Power experience to the position, thus ensuring the Master Power creed and quality standards are maintained.

"I am very excited about heading up a Namibian office as this enables us to better service current and future projects by having a foot on the ground." Vermeulen says.

"A direct presence will give us the opportunity to increase our market share and we can work closely with our local partners. We have had a very positive reaction to having an office in Namibia.

Being local will provide a better platform to conduct business within a variety of market sectors such as government and parastatal, retail, food and beverage, Telco's, banks, medical, education, hospitality, not to mention construction and mining" continues Vermeulen.

"Our aim is to implement and utilise our proven expertise here. This will include offering products like generators and power plants, UPSs, rectifiers, batteries, medium and low voltage distribution panels, transformers, modular facilities for various applications, services/maintenance and remote monitoring with our advanced Universal Controller" Vermeulen concludes.

86MW Prieska Solar PV project nears completion right on schedule and budget

Aerial view of a portion of the Mulilo-Sonnedix-Prieska PV project, a 125 hectare solar PV project valued at R1.3 billion and situated 50km south-west of Prieska in the Northern Cape

The Mulilo-Sonnedix-Prieska PV project, a 125 hectare solar PV project valued at R1.3 billion and situated 50km south-west of Prieska in the Northern Cape, is already nearing completion, absolutely on schedule, on budget and is set to connect to the grid in the third quarter of this year. The Northern Free State area of Prieska is fast becoming the solar capital of the country and the 86MW project, which covers an area equal to 125 football or rugby fields, is expected to power 86 000 homes.

Farid Moucer, Sonnedix country manager, said that the project, which is being developed under the renewable energy independent power producers programme (REIPPPP), will be run under the auspices of the Department of Energy. *"The project will connect to the grid later this year and has an expected 20 year lifespan, which we will operate with a local team."*

juwi Renewable Energies (Pty) Ltd, the South African subsidiary of the international juwi group, is building the Mulilo Sonnedix Prieska PV solar park in the Northern Cape Province for Independent Power Producer (IPP) Sonnedix. When complete, the 125 hectares site (approximately 2km by 1km) will host 275 000 PV modules, connected by 990km of cable. Even if the technology is not complicated, the logistics behind coordinating such a project are tremendous. *"As the EPC we do the design and the engineering - we procure all of the materials and services, every single thing down to the last nut and bolt, and we put it all together on site. So we have integrated a lot of services and a lot of functionality to deliver a project that performs at a guaranteed level for the investor,"* said Greg Austin, MD of juwi.

The RE industry has made a considerable impact on the Northern Cape region in terms of job creation and opportunities for South African suppliers. *"For us it is important to use as many South African suppliers as possible. Most of our large equipment, solar modules, the mounting structures, the invertor station, is all procured through a local South African entity. Some of the components are imported as they are not manufactured in South Africa, but our full supply base is South African for this project,"* said Austin.

According to Moucer, 850 jobs have been created on the Prieska project, with over 500 going to local people living in the region. *"The lifestyle of the many people has really, changed. Many came with nothing and are now supervisors, junior supervisors, team leaders, forklift drivers. This solar project gives the community of the Siyathemba area a lot, a lot of hope,"* said Piet Olyn, project community liaison officer.

Rockwell Automation Announces Leadership Changes

From left: Blake Moret named CEO, Keith Nosbusch to remain chairman

Rockwell Automation announced that its board of directors has elected Blake D. Moret, a 30-year veteran of the Company, as President and Chief Executive Officer, effective July 1, 2016. At that time Keith D. Nosbusch, 65, who has been President and Chief Executive Officer since 2004, will transition from those roles while continuing as Chairman of the Board. Moret, 53, is currently Senior Vice President of the Company's Control Products & Solutions segment.

Donald R. Parfet, Lead Director, said: *"Blake has proven himself to be an exceptional leader, with demonstrated readiness to lead the company. We welcome him to his new role at the conclusion of a deliberate and planned succession process. We are delighted he will build on the Company's many accomplishments under Keith's direction and propel our vision of The Connected Enterprise to the next level."*

"The past 12 years have been transformational for Rockwell Automation," Parfet continued. *"We thank Keith for his outstanding leadership during this period, including his work as a vocal champion of smart, productive, and secure manufacturing. We are pleased that he has agreed to stay on as chairman so that the Company can continue to benefit from his experience and support Blake's transition to CEO."*

Schneider Electric's Galaxy 300 uninterruptible power supply offers efficiency, & reliable protection

Schneider Electric, a global specialist in energy management and automation, has announced the expansion of its Galaxy 300 uninterruptible power supply (UPS) system, which now includes 60 kVA and 80 kVA models.

Ideal for small and medium businesses, commercial buildings and technical facilities with small server rooms, the Galaxy 300 60 kVA and 80 kVA UPS systems provide effective and reliable three-phase power protection to prevent downtime and data loss for mission critical applications in a robust, simple-to-install and cost-effective configuration.

The new UPS systems also enable users to lower operational and cooling costs with power efficiency and total harmonic distortion of current at less than 3,5 percent with full load.

"There was a need expressed by our low- and medium-level power users for a system that offered greater power availability, reliability, manageability and convenience," says Bruce Grobler, vice president of the IT Business for southern Africa at Schneider Electric. "Serving a range of organisations, the addition of the 60 kVA and 80 kVA models, the Galaxy 300 10 to 80 kVA UPS portfolio directly answers customer and partner requirements by offering a best-in-class UPS with simplified installation, management and maintenance features, as well as enhanced efficiency and ease of use via an intuitive interface."

To ensure uptime and availability, the Galaxy 300 10 to 80 kVA portfolio allows for standard installation of one or two independent power sources, and utilises an online double conversion topology to provide true isolation between input and output with zero transfer time.

A built-in 100 percent rated bypass static switch prevents interruption by allowing load transfer to utility power during heavy overloads.

Connected equipment can be powered with two UPSes united in parallel to increase system redundancy. In addition, the system provides users with options for an integrated battery backup with up to 10 minutes of runtime, or a robust charger for external batteries on rack or in external cabinets that provides run times of up to four hours.

Designed for ease-of-use, users are able to monitor and manage power requirements locally and remotely through a simple web/ simple network management protocol interface. The simple-to-read and highly graphical user interface provides mimic diagrams, audible alarms and is available in 18 languages.

The Galaxy 300 10 to 80 kVA UPS systems are also equipped with several features that enable simple installation as well as tools to streamline compliance, maintenance and serviceability over the system's service life.

An accessible maintenance bypass allows for complete isolation of each part of the system without power interruption, and the system features push-open doors and slide out boards for effortless maintenance in confined spaces.

For timesaving installation, the compact wide or narrow tower configurations can easily be rolled into new or existing facilities, and all wiring connections are easily identifiable. Step-by-step guidance and intuitive menu screens enable fast setup and system navigation.

Rolls-Royce To Supply 160 Mtu Onsite Energy Gensets To Vpower Group

Rolls-Royce and the VPower Group have recently signed a strategic agreement that strengthens their partnership in power generation markets across China and the rest of Asia. A framework agreement for 2016 was also signed for the supply of 160 MTU Onsite Energy gas gensets based on 16V 4000 L32 units, each with 1,560 kW electrical power output.

These agreements cement a long-lasting collaboration between MTU Onsite Energy and VPower, a world leader in decentralized power generation. By signing the framework agreement, VPower is able to secure production capacity within MTU Onsite Energy enabling it to meet the needs of its customers at short notice. The MTU Onsite Energy brand is part of Rolls- Royce Power Systems.

Rorce Au-Yeung, Co-CEO, VPower Group said: *"Our past successes in cooperation with Rolls-Royce on numerous power plant projects have motivated us to develop our partnership. The high rates of efficiency, outstanding reliability and low service costs of gas gensets from MTU Onsite Energy make them the ideal product for this application."*

VPower customers also benefit from the worldwide service networks that MTU Onsite Energy and VPower have in place to ensure swift delivery of spare parts.

Matthias Vogel, Vice-President Power Generation, Rolls-Royce Power Systems, said: *"China and the Asian region as a whole are key strategic markets where MTU Onsite Energy is very keen to grow by joining forces with a strong partner such as VPower."*

The Student Expo South Africa 2016 not to be missed!

The Student Expo is back again and will be taking place in January, April, May and July in Johannesburg, Cape Town and Durban. South Africa's largest student focused Expo has evolved to offer an informative and stress-free student career advice experience. The Student Expo is designed to provide both current and prospective students with the necessary tools to succeed in finding professional, tertiary education as well as guide them towards a suitable working career.

The Student Expo targets more than 1000 private and upmarket government schools students (LSM 8-12), as well as top University faculty students to help them further professional careers in the legal, medical, engineering, commerce and culinary arts spheres.

The Student Expo prospective students will be able to meet with representatives from a wide range of universities, to determine which school and program best meets their needs. Students will gain insight and career advice from leading field specialists, to better understand the expectations and roles of their potential professions. The Student Expo aims to feed students with valuable knowledge to make educated decisions regarding their futures through discussions, presentations and a variety of interactions.

Matriculants will also have the opportunity to explore the various options for extra-curricular activities provided by the Universities, including social clubs, sports clubs and other clubs on offer.

Prospective students can learn how to secure student loans. They will also get advice on how to manage finances when living away from home, as well as meet and share information with other school leavers and parents.

Graduates will be able to explore career opportunities both locally and internationally. They may attend talks where they are given pointers on how to develop and write an effective and professional Curriculum Vitae as well as how to attend a professional interview.

Graduates will have the opportunity to meet the top Graduate Recruitment Companies in South Africa.

Prospective Postgraduate students will be able to meet with representatives from a wide-range of universities to determine which post graduate program best meets their needs. They will gain insight and career advice from leading field specialists to better understand the expectations and application of their further education. After the Student Expo the graduate will be better equipped to make decisions regarding their futures.

The Student Expo brings together professionals from legal and accountancy partners, entrepreneurs, engineers, doctors, scientists, renowned chefs and even overseas sailing instructors.

The Expo offers "Motivational and Educational Speaker" forums and students will have the opportunity to ask questions with concerns of where to go and what to study. Students will interact with tertiary institutions and find out more about courses on offer and how to apply for them.

Employment agencies will be available to assist post-graduate students with career choices as well as finding them their first jobs. Come join the Student Expo that offers something for everyone!

For more info,
info@youniqueconcepts.co.za

Local PDS Technology Leads The Drive

Lack of knowledge when it comes to legal compliance of Pedestrian Detection Systems (PDS) is not a good enough excuse. Access to information is fairly simple and for those that need a more in-depth understanding Booyco Electronics is well positioned to assist with the application of this technology in both underground and surface mining operations.

The company has led the drive towards producing PDS technology that will meet and, where possible, exceed the legislated requirements within the South African mining industry. This is according to Anton Lourens, Managing Director of Booyco Electronics who confirms that the company is one of those selected to participate in The Earth Moving Equipment Safety Round Table (EMESRT) forum.

"This level of collaboration is important in the industry, especially with technology that is cutting edge," he says. Participation at EMESRT has allowed the company to gain insight into the global requirements for PDS equipment and also to share with the leading international mining houses the strides Booyco Electronics has made with its technology.

Staying close to the market and understanding the operational challenges faced by customers has enabled the company to accelerate its research and development programme, and strategic re-engineering of its products will see these not only meet the South African legislative but also the requirements of EMESRT.

Each Booyco PDS is deployed as a fit-for-purpose technology solution based on application specific risk assessments, and can be integrated across systems for use both underground and on surface, as well as a combination of both.

Tough Economic Times Ahead for Engineering Industry

The Consulting Engineers South Africa (CESA) Bi-annual Economic and Capacity Survey for the period July to December 2015, indicates that times are tough and getting tougher with industry confidence the lowest in 16 years.

The report indicates that the consulting engineering industry will have to adapt to a low growth environment as the outlook for infrastructure spending is hampered by poor economic growth, lower than expected revenue by government, international economic instability and price volatility, and low private sector confidence. Over 540 firms employing just over 24 315 staff, who collectively earn a total fee income of R23.4 billion per annum, are members of CESA.

Three key factors continue to influence the global outlook these are the gradual slowdown and rebalancing of the Chinese economy; lower prices for energy and other commodities; and the gradual tightening of US monetary policy.

GDP growth in South Africa slowed to 0.6 percent q-q, from 0.7 percent q-q in the previous quarter. South African economic growth slowed from 1.5 percent y-y in 2014 to 1.3 percent in 2015. Growth was largely dragged down by a further contraction in the agriculture sector while construction recorded marginal growth of 1.1 percent in the 4th quarter (from 0.5 percent in the previous quarter).

Chris Campbell, CESA CEO believes, *"Government needs a strong focus on the implementation of more of its strategic infrastructure projects as detailed in the National Development Plan in order to mitigate the decline in the economy and improve investor confidence."* He further reiterated that *"Engineers in South Africa stand ready to partner with government in eradicating the leakage from the fiscus, not only through water which does not reach domestic households, but also through poorly spent monies or corrupt practices which have led to payment for poor quality and even non-existent services in the infrastructure space."*

Probably the most critical concern, and most significant downside risk to inflation and economic growth, for the domestic economy is the fear of a further sovereign credit rating downgrade and its effect on the industry. A lower credit rating means the cost of borrowing for the South African government will escalate, which means more tax payers money will be used to finance debt, with less available to spend on critical economic and social infrastructure. Currently government expects that 3.6 percent of GDP per annum will be used on interest expenditure, estimated at around R260 bn per year, equal to total public sector infrastructure allocations a year.

Chris Campbell
CESA CEO

FEE EARNINGS – SOFTER GROWTH OUTLOOK

Consulting Engineering fee earnings in the last six months of 2015 increased by around 6 percent, against an expected decrease of between 2 percent and 3 percent. Larger firms reported muted growth of 2 percent on average for the last six months, while stronger growth was reported by medium and smaller firms (up by 31 percent and 11 percent respectively).

Although respondents expect earnings to fall by 5 percent in nominal terms during the first six months of 2016, compared with the second half of 2015.

Campbell states, *"Although the outlook is concerning it is encouraging to see that profitability among member firms has increased."* The percentage of fees outstanding for longer than 90 days as a percentage of total estimated income showed some improvement to 23 percent, from 24.5 percent and 24.0 percent in the previous two surveys. It is estimated that around R5,8bn in earnings is currently outstanding after the 90 day period.

INDUSTRY CONFIDENCE LEVELS – LOWEST IN 16 YEARS

Confidence levels fell to its lowest level in 16 years, and were significantly weaker in the last six months of 2015, compared to expectations in the June 2015 survey.

Levels fell from an expected 56,0 percent satisfaction rate to 39,4 percent, and although business conditions are expected to improve slightly to a satisfaction rate of 48 percent (first six months of 2016) and 44 percent (last six months of 2016), levels are well below the average of the last five years.

