AMEU
LEADING THE ELECTRICITY DISTRIBUTION INDUSTRY

AMEU Convention 2010
The 62nd AMEU Convention
27 to 29 September 2010

"Municipal Distribution in a Challenging Environment"

Special AMEU Convention Proceedings edition

energize

AMEU Proceedings

2010

Actom makes its mark at AMEU Convention 2010

Actom's participation in AMEU Convention 2010 comprised presentations of papers by two senior staff of Actom Protection & Control (P&C), the group's supplier of protection, control and metering solutions, as well as participation by the group in the AMEU Convention 2010 Exhibition.

The papers were by Leon de Nysschen, P&C's manager, energy metering, who presented a paper outlining the various metering technologies available to municipalities, and Barry Gass, P&C's training manager, whose paper outlined a case history relating to safety and the measures that were put in place to avoid recurrence of an accident that occurred when an oil circuit breaker exploded in a substation.

Among a variety of products and service offerings displayed and demonstrated by various Actom business units on its exhibition stand at the AMEU Convention 2010 Exhibition, two sets of innovative products stood out.

Two new street lighting products, offered by Actom Electrical Products, had their local launch at the exhibition. They are a ceramic metal halide (CMH) street lamp designed to replace an existing high-pressure sodium (HPS) street lamp without the original luminaire having to be replaced and a street lighting luminaire designed for both HPS and CMH lamps.

The other innovation comes from Current Electric, which has introduced 11 kV current and voltage transformers that are screened by means of a metallic coating to ensure that no live parts are exposed.

Actom was once again a major sponsor of this year's AMEU Convention, sponsoring the lunch on the opening day and cocktail drinks at the affiliates dinner, as well as providing sponsorship for the golf and bowls events.

Street lighting

Of the new GE Lighting ceramic metal halide (CMH) street lamp, called CMH Streetwise, Jack Carne, Actom Electrical Products's marketing specialist, Lighting Products, said: "The modern trend is to move from yellow to white light and it is simply a matter of changing the lamp, not the fitting, as the new lamp is compatible with the existing fitting. For old mercury vapour (MV) fittings, all that is required is to replace the existing magnetic control gear with modern electronic control gear. There is also an energy cost saving, due to the more energy efficient electronic control gear and the fact that the lamp is capable of being dimmed remotely."

Of the new Luna street lighting luminaire from GE Lighting, he said: "It is competitively priced against other locally available street luminaires, yet it has the advantage of having an IP66 rated lamp compartment that makes it resistant to high pressure water spray, moisture and dust. There is also a quick-release plug on the lamp wires to disconnect the gear tray from the luminaire for easy maintenance."

Screened CTs and VTs

The new screened 11 kV current transformers (CTs) and voltage transformers (VTs) introduced by Current Electric, the leading local producer and supplier of medium voltage CTs and VTs, were awarded international IEC60044 quality certification by SABS late last year after being successfully type-tested for impulse, short circuit and power frequency.

General Manager Vanessa de Swardt pointed out that screen coating is applied to the body of the CTs and VTs. "Screened connectors that come in kit form have to be installed over the bushings to provide the complete protection that is required," she explained.

Paper

In his paper, Leon de Nysschen examined the various electricity metering technologies available to municipalities. Of the three technologies – credit metering, advanced metering infrastructure (AMI) and prepayment metering – the precision credit meters are the most sophisticated and expensive, being designed for use by large power users.

Credit metering's functions and services include load profile, time-of-use tariffs, interface with SCADA and control systems and automatic meter reading (AMR) systems.

The main components of AMI, the measuring function in a smart grid system, are a master station, a bi-directional communication network and smart meters. Functions include monitoring and recording demand, real time logging of events, more effective anti-tamper mechanisms and remote disconnect/reconnect.

The prepayment system requires that customers pay in advance, with the prepayment meter automatically disconnecting supply when available credit is exhausted.

In rural environments where average consumption is low, prepayment meters without AMR support are usually the answer, whereas in urban areas where the communication infrastructure is well developed, AMI systems offer the flexibility of both credit and prepayment modes, with the added benefits of load control, customer management and on-line anti-tamper functionality.

Contact Mark Dixon, Actom,
Tel 011 820-5037, mark.dixon.Actom.co.za

The end of an era...

The Enermax E3 meter is a legend in electricity metering in South Africa. A reliable, easy to use meter with powerful features and communication abilities were just some of the reasons why this meter became a market leader in its day. However, the time has come to retire the E3 meter from active service. Consequently, we have discontinued the support and repair of these meters. This decision is made very simple with the availability of our Enermax+ range of energy metering. Simply put, the E3 meter is overshadowed by the capabilities of our Enermax+ range of meters.

"Launched in 1994, the locally designed E3 meter formed the foundation of programmable three phase energy and demand metering in South Africa and it was a privilege for me to be associated with this iconic product for over a decade"
Pat Kühn, Founder, Strike Technologies

To celebrate this event, we are offering a rebate programme to our customers with existing E3 meters the opportunity to upgrade these meters for an equivalent Enermax+ meter. We think you will be pleased with our offer.

Please contact us for more information.

106 Richards Drive, Midrand. PO Box 1810, Halfway House, 1685, South Africa
Tel: +27 (0)11 315 0815 Fax: +27 (0)11 315 2559
www.strike.co.za

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Opening speech by outgoing AMEU president

It is indeed an honour, privilege and blessing for me as the president of the association and on behalf of the members of the executive committee to extend a warm welcome to you all to this 62nd Convention of the Association of Municipal Electricity Undertakings of Southern Africa, (AMEU).

It is a pleasure to see so many delegates in this warm and friendly city of Stellenbosch. This year has been a record with the registration of over 600 delegates and 125 spouses, an indication of the ever growing support for the AMEU. A special welcome to the Windhoek members and international guests, especially those from our African continent, Malawi, Kenya, Zambia and Lesotho, who have honoured us with their presence.

Ladies and gentlemen, this conference, themed "Municipal distribution in a challenging environment" comes at a time when we are facing numerous challenges in the electricity supply industry not least of which are the local government elections around the corner, the skills shortage and diminished finances.

As my two-year term comes to a close today, I look forward to the president-in-waiting Michael Rhode taking over the reins and taking the AMEU to new heights.

This last year of my term of office has been a busy one. I am pleased to say that our ongoing collaboration with SALGA and several government departments continues to get stronger, ensuring our participation in a positive manner to national issues and debates. Among the highlights of the year has been the inclusion of female representation from each branch on the executive council and the new branch opening in Windhoek, Namibia.

I am particularly proud of the AMEU's contribution to the 2010 ESI Forum which contributed to the success of the World Cup tournament by ensuring a reliable and secure supply of power. My special thanks and appreciation are extended to all those municipalities, Eskom and other stakeholders and in particular to Peter Fowles and Clinton Carter Brown who led the team.

Some of the major issues we are addressing currently are the Integrated Resource Plan, the Energy Policy, the Generation Crisis, the Independent Power Producers (IPPs), Integrated National

Sy Gourrah, outgoing AMEU president.

Electrification Programme (INEP), the establishment of the Independent System Operator, the future of the REDs, the 17th Constitutional Amendment Bill, maintenance backlogs, renewable energy programmes, regulatory frameworks to enable the environment etc.

All these issues are facing us as our country tries to deal with the impact of the global economic decline, associated strikes, job losses, safety issues and the threat of climate change.

Arising from the national debates on these issues, it is quite clear that there is an immense amount of effort on the part of the stakeholders involved in these debates and we at the AMEU are proud to say that we are actively participating in many of them.

Currently NERSA has the "Municipal tariff guidelines, benchmarks & proposed timelines for municipal tariff approval process for the 2011/2012 financial year" and the "Regulatory framework for the economic regulation of municipal electricity distributors of South Africa" out for public consultation with the submission of comments closing on 30 September and 26 October and public hearings on 6 October and 4 November respectively. Active participation from all delegates at this conference is encouraged.

Partnerships amongst the stakeholders are of utmost and crucial importance for the sustainability and transformation of the industry, especially in light of the current energy and skills shortages and with the daunting task and challenges that lie ahead.

I trust that the papers and discussions at this convention will assist us in forging these partnerships.

This convention is not all about serious discussion and the AMEU has also provided some fun and enjoyment as we network. It commenced yesterday with the sports events, the most colourful dinner themed "All nations under African skies" hosted by our wonderful affiliates last night, tonight the executive mayor of Stellenbosch Municipality will be hosting the civic reception followed by our "Night at the Oscars" gala evening tomorrow. Our spouses have a wonderful two days of enjoyment ahead as we tackle the industry issues.

I look forward to the keynote presentation from our acting DDG for electricity, nuclear & clean energy who will address the convention on behalf of the minister who unfortunately could not make it today.

I would like to thank the Department of Energy for accepting our invitation. Also the mayor of Stellenbosch Municipality for hosting this national event in this beautiful city, my Portfolio Councillor, Cllr. Mgesi, Cllrs. Fritz & Yenana and Buffalo City Municipality Council for its continuous support to my involvement with the AMEU, the excellent team from the Stellenbosch Electricity Department especially Chantal, Bradley, Fiona, Anthea and your teams who have worked with such dedication to make this event a success, the affiliates, Loui, Davie, Jacqui and team, the executive council, secretariat, sponsors, stakeholders in the industry, speakers, delegates and colleagues.

I once again would like to acknowledge with sincere appreciation, the constant and generous support I received during my term of office from all members of the executive council, the past AMEU presidents, the AMEU secretariat, Jean Venter, Dion Abrahams, Gillian and your team, including the strategic advisor, Peter Fowles and the publicity secretary, Max Clarke.

In closing, I welcome you again to this conference and I hope that it will prove to be informative, interactive and a useful platform to exchange ideas.

Speech by incoming AMEU president

I count it a great honour, a true blessing and privilege to be inaugurated as president of this important association. I am deeply conscious of the fact that I have some great boots to fill! All past presidents have carried the baton with pride and taken this association from strength to strength and I intend continuing that legacy with the support of my executive committee and the strength and wisdom from my heavenly father.

It is 21 years since an engineer from this province was last elected president of the AMEU and the first time ever from a municipality other than the City of Cape Town. It is also recorded that delegates were last seen in this province at an AMEU Technical Convention in George 20 years ago. An interesting fact, worth noting, is that the last president from the Cape, Fred Daniel, employed me into the municipal environment 19 years ago!

The theme for this year's convention was carefully and appropriately chosen as "Municipal distribution in a challenging environment". The record number of registered delegates, some 605, speaks to the appropriateness of this theme and it is my wish that delegates find the answers to their particular challenges in the papers that will be presented over the next three days as well as during the many networking opportunities on offer. On this note I want to encourage delegates to please use every opportunity to visit the exhibition area which is also bigger than ever!

Michael Rhode, incoming AMEU president.

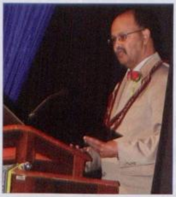
I want to thank God for the opportunities that he has created for me and the people and institutions he put in my path to support me on my journey to this moment, among others, my wife and family, Clive Peck, Harden Beck, Ockert Botma, Johan Nel, the Good Hope Branch of the AMEU, Vally Padayachee, George, Stellenbosch and now Drakenstein Municipalities, etc.

Last year at the Port Elizabeth Convention, Cllr. Mgijima promised to roll out the red carpet and have the red wine ready when you arrive in Stellenbosch in 2010... let me tell you, we worked tirelessly so as not to disappoint you (she also said something about RED 1... which I forgot!). But back to the theme of bigger and more... for the first time we had a praise and worship event on sports day, thanks to Willie and his team, and there will also for the first time be an official partners day, where partners will have the choice of going shopping or strawberry picking!

All of this is possible thanks to the generous sponsorships from the affiliates and the organising committee under the leadership of Sharntell Poole and supported by Fiona Kruywagen, Bradley Williams and Anthea du Preez and the rest of the team. Guys, I note and regret the difficult circumstances you had to work under to make this experience special for the people who will be attending this convention over the next three days, but your reward will lie in the fact that you have contributed to the success of the biggest AMEU Convention ever! Also a special thanks to Floris Koegelenberg, engineer from Franschhoek, and his team who stepped up to the game to sort out the electricity challenges, when those who were supposed to, failed... I salute all of you.

At this opportunity I want to thank Sy Gourrah for her outstanding handling of the affairs of the AMEU over the last two years. Your restructuring of the committees has enhanced the effectiveness of the workings of the AMEU and your leadership has served as an inspiration to myself and others.

Mayor's welcome: AMEU Convention 2010



Alderman Cyril Jooste, executive mayor of Stellenbosch, welcoming delegates.

To say that I'm honoured and proud is an understatement. Welcome to such a prestigious group of delegates from South Africa and around the world. This is one of the biggest highlights since I've assumed the position of Mayor of Stellenbosch Municipality.

Events like these are very important in order to share and discuss the challenges facing the electricity industry. To talk to your peers and learn from them whilst sharing your own knowledge benefits everyone not only at the convention but in your industry and ultimately the poorest of the poor. The work you do is very important for Stellenbosch, South Africa and the world if I may be so bold. Solutions to our problems are not normally found in the halls of learning but in settings like these.

Besides attending the many talks and listening to papers being presented, I urge you to take a few minutes and appreciate your surroundings, appreciate Stellenbosch. From the Paul Roos Gymnasium, to Stellenbosch University, to the vineyards and wine farms, the cuisine from our world-leading restaurants and hotels, the nature reserves and mountain passes to our people who will welcome you with open arms.

I'm wishing you the very best at the convention and trust that this experience will leave you with a sense of returning to our beautiful town – again and again...

Keynote address at the AMEU Convention 2010

by Ompi Aphane, Department of Energy, on behalf of the Minister of Energy

I am honoured to speak on behalf of the Minister of Energy who is unable to attend the proceedings here this week.

The AMEU is an important stakeholder as we grapple with the challenges that the electricity sector faces. Last year we outlined a set of issues that we had identified as priorities for the year, in order to take the electricity distribution sector forward as it grapples with the challenges it faces. To recap, we had indicated that some of the priorities that government was driving included:

- On the supply side, the power stations are performing sub-optimally as they edge closer to their end of life. We had started to see a declining system performance not inconsistent with 30- and 40-year old plant. We indicated that were it not for the global economic downturn that started in September 2008, we would have struggled to continue keeping the lights on.
- In April this year we announced that electricity tariffs would increase by an aggregate 25% this year and for the next 2 years, against a backdrop of 20% of our households lacking access to electricity. We are not lost to the central role that the municipalities play as a key component of the state machinery, and your role has been identified at the centre of electricity security, which is crucial in the quest to create jobs.
- We indicated that the disparity in service provision takes a number of dimensions – credit worthiness, tariff levels, service standards, maintenance backlogs, free basic electricity provision, quality of customer service, skills capability etc. We need to start dealing with the estimated R27-billion infrastructure refurbishment backlog, or the estimated [R5-billion] in bad debts and related credit control problems.

We have been fairly successful in managing the distribution sector during the FIFA World Cup, and network interruptions were reduced to a minimum, in the middle of the winter nogal. We need to find a way of mobilising municipalities around a similar rallying point, in order to move into the highest quartile of distributor performance. The World Cup experience did indicate that it is possible for South Africa to eliminate unplanned power disruptions, if we put our hearts and minds to it.

Now there are 187 licensed municipalities plus Eskom, providing disparate services to a captive domestic and industrial user market and this is perhaps the challenge we would like to focus on this year.

Ompi Aphane, Department of Energy

Where South Africa's infrastructure spend over the past few years peaked with the infrastructure investment in preparation for hosting the FIFA World Cup 2010, this has also buoyed the country against the full impact of the global financial crisis in 2008. Infrastructure maintenance has been and remains a critical challenge to economic development in the country. Studies show that there is a correlation between the country's investment in infrastructure and its growth indicators.

Over the years there has been inadequate investment in economic infrastructure and the backlogs continue to grow. Consequently economic growth has been constrained by the lack of infrastructure in some instances, and in other instances by the infrastructure going into disrepair due to inadequate investment in maintenance.

This problem stems from the lack of long term planning in a manner that takes into account projected economic demand growth. The lack of co-ordination between capital investment programmes by the public and private sectors, including it's sequencing and financing, leads to poor harnessing of potential synergies that exist for the country's common good.

Funding in a constrained economic climate is an additional problem, but we have not been able to manage this through innovative approaches to mitigating the financing risks. Poor leveraging of finance sometimes leads to investments in old technologies, in a cost cutting attempt which in the long run becomes costly for the country in time and financial terms.

The lack of adequate electricity distribution infrastructure in certain geographical locations in South Africa has been identified as a constraint to economic growth. Whilst access to electricity might be seen as a social programme, there is correlation between access to electricity by households and economic growth. Consequently mechanisms need to be put in place to ensure that universal access is not a constraint to economic growth.

Lack of maintenance and refurbishment

Maintenance of economic infrastructure does not enjoy the level of priority commensurate to ensure sustainability and reliability of the service. In some sectors the problem is due to service providers appropriating inadequate levels of funding for maintenance, and in others the problem is due to the funding not being used for the intended purpose. Poor maintenance leads to accelerated asset degradation and if there is no investment in refurbishment, the infrastructure will reach a state of complete degradation – the problem of infrastructure that needs complete overhauling is commonplace in the electricity distribution sector.

Poor maintenance and refurbishment of infrastructure can be located in the lack of enforcement of regulatory instruments. Are we perhaps guilty as policy makers and as regulators of the sector, of not ensuring that budgets provided for maintenance programmes are monitored for compliance with some predetermined norm and standard? In some cases incentives are provided to utility managers, which direct them against investments in maintenance in a perverse manner – for example, where bonuses for managers are linked to the budget savings that have been achieved.

A particular problem that is prevalent in municipalities is the lack of institutional capacity for maintenance, due to skills shortages. Generally, there is a lack of sector specific asset management policies, life-cycle management models and management capacity for executing maintenance to the desired standard.

Increasing electricity tariffs

The need for capital investment will undoubtedly lead to upward pressure on tariffs. We need to mitigate the adverse impact of electricity tariff increases on the poor through a number of mechanisms over and above the Free Basic Electricity Programme. The first mechanism is based on inclining block tariffs and the second one is related to the savings on the electricity bill derived from, amongst others, efficiency improvements through the solar water heating programme. As you might be aware, we have announced a programme to retrofit electric geysers with solar water heaters.

For example, the tariff increase applicable to the indigent will be the lowest part of the block tariff proposed by NERSA, and this is (minus 10%) for year 1 for consumption below 50 units per month, followed by 5,4% for year 2 and 5,5% for year 3. The highest increase is applicable to customers who consume more than 350 units per month, and this is in line with the "user-pays" principle.

We need to work together with municipalities to ensure that metering technology is not a constraint to implementing such measures for protecting the poor. We are aware that where prepaid technology is used, the implementation of block tariffs remains a challenge. In the meantime we call on municipalities to apply surcharge increases in a manner that is sensitive to the circumstances of the indigent.

Energy efficiency

The low electricity tariff has also worked against efforts to use electricity more efficiently, particularly in the industrial and commercial sectors. We estimate that there is at least a 30% upside in energy efficiency opportunities that South Africans can harness. In other words, that is the extent of our energy wastage and we need to do something about it.

The integrated resource plan (IRP2010), will be promulgated soon, and will indicate demand side options as well as energy efficiency interventions. Energy efficiency interventions at the domestic level can only be effected with municipal collaboration.

Since NERSA promulgated renewable energy feed-in tariffs for a number of clean energy technologies, we have kick-started the process of procurement of clean power. This week we intend to issue a request for information regarding clean energy opportunities that are ready for introduction into the grid, as we give practical meaning to the target of 10 TWh of renewable energy by 2013. Invariably the renewable energy projects are located in areas where the biggest need for employment and infrastructure development are located. Municipalities could play a key role in ensuring access to land, environmental impact assessment, connection to the distribution network, local community mobilisation etc. The socio-economic potential and impact of renewable energy must be maximised through collaboration with municipalities.

Conclusion

Electricity distribution has been characterised by supply disruptions which impact negatively on the economy. We identified the following key issues that when successfully addressed, will significantly improve the distribution and sustainable supply of energy for the country:

- The introduction of a long term planning framework (Integrated Resource Plan or IRP). The need to provide a long-term plan for electricity capacity expansion is premised on the need to trigger timely investment decisions that will be in tandem with economic growth. Historically South Africa has either over-invested in new power stations, or delayed investments to such an extent that energy security has been jeopardised. This problem is based on the lack of a co-ordinated approach to initiating timely investments, exacerbated by the lack of a long-term plan that provides certainty about the investments necessary for the sector. The IRP is designed to address this problem. It also provides a framework for meeting other government objectives for the electricity sector, including diversification from coal as a dominant source of or primary energy, curbing environmental degradation caused by the sector (through renewable energy and energy efficiency) and aligning with the growth path set for the country.
- The IRP must be accompanied by the development of a funding model for the capital programme of the country, including distribution network rehabilitation. We need to start a process of mapping all the critical distribution infrastructure, with a view to identifying the hotspots and to refurbishing the affected networks.
- The introduction of a regulatory framework that defines distribution sector norms and standards that are enforceable, and that will improve the asset management in the sector.
- Increasing access to electricity by domestic households.

The distribution leg provides the critical interface with the end-user in the electricity value chain. Whilst it is necessary to build new power stations and to increase supply capacity, it is equally important that the integrity of the distribution sector is improved for energy security. The reliability of municipal distribution infrastructure in particular, is compromised by huge backlogs in maintenance and refurbishment. Reliability can be improved through the reduction of current levels of maintenance and refurbishment backlogs in municipalities and Eskom (currently estimated at R27-billion) to the targeted R15-billion by 2014.

The reduction of distribution infrastructure maintenance backlogs to R15-billion by 2014 can be achieved through a tariff-funded programme, which would be earmarked for the purpose and without any fiscal support. Municipal distributors would access the funding subject to agreeing to use the funds on the conditions set for them. As an illustration, a 1c/kWh refurbishment levy could provide about R600-million annually.

We need to make such interventions, so that we can improve the reliability of the electricity distribution sector.

Outgoing President Sy Gourrah of Buffalo City Municipality delivering the valedictory address.

Alderman Cyril Jooste, executive mayor of Stellenbosch, welcoming delegates.

Ompi Aphane, deputy director general of the DoE, delivering the keynote address.

Alderman Clive Justus extending an invitation to all delegates to attend the 2011 AMEU Technical Convention in Cape Town.

Incoming President Michael Rhode of Drakenstein Municipality delivering his presidential address.

President Elect Silas Zimu of City Power Johannesburg delivering the convention summary.

Incoming Vice President Elect Vincent Kobuwe of Tshwane Municipality.

Bob Wallis, receiving his Honorary Member Award (he also received the Affiliates Merit Award)

Jan Coetzee receiving his Honorary Member Award.

Robert Els receiving his Affiliates Merit Award.

Ockert Bothma received an Honorary Member Award in absentia.

Sandile Maphumulo of eThekwini Electricity receiving the Best Paper Award.

Asset management regulatory compliance challenges

Asset management in utilities is exposed to a plethora of legislative and statutory requirements as well as a myriad of frameworks, guidelines, norms and standards in addition to other pressures for compliance.

by A G Booyzen and S E Fourie, Bigen Africa Services

It is easy to lose sight of the actual service delivery function in trying to achieve compliance to these requirements. The Local Government Turnaround Strategy describes this dilemma as follows: "Due to the onerous compliance regime, many municipalities have tended to focus much of their energies on fulfilling compliance requirements rather than focusing on the critical issues of service delivery and enhancing performance." This paper attempts to describe these requirements and to find a common set that if met, will lead to a maximum level of compliance.

Background

The electricity industry all over the world is grappling with the challenges of providing access to clean, reliable and affordable electricity in addition to addressing major environmental challenges such as climate change. Government's goal to extend access to electricity to all citizens of South Africa has not yet been met and communities across the country have expressed concerns about access to electricity services and the affordability and quality thereof. This paper is written against a backdrop of significant national concern over how to meet the growing demand for electricity, Eskom's major increases in the price of electricity and municipal entities' responsibilities for corporate governance and asset management.

Expectations in respect of local government are clearly stipulated in South African legislation. These range from the Constitution and the Bill of Rights to legislation developed specifically for local government such as the Municipal Structures Act, the Municipal Finance Management Act and the Municipal Systems Act. Moreover, strategic transformation imperatives in municipalities have to be aligned with national government priorities, such as the five-year local government strategic agenda (2006) and the cabinet lekgotla (2007) strategic priorities.

The factors influencing asset management are presented against an historical background of extensive reforms in the electricity sector since the 1980s – dating from the De Villiers Commission, to the Eskom Conversion Act of 2001, to the commitments by government to the separation of generation, transmission and distribution. The advent in 1994 of a democratic dispensation in South Africa resulted in refocusing the electricity sector in order to respond to the electricity demands of the broader South African society which did not have the benefits from electricity.

During May 2008 EDI Holdings presented to ASGISA the challenges pertaining to electricity distribution related asset maintenance, refurbishment and strengthening. Following the Electricity Distribution Maintenance Summit in 2008, EDI Holdings has developed a new Approach to distribution asset management (with the acronym ADAM) that aims to identify and develop strategies to address maintenance, refurbishment and funding gaps. However, the skills shortage and funding to implement ADAM has hampered this and other processes.

Understanding the context of asset management

NRS 093-1 and PAS 55 define asset management as "the systematic and coordinated activities and practices through which an organisation optimally manages its physical assets, and their associated performance, risks and expenditures over their life cycle for the purpose of achieving its organisational strategic plan". It contains the following three basic elements:

- *Asset provision:* making sure that the most appropriate asset is acquired for a specific application and also making sure that the asset is effectively disposed of (in a responsible manner) at the end of its useful life.
- *Asset operation:* making sure that assets are operated in the most appropriate way that allows the asset to perform to its maximum capacity.

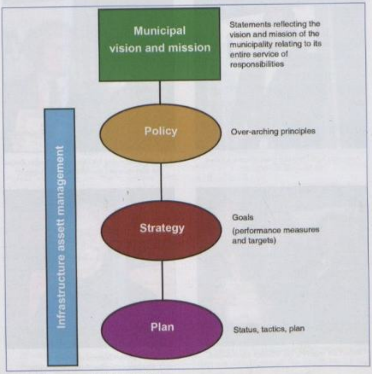


Fig. 1: Asset management within municipalities.