Satisfaction amongst firms are at historically low levels, surpassed only by the 1998/99 recession caused by the Asian financial crisis.

GROSS FIXED CAPITAL FORMATION SLOW IN MEDIUM TERM

Gross Fixed Capital Formation (GFCF) as a percentage of GDP averaged at 20,7 percent in 2014, but slowed to 20,6 percent in the 1st quarter of 2015, compared to an average of 21,1 percent in 2013. The NDP has what may seem a somewhat unachievable target of 30 percent contribution of GFCF to GDP by 2030. All economic indicators currently suggest that investment in relation to GDP is likely to slow over the medium term, due to slower government spending, financial constraints experienced by SOE's and continued weak private sector confidence.

TRANSFORMATION OF THE INDUSTRY

The appointment of Black executive staff (including Black, Asian and Coloured) increased to 39,5 percent from 38,0 percent and 36,0 percent in the previous two surveys. The appointment of Black

Tough Economic Times

continues from page 25

executive staff has steadily increased from 28,1 percent in the June 2012 survey. This shows real significant progress in terms of industry transformation. There has also been a steady improvement in the appointment of women at an executive level. Women (including all races) appointed at an executive level represented 11,0 percent of total executives, from 10,1 percent in the previous survey.

INDUSTRY CHALLENGES

Regulation issues, including the procurement of consulting engineering services, remain one of the biggest challenges faced by the industry. Procurement is currently based on price and broad-based black economic empowerment (BBBEE) points, with functionality or quality having a minimum threshold, thus being largely price driven.

This is affecting tender prices, as firms sometimes tender below cost in view of the diminished availability of projects. Procurement procedures should be standard for the country, or at least for the specific tier of government. Unrealistic tendering fees remain a concern for members, while the extended time it takes in which to finalise a proposal is affecting profitability in the industry.

The quality of technical personnel is argued by some firms to have deteriorated, putting greater risk on the built environment sector. Skills shortage is regarded as one the most significant institutional challenges faced by the private and the public sector. CESA has offered their services to government to procure and implement projects.

Fraud and corruption is affecting the ethos of our society, with a lot of talk and little action accompanying the growing evidence of corruption. CESA is aware that members are under pressure from contractors and corrupt officials, to certify payment for work not completed. This is regarded as an extremely serious matter for CESA and as such will be relentless in holding those in power accountable. Unlocking greater private sector participation is seen as a critical element to fast track delivery which will support engineering fees and as such engineering development in the industry. Private sector participation in this context refers to involvement on a more technical level (and not as a client), to improve municipal capacity and efficiency. Government must create an environment for the private sector so that it can play a much bigger role in infrastructure delivery.

Service delivery, especially at municipal level remains a critical burning issue. The consulting engineering industry is threatened by incapacitated local and provincial governments. As major clients to the industry, it is important that these institutions become more effective, more proactive in identifying needs and priorities and more efficient in project implementation and – management.

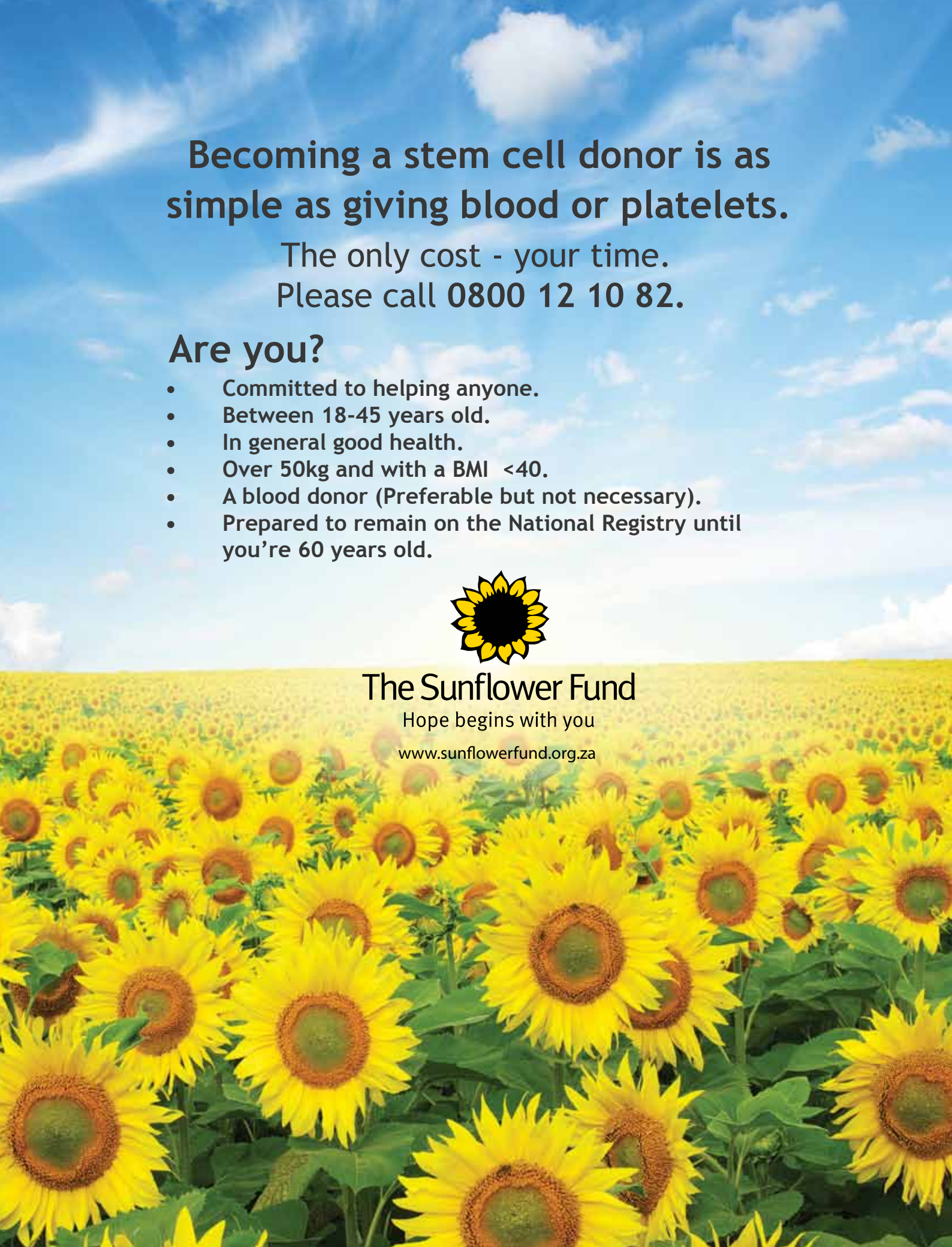
The involvement of non-CESA members in government tenders and procurement continues to threaten the standard and performance of the industry. Non-CESA members do not seem to comply with the same standards and principles as those firms that are members of CESA. This is further exacerbated by the notion that Government procurement entities have that procuring the services of a Profession Engineering Practitioner is the same as buying fruit from an informal trader where one bargains for discounted pricing.

There also seems to be a gross misunderstanding and misapplication on the application of fee scales on projects, where the professional practitioner managing the funds as the Principal Agent, gets to claim the "lion's share" of the fees, currently as is the case when the Professional is from the Quantity Surveying or Project Management Profession, whilst the Professional Engineering Practitioners who may be both Principal Agent and Technically responsible for design risk, is compensated substantially less.

There should at least be equity in the responsibility and remuneration in the roles as Principal Agent across the professions and a separation of this role from that of the Engineering Practitioner who carries design risks and subsequent costs which are to be compensated for separately in any project. Large local firms are tendering at rates on small projects that are not competitive for small local firms just to maintain a cashflow. A practice which is counterintuitive to the commitment to transform the industry.

Lack of attention to maintain infrastructure poses a serious problem for the industry. Not only is it much costlier to build new infrastructure, but dilapidated infrastructure hampers economic growth potential.

For a copy of the CESA Bi-annual Economic and Capacity Survey please visit www.cesa.co.za/node/21 wn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NEW WORLD ENERGY COUNCIL REPORT

Global power generation affected due to global water shortfall

A 2016 research paper in the Journal Nature Climate Change predicts a 40% shortfall of available water across the globe by 2030 with effects not just for drinking, food production, hygiene and public health, but also for 98% of global electric power generation.

In South Africa, water scarcity threatens the viability of coal production, given the water-intensiveness of coal technologies, which is used to generate around 90% of its domestic electricity supply. Mitigation efforts to address the effects of acidic water leaking from abandoned mines into surrounding water ecosystems have cost 30 billion rand. Predicted 40% global water shortfall is affecting its future.

Presented at the Asia-Pacific Energy Leaders Summit in New Zealand, the early findings of a new report, "The road to resilience - managing the risks of the energy-water-food nexus" from the World Energy Council is calling for immediate action in order to secure resilient energy infrastructure. Supported by a task force of over 140 experts from across the world, the report makes five recommendations:

- Improve understanding of the water footprint of energy technologies in order to mitigate the risks of stranded assets. Account for the "price" of water, particularly in areas of water stress.
- Consider a wider range of financial and insurance instruments to hedge short term risks, such as adverse weather incidents and associated electricity price volatility.
- Give investors the confidence to invest by providing them a full risk assessment that includes different climate and hydrological scenarios in financial analyses.
- Provide a reliable and transparent regulatory and legal framework that takes into account water issues and competing stakeholders' interest.

Christoph Frei, Secretary General World Energy Council said: *"The energy-water-food nexus poses a systemic risk which could impact the robustness of the energy supply and demand over many years to come."* Power plants across the world could be affected by

changes in precipitation patterns, which are combining with increasing competition between water users to adversely affect the resilience of energy services.

- Clear co-ordination and integrated planning needs to take place now, or we will start to see the effects of water scarcity on energy supplies in the very near future. Assuming a water price during project planning is one way to trigger the right signals.

- If we are to counter the problems of water access, then cross-border co-operation is vital. We should be taking full advantage of the 261 international trans-boundary basins that cover 45% of the earth's land surface. Energy resilience can only be achieved by moving from individual to joint efforts.

An important issue to tackle is the lack of knowledge about water issues, and limited modelling tools, making long term energy infrastructure investment decisions difficult to make.

To promote infrastructure resilience, policymakers and investors need to create a framework which provides the incentives for adapted infrastructure design and needed financing mechanisms.

The road to resilience managing the risks of the energy-water-food nexus will inform our support for the work of the Asia Pacific Economic Cooperation (APEC) Energy Working Group. The report is the second in a series of reports that assesses the financing of resilient energy infrastructure and identifies the investment and systemic changes required to combat new emerging risks including extreme weather, the energy-water-food nexus and cyber risks.

The reports are prepared with project partners Swiss Re Corporate Solutions and Marsh & McLennan Companies with insights from the European Bank for Reconstruction and Development and will build to provide a detailed report ahead of the 23rd World Energy Congress to be held in Istanbul, Turkey in October 2016. wn

Earn CPD Credits

South African Inventions

Where would you expect to find the inventor of the CAT scan, the makers of the "speed gun" used in cricket ovals the world over, or the world's first oil-from-coal refinery?

COMPILED BY | MINX AVRABOS

There's a wide range of innovative and entrepreneurial activity in South Africa, backed up by a number of organisations that provide support for budding inventors and innovators. Some of the world firsts South Africa can lay claim to are the following:

CAT SCAN

Allan Cormack - The computed axial tomography scan, or CAT scan, was developed at Tufts University in the UK by South African physicist Allan Cormack and Godfrey Hounsfield of EMI Laboratories. Their achievement secured them the 1979 Nobel Prize in Physiology or Medicine.

Cormack's interest in the problem of X-ray imaging of soft tissues or layers of tissue of differing densities was first aroused when he took up the part-time position of physicist for a hospital radiology department.

The two-dimensional representations of conventional X-ray plates were often unable to distinguish between such tissues. More information could be gained if X-rays of the body were taken from several different directions, but conventional X-ray techniques made this procedure problematic.

In the early 1960s, Cormack showed how details of a flat section of soft tissues could be calculated from measurements of the attenuation of X-rays passing through it from many different angles.

He thus provided the mathematical technique for the CAT scan, in which an X-ray source and electronic detectors are rotated about the body and the resulting data is analysed by a computer to produce a sharp map of the tissues within a cross-section of the body.

OIL FROM COAL

Sasol is the world's first - and largest - oil-from-coal refinery. It is situated in Sasolburg in South Africa and provides 40% of the country's fuel.

The history of Sasol began in 1927 when a White Paper was tabled in Parliament to investigate the establishment of a South African oil-from-coal industry.

It was realised then that, because South Africa did not have crude oil reserves, the country's balance of payments had to be protected against increasing crude oil imports. After many years of research and international negotiations, the South African Coal Oil and Gas Corporation was formed in 1950.

Major milestones include the first automotive fuel (1955), the construction of the National Petroleum Refiners of South Africa (1967) and the establishment in 1990 of its first international marketing company, Sasol Chemicals Europe.

Sasol has developed world-leading technology for the conversion of low-grade coal into value-added synfuels and chemicals.

South African Inventions

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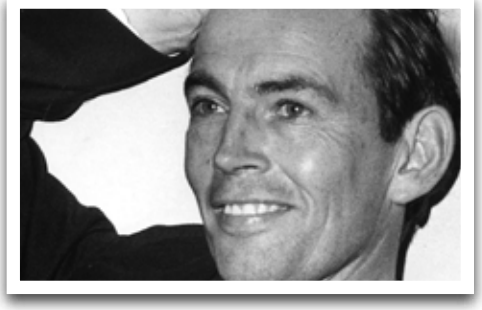


HEART TRANSPLANT

Dr Chris Barnard - The world's first heart transplant was performed by Dr Chris Barnard in Cape Town on 3 December 1967.

Barnard was born in the town of Beaufort West in 1922. The seeds of his future career were sown when one of his patients delivered a baby boy with a heart defect which could not be remedied. The baby died, causing him to think deeply about the need for remedial surgery and the replacement of heart valves.

A turning point came when Barnard was offered a chance to work in Minneapolis in the US under Professor Wagensteen, a great teacher of experimental surgery. The heart-lung machine was perfected, and this turned out to be the gateway to cardiac surgery.

The idea of transplanting occurred to Barnard. If it was possible with kidneys, why not the heart? After more years of study in the US, he returned to South Africa with a parting gift from Prof Wagensteen – a heart-lung machine.

Groote Schuur hospital was waiting his return in 1958 to start the first heart unit to perform a cardiac bypass operation. After performing the first successful kidney transplant on Edith Black, in October 1967 Barnard informed Professor Val Schrire, who had built up the cardiac clinic: *"Everything is ready for a heart transplant. We have the team and we know how to do it."*

In November 1967, Schrire called Barnard and told him that there was a suitable patient for a heart transplant. Louis Washkansky was suffering from heart failure and was prepared to take the chance. After that, Barnard became an international celebrity. He went on to perform more than 10 other heart transplants, with one of the recipients surviving a further 23 years.