Schneider Electric MV mobile substation makes an impressive debut in the Cape

A complete MV mobile substation, fitted into a 40ft container and mounted on a truck-trailer, raised eyebrows among hundreds of electrical department representatives from 34 municipalities during a special road show undertaken by Schneider Electric South Africa in the Eastern, Southern and Western Cape during October this year.

The Schneider Electric MV mobile substation got off to a flying start at Stellenbosch where the annual conference of the Association of Municipal Electrical Undertakings (AMEU) was taking place with 350 delegates from around the country, all of whom had the opportunity to walk through the Schneider Electric mobile display container and operate the switchgear.

"The fitting of state-of-the-art equipment into the mobile substation illustrates the complete scope of the total MV solution offered by Schneider Electric," says Dudley Miller, Energy Business vice-president, Schneider Electric South Africa.

"All of the gear in the mobile substation is wired in and includes networking equipment that connects with a SCADA power suite through a T200 hardware interface controller from a laptop computer. It is a complete MV solution from the incoming breaker through to the distribution ring main unit for underground cabling and MV auto-reclosers and sectionalisers for overhead wire transmission," says Miller.

Miller adds that the display fully demonstrated Schneider Electric's Geni Evo, a compact, fixed pattern demountable configuration switchgear solution, suitable for both utility/municipal and large industrial MV power supply requirements. "This attracted a great deal of interest and was entirely appropriate as the marketplace is moving strongly towards the implementation of fixed pattern equipment."

There was a lot of attention shown to Schneider Electric's Nu-Lec N-Series automatic circuit re-closers, which combine high technology vacuum arc interruption with integrated voltage and current measurement all contained within a 316 stainless steel enclosure with SF6 gas insulator.

"The Nu-Lec N-Series offers intelligent switching: The re-closers have built-in load and source side voltage measurement which ensures the network makes correct switching decisions within fractions of a second. This quick response to faults reduces maintenance and keeps outages to a minimum. RL-Series load break switches or sectionalisers, which offer extremely short arcing times of within half a cycle, also attracted attention," says Miller.

After the conclusion of the AMEU event, the MV mobile substation took to the road again to visit customers in the Southern and Eastern Cape where more than 200 engineers, consultants, municipal representatives and other interested parties were introduced to the Schneider Electric MV solutions offering. It also provided an excellent opportunity to remind customers that the Clipsal, Nu-Lec, Conlog and APC brands have now migrated to Schneider Electric.

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Schneider Electric

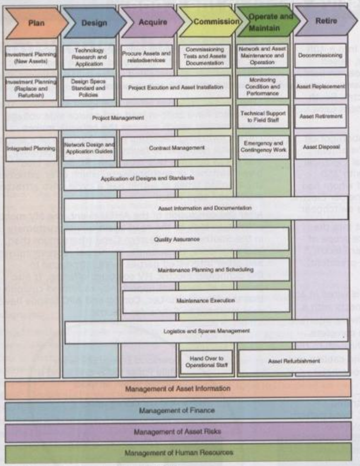

Fig. 2: Life cycle elements are described in NRS 093-1.

- *Asset care*: making sure that assets are looked after in the most appropriate way that will ensure continued performance at its originally intended design capacity.

The organisational context of asset management within municipalities is depicted in Fig. 1.

The asset management process centres around the asset lifecycle and its intention is to ensure the delivery of a function at a minimum life cycle cost. The life cycle elements are described in NRS 093-1 and summarised in Fig. 2.

Asset management standards and legislation

There are numerous acts, standards, guidelines and regulations all impacting on the management of a municipality's assets. They have been developed to concretise government's vision of municipal infrastructure, namely:

- Long-term sustainability and risk management
- Service delivery efficiency and improvement
- Performance monitoring and accountability
- Community interaction and transparent processes
- Priority development of minimum basic services for all
- Financial support from central government

These main asset management drivers are:

- PFMA/MFMA
- GRAP 17
- DPLG guidelines for infrastructure asset management in local government 2006-2009.
- National Treasury guidelines (various)
- Regulator reporting requirements
- GIAMA (Currently not applicable to local government)
- NRS 093-1: 2009 Asset management of electricity infrastructure
- British PAS 55 standard
- ANZAC infrastructure maintenance manual

In addition, the following have a significant impact on asset management in a municipal environment:

- OHS Act
- Municipal Systems Act
- Municipal Structures Act
- Electricity Regulation Act
- Electricity Act
- Electricity pricing policy
- ASGISA
- National Treasury asset management framework
- Various National Treasury regulations (R773)
- NERSA licensing requirements
- EDI ring fencing requirements
- Internal municipal requirements (IDP, CMIP)
- NRS 047 and NRS 048
- COSO guidelines for risk management
- Environmental management framework
- Environmental legislation
- Medium term revenue and expenditure framework
- Public sector risk management framework
- Provincial growth and development strategy
- Provincial spatial development framework
- National Treasury asset management framework
- Sector specific requirements i.e. water plans, energy efficiency plans, etc.
- Industry guide to infrastructure service delivery levels and unit costs (MIG)

These documents all contain legislation or guidelines that differ from each other. These differences are making it difficult to achieve regulatory and standards compliance in asset management. The remainder of this paper focuses on the commonalities between the requirements and highlights the differences hindering compliance.

Government Immovable Asset Management Act, No. 19 of 2007 (GIAMA)

GIAMA has been the focus of attention when asset management has been discussed. It applies to national and provincial government and organs of state, where "organ of state" means any department of state or administration contemplated in paragraph (a) of section 239 of the Constitution of the Republic of South Africa, of 1996, but excluding the department or administration in the local sphere of government. The act is not applicable to members of the AMEU at the moment, and thus will not be discussed in detail. It describes the principles of immovable asset management and stipulates that asset management plans must be compiled. It describes the contents of the asset management plans and the duties of officials as related to asset management.

Documents stipulating technical requirements

NRS 093-1: 2009 Asset Management of Electricity Infrastructure

NRS 093 is based on the British PAS 55: 2008 Asset Management. It is an adaptation of PAS 55 to cater for unique electricity related processes, but focuses less strongly on the strategic element of asset management. Up to now, only part 1 of NRS 093 has been published and accepted. Part 1 contains minimum requirements for asset management in the South African electricity distribution industry. It is envisaged that it will be followed by:

- Part 2: Guidelines for implementation
- Part 3: Financial management of assets
- Part 4: Information systems requirements

Financial management is not yet addressed, but the document does contain a section stipulating the compilation of an asset register. The set requirements fall short of compliance with MFMA and GRAP 17, however the information will form a comprehensive subset of MFMA/GRAP 17 requirements. It will need to be expanded to achieve full compliance.

The GRAP 17 guidelines state that a full verification of assets is required, while NRS only requires a condition assessment of critical assets. As for asset information, additional information over and above the specified NRS information will be required for GRAP compliance.

In general, NRS 093 focuses on assets specifically, not on the use of assets to achieve service delivery. Reporting on NRS 093 performance will be in accordance with the NRS 048-2 specification requirements. NRS 093 redefines the life cycle stages of assets, but compliance to NRS will ensure compliance to PAS 55 in this aspect.

NRS 047: Quality of service and NRS 048: quality of supply

NRS 047 and NRS 048 do not specifically address assets, but compliance to the requirements of these specifications will be difficult to achieve without applying solid asset management principles. Their main thrust is the "customer experience" in terms of service and supply. Compliance to these specifications will not ensure compliance to the conditions stated in other asset management related documents, but they do support all the other regulatory requirements.

Occupational Health and Safety Act no. 85 of 1993 (OHS Act)

Safety issues form an integral part of an asset management system and should be a built in function of the system. The OHS Act requires the "owner" to maintain a structure (including infrastructure) in such a manner that the structure remains safe for continued use. Asset management is a way to ensure compliance with the act and its regulations.

In addition, the OHS Act requires the keeping of maintenance records. These records are to be made available to an inspector upon request.

Effective application of asset management principles will assist in compliance with the OHS Act and this act supports all other regulatory requirements. Compliance to the OHS Act will however not ensure compliance with other legislation.

Regulation 773 (Notice 1190 2008): Compulsory norms and standards for reticulation services

R773 does not seem directly asset related, but it will have a significant impact on the asset base. R773 was promulgated in response to the energy crisis and covers aspects of energy efficient lighting, hot water systems, heating, ventilation and cooling and the implementation of smart metering. These regulations are due for implementation by 1 January 2012, except for the sub regulations on energy efficient lighting which should have been implemented by 1 January 2010.

In addition, the regulation states that the supply of electricity to customers may only be reduced or controlled during capacity or network constraints. Load control to achieve savings on bulk purchases is not allowed.

The implication of these two factors in combination is an increase in capital expenditure requirements with its associated expenses and a simultaneous increase in the cost of bulk services. This will affect the affordability of the electricity service.

Compliance to this regulation will not be affected by or lead to compliance with any other legislation.

DPLG guidelines for infrastructure asset management in local government 2006-2009

This document draws on the Australian and New Zealand experiences as per the international infrastructure maintenance manual. This document is at a more operational level than NRS 093. It introduces the concept of an asset hierarchy and proposes the use of straight line depreciation of assets.

The document utilises a different criticality measure as the one stipulated in NRS 093, implying that compliance to both documents can only be achieved by running parallel systems. In addition the proposed useful lives of assets differ from those used in other documents, for example the national treasury guidelines on asset management.

Documents stipulating financial requirements

Local government: Municipal Finance Management Act no 56, 2003

The overarching objective of this act is to secure sound and sustainable management of the fiscal and financial affairs of municipalities and municipal entities. It covers the full spectrum of municipal financial management and allocates certain roles and responsibilities to officials. There are a number of sections dealing with assets and asset management. The most relevant of these will be discussed.

Section 63 (1) states that the accounting officer of a municipality is responsible for the management of the assets of the municipality, including the safeguarding and the maintenance of those assets. This leads to the stipulations in section 63 (2) that the accounting officer must take all reasonable steps to ensure that the municipality has and maintains a management, accounting and information system that accounts for the assets and liabilities of the municipality; that the municipality's assets and liabilities are valued in accordance with standards of generally recognised accounting practice; and that the municipality has and maintains a system of internal control of assets and liabilities, including an asset and liabilities register.

The accounting officer must furthermore ensure that the municipality or municipal entity for each financial year prepares annual financial statements which fairly presents the state of affairs of the municipality or entity, its performance against its budget, its management of revenue, expenditure, assets and liabilities, its business activities, its financial results, and its financial position as at the end of the financial year.

Senior managers and other officials of municipalities are given the responsibility to ensure that the assets and liabilities of the municipality are managed effectively; that assets are safeguarded and maintained to the extent necessary; and that all information required by the accounting officer for compliance with the provisions of this act is timeously submitted.

The format and contents of the asset register is prescribed in GRAP 17.

Standard of generally recognised accounting practice: Property plant and equipment (GRAP 17)

The GRAP Implementation guide for municipalities 25 September 2008 is used as the main source of information for this section.

GRAP 17 focuses strongly on the compilation of the asset register for immovable assets. It states the following:

"Most municipal assets registers in respect of infrastructure assets are inadequate. This is due to historical factors and the use of the fund accounting system. Property, plant and equipment that are classified as infrastructure assets will typically be long-life assets. It is likely that such assets will need to be re-valued on a regular basis when accounting standards are updated, as depreciation is not an appropriate measure of the consumption of such assets."

The minimum content of the asset register is stipulated as:

- Acquisition date of the asset
- Descriptions of individual items
- Expected useful lives of individual items
- Historical cost or fair value of individual items of property, plant and equipment or the fair value of assets received as donations.
- Depreciation rates
- Location
- Department or service using or controlling the asset
- Identification reference for verification (bar code)
- Accumulated depreciation per item
- Impairment losses per item
- Carrying value of the asset
- Funding source
- Revalue amounts for land and buildings, revaluation date
- Residual values
- Insurance arrangements
- Is the asset pledged as security (Yes/No)?

The following process for populating the asset register is prescribed:

- Ensure that all PPE are capitalised and recorded as soon as acquired.
- If the asset is constructed over a period of time, record expenditure as work-in-progress until it is available for use.
- Bar code all items of PPE with a unique identification number upon delivery to the municipality.
- Undertake a physical verification of the assets. The AR should be the end result of the physical verification.
- Certify that all assets contained on the AR have been physically verified.
- Review the remaining useful life of all items of PPE at 30 June.
- Prepare a schedule of the remaining useful life for each asset.
- Identify items with a shorter remaining useful life than the one reflected on the AR.
- Override and amend the useful life column in the AR.
- Reveal assets that should be financially impaired as well as the related impairment expense and accumulated impairment. (Impairment is a loss in the future economic benefits or service potential of an asset, over and above the systematic recognition of the loss of the asset's future economic benefits through depreciation).

The expectation in these guidelines is that all assets should be verified annually. This will place a significant burden on the municipality, especially in the larger municipalities such as the metro's. A significant portion of the asset value lies in underground cables, with the MV cable network comprising of between 30% and 40% of asset value in a large municipality. These assets cannot be verified by physical inspection.

The guidelines furthermore recommend the bar-coding of all assets. The estimated cost and duration of such a project in a metro supplier would be in the region of R40-million and take up to three years to complete. It is debatable if the benefits of such a process would outweigh the cost.

Acquisition dates are crucial to determine accumulated depreciation. These dates are often difficult to obtain, especially in older networks. A number of options to determine the acquisition dates are proposed:

- Check old accounting records, such as internal advances registers, external loan registers and approved budgets.
- Identify the items of property, plant and equipment without acquisition dates and visually inspect and evaluate the assets to determine a likely acquisition date.
- Assume that the municipality has owned these assets for periods that are longer than their useful lives and that they are fully depreciated.

In many instances only global amounts are recorded in the current asset registers. Acquisition dates and historical cost prices for each infrastructure asset will need to be recorded to enable the calculation of depreciation.

An asset created by developers and which becomes part of the municipal infrastructure has to be recorded and taken into the asset register at fair value. Once in the asset register, the asset will be treated the same as any other assets.

The MFMA/GRAP 17 requirements pose significant compliance challenges to municipalities. International experience shows that it can take up to eight years to comply with this legislation. The challenge in the current economically and capacity constrained environment is huge.

NERSA reporting guidelines

The NERSA reporting guidelines describes the accounting system required for compliance in some detail, including the asset register requirements. An accounting system complying with the MFMA and GRAP 17 should however also be compliant to the NERSA reporting guidelines.

EDI ring fencing exercise and toolkit

The EDI ring fencing exercise has produced asset registers and valuations with varying degrees of accuracy amongst utilities. The asset registers mostly do not comply with GRAP 17 requirements. Global figures are used for many asset categories, and assets with different useful life expectancies are grouped together. Individual assets cannot always be identified.

The EDI toolkit adds value in setting up a basic asset hierarchy and utilising a common set of replacement values and useful lives. The useful lives do however differ from those proposed in other documents.

Conclusion and recommendations

This paper highlighted some of the strengths and weaknesses in die current regulations, standards, guidelines and approaches for asset management in electricity distribution utilities. Skills shortages, funding constraints, aging infrastructure and varying regulatory demands are major challenges to managing the electricity assets in municipalities. A unified approach to tackling the issues is required. It is recommended that an AMEU workgroup on asset management be formed. The workgroup should focus on the alignment of processes and standards to enable MFMA and GRAP compliance without duplication of effort (e.g. EDI vs. GRAP). The workgroup should establish the following collective standards:

- Standard for replacement equipment
- Expected useful life standard
- Measurement criteria for condition of assets
- Impairment indicators
- Provide regular updates of replacement values

References

[1] ASGISA – Accelerated and shared growth initiative of South Africa.

[2] Constitution of the Republic of South Africa, Act 108 of 1996.

[3] COSO guidelines.

[4] Electricity Act 41 of 1987.

[5] Electricity pricing policy of 2008 (EPP).

[6] Electricity Regulation Act, 4 of 2006.

[7] Government Immovable Asset Management Act, 2007.

[8] GRAP 17 Property plant and equipment (GRAP implementation guide for municipalities 25 September 2008).

[9] Guidelines for infrastructure asset management in local government (2006 – 2009).

[10] International infrastructure management manual.

[11] Local government capital asset management guideline.

[12] Local government turnaround strategy.

[13] Municipal Finance Management Act 56 of 2003.

[14] Municipal Structures Act 117 of 1998.

[15] Municipal Systems Act 32 of 2000.

[16] National spatial development perspective.

[17] National treasury asset management framework.

[18] NRS 093-1: 2009 Asset management of electricity infrastructure.

[19] Occupational Health and Safety Act 85 of 1993.

[20] PAS 55: 2008 Asset management.

[21] Public Sector risk management framework.

[22] Regulatory reporting manual – Electricity

[23] The Municipal Planning and Performance Management Regulations, Regulation 796 of 2001 to the Systems Act.

[24] Treasury regulations for departments, constitutional institutions and public entities.

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International practices and trends for managing municipal and utility infrastructure

Asset management (AM) is a process of maintaining asset performance at a required level of service while minimising total life cycle cost. Integrated asset management systems provide information to support decision-making on capital and operational spending, optimisation of infrastructure assets, and rehabilitation and eventual replacement of assets.

by M Damm, Fuseforward International

As the costs of operating and maintaining critical infrastructure rise – primarily as a result of asset aging and demand for system expansion – resources continue to tighten as municipal taxpayers and utility ratepayers prove reluctant to approve new funding without compelling demonstration of need. Asset management equips organisations such as utilities with effective tools to maximise return on investment on both capital and operating works, demonstrate these successes to stakeholders, and make a clearer case for rate increases as required.

What is asset management?

Asset management processes and systems allow service-driven organisations to:

- Assess service responsiveness and accessibility
- Monitor and report performance of assets, systems and services
- Measure results and ensure overall accountability
- Make effective short to mid-term business decisions and long-term plans
- Institutionalise a culture of continuous improvement
- Incorporate stakeholder involvement into decision-making and obtain support

An effective AM system will address six key performance areas:

- Practices to plan and manage infrastructure assets to ensure a sustainable future
- Processes to measure and support performance management
- Data and information to provide complete and accurate records of assets
- Technology systems integrated to manage, monitor and report asset information
- Organisational integration of asset management principles and practices
- People management strategies to instil a culture of continuous improvement

Asset management is a way of doing business that is strategic, long-range and comprehensive. It combines engineering principles with business practices and economic theory, and provides tools to support agencies in making informed decisions about investments in infrastructure assets. Asset management includes:

- Asset performance management processes and systems to measure, analyse and report on asset performance in order to enable informed decision-making and planning for renewal, replacement and expansion.
- Asset operations management processes and systems to manage the design, build, operations and maintenance of infrastructure assets and services, including smart metering, control systems, and work management.
- Asset financial management processes and systems to manage financial reporting and address accounting and other regulatory reporting requirements.

Asset performance management

Asset performance management (APM) is a set of mid and long term processes of decision-making and planning in order to maintain and optimise asset performance at required levels of service while maximising return on asset investment and minimising total life cycle cost. APM processes and systems should:

- Be driven by the organisation's mission and long-term strategic goals
- Support informed decision-making about current and long-term management of infrastructure
- Be flexible and adaptable for a variety of uses
- Be accessible to organisation stakeholders, including staff at all levels, policy makers and customers
- Incorporate effective planning and budgeting tools to set, track and report on overall asset, system and service performance

Asset operations management

Asset operations management is the process of managing and maintaining assets on an ongoing "realtime" basis in order to achieve required levels of service in a reliable, cost-effective manner. AOM incorporates:

- A primary focus on providing services to the customer effectively, efficiently and reliably
- Responsibility to ensure maximum uptime, reliability and serviceability of assets at reasonable cost
- Reliance on sound business processes to manage work and predictive/preventive maintenance
- Reliance on established and developing technologies that can include: Work/maintenance management systems; supervisory control and data acquisition (SCADA) systems; geographic information/mapping systems; smart metering/intelligent systems management technologies; and mobile fieldwork technologies.

Asset financial management

Asset financial management (AFM) is a conceptual framework of objectives, standards, policies and practices linked rationally to meet the needs of the stakeholders. This framework includes:

- Projection of maintenance and capital replacement trends into the future
- Development of annual funding profiles for maintenance, repair, rehabilitation and replacement of assets
- Identification of assets projected for disposal
- Reliable information for policy makers to determine long-range funding needs
- Assessments of service efforts and costs of programmes
- Tools to assess the organisation's financial position
- Alignment of budgeting and accounting processes related to management of capital assets.
- Customer management, including acquisition and billing

Benefits of asset management

Organisations can expect a range of

benefits from a comprehensive asset management programme:

- Improved system management, with returns in five to 25 years
- Improved asset life cycle management, with returns in three to 10 years
- Improved work management, with returns in one to three years
- Improved resource management, with immediate and ongoing returns
- Improved financial support for a corporate infrastructure strategy
- Improved tools to assess the utility's financial position and measure performance
- Improved information for policy makers to determine long-range funding needs
- Improved systems to support AFM
- Consistent corporate definitions, policies and terminology
- Consistent accounting treatment of asset-related expenditures
- Consistent framework for decision-making
- Clarity of asset accounting processes for all stakeholders

International trends and practices

Global trends

Infrastructure assets are a crucial part of a society's development. Supporting and developing these assets is very costly and time-consuming, and it has been realised that there is a greater need for accountability and sustainability. Infrastructure managers worldwide have recognised the need to fundamentally change how they do business, shifting from managing short-term projects and services to strategically planning comprehensive delivery of services over the long term. Implementation of an asset management philosophy, systems and business practices have helped agencies manage our significant investments in existing assets; plan for growth, renewal and replacement of assets; define service levels and report on performance; and provide reliable information to customers and stakeholders to improve accountability and build trust. Today, a series of interconnected trends is driving the adoption and advancement of asset management in the field of public infrastructure in both the developed and developing worlds. These trends include:

- *Infrastructure funding deficit:* Throughout the world, stewards of critical infrastructure, including utilities and local governments, face the challenges of renewing or replacing their existing assets and expanding infrastructure systems to serve growing populations while they are constrained by ongoing funding shortfalls and economic uncertainty. According to analysts Booz Allen, global infrastructure investment over the next 25 years is estimated to exceed US $40-trillion for water, wastewater, energy and transportation systems. In North America alone, annual expenditures on infrastructure operations and capital replacement exceed $800-billion. The tools of asset management (processes and systems) and performance analytics and optimisation (performance benchmarking and system modeling) have become critical to enabling infrastructure managers "do more with less."
- *Sustainability:* The operation and maintenance of infrastructure such as

utility systems in a safe, sustainable manner has become a public expectation, if not a legal requirement, in many societies. The notion of sustainability as a "triple bottom line" proposition – economic, environmental and social – recognises that issues such as public health, energy consumption and environmental responsibility are closely intertwined with the efficient operation of critical infrastructure assets. From this perspective, asset management and system performance optimisation have implications and benefits that extend beyond simply operating infrastructure and delivering services cost effectively.

- *Regulation and compliance:* In today's fast-changing business climate, utilities also face a growing web of regulations that typically address public health and workplace safety, financial reporting and environmental footprinting, among other issues. Sound asset management practices, processes and systems all support the various dimensions of compliance required of utilities. For example, in many jurisdictions, accounting standards such as the International Financial Reporting Standards – or here in South Africa, GRAP 72 – require detailed reporting of the inventory and value of physical assets. Assembling this information is an essential first step in introducing a full-fledged asset management programme into an organisation.
- *Service-driven management:* Increasingly, infrastructure operators are managing their systems not simply as assemblies of physical assets but as complexes of services which need to be delivered optimally to subscribers or customers. This approach takes into consideration factors such as growth, demand and cost in managing asset systems in order to achieve agreed or expected service levels efficiently and sustainably. This calls for an advanced approach to asset management that includes better-informed decision-making, long-term planning and advanced system modeling.
- *Smart metering/smart grid:* The introduction of smart metering in utility systems such as water and energy, and the development of smart energy grids require managers to do more than inventory and value their assets. They now need to monitor systems, gather data and evaluate performance in real time, and optimise the performance and service value of assets over their entire life cycle. This represents the most advanced level of asset management. Smart metering is, of course, advancing rapidly in North America, the United Kingdom, Europe and elsewhere as a means of encouraging conservation and enabling flexible billing systems. In Canada, for example, the province of Ontario has mandated smart metering to support time-of-day billing for electricity.
- *Performance optimisation:* The development of new systems management technologies and the unprecedented volumes of data generated by smart meters and similar intelligent sensors and controls in infrastructure systems create the opportunity to harness these tools to manage systems more efficiently today and optimise their performance over the long term. Operations management at this level calls for sound practices and processes, integrated technologies, and tools for performance benchmarking and analytics and long-term system modeling.

International asset management practices

Canada

In recent years, Canadian municipalities and utilities have made significant advances in adopting asset management principles and programmes, driven by a combination of legislation, regulation, infrastructure funding programmes and structural changes in the energy distribution industry. Among these drivers:

- Public Sector Accounting Board Standard PS 3150 requires Canadian municipalities to report all tangible capital assets in their financial statements, including valuation and amortisation, and to develop plans for replacement, renewal and overcoming infrastructure funding deficits. Canadian utilities face similar requirements.
- In Ontario, Canada's most populous province, deregulation of the electric industry has required utilities to inventory their assets, a first step in establishing asset management, to inform regulators and address the incoming International Financial Reporting Standards. Introduction of asset management by the province's utilities is also being driven by the Green Energy Act, the Sustainable Water and Sewage Systems Act, and a mandate to install smart electric meters in order to support time-of-day customer billing.
- The federal government has allocated approximately \$3-billion in fuel tax revenue to enable municipalities to upgrade their traditionally underfunded infrastructure systems. Municipalities can use a portion of this funding to advance their asset management capacity in order to support funding plans.

The City of Hamilton, Ontario, was an early adopter of asset management principles and practices, and is now considered a leader among North American municipalities. Hamilton applies AM principles across its transportation, water and wastewater assets. A dedicated team of 22 staff is responsible for buried infrastructure (water and wastewater distribution and collection) and above-ground assets (pavement, bridges, parks, public works facilities). The team monitors current levels of service, life cycle trends and deterioration models to plan and develop an integrated three to five-year budget, a 20-year capital budget, and a 100-year financial forecast of the city's infrastructure investments.

The city's AM programme began in 1998 when managers began focusing on questions about asset sustainability and funding issues. In 2000, the provincial government required the amalgamation of the Regional Municipality of Hamilton-Wentworth and six other municipalities into one city, and the resulting reorganisation provided further impetus for creating and funding the AM programme and implementation team. Hamilton has seen a number of benefits from the programme:

- Staff can demonstrate to managers and the public that the city is using its resources cost effectively.
- AM processes and data have speeded up the capital budget development process.
- All players see the community as a whole and how assets function together to deliver higher quality of life.