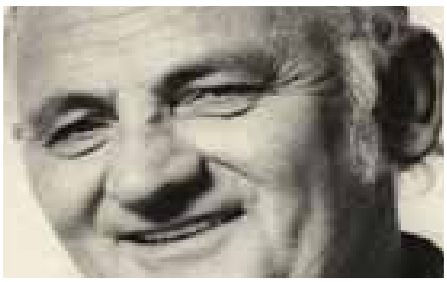
Barnard passed away in Cyprus on 2 September 2001 from an acute asthma attack.

SPEED GUN

The South African-made speed gun, developed by Somerset West inventor Henri Johnson, was formally launched at The Oval in England during the 1999 Cricket World Cup.

In 1992 Johnson invented the Speedball which was manufactured by South African firm Electronic Development House. The device accurately measures the speed and angles of speeding objects such as cricket and tennis balls.

Generally referred to as a "speed gun", Johnson's gizmo is sold in cricketing countries and in the US and Europe.



KREEPY KRAULY

The swimming pool vacuum cleaner was invented by Ferdinand Chauvier, a hydraulics engineer who came to South Africa from the Belgian Congo in 1951.

Chauvier quickly realised that there was a huge market for taking the hassle out of cleaning swimming pools, and went about inventing a machine that would do the job automatically, efficiently powered by the ordinary operation of the pool's filter.

But it wasn't until 1974 that the first Kreepy Krauly was born in Chauvier's Springs home.

He died in 1985, but Kreepy Kraulys continue to keep thousands of pools clean in South Africa and the world over.

PRATLEY PUTTY

Pratley's famous glue is the only South African invention that has been to the moon. In 1969 the putty was used to hold bits of the Apollo XI mission's Eagle landing craft together.

Krugersdorp engineer George Pratley invented his famous sticky stuff in the 1960s while looking for a glue that would hold components in an electrical box.

Pratley died in 1983 and today the company is run by his son, Kim. Hundreds of tons of Pratley putty have been exported all over the world, and the company has diversified into other products.

DOLOSSE

Dolosse are large, unusually shaped concrete blocks weighing up to 20 tons. The structures are designed to break up wave action and protect harbour walls and coastal installations.

Designed by Eric Merrifield, and first installed in East London harbour, they are now used all over the world.

The Coega Project, comprising an industrial development complex and deepwater port 20 kilometres east of the city of Port Elizabeth, made history with the casting of the biggest dolosse on the African continent: 26 500 30-ton dolosse are used on the two breakwaters for the deep-water harbour of Ngqura.

Q20

Q20 was invented in 1950 in Pinetown, KwaZulu-Natal by a Mr Robertson, as a product to displace water from the

distributor caps on the old VW Beetle, which was notorious for stalling in wet weather. It was an effective water repellent, kept rust at bay, eased squeaky door hinges, and made it easy to release rusted or seized nuts and bolts. Initially he did not know what to call it but he told his neighbour that it certainly had 20 answers to 20 questions.

The secret behind Q20 is that it is heavier than water. Since oil floats on water, simply oiling the area will not resolve the problem. But because Q20 has a specific gravity of 1.154, it can displace water which only has a specific gravity of 1. Once Q20 is sprayed on water, it sinks to the bottom, where it acts as a water displacer and lubricant on the problem area.

RETINAL CRYOPROBE

Selig Percy Amoils, FRCS, born 1933, is a South African ophthalmologist and biomedical engineering inventor. In 1965, Amoils refined the cryoextraction method of cataract surgery by developing a cryoprobe that was cooled through the Joule-Thomson effect of gas expansion. His system is still widely used in the fields of ophthalmology and gynaecology.

Amoils was awarded a patent for his "rotary epithelial scrubber" that removes corneal epithelial cells in preparation for photo-refractive keratectomy. Another development of his in 1970, was the diamond vitrectomy cutter, various instruments enabling micro-control of blade depth in radial keratotomy, as well as the oval comparator, or astigmometer, to control astigmatism after cataract surgery.

Born, raised, and educated in Johannesburg, South Africa, Amoils briefly studied mechanical engineering prior to attending medical school at the University of Witwatersrand where he earned his MB and BCh in 1956.

His specialist training was with Baragwanath Hospital in Soweto, Moorfields Eye Hospital in London, and Massachusetts Eye and Ear Infirmary as a Clinical Fellow and research scientist specializing in retinal diseases and surgery and glaucoma.

He advanced cryosurgery for cataracts and retinal detachments during 1962 at Baragwanath hospital in Soweto. This led to the Joule-Thomson effect cryoprobe in 1965, using carbon dioxide or nitrous oxide to cool the probe, which could then be reheated electrically; this dramatically changed cataract and retinal surgery.

Amoils achieved wide recognition for his invention and in 1975 received a Queen's Award for Technological Innovation. His cryoprobe has since been on display in the Kensington Museum in London.

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SMARTLOCK SAFETY SYRINGE

A group of designers at the Vaal University of Technology, William Blake, Paul Lambourn, Jose loureiro, Michael Moore, David Shiel, Mirko Tappero, Henk van der Meyden and Alexis Wadman invented the Smartlock safety syringe.

The Smartlock Safety Syringe is a three-piece single-use syringe which has a safety mechanism built into the syringe. The needle on a safety syringe can be detachable or permanently attached. On some models, a sheath is placed over the needle, or the needle retracts into the barrel, following injection, to protect healthcare workers and others from accidental needle-stick injuries.

The importance of the safety syringe has increased; legislation requiring it, or equivalents, has been introduced in many nations since needle-stick injuries, and re-use prevention, became the focus of governments and safety bodies. The syringes were developed in 1999, and provide improved protection against needle-stick injury and contamination, through diseases such as Ebola virus, Hepatitis and HIV.

The Smartlock Safety Syringe is a three piece, single use syringe. Medication is drawn into the central plunger of the syringe by means of reverse aspiration. Once the medication has been administered, as with a regular syringe, the barrel is pushed down to its maximum return position. This action causes the plastic clips at the top of the plunger to deflect inwards.

However, in the case of the Smartlock Safety Syringe the barrel, plunger and needle are drawn inside the sheath and locked in a retracted position with a distinct click. Once locked it is no longer possible to push the needle out, or to reassemble the syringe.

IVO BRANISLAV LAZIC

With the rapid and lucrative growth in the smartphone industry, we're always told that the world is in our hands. But the infrastructure of that world is not always as seamless as we would like.

A sprawling web of infrastructure, made up of towers, buried fibre optics and orbiting satellites, sometimes encroaches in garish and inconvenient ways.

An important chapter in the history of tree-shaped cellphone towers was written in South Africa. In the mid-'90s, Ivo Branislav Lazic (who worked for a telecommunications company) and his colleague Aubrey Trevor Thomas, were commissioned by Vodacom to solve the visual pollution problem cellphones presented.

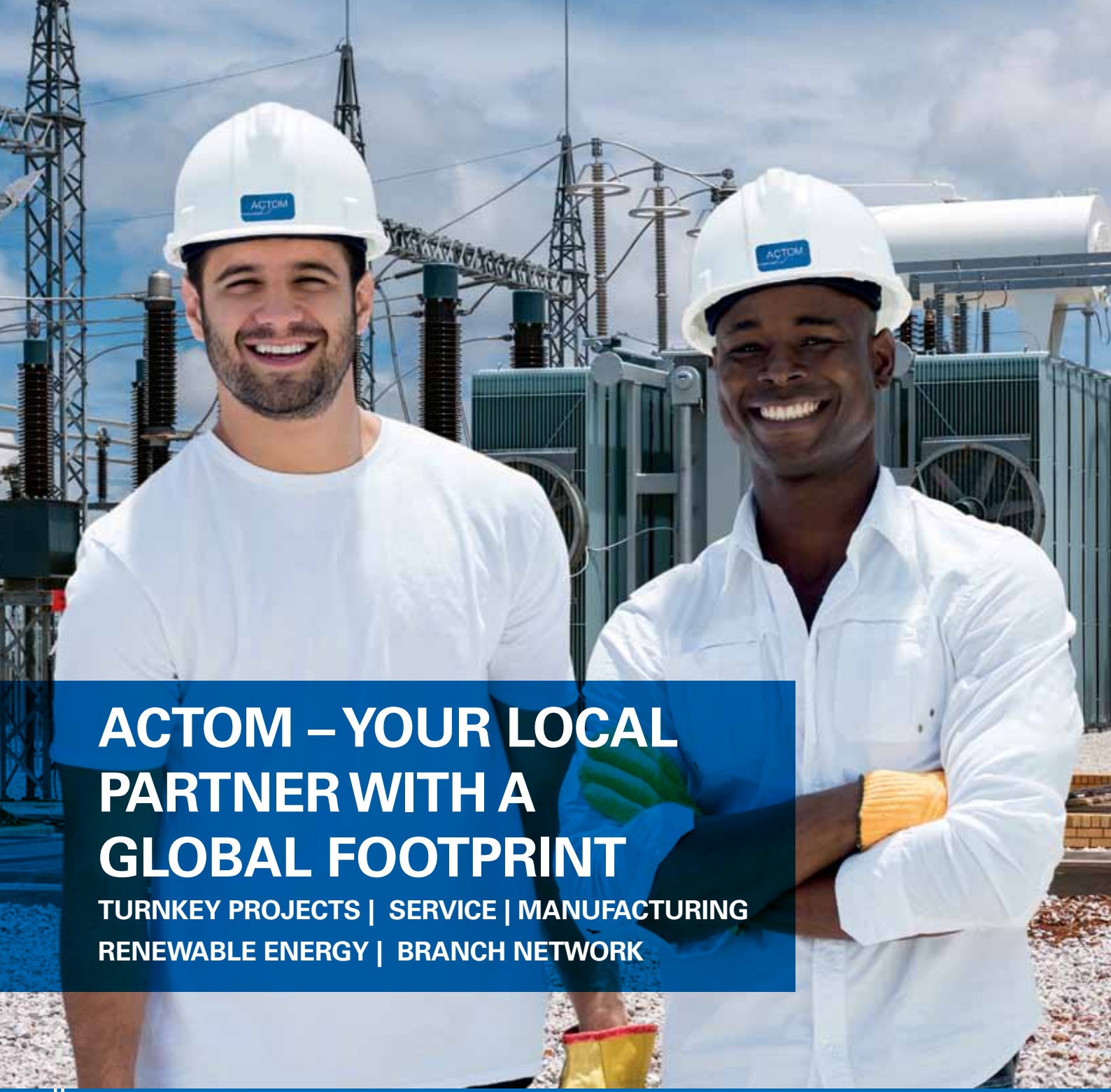
Lazic and Thomas came up with the world's first palm tree cellphone tower. The Palm Pole Tower, made from non-toxic plastics, was installed in Cape Town in 1996.

AUTOMATIC POPCORN VENDING MACHINES

Peter Ramsay and Mark Beagle, from KwaZulu-Natal developed the world's first automatic microwave popcorn vending machine. It dispenses a fresh, hot-popped 100g pack of microwave popcorn at the push of a button. The Pop King stores 200, 100g packs of popcorn in four magazines, thus allowing four different flavours to be dispensed. The hygienic packs are sealed with popcorn oil and flavouring. On selection the pack is pushed into the uniquely-designed microwave and dispensed after 90 seconds.

EXHAUST VIBRATION BALANCER

Capetonian Cobus Cronje invented an exhaust vibration balancer, which solves the problem of stress on vehicles caused by the vibration from heavy diesel engines. wn



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A Wits Electrical Engineering Graduate and a large South African Cyclotron

A Wits Electrical Engineering Graduate and a large South African Cyclotron. Some highlights in radio-frequency experience during 20 years at a unique facility.

BY | JOHAN KRITZINGER | PR. ENG

Johan Kritzinger studied in the Electrical Engineering Department at Wits, while professor Bozzoli was head of the department, and obtained a Ph.D. in 1962 investigating the development of high voltage breakdown in air. He joined the Southern Universities Nuclear Institute (SUNI) in August 1963 as engineer responsible for the 6 MV van de Graaff accelerator at Faure near Cape Town.

In July 1966 a special meeting was held during the annual conference of the Institute of Physics (SAIP) held in Stellenbosch. This was to discuss the future of accelerators for South Africa.

A study group was elected to investigate possibilities. Johan also attended this meeting which is considered the birth of the large cyclotron facility constructed between 1980 and 1987. The study group reported yearly at the annual SAIP conferences. The interest of the medical fraternity in accelerators for neutron and proton therapy and radio-nuclide production gave more impetus to the need for a national facility.

The Cape Provincial Administration (CPA) which was responsible for the two large teaching hospitals in the Western Cape, provided financial support for a feasibility study. This was undertaken during 1974 and 1975.

During the second half of 1974, Johan spent 6 months sabbatical leave at the Pretoria cyclotron as part of the feasibility study. He worked together with Adriaan Botha and Helge Jungwirth on the design of the Radio-Frequency (RF) resonators for a large Separated-Sector Cyclotron (SSC) that was envisaged. A high radio-frequency voltage is needed to accelerate the positive ions of the beam. Theoretical calculations were done on the mainframe computer of the CSIR using punched cards. Fifth scale models were constructed and their characteristics were measured. Johan had obtained RF experience at the van de Graaff and Adriaan was responsible for the RF system of the Pretoria cyclotron. SSC was a new development at that time, initiated in Switzerland. A paper on the proposed RF system was presented in August 1975 at the Seventh International Conference on Cyclotrons and their Applications held in Switzerland. After the conference other facilities and a few possible manufacturers in Europe were visited.

The final proposal of the feasibility study was for a 200MeV SSC (with injection from an 8 MeV solid pole cyclotron) as a national facility, to be located in the Western Cape. It is unique with the ambitious aim to provide for a wide variety of users, for proton and neutron therapy as well as isotope production and nuclear physics research.

Some local and international persons were very sceptical whether such a facility could be designed and constructed in South Africa. An SSC was then not commercially available, and the few that were under development were at the Science & Innovation Network (SIN) in Switzerland, Ganil in France, Vicksi in Germany and Indiana in the USA. None of these were initially intended for medical treatment or isotope production.

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Some unique or new technologies, equipment and materials used for the radio-frequency systems during the construction of the South African SSC facility between 1980 and 1987 are:

1. Local design with international and local manufacture;
2. 150 kW radio-frequency radar transmitters, located outside the vault of the large cyclotron;
3. Electro-forming the large inner and outer cylinders, with integral cooling channels;
4. Glidcop dispersion-strengthened copper used for all contact fingers;
5. Large short-circuiting plates with push-chain positioning, all locally manufactured;
6. Local design and manufacture of low-level phase and amplitude control and stabilization;
7. Kick-pulse to overcome multipacting problems, to enable high RF voltage operation;
8. Development of micro-processor control systems to automate restart after interruptions; and
9. A flat-topping system for the injector cyclotron to increase beam current in 1991.