Calgary, Alberta, is another leader in municipal asset management. The city has embraced multi-sector AM as a way to balance its rapid growth and its need for infrastructure renewal. A corporate-wide infrastructure AM strategy is one of Calgary's key tools to address its growing infrastructure needs and enable effective service management. The city has introduced a corporate asset programme across 13 business units that applies a triple bottom line approach, assessing economic, social and environmental issues. The benefits have included:

- Enhanced decision-making, supported by better data about assets on which to base project prioritisation and budget allocation decisions.
- Better data to justify capital and maintenance expenses to the public.
- Growing city council confidence in the asset data generated by CAMP.

Great Expectations!

Andrew Corbett, product manager at Wilec.

Local energy product specialist, Wilec, has been chosen as the agency to supply Comem insulation materials for the transformer industry in South Africa. The range is set for launch in September this year.

"As a specialist in this industry, it was a natural progression for Wilec to go over to Transformer fittings," says Andrew Corbett, Product Manager at Wilec. "This is a brand new venture for us but it dovetails perfectly with the rest of our product offering."

Wilec will initially stock Buchholz relays, pressure relief valves, oil level indicators and a variety of insulators for both AC and DC applications, with plans to expand the range as demand increases. "We're researching a whole basket of products which we will introduce according to market feedback," adds Corbett.

Comem is an ABB-approved supplier with support in Europe, the Middle East, the Far East, Australia and the Americas, as well as a strong foothold in the local market. It has also found favour with companies such as Schneider Electric, Areva, VA Tech, Siemens and Nexas.

"The products will be directed at all transformer repair customers and OEMs on oil fill transformers and dry-type transformers," Corbett continues, adding that reaction has been overwhelmingly positive thusfar. "Industry members are seeing this as a beneficial development for the market in terms of improvement in service levels as well as availability of product. Wilec has an excellent reputation for its service performance."

The company will be hosting a customer day in September to introduce the items available. "Wilec will also maintain ongoing communications with relevant engineering departments to establish their needs and ensure that these are met at the right price. We have assembled a strong marketing team with a focus on sales experts who have experience in the industry. We will be stocking what customers need," he concludes emphatically.

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Our company, Fuseforward, has worked with a number of Canadian municipalities to introduce the philosophies and tools of advanced asset management into their organisations. We are currently leading a demonstration of the optimisation of electric and water/wastewater systems in the City of Kingston, Ontario. This project includes the implementation of our "Smart Utility" asset and operations management system for Utilities Kingston, a multi-service utility that serves a population of about 120 000 in Kingston, Ontario.

New Zealand and Australia

New Zealand and Australia are world leaders in implementing asset management practices, having developed effective, advanced systems over the past 30 years.

New Zealand mandates involvement by citizens and businesses in choosing levels of affordable service prior to distribution of national funds. Inventory, condition and defined risks associated with various funding levels inform the discussion. New Zealand's Local Government Act requires local councils to consult with citizens on major community decisions. The LGA established a framework that each council must follow in developing its long-term community consultation plans (LTCCP) to reflect sustainable social, economic, environmental and cultural decisions. Asset plans must also include:

Estimated additional demand and current system capacity, the associated costs of meeting demand, and expected funding sources.

- Levels of service options, growth assumptions and associated risks.
- Maintenance, renewal and development projects to address risks.
- Intended level of service (LOS) performance targets and measures, the estimated cost of achieving and maintaining the identified LOS, and funding sources.

In Australia, a study of 15 similar wastewater agencies between 1990 and 2001 found that implementation of asset management process and practices resulted in asset life cycle cost savings of between 15 and 40% with an average of 22,5%.

The city of Brisbane, Australia is a world leader in asset management implementation, driven by state mandates, a desire to further its reputation as an innovative city, and strains on its infrastructure introduced by rapid growth. The city's decision-making considers the triple bottom line while focusing on achieving stated objectives within its adopted vision. Asset strategic plans and 10-year AM plans have been developed for all major asset classes. Key performance indicators (KPIs) have been developed for pavement condition and quality, congestion, public transit system performance, customer satisfaction and worker safety. The city's total asset management system is an asset planning tool that supports decision-making for capital investment, and strategic, operational, maintenance and disposal planning. A well-defined process directs data collection for 16 asset classes. Life-cycle costing and scenario analysis are conducted on pavement condition and are compared to engineering standards, leading to a four-year funding programme for operations, maintenance, and rehabilitation.

United Kingdom

In the United Kingdom, parliamentary legislation mandating that the government maintain the country's infrastructure dates to 1825. In modern times, the UK adopted specific asset management-related legislation in 1999. Here are a few examples of current AM practice in the UK:

Transport for London's (TFL) 2000 business plan included a mandate to bring the city's transportation assets into a state of good repair. TFL's aim to reduce its maintenance backlog, new opportunities for public borrowing for transportation investment, and national requirements to implement whole-of-government accounting procedures and prepare local transport plans, all coalesced to drive the implementation of an AM program.

The TFL programme identifies critical asset needs, determines the most cost-effective strategy to address those needs and measures results in best-value performance indicators (BVPI). Managers also use AM information to value assets and distribute capital maintenance funds. Assets considered most critical and having the highest value to network effectiveness are prioritised for funding. TFL's Asset Inventory and Management System (AIMS) is part of its GIS platform used for city planning and management activities. The AIMS includes network descriptions, information on 59 asset types, condition data and crash data. The system includes both historic data and live video feeds. Condition index ratings establish project priorities for roads and sidewalks. A pavement deterioration model is used to develop a 15 to 20-year investment programme for roads; a similar model is in place for streetlights. The models are used also to test long-term expenditure scenarios.

The Hampshire County Council developed a Highway Maintenance Management Plan that is integrated into the council's service plan, business plan and quality procedures. The strategy is intended to provide a common basis for assessing maintenance needs, resource requirements and implications; assist in the effective allocation of resources; and support a consistent, systematic approach to decision-making.

Gloucestershire was among the first local authorities to begin implementing an asset management strategy in response to national directives to more closely align transportation plans and AM. The county established an asset working group to spearhead the effort, resulting in a statement of objectives and desired outcomes, a definition of asset resources, and the identification of risks associated with asset condition. The group also conducted a gap analysis to identify the difference between current and desired levels of service and the cost of closing the gap, in preparation for developing an implementation plan.

United States

In the United States, the adoption of asset management practices by municipalities and utilities has been driven more by the pressures of growth and significant funding shortfalls than by government regulation. More recently, the dramatic growth of utility smart metering and the development of the Smart Grid and creating new pressures and new opportunities to advance asset management, data capture and performance analysis and optimisation. The GASB 34 accounting rule requires annual reporting of all capital assets and long-term liabilities including infrastructure, utilising accrual accounting methods. Agencies are required to report asset depreciation using a traditional straight-line method, and by reporting revaluations of depreciation based on condition of the asset. However, the rule also provides that agencies do not have to depreciate assets if the agency manages the infrastructure asset using an AM system. Infrastructure managers have concluded that straight-line depreciation did not provide the tools to help them manage the infrastructure and pursued implementation AM programs that brought best practices into their organisations.

Best practice agencies can be found in the following areas of municipal and utility management:

- Transportation (Portland, Oregon)
- Water (Las Vegas, Nevada; Seattle, Washington)
- Wastewater (Johnson County, Kansas; Portland, Oregon; Sacramento and Orange Counties, California)
- Storm water and facilities (Seattle)
- Fleet (Fresno, California)

The growing deployment of smart meters and intelligent sensing and control devices in utility systems essentially require that infrastructure managers move beyond basic asset management practices to leverage the terabytes of data these devices will produce in real-time analytics systems, performance optimisation programmes, and long-term system modeling processes. These initiatives make up the most advanced stage of asset management and are within the reach of infrastructure managers as utilities build out the smart grid. The US and Canada already have the world's highest penetration of automatic meter reading, exceeding 50% and many large US utilities have embarked on ambitious smart grid schemes to deploy second-generation advanced metering infrastructure. Aggregation and analysis of the resulting data will mark the next significant advance in asset management in the utility industry.

Getting started in asset management

A phased approach

Implementing an asset management programme within an organisation that is responsible for a complex of infrastructure assets – such as a municipality or a utility – is typically a four-phase process, as outlined below. This process often begins with "Asset management for compliance" in response to requirements for tangible asset accounting in financial reporting standards such as GRAP 72 (South Africa), PS 3150 (Canada) or IFRS.

The phases or stages of asset management are:

- *Asset management for compliance:* This phase focuses on ensuring that the organisation is able to meet its statutory obligations related to asset financial accounting and reporting. Each business unit will, at a minimum, inventory, classify and value its assets for asset accounting purposes.
- *Asset management standardisation:* This phase expands assets by establishing standards and processes across the organisation, including management practices, processes, data collection and systems. The result of this phase is the implementation of standards for what assets are, where they located, and how the different assets are related to each other (e.g. system models).
- *Integrated asset management:* This phase focuses on implementing an integrated set of processes across an organisation for designing, building, operating and maintaining all asset classes and systems. For instance, in an integrated utility or region, water and electric are managed as integrated systems not independent systems. Integrated asset management incorporates cross system planning and operation. For instance, the replacement of water mains would be planned in relation to the repaving and/replacement of road infrastructure.
- *Sustainable asset management:* This final phase focuses on ensuring that all assets and systems are managed in perpetuity to provide required levels of service. Critical to this stage is the development of sustainable funding methods for all systems and asset within an organisation.

A phased approach enables the organisation to meet the challenge of providing resources to develop an asset management strategy and programme while supporting its various competing initiatives. A step-by-step implementation of an asset management programme might proceed as follows:

Year 1: Establish asset management support infrastructure

- Design and develop the support infrastructure for asset management, including establishing base asset detail to meet financial reporting requirements.
- Establish asset management financial policies to enable compliance to new accounting guidelines and the reporting of tangible capital assets.
- Establish an asset management programme office and governance structure.
- Establish asset management education and communication programmes for audiences including elected councils, directors, executives, management and staff.
- Establish asset management standards.
- Implement base information technology, including asset management systems and an integrated asset repository (data warehouse).

Year 2: Implement AM performance management practices

- Expand asset management education as it relates to the actual process implementation.
- Establish base set of key performance indicators and related service levels.
- Establish baseline performance for future benchmark and report cards.
- Develop initial set of asset management plans for critical assets.
- Develop long-range financial plans for all asset classes.
- Develop new rate models based on long-range financial plans.
- Finalise asset management system implementation.

Year 3 and beyond: Institutionalise asset management

- Expand asset management plans for all asset classes.
- Incorporate criticality and risk analysis models for all major assets.
- Implement an integrated asset planning process as part of the regular budgeting process.
- Review and revise long-range financial plans regularly as part of an ongoing process.
- Enter a continuous improvement cycle (performance management + cross-industry benchmarking + cross-industry best practices + business process improvement) to support long term reduction in overall life cycle costs.
- Implement an integrated service and asset planning process.

Conclusion: Looking ahead

Over the coming years, infrastructure agencies will fundamentally rethink how they do business as they are driven to find innovative ways to balance funding shortages and the demands of growth, aging infrastructure and changing demographics. Success will require a holistic approach to managing infrastructure in order to meet triple bottom line considerations – providing infrastructure services to support a diverse society and a vibrant economy while preserving the environment. New strides in the implementation of asset performance management will include:

Practices

- Long-range planning processes will be integrated with sustainable infrastructure planning.
- Service level modeling across asset classes will support sophisticated consultation with customers to define

levels of service and evaluate methods of service delivery.

- Decisions will be increasingly influenced by predictive asset information at the managerial and political levels.

Processes

- Organisations will be able to monitor performance in real time, making timely adjustments to optimise infrastructure operations and ensure continued service.
- Sophisticated risk modeling processes will help organisations understand and mitigate risks.
- Business case evaluation processes will help organisations develop sound and sustainable investment strategies for the long term, linking capital, operating and maintenance cycles.

Data and records

- Asset records will be complete and accurate and fully accessible to all staff in reporting "dashboards" that present a unified view of asset data across the organisation while providing role-specific views for asset managers, financial managers, executives and other stakeholders, including customers.
- Data confidence will be measured and reported to stakeholders, and data improvement strategies will be identified and implemented.

Technology systems

- Technology systems will be integrated through a common foundation of information and communication, and will be accessible and secure.
- Management and assessment tools will enhance the organisation's ability to monitor infrastructure condition and predict the consequences of decisions.
- New innovative infrastructure equipment can be installed, managed and monitored for benefits realisation.

Organisation and people

- Organisational structure will be designed to optimise the integration of asset management, resulting in greater collaboration across business units and job functions.
- Asset management data will inform decisions at all levels of the organisation.
- Broad access to AM information will improve job performance and enhance personal productivity.

Selected sources

[1] J A Barry: "Watergy: Energy and Water Efficiency in Municipal Water Supply and Wastewater Treatment," The Alliance to Save Energy, 2007.

[2] M G Damm, and C Yee: "A Continuous Improvement Approach For Municipal Infrastructure Management," Fraser Institute, 1998.

[3] T E El-Diraby: "A Perspective on Infrastructure Management in the 21st Century," University of Toronto, 2010.

Acknowledgement

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Asset management: an executive perspective

An integrated and holistic approach to the effective management of the asset base through its entire life cycle is fundamental to the success of an asset-centric business. Without executive management, strategic direction setting and active sponsorship of the asset management programme, business performance, at best, will be less than optimal. In the longer term, the lack of a leadership-driven asset management strategy and the effective implementation thereof result in an unsustainable business where the risk of unpredictable and catastrophic asset failure is high.

by Dr. W de Beer and N Waters, EDI Holdings

Business leaders' success depends on the flawless execution of business strategy, but this seldom happens in practice with failure rates for major projects reaching 80 to 90%. High turnover of executive leadership is closely linked to the inability to execute strategic plans and major projects. So why do so many business strategies fail? The five most prevalent and costly barriers to project success are:

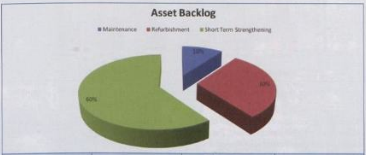
- Fact free planning: deadlines and resources are set up with no consideration for reality
- Absentee sponsors: lack of visible leadership, political clout, time or energy to see a project through to completion.
- Skirting real issues: people work around the priority setting process.
- Lack of openess on project problems: team members wait for someone else to speak up first.
- Team failures: team members perpetuate dysfunction when they are unwilling or unable to support the project.

The real problem is not that these barriers are common, but that they are not effectively confronted and resolved. When leaders successfully address one or more of these five barriers, success in achieving project objectives increases by 50 to 70%.

Business world-wide is faced with the need to improve company performance while lowering costs. In a utility context, performance improvement can include increasing system reliability, reducing lost time accidents, optimising people performance, improving stock turn ratios and a host of other critical processes. Optimising cost means spending critical and required capital, focusing on projects that add appropriate value, reducing operating and maintenance expenditures while still focusing on optimising system integrity. The UK Publicly Available Standard (55) defines asset management as "the systematic and co-ordinated activities and practices through which an organisation optimally manages its physical assets, and their associated performance, risks and expenditures over their lifecycle, for the purpose of achieving its organisational strategic plan" or, in plain English, making smart decisions to achieve desired asset performance. An effective asset management business model helps turn possible contradictory objectives into complementary goals. While asset management models vary, the core principles of fact-based decision making integrated with risk management are critical to balancing spending and performance, through application of consistent best practices that support an effective and efficient asset management business model.

SA electric utility reality check

Asset management strategies and appropriate systems do not exist throughout the industry. Some asset owners do not provide for sufficient investment in existing and planned network assets. Plans are generally based on what can be achieved, not on what is required. Demand growth, in many areas, exceeds the loading capacity of the networks and plant which complicates plant availability for "dead condition" maintenance and refurbishment. Insufficient skills exist to perform "hot work". The demand for competent staff is rapidly increasing while there is a severe lag in the training and development of skills. Lack of experienced and effectively trained contractors results in safety and quality challenges. The number of outages due to poorly performing networks and incidents related to electric cable and associated



Maintenance	Refurbishment	Short Term Strengthening	Total
R2 736 914 699	R8 210 744 098	R16 421 488 197	R27 369 146 994
2008 data with backlog growth projected at R2,5-billion per annum.			

Fig. 1: SA power utility asset backlog: 2008.

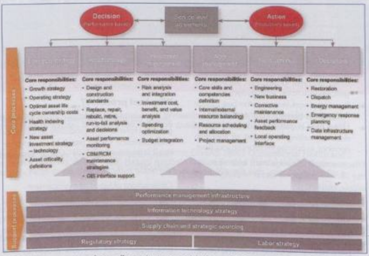


Fig. 2: The core processes for an effective business model. (Source: PA Consulting)

Fig. 3: A structure for assessing current capabilities, defining opportunities and crafting for implementation. A project can include any combination or all four steps.

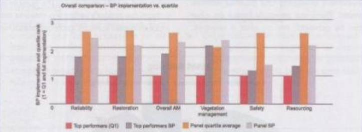


Fig. 4: Performance management. (Source: PA Consulting Polaris International Benchmarking Programme)

equipment theft indicates that the number of sites with poor network reliability is increasing. The asset maintenance, refurbishment and strengthening backlog was calculated at R27,3-billion in 2008, projected to grow at R2,5-billion per annum.

Leadership is critical

We have seen that business strategy fails through lack of leadership and inability to confront problems. We know that there are fundamental flaws in the management of the South African distribution networks and that there is a huge backlog. The challenge to leadership in the industry is to address the real issues and play a strong executive leadership role. This is achieved by effective asset management which entails:

- Managing limited human and financial resources in the most effective way to meet business objectives, focused on performance rather than budget.
- Investing in work/resources that best support the strategic objectives of the company
- Using fact-based, performance-driven decision making to support all spending decisions, to optimise the return on your asset.

Effective asset management also requires the identification of asset management accountabilities.

Asset management accountabilities include:

- Identifying the right work to be done on the right asset at the right time
- Finding the best course of action in terms of retire, replace, repair, refurbish, and run-to-fail options for any given asset.
- Developing an optimised work plan with the appropriate balance of cost, performance, risk and resources.
- Developing and maintaining the appropriate planning, design, construction, operating and maintenance standards.
- Understanding the entire risk exposure profile and determining the best level of risk tolerance.
- Defining the best mix of resources to complete work
- Managing the regulatory environment

The third requirement for effective asset management is the use of a management model.

The example in Fig. 2 defines the core processes necessary for an effective business model, as well as the separation of decision and action components.

Why best practices?

Strong correlation between consistent best practice implementation and utility performance implementation of best practices as part of an holistic asset management strategy, improves utility performance.

Observations of top asset management performance

Technology is a critical factor: virtually every best practice company has the technology infrastructure in place that integrates with and supports the business processes and practices.

Performance management is a key component: most top performers have a comprehensive performance management system including regular dashboard reporting to measure a wide variety of metrics that support corporate goals.

Top performers tend to perform well across business processes, indicating the benefits of using a balanced scorecard approach.

Which best practices really make a difference in the long term?

A comprehensive list of practices is available, but a limited selection tends to suggest the critical role of strategic leadership, accountability and decision making:

- *Life cycle strategy:* an asset data base with physical, operational and maintenance data for individual assets is in place and updated regularly.
- *Safety:* executive management audits are conducted for all lost time accidents, and corporate safety culture is emphasised by senior management focus and example.
- *Investment optimisation:* business case documentation is formalised for each project and benefits tracking is done after project completion to validate original benefit assumptions.
- *Resourcing strategies:* performance metrics are in place to measure progress, quality, budget, safety and customer satisfaction on a monthly basis (for contract resources and employees).
- *Performance management:* balance Scorecard metrics using financial, process, customer and people criteria are in place and regularly reviewed for validity and management compensation, including base salary and bonuses directly tied to achievement of KPI targets. (See Fig. 4).

Conclusion

An asset-intensive business requires a well integrated asset management strategy to ensure business sustainability and customer satisfaction. Executive management of an asset-centric business has a critical role to play in defining the asset management strategy and ensuring that it is well understood, barriers to implementation are overcome, and performance against the strategy is measured and corrective action is taken. Without a well defined approach to asset management and effective implementation, maintenance efficiency will be limited, refurbishment costs will increase to address the maintenance gap and asset performance will be poor, with an increased probability of catastrophic failure in the longer term. Leaders who understand their business find effective solutions to the asset management constraints, even in an environment that is far from enabling.

References

[1] Kaplan and Norton, The strategy focussed organisation, 2001.
[2] Scientific American, June 2006.
[3] Vital smarts: Silence Fails, 2006.

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Improving service delivery and revenue protection of split STS prepayment metering

This paper describes the benefits of adding remote access terminals to split STS prepayment metering installations. Characteristics of two pilot sites are given to demonstrate the versatility of such systems to utilities and consumers. Interoperability and co-existence issues are noted and the end use capabilities of this form of "smart" prepayment system are compared with those of emerging "smart" AMI meters.

by R Hill and H J Hayes, Landis+Gyr

Prepayment metering has a long and successful history in over fifty-six countries around the world. The incompatibilities and un-reliability of early systems have been resolved through the standardisation efforts of Eskom in the early 1990s and by the STS Association in the early 2000s. The technologies and associated products have since matured into highly cost competitive devices, compliant with over 60 international, regional, national and industry standards.

The focus on quality and dependability continues with the pending release of the STS 501 series of conformance standards and the national efforts to register the IEC 62055-31 standard under the IECEE conformance scheme. These efforts serve to minimise the disruptive consequences of non-compliant product in systems that are becoming increasingly integrated and inter-connected as we move rapidly towards the "smart" grid.

Despite all of the above, non-split/single part STS prepayment meters have one serious limitation, in that they must be placed in a location accessible to the consumer; so that the consumer can enter the digits of the STS credit tokens and view their amount of credit remaining. Valiant efforts to define better sealing standards and enhanced codes of practice for revenue protection practitioners have always been thwarted by the need to undertake a "home invasion" to access the prepayment meter for auditing and inspection purposes. Two-way token systems such as smart cards, offer marginal additional protection against tampering and bypassing of a meter fitted in a home and they introduce additional logistical and electrical failure mechanisms. Such systems have failed to gain support in the STS market and none have been standardised.

Fig. 1: Single part vs. multi-part (split) prepayment meter configuration.

Fig. 2: Variety of types and locations of enclosures for split prepayment meters.

The STS prepayment industry has made a fairly rapid transition to split prepayment meters where the measurement and load disconnection functions are located in a secure enclosure, remote from the consumer's premises. A simple and cost effective consumer interface unit (CIU) is then fitted on the consumer's premises for the purposes of entering credit and viewing the remaining credit balance. The measurement and control unit (MCU) of the split metering installation is then designed to communicate with the CIU, typically via a wired, twisted pair connection or a more convenient power line communication (PLC) technology. Fig. 1 illustrates the difference between single part and split prepayment meters.

Limitations of split prepayment meters

Split prepayment meters are inherently more secure and less prone to tampering than single part meters. This comes at additional cost, depending on the communication technology used between the parts. Split meters using dedicated twisted pair wires, are typically double the cost of a single part meter and split meters using PLC are typically triple the cost of a single pan meter. Thus single part prepayment meters still have a significant market share in communities where energy theft and tampering is not prevalent (Yes, they do exist!).

Tampering of the metering part (MCU) of a split meter will typically be done in full view of the community at a kerb side enclosure or at the top of a tall pole, which is much less likely than when a single part meter is fitted within the customer's premises. Unfortunately, it is often impossible to tell the difference between a utility staff member performing maintenance duties on a pole top MCU, and a revenue theft syndicate member bypassing a MCU. The visibility of the meter tampering activity is thus not a great deterrent.

Placing meters on top of a pole makes access for tampering purposes more difficult, but the hardened criminal is not really put off. It is often said that pole top meters simply create a market for ladders and make the life of the utilities maintenance staff more difficult and less effective.

Furthermore, a home owner or consumer can be held legally liable for damage to, or tampering with a single part prepayment meter when it is fitted within his/her premises, as he/she has authority over who has access to the single part meter. This is not the case when the MCU of a split meter is installed in an enclosure in a public place as it is almost impossible to prove who performed any tampering that occurs.

Split meters do however have some significant advantages over single part meters:

- *Ease of auditing:* Bypassing of the meter must now be done upstream of the MCU which is now in a remote public location. Auditing, detection and removal of illegal bypass conductors can thus be performed without the hazards and disturbance of a "home invasion". The value of this ease of access to the MCU, more than justifies the additional cost of the split meter configuration, albeit at the increased risk of unauthorised alterations and loss of legal accountability of the consumer.

Fig. 3: Example of a clustered meter enclosure using PLC or wired split prepayment meters.

Fig. 4: Example of a remote access solution for clusters of 2 to 30 prepayment meters.

- *Remote asset protection:* The consumer has no reason or right to access the MCU, which means that it can be located in a highly secure enclosure i.e. one which is able to selectively control and record who is granted access to the meters for "maintenance" purposes. This is done with a remote access control system to prevent the theft of enclosure "keys" or seals from dependable utility staff. Access is remotely granted and logged for recognised personnel and purposes only. Reliance on simple meter seals, tamper switches and terminal covers on meters within a non-secure enclosure, are not as effective and may be compromised by the utility staff tasked to maintain such equipment.
- *Remote revenue protection:* It is possible to remotely monitor and control the performance of the meters, particularly when PLC technology is used to communicate between the parts of the split meter. The information thus gained has many applications and advantages to the consumer and to the utility, as described in the remainder of this paper.

Remote access topologies

It should be obvious by now that split meters alone, do not provide adequate levels of revenue protection. The additional cost of the split meter format is warranted, but to be truly effective, it must be supplemented by add-on remote access capabilities in order to provide a truly secure "smart" STS prepayment metering system.

The add-on nature of such remote access capabilities exploits the communication facilities inherent in the split meter design and more significantly, allows the remote access products to be installed, maintained, upgraded and replaced without the knowledge of, or inconvenience to the consumer.

Furthermore, the commercial justification of the remote access equipment can be independently assessed and motivated depending on the level of tampering prevalent within a specific community. This benefits the revenue protection practitioner as the investment into such equipment can be made long after the initial electrification of the sites, and it can be adjusted periodically if necessary, to match the degree of tampering known to exist at a point in time.

The topology of a remote access system is dependent on the capabilities of the communication technology used between the MCU and CIU of the split meter and the location of the MCUs within a particular site.