A more detailed description of these items follow.

The proposal was accepted by government and the National Accelerator Centre (NAC) was formed in April 1977 under the administration of the CSIR. One of the first requirements was to find a suitable location in the Western Cape. Many locations were investigated for suitable rock foundation. One of the sites was next to the SUNI van de Graaff accelerator at Faure. It is located halfway between Cape Town and Stellenbosch. During lunchtime the staff visited the drilling operation. When the drilling core from 30 m down was exposed and showed the shale rock, Johan realised that it was the moment when the site of the NAC was determined.

From the few persons involved in the feasibility study the technical staff expanded rapidly. Initially they were housed in the new Electrical Engineering building of the University of Stellenbosch, and the Van de Graaff building at Faure. Johan was seconded from SUNI to NAC, mainly for development of the RF systems and the building layout. The staff of the Accelerator group reached a peak of 100 persons during the main construction phase, with a maximum of 8 in the RF division.

Early work concentrated on the design of the solid-pole injector cyclotron, with a capability of 8 MeV protons The first constructed part was a full scale copper model of the quarter-wave resonator. The required frequency range was from 8 to 26 MHz, and was obtained by changing the position of a short-circuiting plate.

Various methods of coupling the RF energy into the resonator were investigated. Two 20 kW power amplifiers to drive the two resonators were also developed by the RF division, with Reg Fenemore, Pieter Kriel, Dick Jones and Jan Carstens doing most of the work. It took into account the power requirements over the frequency range, and resulted in units with only two adjustable components, to cover the required frequency range. The cabinets were manufactured by local industry, and the amplifiers were assembled at NAC, using standard components. The power supplies for the first two amplifiers, of the first injector cyclotron are standard units, obtained from the USA and Germany. The wide-band driver amplifiers were standard units from the USA. The synthesiser for the basic frequency generation was purchased, but all other low-level units for phase and amplitude adjustment, and stabilisation, were developed and constructed by the staff. Gordon Hardman, Johan van

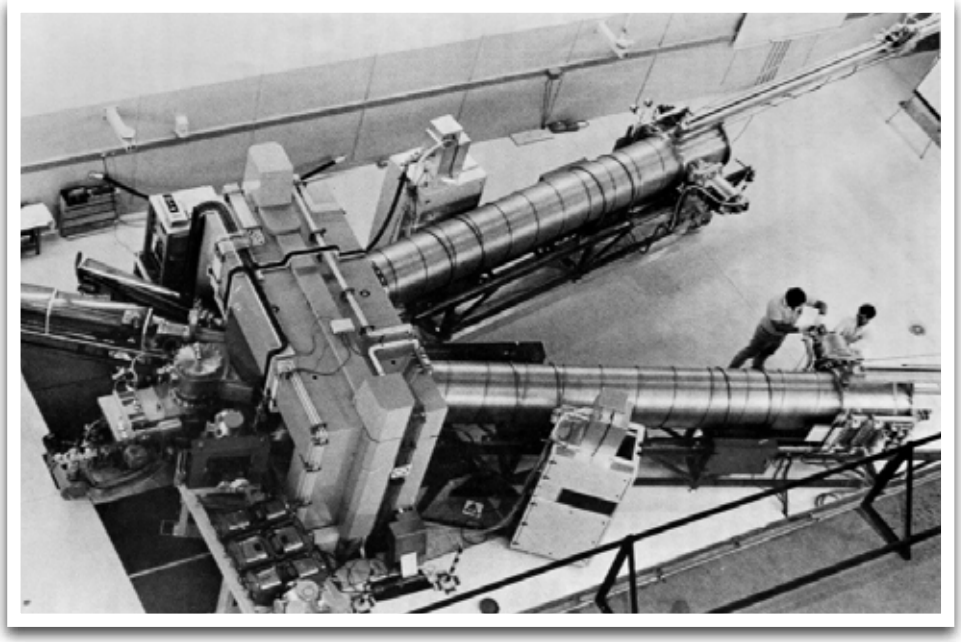


Fig 1: The solid-pole injector cyclotron with two resonators and their power amplifiers in position.

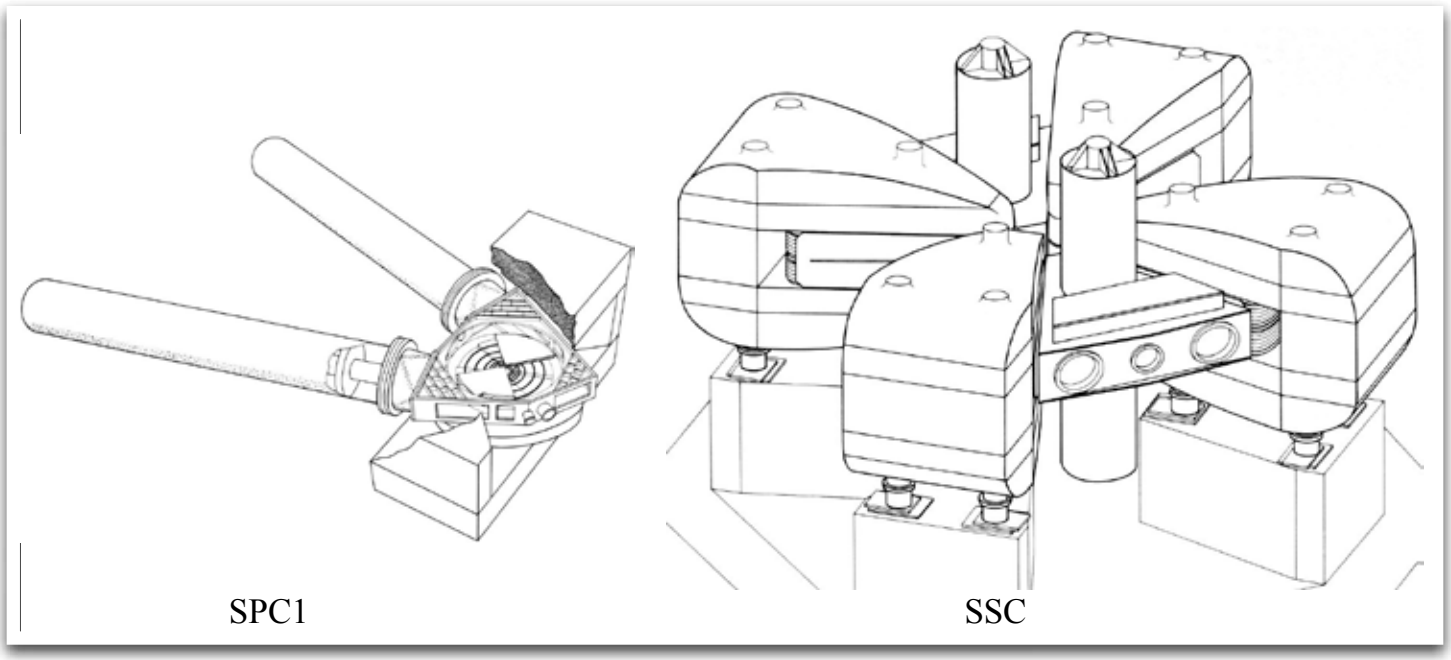
Niekerk, Johan Kriel and Zenek Hajek were responsible for this aspect.

The copper inner and outer conductor of each required resonator were made by special electro-forming in a factory located in a remote part of Germany. The rest of the copper parts were made in the NAC mechanical workshop, where expertise in copper welding was highly developed. The short-circuiting plate for each resonator was manufactured by a local company, established to manufacture special components for NAC (e.g. vacuum impregnated coils for electromagnets).

The major technical challenge was with the SSC. Compared to other SSC's, South Africa was in the unique position that there was no local infrastructure to manufacture the larger components. For the other SSC's the manufacture tended to be in the local country. At NAC there was the possibility to source components worldwide from the most suitable manufacturer. This meant that parts came from Germany, Austria, France, Denmark, USA and even New Zealand. It is therefore the most international SSC, but with NAC design and a large local input. The challenge was to make it all fit together.

During 1979 much mechanical detail design of the SSC resonators were done by the newly appointed mechanical designers. The SSC consists of four large electromagnets, each with a triangular horizontal profile (each weighing 400 ton), arranged to give four valleys. Two large resonators are situated in opposing valleys. One of the remaining valleys is used for injection of the beam from the injector, and the other for extraction. A resonator has a large, almost triangular horizontal delta electrode, with 4 m sides, connected to a 3 m long co-axial quarter-wave resonator above and below. This results in a half-wave resonator with a vertical height of approximately 7 m. Finite element analysis of the resonator structure was undertaken by the Civil engineering department at the University of Stellenbosch, to calculate deformation when evacuated. This indicated the need for a stainless steel triangular chamber to contain the copper surfaces required and copper cylinders for the upper and lower parts of the resonator.

In the first half of 1980 quotations were requested for the supply of two 150kW RF amplifiers, and the manufacture of two resonators. No suitable solution was found for the design and construction of the amplifiers. It was then decided to look at short-wave radio transmitters working in the required frequency and power range, that could perhaps be modified. Possible manufacturers for the resonators were identified. During June and July of 1980 an extended tour was undertaken by Johan and Max Hurwitz the mechanical engineer involved in the design of the resonators and the NAC cooling systems. The manufacturer of the resonators for the Swiss SSC, and a large manufacturer at Hanau in Germany, were visited and quotations requested for completion of the detail design, and subsequent manufacture. In the USA power supply manufacturers,



SPC1

SSC

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the Indiana SSC, the Los Alamos linear accelerator, and a radio transmitter exhibition in Washington were visited. The last stop was in Dallas where Continental Electronics, a radio transmitter company was situated. During the discussion with their technical representative different options were evaluated. Normal communication transmitters have 10 pre-tuned frequencies and provision for high level audio modulation. The latter would require modification for the SSC.

A question about other possible options did not produce new information.

However during the subsequent tour of the factory Johan noticed a row of new cabinets and asked what they were for. After the representative had explained it for about two minutes, they both realized that this was exactly what NAC needed.

Johan said " *If you can provide me with two of these at a reasonable price, I will buy them*". These units were then newly developed for over-the-horizon radar. The specification was exactly what was required for the SSC.

Tuning is automatic over the full frequency range from 4 to 27 MHz, without high level modulation, but suitable for pulsed or continuous fixed level operation, with input at a low level. The noise level is minus 75 dB compared to minus 60 dB of normal radio transmitters. The output is into a 50 ohm coaxial cable. The power supply is also low noise and low ripple, forming part of the unit. The two units were delivered during 1982 and were ready for use before the resonators were completed. It was a case of asking the right question at the right time and place. Reg Fenemore and Pieter Kriel observed the acceptance tests at the factory.

During the design of the layout of the facility, it was decided to locate the SSC amplifiers outside the SSC vault, using 150 mm OD flexible 50 ohm coaxial cable, to convey the RF power to the resonator, which was designed to represent a 50 ohm load. This was a deviation from the standard SSC approach at that time, as the amplifiers were normally mounted on and directly connected to their resonators. With appropriate coaxial switches, a 200kW 50 ohm dummy load is connected in turn to each amplifier, to enable automatic tuning to a new frequency.

The tuning of the amplifier is frozen at this setting, so that it works with fixed tuning when connected to the resonator. In order to avoid taking up valuable space at ground level, the amplifiers are situated on a specially constructed mezzanine at first floor level, next to the SSC vault.

In addition to the basement, this level was later very useful for expansion needed for electronic equipment for the SSC. Such an arrangement allows easy access to the cyclotrons, and experimental areas at ground floor level. Locating the amplifiers outside the SSC vault has since that time also been used at other facilities.

After the solution for the SSC power amplifiers was found, attention was concentrated on the biggest challenge, that of the two resonators for the SSC. Prior to the overseas visit in June 1980, a one fifth scale model was built in the NAC workshop within 6 weeks. This had all the planned working parts, and relative dimensions of the final design. Detail RF measurements were made to verify that all electrical characteristics are according to requirement.

The quotation from Leybold-Heraeus (LH) in Germany was approximately 70% of the Swiss quotation for the detail design, and manufacture, of the two resonators. Johan considered LH to be technically better for the copper work than the Swiss, who were more familiar working with aluminium. However the Swiss did a better cost estimate. Johan advised the NAC and the CSIR to accept the LH quote but warned that they will not be able to do it at the quoted price, so that the final price may be closer to that of the Swiss. The order was placed in March 1981, with delivery planned for 1983. LH had a local agent in Johannesburg but Johan arranged that contact should be directly with LH. The arrangement was for a two week visit every three months. The first three visits had three persons from NAC (Johan, Max Hurwitz the mechanical engineer and Ron Quantrill a mechanical designer) to complete the detail design. Later Johan was usually the only visitor to observe progress.

LH had a very good mechanical design team at that time. Excellent co-operation was established with the head designer Herr Grein, and the project leader Gunther Matthiensen. The German approach is that the "devil is in the detail". The detail design and manufacture was for the stainless steel chamber, its copper liners, copper inner and outer cylinders, inner delta and the large adjustable capacitors for the low frequency range. The short-circuiting plates, trimmer capacitors and coupling capacitor were excluded.

While in New York during the 1980 trip, Johan decided to buy a newly available HP 41C scientific pocket calculator. After getting prices from a few stores he returned to the one with the lowest price. However

the previous salesman was nowhere to be seen and the price was then 20% higher. This happened at the next store as well. If you return they know that you are interested and that their price was the lowest. Going to a store where he had not been, and with the price reasonable, he bought it for himself, together with extended memory and a thermal printer. This calculator can do rectangular to polar conversion, and the reverse, to enable calculation of the characteristics of the resonators. The calculation makes use of transmission-line impedance transformation, and the geometric determination of the characteristic impedance, represented by the different parts of a resonator.

The calculator has enough memory and capability to do the same calculations that were done on the mainframe computer. It was possible to calculate the required short-circuiting plate position for a frequency, and the corresponding current, current density and power for the various parts, as well as the total power for the required peak accelerating voltage. With the final mechanical dimensions as input, these results gave the information that was used for the detail design of all the cooling circuits and contact fingers required. The prediction is so accurate that the short-circuiting plate can be positioned at the the calculated value, and only a slight adjustment of the trimmer is required. It applies over the whole range of short-circuiting plate position. The power prediction was also found to be accurate. This program was later converted to run on a PC using the same data.

Towards the end of 1981 Johan read an article in a technical magazine describing a newly developed product. This dispersion strengthened copper, under the trade name Glidcop made in the USA, has a small amount of aluminium oxide (1.5 or 2.5%) mixed with copper. It claimed to have almost the same electrical and thermal conductivity as pure copper but with spring and deflection properties. Until then beryllium copper was almost universally used for spring contacts, although its thermal and electrical conductivity are only one third of that for copper. Silver plating was used to improve electrical conductivity, but does not help significantly with thermal conductivity.