The location of the MCUs is typically arranged in one of two categories:

- *Clustered meters:* This is typical of pole top enclosures and kerb side kiosks. A limited quantity of meters (typically four or eight, up to a maximum of 32) is located in a single secure enclosure. The integrity of the meters is protected by a remote asset protection system at each enclosure.
- *Distributed meters:* These meters may be fitted in an enclosure similar to the clustered meters, but importantly, may also be located in existing homes, distribution boards or meter rooms in offices and multi-tenant buildings. These are more likely to be managed via a remote revenue protection system fitted at a distribution transformer or sub-station.

The communication technology used between the MCU and CIU typically falls into one of three categories:

- *Wired:* The STS split prepayment industry has standardised on a two-conductor, twisted pair arrangement that may or may not be incorporated into the service delivery cable to the consumer's premises. Wired systems are the most cost effective form of split meter communication, but they are prone to failure from high winds, poor terminations or copper theft syndicates seeking to replace an entire service cable when a pilot wire within the cable is induced to malfunction. Distances of 50 to 100 m are typical. Data transfer rates range from 1200 to 9600 bps.
- *PLC:* The STS split prepayment industry has standardised on the use of the IEC 61334-5-2 FSK technology as it conforms to the EN 50065-1 spectrum and emission level limits. Some manufacturers have mistakenly implemented systems in the Cenelec C band reserved for consumer applications, rather than the preferred Cenelec A band reserved for utility exclusive use. Both are prone to interference from "rogue" appliances swamping the bands with interference. Distances of 100 to 200 m are typical and hopping and mesh networks are not used, in order to keep costs down. Data transfer rates are typically 1200 bps due to the frequencies available in the Cenelec A band.
- *RF:* The STS prepayment industry has not yet standardised on an RF technology as there is no utility exclusive spectrum available, and there is some uncertainty around the coexistence issues in the available ISM bands. Mesh systems have yet to prove themselves in this cost sensitive market.

Various topologies of remote access systems are thus possible depending on the nature of the site and the communication technology used within the split meter. Multi-part prepayment meter standardisation efforts by the IEC TC 13 WG15 have not progressed and the future of the IEC 62055-32 specification is uncertain due to the ever expanding requirements of the smart grid. It is thus necessary (at this time) for utilities to allocate sites to specific manufacturers to avoid coexistence issues between various remote access systems.

Examples of remote access solutions

Figs. 4 and 5 give graphic representations of remote access solutions for clustered and distributed meters.

Remote access terminals (RAT) differ from the traditional data concentrators used in AMR systems. The primary purpose of a RAT is to provide an access path to the data in a prepayment meter, for auditing and revenue protection purposes. Used properly, they therefore do not need the back-haul bandwidths typically associated with AMI data concentrators. This helps to reduce their operational data transfer costs. Whilst capable of much of the data transfer functionality of advanced AMI systems, a remote access solution is intended to be simpler to use and maintain. It is therefore provided with basic AMI functionality only.

Capabilities and use cases of remote access terminals

The capabilities of a remote access terminal can be classified into five primary use cases as follows:

To provide advanced on-line prepayment services to consumers, such as:

Fig. 5: Example of a remote access solution for sites with 20 to 300 distributed meters.

- Automatic credit token transfers (from PoS to meter)
- Monthly bulk distribution of free basic electricity tokens
- Improved understanding of inclined block tariff charges (at PoS)

Alternatively, to provide basic AMI credit metering services to consumers such as:

- On demand or scheduled meter readings via an internet or mobile website
- On-line energy and demand monitoring via an internet or mobile website

Remote service monitoring and management for utility support staff, including:

- Outage detection and restoration verification
- Power reliability and quality of supply monitoring
- Remote service reconfiguration (prepayment vs credit mode)
- Remote service interruption and restoration (collections and moving in/out)
- Meter maintenance and asset management records (repair records)

Revenue protection and energy theft detection for utility revenue loss staff, including:

- Logging and escalation of meter alarms and alerts (e.g. tamper switches)
- Auditing of energy purchased vs energy consumption profiles
- Detection of ghost meters and vending systems
- Detection of fraudulent meter bypassing and/or reconfiguration
- Monitoring of supply group, tariff index and key change information
- Interface to kiosk controllers and asset protection systems

Remote load management and demand reduction for utility DSM/DR goals, including:

- Remote activation/configuration of energy limiting modes (if provided)
- Remote setting/adjustment of maximum power limit threshold
- Control and programming of remote load switches for DSM (if fitted)
- Energy balancing/comparison with ZMD check meters (if fitted)
- Interaction and coupling with AMI and ripple control systems (at head-end)

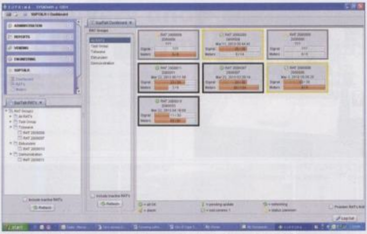

Fig. 6: Example of a back end communications controller showing the "health" of 7 RATs.

Fig. 7: Example of meter specific data showing a tampered meter that is out of credit.

- Interval and register data reading (e.g. STS 201-15.1.0 register table)

A well designed RAT will be able to provide access to the following STS standard data registers:

- Meter serial number (URN)
- Available credit register (kWh)
- Accumulated energy consumed register (kWh)
- State of internal load switch (open/closed)
- Maximum power limit threshold
- STS key type and revision number
- STS tariff index
- STS supply group code
- Meter firmware version

Typical features that should be provided by a remote access terminal are:

- Operation on three phase supplies with various earthing schemes
- Self discovery and remote access of PLC split prepayment meters
- Remote access of wired split prepayment meters via the meter's optical interface
- Modular communications facility with support for GPRS and Ethernet as a minimum.
- Ability to load STS tokens into a prepayment meter from a communications controller.
- Notification and logging of meter tamper events and alarms
- Real time clock for date/time stamping of all meter events and alarms
- RAT event notifications (such as phase failure or low backup battery)
- Last gasp power failure notification from the RAT to the communications controller

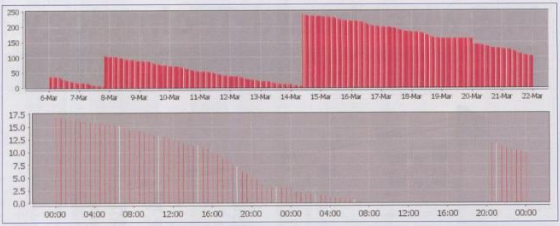

Fig. 8: Examples of half hourly consumption data from the STS available credit register.

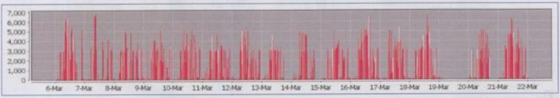

Fig. 9: Example of half hourly maximum demand data the STS instantaneous power register.

- Liquid crystal display for programming and interrogation purposes in the field
- LED communications indicators showing communications per phase (diagnostics)
- Menu scroll and command execute buttons (to access features and functions)
- Two inputs, typically used for sub-station or meter kiosk door switches
- Two system controlled outputs, typically used for alarms linked to inputs
- USB port for local data transfer to memory sticks (on site auditing)
- .Interfaces to known industrial and commercial meters for the purpose of "check metering"

Capabilities of back end communication controllers

It is necessary to provide a simple and intuitive interface to the many capabilities of a remote access solution and important for the industry to rationalise these into a common set of use cases based on standardised information models used within the utility. The activities of the IEC TC57 WGI4 committee and the common information models being developed are valuable tools to manage the growing complexity of multi-vendor integration layers that are necessary when integrating remote access solutions from various manufacturers.

Characteristics of Pilot Site 1

The site selected was a three storey block of flats with low to middle income tenants using an average of 250 kWh per month. One hundred PLC meters were installed with a maximum meter to RAT communication distance of about 100 m. Reliable communication was established with all of the meters.

Characteristics of Pilot Site 2

The selected site has approximately 220 houses fed from three MV mini-substations. The RAT was installed on one side of a mini-substation. All cabling is underground. Reliable PLC communication was confirmed with all of the meters connected to the mini-sub.

Inter-operability and co-existence issues

Split prepayment meters and smart prepayment solutions are designed for cost effective electrification of rural communities. They therefore avoid use of complex communication stacks capable of negotiating network conflicts and similar co-existence issues. They also use low bandwidth technologies as they do not have to deliver the vast quantities of profile data expected of smart AMI systems, nor do they have to perform to tight response times and communication latencies for high levels of interactivity or fast emergency response times. Such technologies are well proven and standardised (e.g. IEC 61334-5-2 FSK PLC) and most have negligible co-existence or inter-operability capabilities as they are usually applied universally throughout a site.

It is common practice to allocate specific smart prepayment sites to particular manufacturers serviced by one or more RATs capable of interfacing that manufacturer's communications controller to any and all of the portfolio of metering devices supplied by that manufacturer. The onus is thus on the manufacturer to ensure that their remote access solutions are compatible with their entire portfolio of STS metering products. This is consistent with the draft IEC 62055-32 multi-part payment metering standard. This draft purposely does not attempt to standardise the intra-part communication technologies of multi-pan STS prepayment systems.

Competition between manufacturers occurs on a site by site basis according to normal tender procedures. Manufacturers are not able to get a utility – wide lock-in on a particular technology except if the head end support of the communications controller is not able to integrate with those of other manufactures or other utility systems. Should the utility desire to deploy remote access solutions from more than one manufacturer, the onus will be on the utility to ensure that the equipment from the different manufacturers is able to coexist at that particular site. Should co-existence problems occur during installation or thereafter that can't be resolved between the parties, then ICASA will be called in to arbitrate on the legitimate use of the PLC or RF spectrum and to confirm compliance to legislated EMC requirements. The draft NRS 094 PLT guide for power system operators, provides guidance on the technical,

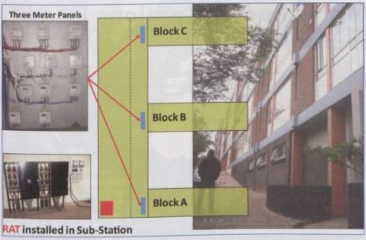

Fig. 10: Pilot Site 1 - Distribution of meter panels and RAT location.


Fig. 11: Pilot Site 2 – Kerb side meter kiosks and mini-substation with RAT.

operational and contractual factors that utilities need to consider.

Emerging communication standards promise to include versatile co-existence capabilities via an inter-system protocol (ISP) such as the G.cx standard proposed by ITU-T and IEEE. Such protocols and standards are not yet mature and they will take time to stabilise and to be widely adopted amongst manufacturers and to reach significant quantities in the field.

Data privacy and security

Smart STS prepayment solutions are built upon the security services of the IEC standardised STS technologies. As such, all credit transfers and engineering tasks are adequately encrypted to an appropriate level of security. The key management infrastructure to deliver this has matured to cater for a global distribution of cryptographic keys in a highly secure and co-ordinated manner. Utilities are encouraged to use the on-line vending security capabilities in the soon to be published SANS 1524-6-10 on-line vending standard.

Security capabilities always rely on two strategies, namely robust data encryption to prevent compromise of the data transferred, and thorough auditing processes to detect when data has been compromised. The remote access solution has considerable value to the latter strategy.

Integrating smart STS prepayment and AMI metering solutions

Maximising revenue collection and improving service delivery to communities is all about listening to and flexibly responding to the needs of a community down to the level of individual preferences. This dictates that modern utilities deploy systems capable of offering consumers a choice between various service alternatives.

Modern STS prepayment meters are capable of operating in a prepayment mode or a credit metering mode. Thus specific individuals in a community fitted with STS split prepayment meters may be offered a basic credit metering service when a RAT is deployed to remotely read the meters. The smart STS prepayment system thus functions as a low cost AMI metering system via the communications controller.

Although smart STS prepayment systems comply with the definition of a "smart system" given in RSA Government Gazette R773, and hence may be used for consumers with an average monthly energy consumption of greater than 1000 kWh per month, they do not provide the high levels of advanced tariff and energy efficiency services that a fully standardised NRS 049-1 smart AMI metering system requires. Smart STS prepayment systems are thus ideal for the low consumption users as contemplated in the NRS 049-2 standard being prepared. In such low income applications, utilities can implement credit control policies that remotely switch credit based customers to a prepayment service when they run into financial difficulties – and switch them back again, when appropriate, without a site visit or a physical swap out of the meter.

Utilities also need to cater for consumers in a smart STS prepayment site, who will demand an electricity service offering greater flexibility in tariff selection and/or enhanced load management and information display capabilities – such as those provided by modern smart AMI solutions based on the DLMS suite of standards. This request can be accommodated by replacing the split STS meter with a smart AMI meter having a GPRS modem communicating directly to the utility's head end AMI system.

The utility is however, then faced with the logistics of transferring the consumer's account between the smart prepayment and AMI head-end systems – unless the utility has invested in an integrated head-end system compliant with the evolving IEC 61968 common information model (CIM). It is expected that utilities will make significant investments into multi-vendor integration layers to manage the provision of a diverse set of services to consumers with various forms of smart STS prepayment systems and smart AMI systems so that these may be managed and controlled via messages conforming to the present and emerging IEC 61968 series of standards. Such integration work will be substantially simplified when advanced AMI meters are procured that are compliant with the emerging IDIS specification. IDIS is an abbreviation for "Interface definition for interoperable systems".