Samples of Glidcop were ordered and tested. It does not have the excellent spring properties of beryllium copper, but allows spring movement for 10% of the length of a contact finger. In addition it retains this property at high temperature, to allow welding for attachment. Beryllium copper can only be attached by soft soldering because high temperature destroys the spring characteristics. Glidcop was found to have a ten times lower temperature rise than beryllium copper, and with silver plating approximately four times lower, for the same current density. Pure copper is not suitable for repeated bending, as it work hardens and finally cracks. Glidcop sheet 150 mm wide, was available in rolls. Rolls of 0.15, 0.2, 0.25 and 0.5 mm thickness were ordered in the beginning of 1982 to fulfil in all foreseen requirement.

The knowledge of Glidcop was too late to alter the contact fingers, which connect the vertical liners of the SSC resonators to the horizontal liners. For this silver-plated beryllium contact finger strips were used, soft soldered (with some difficulty and problems with the initial silver plating) to the top and bottom edges of the vertical liners. The contact fingers of the large capacitor units, which were designed later during the project, were made from Glidcop.

The two large resonator chambers were manufactured using 40 mm thick non-magnetic stainless steel plates, and accurately machined with a large new, computer controlled, milling machine. It

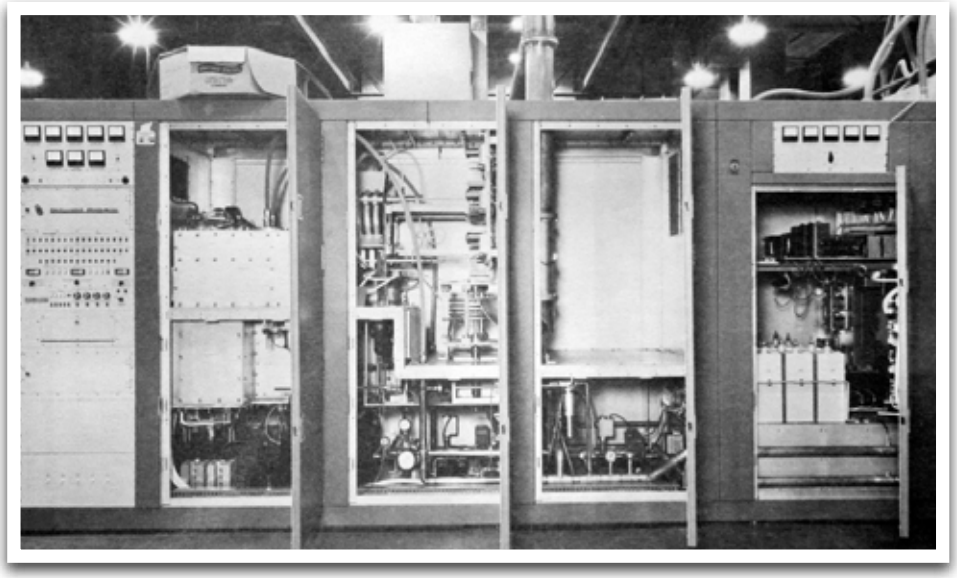

Fig 2 - Front view of the SSC power amplifier cabinets, showing the interior

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was done at a shipbuilder in Deggendorf, on the river Donau, in the south-east of Germany. Two reference edges, 4 m apart, were machined at the rear of each chamber. When Johan controlled this distance with his 5 m tape measure, which he used to check all dimensions, it agreed to within 0.1 mm. Johan still has this tape measure, which helped to ensure that the parts of the SSC fitted together, after timely correction of some errors indicated by it.

The four large inner and outer copper cylinders, with integral cooling channels, were made at the same Kabelmetal factory as for the injector cyclotrons at Schladern, a small rural town in the hilly forest next to the river Sieg, 35 km east of Bonn and the river Rhine in Germany. A steel cylinder with a wax coating was used as a base on which the copper was electro formed in a large bath. The end flanges were pre-machined and fitted on to the base, the correct distance apart. After plating the wall to sufficient thickness it was removed from the bath and a spiral grove was machined in it to form the integral cooling channel. The channel was then covered with a thin copper strip before continuing with plating to finish the outer part. Final machining of the inner and outer surface and the end flanges produced an excellent and accurate end product. The 4 inner cylinders are 3.5 m long with 500 mm outer diameter. The 4 outer cylinders are 3 m long with 1.3 m internal diameter.

Meanwhile the short-circuiting plates were designed at NAC. Johan arranged a meeting between Attie Mueller, the Swiss staff member doing the design at NAC, the head of the NAC workshop, and the staff of the local manufacturer. It was to find the best solution to enable the welding of the 0.25 mm thick Glidcop fingers to the 5 mm thick copper disc. The disc has an outer diameter of 1265 mm and a 510 mm hole. The elegant solution was to machine a V-shaped groove, in the flat part of the disc, along the inner and outer perimeters, in such a way that the perimeters taper to a thin edge, to which the thin fingers can be welded. Each contact finger is 14 mm wide, with two silver contact buttons hard soldered on. The effective length for the current on the fingers along the inside perimeter is 23 mm, and 33 mm on the outer. Bellows operated lever systems are used to withdraw the fingers, to allow positioning of the short-circuiting plate or to apply pressure for contact during voltage operation. The four short-circuiting plates were made locally.

The mechanism to position the short-circuiting plates was one of the bigger challenges. Johan discussed this with many persons, also with Herr Grein of LH. Owing to the height restriction between basement and the roof beams, a long tube (as used for the injectors) could not be used. Originally a three stage lead-screw system was planned. The LH suggestion was to consider a chain that can fold in one direction but cannot unfold further than a straight line. Grein remembered that it was used to push an object with the chain held straight by sliding and pressing on a smooth surface or a set of rollers. He suggested using two chains in a back-to-back fashion. Sufficient length of this type of chain was obtained and tested for rigidity, and load carrying properties. The test was successful and it was an excellent solution, enabling 3 m extension into the resonator, but folding away horizontally, in opposite directions, on the outside. With an end of each chain clamped together, the chains are driven by two sprockets (synchronized by two meshed gears) from a reduction gearbox. If the outside end of each chain is mounted appropriately, and a sprocket is inserted in each of these two outside loops, they form a T-configuration where the ratio between height and width can be changed. A pulley mounted on each side of a sprocket enables the 2 cooling water pipes, the air pressure pipe and the electrical cable to be neatly arranged on the two sides, as the short-circuiting plate position is altered. The chain remains in air in the space between the inner and outer cylinder, surrounded by a two stage sliding tube system, with double sliding seals using guard vacuum. The final design and manufacture of the four systems were done by a company in Pretoria.

Instead of three such mechanisms per short-circuiting plate, only one was used. To counteract the tilting of the short-circuiting plate that results, 12 guide wheels were used, fitting around the inner cylinder at two levels, 350 mm apart. Only three at each level (on opposite sides) prevent tilting by more than 4 mm. The rest are only to aid installation. The bottom short-circuiting plate is pushed upward against gravity by the chain mechanism, while the top is suspended by an identical system. This solution has proved to be very effective and reliable. It is much better than lead screws, as shown by the experience with the 3 lead-screw system of the large capacitor units that are needed to reach the frequency range down to 6 MHz.

The inner delta consists of a top and bottom half, separated by a gap through which the beam can pass as it is accelerated. Each half is connected to its associated inner cylinder. By means of the support structure joining each inner cylinder to its outer cylinder, the inner cylinder can be accurately centred, and the height of the inner delta half can be adjusted for the correct beam gap between the two halves. The two halves only make electrical contact by means of contact fingers at the narrow and its opposite side of the delta.

In order to install or remove a short-circuiting plate, the associated inner cylinder must be supported from its opposing inner cylinder. This is done by means of three strong bolts, (called the "latching device") joining the the inner cylinder ends together. Long extension tubes, located inside the bottom inner cylinder, are used to turn the bolts. Because the centre of gravity lies outside the area of the inner cylinder, some bolts must use compression, and others tension, depending whether the top or bottom structure has to be removed. The distance going all the way around is approximately 16 m. However by careful adjustment, it was possible to centralize the opened outer and inner to within 1 or 2 mm, to enable installation or removal of the short-circuiting plate, while it is attached to its support structure. In this way all four short-circuiting plates were successfully installed. The "latching device" is parked out of the way, so as not to obstruct the accelerated beam.

Owing to the two beam extraction magnets, that have to be installed between the upper and lower inner delta halves of the one resonator, and to allow assembly or repair to the components inside the resonator chamber, the top lid of the stainless steel chamber is removable. By means of a frame, the top lid, top outer and inner cylinder, and upper inner delta half can be lifted away and stored on the roof beams of the vault. A number of lifting frames were made to aid movement, assembly and disassembly of the large resonators.

While the field mapping of the large magnets was in progress in the SSC vault, the SSC resonators were assembled in the area later to be used for the second injector cyclotron. Originally it was thought that a resonator will need to be taken into the SSC vault as two parts. However, with two frames bolted to a resonator, it was possible to lift it in one piece (with the two crane hooks) over the wall of the SSC vault. Only the bottom short-circuiting plate positioning system had to be removed. The clearance at top and bottom was 100 mm, but it was sufficient. The first resonator was installed in the SSC vault during August 1985. The second resonator was lifted into the SSC vault on 28 August, and was completed by 20 September. Each resonator weighs about 25 tons. After installation of the two resonators, which form part of the SSC ring, the first vacuum pump-down of the SSC started on 21 September.

After the initial evacuation of the east resonator, it was very difficult to overcome multipacting and obtain high voltage on the resonator. Multipacting is caused by secondary electron build-up, when the RF voltage is such that, for the particular frequency and gap length, the time taken by electrons to cross the gap, is equal to half of the period of the frequency. This produces a rapid increase in electron density, when secondary electrons are produced, that in effect causes a short circuit. Fast rise-time pulsing up to 10 kW (the reflected power trip level), was not sufficient to prevent the build-up. Consequently a short-duration "kick-pulse" circuit was developed. Using a double-balanced mixer, 80 kW drive level is applied to the resonator for 15 microseconds, before reducing it to 10 kW. The rise-time of the power amplifier output is 1 microsecond. The low Q-value circuits of the amplifier, intended for radar application, is essential to obtain such a fast rise time. The power amplifier protection circuitry does not respond significantly to the 15 microsecond pulse. By means of this pulsing it was much easier to start the RF voltage on a resonator, by preventing the build-up of secondary electrons. Both resonators were operational up to 70 kV at 16,4 MHz by 3 October. On 9 October 1985 the first beam was accelerated up to 66 MeV in the SSC, using a peak voltage of 90 kV per resonator.

Multipacting in a resonator is a strong function of the stray magnetic field produced, by the two adjacent sector magnets. When the main pole-gap field was less than 0,6 Tesla, it was relatively easy to start the RF voltage, but as the magnetic field was increased, it became progressively more difficult to start. Multipacting is associated with a layer of contamination (mainly oil) deposited on the RF surfaces during the various manufacturing processes. This layer can be converted to carbon by conditioning (electron bombardment). The most suitable method was found to be as follows: start the RF voltage at 22,5 MHz with a relatively low magnetic field, then slowly increase the magnetic field in steps, while observing the vacuum condition. With each step the vacuum gets poorer, but recovers to the previous value in ten to fifteen minutes.

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Residual-gas analysis showed strong peaks of mass 28 (carbon monoxide) and mass 44 (carbon dioxide) during conditioning. With the voltage at 150 kV, it required 4 hours to condition both resonators up to the maximum pole gap field of 1,25 Tesla, at the end of November 1985. Further conditioning at 26 MHz up to 250 kV was done in April. This conditioning is normally a once-only process and is not affected by venting of the resonators. It is very much quicker to condition a resonator while operating at a high voltage, than when the voltage is clamped at a low level.

The Q-values of the two resonators agree closely with calculated values, specially in the frequency range above 8 MHz. The positions of the short-circuiting plates and the large tuning capacitors, agreed within 1% with the scaled measurements obtained on the 1/5 scale model during 1980. The mechanical stability and repeatability of both resonators are excellent. Two auto-tune capacitors were provided to ensure adequate tuning range at minimum frequency, but in the upper frequency range only one needs to be moved. Only 3 mm movement is required to keep the resonator tuned at 26 MHz while the power is increased from a very low level up to the maximum of 100 kW. The maximum thermal time-constant of the resonator is approximately 5 minutes, showing that the cooling system is effective.

In the meantime, the low-level equipment for the different RF systems was developed and constructed at the NAC, either by the RF division or the Electronic division. Early on it was realized that a minicomputer was not ideal to control the RF systems directly. Newly available microcomputers offered a better way to control the different variables,

and to run an RF system. Rudi Fisch of the Control Systems division was given the task of developing the control of the RF systems. He had experience of electronics before moving to programming.

Johan had very good interaction with him, enabling a very effective solution. Pascal was the programming language used for the main systems, and Basic for some of the sub system microcomputers. The aim was to have all variables under computer control in order to do frequency changes, and for subsequent operation. Johan, and a few of the members of the Accelerator group, purchased BBC microcomputers for themselves in 1983, to gain experience with the new age of computers and programming. These were able to do word processing, spreadsheets and graphics in addition to Basic and Pascal programming. The program on the HP 41c was converted to run on the BBC, and further extended.

The low-level equipment for the different RF systems are very similar, and controlled in the same way with similar software. A main microcomputer is used to control two RF systems. That means one for SPC1, one for the SSC and a third for the buncher and pulse-selector together. Display was on a CRT terminal and control via keyboard for each microcomputer. They were connected to their processor via RS 232 by cable, so that it could be extended, from the local electronics in the basement, to the main central control room. The run mode of the microcomputer is a task which monitors the RF systems on a continuous basis, and runs concurrently with any data entry from a terminal. In the case of the two SPC1 RF systems which are coupled, the run mode loop will start both systems simultaneously. For the SSC, where the two RF systems are not coupled, the run mode task alternates between the two systems and starts each system separately. In run mode, when the RF trips, the systems, are automatically restarted. If the RF trips repeatedly, the nature of the problem is displayed on the terminal, and operator intervention is required to restart the system.

The system reference values are automatically stored every 2 minutes, and are reloaded on boot-up. Reliable solid-state bubble memory is used for data storage of the reference values, for each used frequency, and a backup of these values is made. This allowed easy recovery from all disruptions. All equipment values are stored in the individual equipment, so that the microcomputer is only used to make changes, or to initialize after a power interruption. It is therefore possible to reboot a microcomputer while the resonators are in operation, provided no changes had been made during the previous

two minutes. Many of these systems were still in use after more than 25 years.

If a trimmer is not adjusted while, or after cooling down of an SSC resonator, the resonant frequency changes sufficiently to prevent restoration of voltage. Restoration after an interruption is achieved by measuring the off-period with the controlling microcomputer. The microcomputer then uses this time to position the trimmer according to two straight-line approximations. This approach enables resonator voltage to be restored, after any interruption lasting between a few seconds and 15 minutes (when the resonator has cooled down completely), or longer.

The gains of the power amplifiers change significantly with ambient temperature, and mains supply voltage variations, and hence corrective action is needed. The error signal of the amplitude stabilization-loop is proportional to the amplifier gain, and is used by the microcomputer to determine the necessary attenuator setting. It is updated every two minutes if it falls outside the allowed band. In this manner the power-reserve (needed for fast amplitude stabilization) is maintained at plus 20%, but avoids overpowering. As a result of these adaptive control strategies, the resonators of the SSC operate extremely well.

After November 1986 operation has been almost continuous. Interruption of resonator voltage occurred on average less than once per day and the longest run without any interruption whatsoever was 140 hours (at 16,36 MHz). When a discharge occurs in a resonator, voltage is restored within 3 seconds. Frequency resettability and the mechanical stability of the resonators are excellent. During the first half of 1987 three frequencies were used to produce beam. Normal operation for 200MeV at 26 MHz was with 225 kV, requiring 85 kW per SSC resonator. For 66 MeV at 16,37 MHz it was 210 kV, using 55 kW, and at 13,73 MHz it was 170 kV using 35 kW. The maximum design voltage is 250 kV and this was achieved at different frequencies during the initial tests, but was not necessary for most operation. The smallest resonator voltage increment is 0,01% and smallest phase increment is 0,1°. The long-term voltage drift is less than 0,03% and the phase drift 0,3°. The loop-error signals are observed in the control room (on oscilloscopes and the control system displays), to optimise the stabilizing loops, and to ensure optimum performance over the long term.

Between 1984 and 1987 each new achievement was appropriately celebrated at the equipment involved or in the main control room. This occurred at regular intervals and ensured the good team spirit of the Accelerator Group. It was the culmination of many years of planning and hard work.

The SSC power amplifiers from Continental Electronics generally performed reliably, and their pulse capability and low noise meant that the beam stability and availability was excellent. This was proven when the time of flight experiments with neutrons developed problems. At the time the beam from the ion source in the injector was fluctuating so much in amplitude, that some beam pulses were missing, causing difficulties with the timing beam pick-up near the beam target, in the high energy area. By taking a time reference from the master oscillator of the RF system, it became possible to do time of flight measurements. This means that the time taken by beam pulses to go from the injector ion source to the target in the high energy beam line, is constant to about 1 nsec. The total beam flight time is of the order of 8000 nsec and 60 % is spent in the SSC.

Two other parts of the initial total RF system were the beam-line buncher and the pulse selector. The two-gap buncher (needed to shorten the beam pulses) was located in the beam line, halfway between the injector and the SSC. It operates at double the frequency of the injector (17 to 54 MHz) and uses only capacitor tuning to obtain this range. The lower voltages needed at the lower frequencies makes this possible. Only sliding Glidcop fingers are used for the 200 mm movement of the two symmetrical capacitor units.

The pulse selector is situated in the injection chamber of the SSC, and enables a number of consecutive beam pulses to be prevented from entering the SSC injection magnet. This allows a longer time between the SSC output pulses that is needed for neutron time of flight studies.

By 1988 the accelerators had operated for a full year, and some extracts from the June 1988 Annual report give a good idea of the performance of the RF systems.

"The SPC1 RF-system has operated very reliably during the past year. Frequency changes (to previously used conditions) are now fully automated. After a power failure all electronic variables are easily re-initialized by selecting the appropriate procedure. The contact-fingers of the short-circuiting plates are released, and then restored, as part of this procedure to

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restore the "dees" to their correct position (they are displaced by induction owing to the magnetic-field collapse associated with a power failure). At present, discharges seldom occur in the resonators. The main reason for resonator voltage interruption is the need for equipment protection (in the beam lines and the SSC), which switches off the RF (with a fast response time) while the Faraday cups move into position. As soon as the cups have operated, the RF is automatically restarted to maintain the operational temperature in the injector cyclotron.

Further improvements in the SPC1 system monitor program have been implemented. The trimmer position is stored as a "warm" value when operation is normal (i.e. with small error voltages in the amplitude control loops). This value is updated every 10 seconds, and allows the system to track the normal movement of the ion source during beam optimization. An operator-adjustable offset value is stored for each resonator, corresponding to the difference between the "cold" and "warm" trimmer positions. After a voltage interruption, the computer control tries to restart in the "warm" position, but if unsuccessful it re-tries, by repositioning the trimmers in increments of 1/4 of the offset, in the direction of the "cold" position. More than 3 tries are seldom required.

The SSC RF system has operated reliably during the year at 16 different frequencies between 10.7 and 26 MHz. Most of the operation was at 16.373 MHz (the frequency for 66 MeV protons). The "kick-pulse" starting of voltage, the compensation for the cool-down characteristic of a resonator ,and making allowance for the change in amplifier gain have functioned well. This has resulted in long runs without needing attention by a person from the RF division. Each 150 kW power amplifier has now been in operation for a total of 10 000 hours. All protection systems have operated reliably, and give suitable indication on the control console. The phase and amplitude stabilization systems have performed extremely well, and no improvements were required during the year. When restarting at a previously-used frequency, no changes are required from the stored values. It is only necessary to change phase or voltage when the beam characteristics of the injector cyclotron have changed, or when the SSC magnets are adjusted.

It was necessary to lift the top half of the West SSC resonator during December 1987, to repair a water leak on the first extraction magnet. When the resonator was open it was noticed that a 50 mm length of beryllium-copper contact fingers had overheated and that some of the same type of fingers had been dislodged during the opening. Most of these contact fingers were then replaced by contact strips made from dispersion-strengthened copper (Glidcop). This refers to the joints between the outer copper side-wall and the copper top plate, as well as the bottom plate. For the bottom joint the contact strips (150 mm long and 25 mm wide and 0.15 mm thick) were pushed into position, adjacent to the existing beryllium-copper contact fingers (without removing them).

At the top joint the beryllium-copper contact fingers were removed, as the resonator was open, and 0.25 mm thick contact strips with positioning-clips were installed on the vertical plates before closing the resonator. Installation was very quick and straightforward, requiring no soldering, unlike the beryllium-copper contact fingers. Performance of the West resonator since January has been even better than before and shows that these contact strips operate comfortably at a current density of 15A rms per cm in vacuum at the operational frequencies." These Glidcop strips do not need to have fingers, and simply have to be bent as a shallow V in the centre along its length, with 2 small locating lips at each end, for the bottom joint. Glidcop has helped tremendously to obtain reliable high power resonators. Practically all beryllium-copper fingers failed at some point, whereas Glidcop has survived.

Wikipedia (2014) gave this information on the now almost universal use of Glidcop: (Edited) *"Glidcop has found use in relay blades, contactor supports, x-ray tube components, and heat exchanger sections for fusion power and synchrotron units. Other uses include high field magnetic coils, sliding electrical contacts, commutators, high speed motor and generator components, and microwave power tube components. One of the more intensive uses of Glidcop has been in particle accelerator components, where the alloy may be subjected to high temperatures and high radiation simultaneously."* NAC was probably the first particle accelerator facility to use Glidcop extensively, starting in 1982.

After 1987, the one task was the operation of the completed accelerators, and the second the completion of the heavy ion injector (SPC2), and all the user facilities. The RF systems for the SPC2 are very similar to that for SPC1, and did not require much further innovation.

During 1991 Lowry Conradie (presently Head of the Accelerator Group) was doing

his Ph.D. thesis on different aspects of the cyclotrons and their beam lines, particularly on the aspect of increasing beam current. It involved the different bunchers, but also the possibility of flat topping. Flat topping is the process of adding an odd harmonic voltage to the fundamental frequency accelerating voltage. With the correct phase and amplitude, it flattens the top of the fundamental sine wave to allow a longer beam pulse, and therefore a larger average beam current. During April and May 1991 Johan, Lowry and Adriaan Botha had discussions about possible flat topping for SPC1. With separated-sector cyclotrons, as with the Swiss SSC, it is done with harmonic resonators in different valleys than used by the main resonators. In SPC1 this is not possible, and the question was whether it would be possible to produce the harmonic voltage on the same "dees" as used for the fundamental frequency.

As the main resonator of SPC1 is not a fully uniform transmission line, the higher order resonances are not exact multiples of the fundamental. They are lower in frequency, so that simple capacitor addition cannot produce an exact multiple.

Different measurements were done on the old full scale model to confirm the calculated values. Johan suggested that a small additional tunable resonator, for the harmonic frequency, may be able to produce correspondence. If this resonator is coupled capacitively to the inner of the main resonator, the harmonic resonator can shift the harmonic in the main resonator by suitable tuning, with the short-circuiting plate of the harmonic resonator and its coupling capacitor. This resonator can also serve as the point to apply the harmonic drive power.

The only suitable place to mount such a resonator is on the tapered section, between the outer conductor of the main resonator and the magnet, to be out of the way of the main adjustable short-circuiting plate. Test on the model showed that it was indeed possible, and the effect could be observed on an oscilloscope. The 5 th harmonic was the most suitable. Two small resonators were designed and constructed in the mechanical workshop. Two suitable amplifiers, plus phase and amplitude control systems for the 65 to 130 MHz frequency range, were made and tested on SPC1 during 1992. An extract from the 1993 NAC Annual report describes the result as follows:

"In the previous Annual Report a fifth-harmonic flat-top system was described which makes use of the existing main resonators of SPC I. The system has been completed and tested at a main frequency of I6.3 MHz. The main and flattop RF systems performed well and without mutual interference, despite the common resonators. The required phase and amplitude stability has been achieved. With the usual setting of the slit gaps in the central region, the beam current in SPC1 increased from 320 to 650 uA when the flattop system was switched on. The extraction efficiency increased from 82% to 92%. These measurements show that the flattop system behaves as was expected."

This novel system has since then also been used at other cyclotrons.

From 1987 to 1995 the different RF systems continued to operate reliably and on the average was responsible for only a 1% time loss of the total scheduled beam time. The overall performance between the start in 1987 and 1995 is shown in Table 2.1 (from the 1995 NAC Annual Report).

The following operating conditions have been achieved: (1987 to 2014)

- Highest proton energy (for 1 week only) 223MeV at 27 MHz normal maximum 203 MeV (design value 200 MeV).
- Highest current from SSC with flat-topping (in SPC1 and SSC) 250 uA at 66 MeV (design value 100 uA).
- The highest operating voltage of the SSC resonators 300 kV peak RF (design value 250 kV)

To summarize: The facility has now been in full time operation for more than 27 years. (May 2014) The injectors operate from 8.3 to 27 MHz. Main tuning only by adjustable short-circuiting plates. The buncher operates from 17 to 54 MHz. Main tuning only by adjustable capacitor plates. The SSC operates from 6 to 27 MHz using both short-circuiting plates and capacitor units for the main tuning.

Similar to the international aspect of the components of the facility, the staff also had an international component. Although most of the staff of the Accelerator Group were South Africans, there were staff who were born in Germany, Austria, Holland, Belgium, United Kingdom, Spain and Czechoslovakia. Without such a dedicated team it would not have been possible to establish such a unique facility. This SSC is still the largest in the Southern hemisphere. This description only refers to the Radio-Frequency systems, and it must be remembered that there was also an impressive amount of unique design, development and research at the other parts of the facility, such as the magnets, beam line transport, ion sources, vacuum and control systems and equipment for isotope production, cancer therapy and nuclear physics experiments. wn

Earn CPD Credits

Supermagnets

Magnetism and Electricity are the basis of modern technology, and massive funding is being ploughed into research into magnetism and is applications. One aspect of magnetic technology is the so-called "Super Magnets" that are becoming fundamental to our everyday modern lives.

BY | MIKE CROUCH | PAST PRESIDENT | SAIEE

For details and demonstrations of permanent magnet drives, contact Patrick Shorten MD of Conshor Services, on 011 728 4868.

These magnets are also referred to as "Rare Earth Magnets" or "Neodymium Magnets", and they are used in a surprising number of devices in our daily lives. For instance, the hard drive in our computers has these magnets, as do electric motors and generators in motorcars. Hydraulic Fluid Couplings and Variable Frequency Drives (VFD's) are being replaced in many applications by Permanent Rare Earth Magnet Couplings using super magnets. Generally, Neodymium magnets are replacing Alnico and Ferrite magnets in industrial applications.

The purpose of this article is to explain how Neodymium magnets are made, and how they are used in rotating machinery.

NEODYMIUM

Neodemium is a metallic Element having the atomic number 60 on the Periodic table.

When combined with Iron and Boron, it forms Nd2Fe14B. Neodymium was discovered in 1885 by an Austrian chemist, Carl Auer Welsbach, and was initially used to colour glass purple. However, in modern times it is used in the manufacture of certain types of LASER and super magnets.

The element is obtained from the raw materials Monazite and Bastnäsite, which are available fairly widely throughout the world, but are mostly mined in China. China has recently levied export restrictions on the metal, which in turn has inflated its market price.

MANUFACTURE OF NEODYMIUM MAGNETS

The manufacture of super magnets is a fairly complex process, which will be described briefly below in a number of steps:

- **Raw Materials:** Iron, Boron and Neodymiun are combined in various ratios, depending on the customer requirements for various types of Neo Magnets. These raw materials are then melted together at a temperature of 1450˚C.
- **Strip Casting:** This takes out most of the Oxygen from the melt.
- **Hydrogen treatment:** Hydrogen is combined with the remaining Oxygen. Because Neodymium oxidises very readily, it is essential to remove all traces of Oxygen prior to the remaining processes.
- **Jet Milling:** Here the material is ground to a fine powder ready for casting into its final magnet shape.
- **Plastic sealed:** The shapes are vacuum sealed in plastic film to keep out Oxygen.
- **Compacting:** The shapes are compressed at 23000 psi prior to sintering.
- **Sintering:** The pieces are unwrapped and sintered at 900˚C for 20 to 36 hours depending on the product size and shape. Sintering is a process where powdered metal is compression moulded, then heated (sintered) to just below the melting point of the metal powder.
- **Descaling:** The magnets become covered with scale during the process, and this is removed while the magnets are ground to their accurate final size.
- **Electro-plating:** The magnets are then electroplated to prevent oxidation.
- **Epoxy coating:** The magnets are dipped in epoxy resin of different colours to identify and protect them.
- **Magnetisation:** Finally the magnets are subjected to a very powerful magnetic pulse, generated by discharging a large capacitor from 2400 Vdc at 12 Amps through a solenoid. This aligns the atoms in the magnet to form North and South poles.

APPLICATIONS OF NEODYMIUM MAGNETS

As Neodymium magnets have a very high power to weight ratio, they find many applications where light weight is important, for instance in aircraft and hybrid vehicles, where electric motors and generators are used. Small Neo magnets are used in computer hard drives, loud speakers and headphones, and in dynamic microphones. Very large Neo magnets are also being used extensively in permanent magnet drives, or torque transmitters, which are described in more detail below.

PERMANENT MAGNET COUPLINGS AND ADJUSTABLE SPEED DRIVES

The use of large Neodymium permanent magnets in drives is based on Lenz's Law and Newton's Third Law of Motion. Heinrich Lenz's Law (1833) states that when a body exerts a magnetic flux force on a second body, the second body simultaneously exerts a magnetic flux force of equal magnitude and opposite in direction on the first body. Isaac Newton's Third Law (1687) states that every action causes an equal and opposite reaction between two bodies.

All electrical engineers learn about "Eddy Currents", which are an example of Lenz's law whereby, for instance, a permanent magnet being brought towards a non magnetic conducting (eg copper) plate will generate electric currents in the plate that will try to push the magnet away. Similarly, a circle of magnets rotating around a copper disk will move the disk in the same direction as the magnets. The closer the magnets are to the copper disk, the greater is the torque transmitted, up to 98%. Energy savings are about 70% as compared to other drives, such as variable frequency and fluid drives. Other advantages of permanent magnet drives are as follows: They have: High reliability, no vibration, ease of installation, zero maintenance, tolerance of shaft misalignment and low overall cost of ownership. wn

The New Registration System

From 1 April 2016 ECSA will only consider applications for registration as Professional Engineer in accordance with the New Registration System (NRS).

All applications in accordance with the legacy systems which had been submitted to ECSA by 31 March 2016 will be assessed. The NRS for Professional Engineer Registration was introduced on 1 April 2013.

The NRS for Professional Certificated Engineer, Professional Engineering Technologist, Professional Engineering Technician and Specified Categories will be introduced later. In the meantime, the Engineering Technologist and Engineering Technician Categories have already changed their application forms to the NRS format in preparation for the introduction of the NRS for those categories. Also, to date no changes have been made to the processes applicable to registration as a candidate, renewal of registration nor re-registration in any category.

THE NEW REGISTRATION SYSTEM

ECSA is obliged to register any applicant who meets the prescribed competency requirements for the category of registration applied for. In case of engineering professionals that is the academic education requirement (stage 1) and post academic professional development (stage 2) in a professional category. The two stages of competency are assessed in a combined peer judgement assessment.

A new set of guideline documents replaced the legacy system Policy Statement R2/1A, Discipline Specific Guidelines and Guidelines for Mentors.

New Guideline format consists of:

- R-01-P Policy on Registration of Persons in Professional Categories;
- R-02-PE Competency Standard for Registration as a Pr Engineer;
- R-03-PE Processing of Applications for Registration as Candidate Engineer and Professional Engineer;
- R-04-P Training and Mentoring Guide for Professional Categories;
- R-05-PE Discipline-specific Training Guidelines

DISTINGUISH BETWEEN:

- Discipline-specific Guidelines applicable to legacy registration system: best practice in training (normative approach);
- Discipline-specific Training Guidelines: (informative approach) applicant must produce evidence of how outcomes were achieved) at registration, and
- R-08-PE Guide to the Competency Standards for Registration as a Professional Engineer.

The NRS has not changed the competency requirements for Stage 1 Development and hence the application details have not changed.

BY | DU TOIT GROBLER
INTPI(SA)(EE) | PRING(EE) | PRDIPLING(EM)
BSC(ING)(ELEK)(PRET) | MDP(UNISA) | GSAIEI | SMIGWEISA

The competency requirements for professional development has been redefined as 11 Outcomes in 5 Groups which have to be met by all applicants, namely – see figure 1:

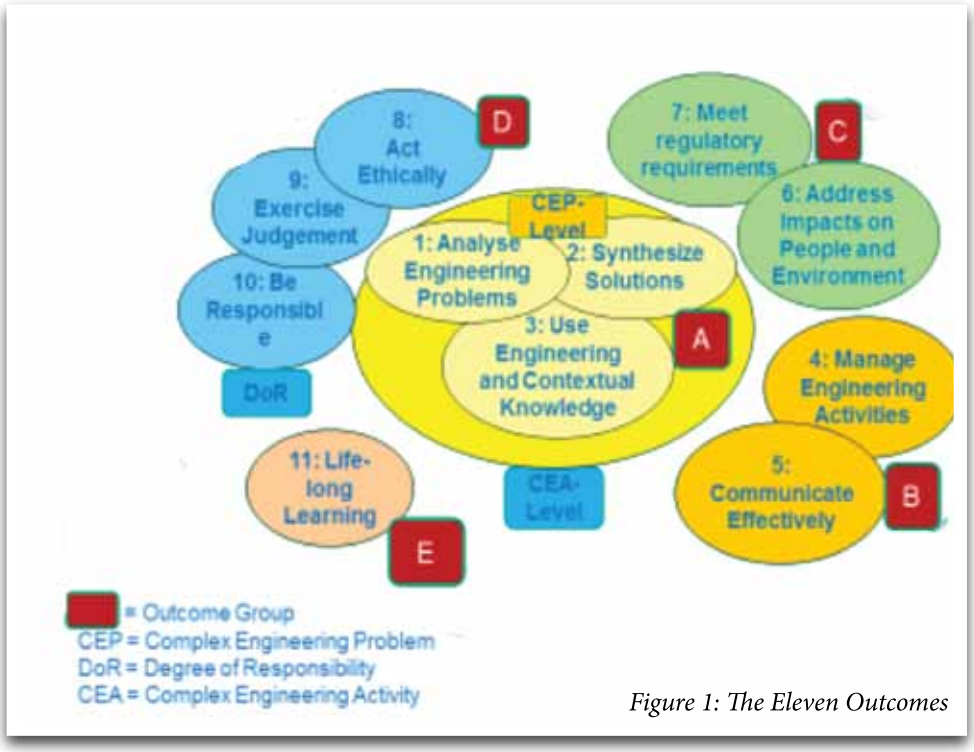

Figure 1: The Eleven Outcomes

GROUP A: KNOWLEDGE-BASED ENGINEERING PROBLEM SOLVING

Outcome 1:
Define, Investigate and Analyse Engineering problems.
Outcome 2:
Design or develop solution to Engineering problems.
Outcome 3:
Comprehend and apply knowledge: Principles, specialist knowledge, jurisdictional and local knowledge.

GROUP B: MANAGE ENGINEERING ACTIVITIES.

Outcome 4:
Manage Part or all of one or more Engineering activities.
Outcome 5:
Communicate clearly with others in the course of his or her Engineering activities.

GROUP C: IMPACTS OF ENGINEERING ACTIVITY

Outcome 6:
Recognise and address the reasonably foreseeable social, cultural and environmental effects of Engineering activities.

Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his or her Engineering activities.

ECSA's New Registration

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LEVEL	NATURE OF WORK	RESPONSIBILITY	LEVEL OF SUPPORT	TYPICAL TIME
Being Exposed	Induction/Observes	None	Explains challenges/ solutions	6 to 12 months
Assisting	Performs under close supervision	Limited for work output	Coaches and feedback	
Participating	Performs under limited supervision	Full for supervised work	Progressively reduces support	12 to 18 months
Contributing	Performs with approval of work output	Full to supervisor for quality of work	Candidate articulates own reasoning and compares	
Performing	Works without supervision	Full as appropriate for a registered person	Candidate takes on without support/ limited guidance	12 months

Table 1 Training progression to be used to identify the level at which the development has taken place

GROUP D: EXERCISE JUDGMENT, TAKE RESPONSIBILITY AND ACT ETHICALLY

Outcome 8:
Conduct Engineering activities ethically
Outcome 9:
Exercise sound judgment in the course of Engineering activities
Outcome 10:
Be responsible for making decisions on part or all of Engineering activities

GROUP E: CONTINUING PROFESSIONAL DEVELOPMENT

Outcome 11:
Undertake Professional Development activities sufficient to maintain and extend his or her competence.

WHAT HAS CHANGED IN THE APPLICATION PROCESS

- New Application forms have been developed – all based on the 11 outcomes. The forms are identified in the top right-hand corned by an A for professional engineer and a N for NRS.

  NOTE: When applying for registration in terms of the NRS, do not include any forms from the Legacy System.
- The Project Report which was based on a single project has been replaced by an Engineering Report (ER) which has to cover all eleven outcomes. It is neither a chronological report, nor is it based on single activities/projects, but rather a report demonstrating compliance with the 11 outcomes. The ER may not exceed 6 000 words.
- The applicant has to self-assess the level of his or her professional development in terms of the 11 outcomes against the prescribed instrument – see table 1 below

WHAT HAS CHANGED IN THE ASSESSMENT PROCESS?

- The principles and procedures of the peer assessment process have not changed.
- The application which includes inter alia, the Training and Experience Reports (TERs), Engineering Report (ER) and confidential Referee Reports are all assessed in terms of the 11 outcomes.

  This provides a portfolio of evidence against every outcome on which a decision of compliance or a proposed remedial process is based.
- During the compulsory professional review interview the Applicant is expected to present in a MS PowerPoint overhead presentation, the compliance of his or her professional development with the 11 outcomes.

HOW TO APPLY FOR REGISTRATION?

The policy documents, which details the NRS requirements, as well as the application forms for registration can be found on the ECSA website.

THE WAY FORWARD

ECSA is in the process of developing of an on-line application version of NRS for Professional Engineer registration, which will eventually also be introduced in all other registration categories. wn

For more info, visit www.ecsa.gov.za

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BY | YOLANDI ESTERHUIZEN | SAGE

Finance Minister Pravin Gordhan's recent budget speech admirably brought a sound outline for the country's framework for the next year, with some changes in tax legislation.

Some of these legislative changes (as included in the amendment Acts, and reiterated in the budget speech), such as employee contributions to retirement funds, will most probably have an impact on the company's payroll systems.

Here are the five tax questions every small business owner should be asking their tax consultant this year:

WHAT IS HAPPENING WITH THE EMPLOYMENT TAX INCENTIVE (ETI)?

The 2016 Budget indicates that the ETI will be reviewed in the third quarter of 2016, with a view to extending its life for another year. It is still debatable whether ETI has been effective in addressing the crisis of youth unemployment. If the legislation is to be renewed, it needs substantial changes to make it more effective, and to encourage wider participation by businesses. Areas of difficulty in the current legislation include:

- Putting the responsibility for minimum wage compliance into the ETI Act has compromised its simplicity and effectiveness.
- The three-step formula used to calculate the monthly incentive, results in complicated and poorly understood 'grossing-up' calculations, that the payroll must perform if a 'partial month' is worked.
- If employers claim the monthly incentive in a month in which they are inadvertently not tax compliant, penalties and interest can be the result. This risk is too high in the opinion of some employers.

Generally, some employers are of the opinion that the administrative costs and risks outweigh the financial benefit of the incentive. I am hopeful

5 tax questions every business owner should ask in 2016

It's tough out there. Entrepreneurs need to do more with less and keep an eye on changes in the tax legislation, as these could affect their payroll calculations and the tax they need to pay on behalf of their employees.

that pragmatic changes to the ETI Act can address these challenges and improve its effectiveness as a way to boost youth employment rates.

WILL THERE BE ANY CHANGES TO EMPLOYEE CONTRIBUTIONS TOWARDS RETIREMENT FUNDS?

Yes. From March 2016, any employee contributions towards a retirement fund (pension, provident and retirement annuity) are tax deductible, subject to a limit which must be applied by the employer. Previously, contributions towards a provident fund were not tax deductible.

The employee may contribute more than these limits, but he/she will only receive the tax benefit up to the statutory limit. Any contributions made by the employee in excess of the limits will reduce the taxable value of any lump sum paid in future.

AM I OBLIGED TO REGISTER WITH SARS FOR SKILLS DEVELOPMENT?

Yes. All employers registered with SARS for employees' tax purposes in terms of the Fourth Schedule of the Income Tax Act, must register with SARS for skills development, irrespective of whether they are excluded from paying the levy by one of the following conditions:

- any public service employer in the national or provincial sphere of government,
- any national or provincial public entity, if 80% or more of its funding comes from government,
- any religious or charitable institution,
- any municipality in possession of a certificate of exemption, and
- any employer where the total annual remuneration for the next 12 months is not expected to exceed R500 000.

HAS THERE BEEN ANY CHANGE TO THE INCOME REPLACEMENT POLICIES SINCE 2015?

No. Since March 2015 premiums towards an income replacement policy were no longer tax deductible and this remains the same. It has not been affected by the changes to retirement fund contributions and how it should be treated on the payroll.

ARE MEDICAL AID CONTRIBUTIONS STILL NO LONGER TAX DEDUCTIBLE ON THE PAYROLL FOR EMPLOYEES WHO ARE 65 YEARS OR OLDER?

Yes. Since March 2014, medical aid was no longer tax deductible for employees who are 65 or older. If an employee contributes towards a medical aid, the employee will be entitled to a tax credit amount.

However, effective from March 2016, these individuals will also be allowed an additional medical tax credit on the payroll. This value is calculated by allowing 33.3% of the value of the medical aid contributions which exceeded 3 times the normal medical tax credits.

CLOSING WORDS

I believe that the global economy is powered by SMEs. Economic stability, growth and employment are reliant on the success of SMEs. Entrepreneurs are the drivers of prosperity and this will only be possible if tax legislation and the country's fiscal policy supports this section of the economy. wn

IN MY OPINION : GERHARD PAPENFUS

The demise of the Metal Industry Bargaining Council (MEIBC)

IT ONLY HAS ITSELF TO BLAME

BY | GERHARD PAPENFUS | CEO | NEASA

Although it's been a well-known fact for quite a while that the Metal and Engineering Industry Bargaining Council (MEIBC) is in severe financial difficulty. Reports in a recent Sunday newspaper in this regard, has prompted me to break my silence on this issue. It is, first of all, important to state the correct facts regarding the circumstances which led to the current situation.

CIRCUMSTANCES ARE:

- The current impasse is a result of the trade unions' refusal to negotiate NEASA (National Employees Association of South Africa) demands regarding the current administration levy dispensation;
- The MEIBC's failure to submit audited financial statements to the Department of Labour, notwithstanding being required to do so by prevailing legislation, among others, due to the fact that the MEIBC Management Committee refused to accept the financial statements as a result of MEIBC officials' redirecting funds they were not entitled to do; and
- The delay in the processing of the extension of current levy agreements was as a result of the MEIBC's own administrative inefficiencies, and non-compliance with prevailing legislation.

For many years the MEIBC has been tormenting SMMEs (Small, Medium and Micro Enterprises) in the Steel Industry.

The MEIBC has created the platform where big business, through their agent SEIFSA (Steel and Engineering Industries Federation of Southern Africa), could collude with trade unions (primarily Numsa - [National Union of Metalworkers of South Africa]) in deals, which, for these role-players, secured their own version of 'stability and labour peace', a dispensation completely hostile to the interests not only of SMMEs, but South Africa as a whole.

The MEIBC secretariat, funded by, among others SMMEs, were then (and still is) used to enforce these outrageous and unlawful wage agreements.

These unaffordable wage agreements, unconstitutionally and unlawfully obtained, has caused the Steel Industry to be 40% more expensive than the second most expensive industry governed by any other bargaining council dispensation.

This has led to hundreds of thousands of job losses; 90 000 since 2008, of which 40 000 was lost in 2015 alone. The MEIBC has set in motion a devastating process of de-industrialisation, a huge contributor to unemployment and consequently economic and social instability.

In 2010, this tyranny by a unconstitutional, but powerful minority, was challenged for the first time, which set in motion a series of events leading to the situation in which the MEIBC currently finds itself in - and all because of the fact that it refused to stop its illegal and unconstitutional conduct, and also because it refused to transform itself into a body catering for the interests of SMMEs.

In 2011, after a dispute declared by two of the employer bodies on the MEIBC, the rest of the parties admitted to the complete unconstitutionality of the MEIBC. The fact is that for many years prior to 2011, the MEIBC was not constituted at all; it functioned in a constitutional vacuum. However, this constitutionally speaking, "empty shell" [with the agent SEIFSA (representing less than 20% of employers in the Steel Industry) on the one hand, and primarily NUMSA on the other side], continuously found it fit to enter into agreements (which a Labour Court judgement referred to as a 'sham'), and then, through the intervention of the Minister of Labour, enforced these agreements on employers who chose not to be part of it, the so-called non-parties.

After lengthy and costly legal processes, the extension of the 2011-14 Metal Industry Agreement was set aside by the Labour Court. A similarly illegal "Agreement", in respect of 2014-17, is the current subject of further Labour Court proceedings. A Court date is awaited.

Court dates are also awaited in respect of a previous and current Administrative Levy Agreements (which is the source of income for this Council).

All these legal challenges, which, among others, contributed to the financial decline of the MEIBC, is the result of unconstitutional, unlawful and undemocratic conduct, playing itself out in an environment in which governance is non-existent, and the voice of SMMEs, the lifeblood of the economy, is suppressed.

For the MEIBC to secure future financial resources, they now need the support of those very SMMEs whose interests where deliberately ignored, but who were victimised and bullied, many to the point where they simply could not continue to conduct business.

There are those who argue that the Steel Industry needs the MEIBC. It is a well-known fact that trade unions desperately need this MEIBC, but only for their own selfish (specifically financial) reasons.

A few big and powerful employers might also need this undemocratic institution, primarily for purposes of market control, and the elimination of competition from SMMEs. Then, off course, there are the few individuals who need this system for purposes of employment, who have found in this bargaining council scheme a lucrative financial source.

The South African economy however, which needs a particular environment to grow, an environment which this Council does not create, does not need the MEIBC.

Neither the millions of unemployed people, for which the MEIBC has created an insurmountable obstacle to find a job, nor the 11 000 SMMEs in the Steel Industry, which are on the receiving end of a repetitive unfavourable, business hostile dispensation, needs the MEIBC, at least not in its current format. wn

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

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

The rapid pace of technological change and product development is a global trend that affects entire economies. We may have access to more information than ever before, but is this information readily understandable? Does it give us insight into the fundamental issues? Is it precise and based on technical clarity?

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

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

We look forward to hearing from you.
- Ed

In the mining and manufacturing world, the electrical and instrumentation contractor (EIC) is generally last on site, and is expected to complete the installation in the time that remains after all/any project float has long since been consumed by the civil, mechanical and piping contractors.

Access often has to be "stolen" i.e. work concurrently with other contractors in areas which are not completely ready to receive electrical equipment. It can be argued that the EIC therefore experiences the most pressure of all the contractors on a project, as it is always the EIC who is holding up the beneficial occupation!

The following is a guideline in how to engage a competent EIC to meet the above challenges, and how to work together to facilitate a mutually beneficial working relationship.

WHAT SELECTION CRITERIA DO I USE?

The EIC should have been in business for a number of years, have an established safety track record, and have successfully undertaken similar projects to yours. Smaller companies can be more agile, due to less formal systems. This can be an advantage on smaller projects. For larger projects, more formal systems are necessary to ensure correct installation, quality inspections, testing and commissioning.

An established EIC will have built up a core of long term staff in management, administration, finance, procurement & logistics, as well as site supervisory staff. The site supervisory staff is the glue between the construction artisans and labour, and the EIC head office. Construction performance on site will be predominantly in their hands.

Due to the time taken to approve payment certificates, and make progress payments to the EIC, the EIC should be financially sound, and have the ability to finance a reasonable percentage of project expenditure, for a reasonable period of time.

The prospective EIC should be able to demonstrate long term relationships with existing clients.

HOW DO I COMPARE APPLES WITH APPLES?

You can expect an accurate cost for your materials and direct labour, only if you provide prospective EICs with a detailed final design. This does not often happen! For a detailed Bill of Materials (BOQ), this price will not differ materially between contractors. Differences can be expected in the Preliminary and Generals (P&G) where the contractor provides his price for supervision, travel and vehicles, tools and equipment etc. The assessment of contractor's P&G offer must be done in the context of the work to be done, and your expectation on deliverables, in terms of project management and administration. Be sure to assess the proposed personnel and resources in the context of the requirements you have laid down.

I HAVE MADE MY CHOICE, NOW WHAT?

Issue the purchase order, or at very least a firm letter of intent, to allow the contractor to incur costs without risk and

Engaging an Electrical & Instrumentation Contractor

hold a structured project kick off meeting. Ensure that all project stakeholders are present, and that there is a documented agreement of roles and responsibilities for both parties. Ensure that the EIC's battery limits, scope of supply, and progress measurement criteria are clearly understood. To do this, it goes without saying that by now the E&I design should be complete, and you should hand over all Approved For Construction (AFC) documentation!

Agree on the channels of communication, and ensure that appropriate levels of authority are given to designated site personnel, so as to avoid wasting time on site referring queries to respective HO's.

HOW TO GET THE BEST FROM YOUR ELECTRICAL CONTRACTOR

Do not remove "unnecessary" P&G resources in an effort to cut costs. Large projects have substantial administrative overhead – removing administrative resources will inevitably mean that site technical and construction resources end up doing this work, taking their focus away from supervising the construction of your plant.

Minimise design changes during the construction phase. Electrical installation design changes are perceived to be the "easiest" to implement, but have a knock on effect with document management, procurement, logistics and planning. Keep the EIC timeously updated with construction documentation and in return expect that red-lined drawings are submitted as the work progresses.

Allow adequate time to process payment certificates, so that invoices can be paid as per agreed payment terms. Large projects have substantial labour costs, which cannot be postponed without risk of labour unrest.

Communicate, communicate, communicate - to be able to resolve queries and disputes timeously. As with marriage, the relationship you nurture with your EIC on site will be critical, as this is one of the most significant contributors to a successful project.

ANY OTHER TIPS YOU CAN OFFER?

Put a Project Labour Agreement (PLA) in place, to ensure that employment conditions are consistent for all contractors. In an environment of unjustified and unjustifiable mid-project demands for additional benefits on site, the PLA provides a tool to better manage the labour force through structured incentives, based on agreed performance, quality, safety and behaviour targets.

Good luck with your next project!

Eskom submits two new build site licenses

South Africa picks two new-build sites; Global nuclear growth to outpace energy demand

South Africa's power utility Eskom has submitted two Nuclear Installation Site Licence (NISL) applications, at Thyspunt in the Eastern Cape and Duynefontein in the Western Cape.

"Both applications mentioned the applicant's intention to construct and operate multiple nuclear installations (power reactors), and associated auxiliary nuclear installations of a plant type and technology not yet identified," the National Nuclear Regulator (NNR) said March 10.

The NNR will now initiate a review of the application to determine the level of compliance with relevant regulations, and whether it should be accepted for further technical assessments and public comment, it said.

South Africa currently operates two 900 MW reactors at the Koeberg nuclear plant complex near Cape Town. These were commissioned in 1984-85.

South Africa's government has backed a plan to build up to 9.6 GW of nuclear power capacity, although, in the latest budget announced last month, the Treasury said nuclear power capacity would only be expanded at a scale and pace that is affordable.

NUCLEAR OUTPUT TO GROW 50% BY 2035

Global nuclear power output is forecast to rise by 50% by 2035, increasing at an annual rate of 1.9% per annum, mainly due to rising output in China, BP said in its Energy Outlook 2016.

Nuclear power will see its share of primary energy production rise by one percentage point over the next 20 years, to 5%, the report said.

China's nuclear output is forecast to rise as much as 11.2% per year, while nuclear output in the European Union is forecast to fall by 29% by 2035, and output in US and Canada is forecast to drop by 13%.

The decline in Europe and North America will come as ageing plants are gradually decommissioned, and economic and political challenges stunt new investments, BP said. wn

calendar

MAY | JUNE

MAY 2016

9-11	Civilution Congress	Midrand	www.civilutioncongress.com
10	SAIEE President's Inaugural Address	Pietermartizburg	www.saiee.org.za
12	SAIEE President's Inaugural Address	Mpumalanga	www.saiee.org.za
10-13	Managing Projects Effectively	Johannesburg	roberto@saiee.org.za
17	SAIEE President's Inaugural Address	Bloemfontein	www.saiee.org.za
17-19	Africa Utility Week	Cape Town	www.african-utility-week.com
17-20	Insulating Oil Management	Johannesburg	roberto@saiee.org.za
24-25	Broadband Access Technology	Johannesburg	roberto@saiee.org.za
25-26	Fundamentals of Practical Lighting Design	Johannesburg	roberto@saiee.org.za
25-26	Photovoltaic Solar Systems	Johannesburg	roberto@saiee.org.za
26	SAIEE President's Invitation Lecture	Johannesburg	geyerg@saiee.org.za
27	Western Cape Dinner & Dance	Cape Town	jpburdes@cybersmart.co.za

JUNE 2016

7-8	Design of Economical Earthing Systems	Western Cape	khuvutli@saiee.org.za
7-9	Fundamentals of MV Protection	Johannesburg	roberto@saiee.org.za
8-9	Optical Fibres, Cables & System Fundamentals	Johannesburg	roberto@saiee.org.za
14-15	Cloud Computing Fundamentals	Johannesburg	roberto@saiee.org.za
14-16	Carolinas Energy Association Sustainability Workshop	Johannesburg	gary@carolinasenergy.com
22-23	HV Circuit Breaker, Operating & Maintenance	Johannesburg	roberto@saiee.org.za
27-30	Managing Projects Effectively	Cape Town	khuvutli@saiee.org.za
28	Design of Economical Earthing Systems	Johannesburg	roberto@saiee.org.za

what's in it for me?

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SAIEE

May

Movers, shakers and history-makers

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

1 MAY

1707 England, Wales and Scotland were united to form Great Britain.

2 MAY

1885 Clark W. Bryan published the first edition of Good Housekeeping.

3 MAY

1984 Dell Computer Corporation was founded by Michael Dell, who ran the direct-to-order PC company from his dorm room.

4 MAY

2000 The Love Letter computer virus, aka the "ILOVEYOU" bug, spread to personal computers running Windows around the world in just six hours.

5 MAY

1952 GWA Dummer, an English electrical engineer, predicted that all electronic components of a circuit or system would be included in a single block of semiconductor material. During 1958 Bell Labs and RCA demonstrated the concept of an integrated circuit.

6 MAY

1998 Steve Jobs, announced one of the many changes in the Mac line. The iMac G3 computer. The iMac was the first computer to offer USB ports as a standard.

7 MAY

1864 The world's oldest surviving clipper ship, the City of Adelaide was launched by William Pile, Hay and Co. in Sunderland, England, for transporting passengers and goods between Britain and Australia.

8 MAY

1886 Pharmacist John Pemberton first sells a carbonated beverage named "Coca-Cola" as a patent medicine. In the first year John Pemberton sold an average of just nine glasses a day (as opposed to 1.4 billion beverage servings every day now).

9 MAY

1996 Linus Torvelds adopted Tux the Penguin as the official mascot of Linux. Tux got his name from Torveld's UniX.

10 MAY

1940 Following the resignation of Neville Chamberlain, Winston Churchill became Prime Minister of the United Kingdom. Churchill was awarded the Nobel Prize in Literature in 1953.

11 MAY

2015 Pablo Picasso's Women of Algiers (Version O) became the most expensive artwork ever to be sold at an auction at Christie's auction house. It sold for US$179,365,000.

12 MAY

2012 The 2012 phenomena were proven to be false after a missing piece of the Mayan calendar was discovered. Many believe the world would suffer a series of

cataclysmic events on or close to 21 December 2012.

13 MAY

1985 Dire Straits, a British rock band, released their fifth album, Brothers in Arms, which became the first CD to sell over a million copies. It was the most successful album release on compact disc for over two decades.

14 MAY

2015 Blues legend B.B. King died at the age of 89.

15 MAY

1940 Nylon stockings went on sale for the first time; during the first year on the market, DuPont sold 64 million pairs of stockings.

16 MAY

2000 U.S. First Lady Hillary Rodham Clinton was nominated to run for U.S. Senator in New York. She was the first U.S. first lady to run for public office. (watch this space…)

17 MAY

2011 Don Gorske, from the USA, claims to have eaten his record-breaking 25,000th Big Mac (??!!). Despite doctors not recommending this diet, Gorske maintains a healthy weight and low cholesterol.

18 MAY

1974 Construction of the Warsaw radio mast was completed. It was 646.38 metres tall and collapsed on August 8, 1991.

19 MAY

2005 Star War's final chapter, "Revenge of the Sith," opened in cinemas with fans queuing all night to get tickets.

20 MAY

2015 British Formula 1 driver Lewis Hamilton signed a three-year contract with the German constructors, Mercedes AMG.

21 MAY

1937 North Pole-1, the first Soviet manned drifting station, was established in the Arctic.

22 MAY

1762 Rome's Trevi Fountain was officially completed and inaugurated by Pope Clemens XIII.

23 MAY

1995 The first version of the Java programming language was released.

24 MAY

1976 Concorde began scheduled flights between London, UK and Washington, D.C., USA.

25 MAY

1983 Return of the Jedi, the third instalment of the original Star Wars trilogy, was released six years to the day after the first Star Wars movie.

26 MAY

1966 Zola Budd Pieterse, famous South African track star celebrates her birthday.

27 MAY

2012 Mark Webber won the Monaco Grand Prix, his second victory there in Formula 1 racing.

28 MAY

1929 Warner Brothers' film "On With the Show", the first talking colour movie debuted at New York City's Winter Garden theatre.

29 MAY

1919 The patent for the pop-up toaster was applied for by Charles Strite, a master mechanic from Stillwater, Minnesota, USA.

30 MAY

2013 Russian scientists discovered a "perfectly preserved" woolly mammoth's.

31 MAY

1961 The Union of South Africa became the Republic of South Africa. wn

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