Conclusion

The combination of proven STS split prepayment metering technologies with complimentary remote access, terminals and remote access solutions provide enormous benefits for utilities and consumers. Revenue protection programmes can now advance to more effective online methods and avoid the conflict and disruption of home invasions. The question now is: Can you afford not to fit remote access terminals to all your split STS metering installations?

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Electrical metering technology options in the municipal environment

An overview of available metering technology is offered, providing the main features of each. Further, the benefits of utilising these metering technology options in a municipal environment are sketched. This then provides a platform from which conclusions can be drawn.

by L de Nysschen, Actom Protection and Control

According to a CSIR/cidb Discussion Document: "Towards a framework for the maintenance of municipal infrastructure: In support of government growth objectives", prepared in August 2006, municipalities collectively account for 43% of the total volume of electricity sales, while Eskom supplies the balance. Few municipalities other than those in the larger urban areas, generate electricity themselves and these municipalities would usually be responsible for the transformers, the below-ground (and sometimes above-ground) cables and the metering systems for electricity distribution. The discussion paper further suggests that the following issues are responsible for non-performance:

- Inadequate budgets for maintenance and upgrade of infrastructure
- Inadequate skills

The purpose of this paper is to look at available electricity metering technologies, to ensure that funds spent on maintenance and infrastructure upgrade, related to metering, are directed at both appropriate and cost effective solutions. Addressing the other issues is beyond the scope of this paper.

Metering technologies

In the NRS057 document, a clear distinction is made between "meter" and "metering equipment" The "meter" is defined as a device employed to measure and totalise the variable consumption of electricity, whereas the "metering equipment refers to all components, including the meter making up the metering installation. In the electric energy environment high importance must be given to measurement methods and recording and storage devices for electrical consumption data.

The NRS 057 clearly identifies minimum standards pertaining to the meter accuracies required based on nominal size of load, highlighted in Table 1.

Interval and time-of-use metering systems

Interval and time-of-use meters (credit meters) are traditionally installed to measure commercial and industrial customers (large power users), which are defined as consumers of electrical energy with a nominal load of in excess of 100 kVA, depending on the utility. These meters have evolved with the advent of solid state technology, offering a wide range of possibilities, allowing them to be included as part of a complex metering system. These meters also introduce additional services, which were not available during the era of electro-mechanical metering systems. These services are available to benefit utilities and consumers alike.

- *Load profile:* Load profile is a record of time stamped consumption data every integration period (currently 30 minutes in South Africa). The study of this information allows for the analysis and the definition of a "customer's consumption pattern", on which various billing algorithms may be proposed. Furthermore, load profile data supplies information about the loading of the electric system and the forecast of the energy request, therefore it is possible to schedule load profiles as an energy function of the losses and the availability of the primary sources in the production centres.
- *TOU (Time of use):* Time of use tariffs take into account defined time slots or integration periods, each of 30 minute duration during the day; days during a month using holidays, workdays and weekends; months constituting the winter or summer seasons. Modelling the outcome of applying alternative TOU tariffs is only possible with the availability of load profile data.
- *Monitoring and service interruption:* Monitoring allows for optimum management of distribution networks, with consequent reduction of losses in line and service interruptions. Real time recording of the number of instances and duration of electrical service breakdowns can help to evaluate the supply quality in the various areas. This information, with load profile data, provides a very good tool to evaluate the quality of supply services proposed and the real needs of the customer. So it can help the utility to know the site and the cause of the problem before sending out service teams. The optimum management of the whole electric system influences the final consumer.
- *Interface with the SCADA and control systems:* The electric parameters measured by the meter can be added incorporated in the SCADA (Supervisory Control and Data Acquisition) or control systems. These measurements may be actual measured quantities, weighted pulses or parameter status indications. These control systems are used on the electrical grid to make control and forecasts of load demand, and assist in energy costs of the consumer.
- *AMR systems:* Automatic meter reading, or AMR, is the technology of automatically collecting consumption, diagnostic, and status data from energy metering devices and transferring that data to a central database for billing, troubleshooting, and analysing.

  AMR technology saves utilities the expense of periodic trips to each physical location to read a meter. Another advantage is billing can be based on near real time consumption rather than on estimates based on previous or predicted consumption. This timely information coupled with analysis, can help both utility providers and customers better control the use and production of electric energy, gas usage, or water consumption.

  Electronic meters use a range of communication options including;

Load	Accuracy class			
	Active energy meter	Active energy meter	Current transformer	Voltage transformer
> 100 MVA	0,2S	1	0,2	0,2
10 - 100MVA	0,5S	2	0,2	0,2
1 - 10 MVA	1	2	0,5	0,5
100 kVA - 1 MVA	1	3	0,5	0,5
< 100 kVA and whole current	2	3	1	-

Table 1: Minimum requirements for metering installations.


CBI electric
aberdare atc telecom cables (Pty) Ltd
low voltage
medium voltage
african cables

Low Power Radio, PLC (Power Line Communication), GSM, GPRS, Bluetooth, IrDA, RS232, RS-485 and Ethernet. AMR systems, which include protocol interpretation, process this time stamped load profile data along with the tariff structure to formulate the billing information. The processed data may also assist with load studies and planning purposes.

AMR Hosting is a back-office solution which allows a user or utility to track the electricity consumption over the internet. All data collected is stored in a centralised database by high-end data acquisition software. The user can view the data via a secure web application, and can analyse the data using various online analysis tools. The user can easily chart load profiles, analyse tariff components, and verify the utility bill.

Providing customers with added services to manage electricity consumption is highlighted in an address delivered by the Executive Major of Ekurhuleni Metropolitan Municipality, Clr. Ntombi Mekgwe, at the Ordinary Council Meeting in Germiston on 23 September, the following related to the metering system was said: *"With regards to electricity related revenue income, internet based metering will be extended from the current 3000 or so customers, to include every demand for meters in the city, with this project aimed for completion by December 2009. This will not only improve revenue, but also ensure a world class service to our larger customers. Meter data will be available on the internet, updated at 30 minute intervals and fully accessible to the account holder or their agent. The web page includes tools that will practically assist customers to reduce consumption with visible indication on an easy to use, energy dashboard."*

Prepayment

The standard business model of electricity retailing involves the electricity utility billing the customer for the amount of energy used in the previous month or consumption period. In some countries, where non-payment takes place, the utility may install a prepayment meter to reduce the non-payment for services. This requires the customer to make advance payment before electricity can be used. If the available credit is exhausted then the supply of electricity is cut off by a relay.

The meter essentially consists of a software controlled unit, allowing the customer control of the electricity consumption, and offering a visible indication inside the residence (or small business) of the actual consumption and the number of units (credits) left inside the meter. In South Africa as with many other developing economies, prepayment meters are recharged by entering a unique, encoded twenty digit number using a keypad. This makes the tokens, essentially a slip of paper, very cheap to produce. The Standard Transfer Specification (STS) Association promotes a common standard for prepayment metering systems across all manufacturers.

Advance metering infrastructure

The "smart meter" is just one of the components of an advanced metering infrastructure (AMI) system. Smart meters may be part of a smart grid, but alone do not constitute a smart grid. The installed base of smart meters in Europe at the end of 2008 was about 39-million units, according to analyst firm Berg Insight.

The development of advanced metering infrastructure systems, has borrowed from interval and demand technologies, AMR system technologies and prepayment technologies. This has resulted in the advanced metering infrastructure (AMI) becoming the measuring function in the smart grid system. It provides the information about energy usage (demand) to utilities, consumers and the grid itself. This enables all parties to make better decisions about reducing costs and strain on the grid during times of peak demand. The necessary information about demand is coupled along with the energy distribution itself.

Broadly speaking, the three components: smart meters, communication infrastructure and master station, form the infrastructure needed to provide AMI services. The NRS 049 standard, details the AMI system components, which include:

- AMI master station from where the configuration and functionality of the system are controlled.
- Communication network and infrastructure
- AMI or smart meters
- Load switch (disconnect/reconnect/load limiting)
- Load control devices
- Customer interface unit
- Optional interfaces to communicate with a mobile customer interface

The NRS 049 illustrates two typical arrangements of AMI systems, one utilising direct communication to the meter, and another utilising a concentrator. The latter is indicated in Fig. 1.

The most notable functionality of the AMI systems includes:

- *Monitoring and recording of demand:* An AMI system enables a number of services related to demand measurement and billing. Meters supporting automatic meter reading (AMR) can report demand to utilities automatically via communication networks.
- *Logging of power relevant events:* Real time recording of the number of instances and duration of electrical service breakdowns can help to value the supply quality in the various areas. This information, with load profile data, provides a very good tool to evaluate the quality of supply services proposed and the real needs of the customer. So AMI can help the utility to know the site and the cause of the problem before sending out service teams.
- *Anti-tamper measures:* Beyond new interactions with customers and the grid, smart meters bring along new anti-tamper measures. Previous meter tamper detection mechanisms were limited to locks and tamper-evident seals. While these measures are often sufficient for keeping honest people honest, they offer little to deter malicious tampering, and can be circumvented.

Beyond physical tamper detection mechanisms, smart meters may be configured to log events concerning

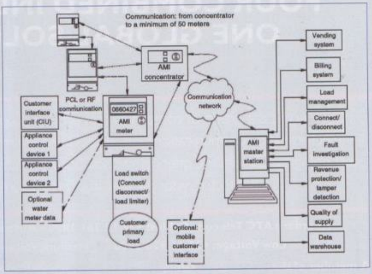

Fig. 1: Illustration of a typical AMI utilising a concentrator.

command history and conditions in the meters environment. This includes the detection of events indicative of physical tampering. One such mechanism, outage notification, records periods during which voltage has dropped or been removed from the meter's sensors. Reverse energy flow, may also be detected through meter firmware.

- *Remote disconnect/reconnect:* Utilities can disconnect and reconnect the service without fieldwork. This is especially important in areas where frequent contract changes and frequent payment delays are verified. So in real-time a remote command can disconnect a supply, for example in the case of abnormal use. In this way the work of the service staff is simplified and the repair time is reduced, the work is also less expensive which advantages the utility, and offers faster service for the user.
- *Load control:* The demand side management (DSM) load control can be managed by a fixed algorithm operating independently, or by real-time control from the central station. In the latter, the meters receive control messages to perform various load control functions from the master station.
- *Switch between credit and prepayment:* In non-homogeneous customer bases, the need for both credit and prepayment options may be required. The supporting systems allow for both these models to be used, and the ease of switching between them is deemed important. In the case of the prepayment model, applicable standards such as STS must be implemented, allowing existing prepayment infrastructure to be utilised, and not duplicated.

Deciding which technology to be used when

Much has been written and said related to which technology is appropriate for which application. In an attempt not to add to the mass of information available, some of the benefits highlighted allow conclusions to be drawn and serve as guidelines for decision making.

Interval and time-of-use meters

Implementing an interval and time-of-use meter requires little infrastructure to obtain benefit from it. The range of installations which may be metered by interval and time-of-use meters include the complete spectrum of installations, from residential to transmission and generation metering. In order to capitalise on the benefits of the meters, AMR systems could be used in conjunction with the meters. Automated meter reading (AMR) systems, which offer less functionality than AMI systems, do however enable the utility to reduce its meter reading costs and increase meter reading accuracy. AMR systems also offer the possibility of enabling some form of dynamic pricing for the customers who would voluntarily choose that approach.

Prepayment

The South African electricity consumer understands and accepts prepayment metering systems. The financial viability of the electricity distribution industry depends on the deployment of appropriate and cost-effective technology for the low consumption customer.

The use of prepayment technology ensures the eradication of meter reading errors, or those errors associated with estimations of meter readings, as meters are read. Additional fees for disconnections or reconnections due to late payment being applicable are not applicable with prepayment systems, as disconnections and reconnection is an inherent feature of the system.

Customers are able to manage electricity consumption much more carefully and may even allow the credit on the meter to run out. Once income is obtained, additional credits may be purchased without facing repercussions at a later stage. Prepayment electricity is neither more expensive nor less expensive than any other form in which electricity is supplied.

Once the meter is installed, there is no need for meter readers to access your property, and tenants are still entitled to free allocations, where this is applicable.

Advance metering infrastructure

- *System operation benefits:* The operation benefits are primarily associated with the reduction in meter reads and associated management and administrative support. The increased meter reading accuracy, improved utility asset management, easier energy theft detection, and easier outage management are further operational benefits.
- *Customer service benefits:* The customer service benefits are primarily associated with early detection of meter failures, billing accuracy improvements, faster service restoration, flexible billing cycles, providing a variety of time-based rate options to customers, and creating customer energy profiles for targeting energy efficiency/demand response programmes.
- *Financial benefits:* The financial benefits accrue to the utility from reduced equipment and equipment maintenance costs, reduced support expenses, faster restoration and shorter outages, and improvements in inventory management.
- *Additional benefits:* As previously described, when operating the smart meter in prepaid mode, additional benefits are in the form of those described with the prepayment metering systems.

Conclusion

It is important to note utilities have a range of technologies and configurations from which to choose in order to reduce the costs of operating their distribution systems and improve communication with customer meters. Each of the technologies described are best suited to specific applications and intended system outcomes.

In all AMI and AMR systems, one critical technological challenge is communication. Each meter must be able to reliably and securely communicate the information collected to some central location. Considering the varying environments and locations where meters are found, that could be a difficult challenge. In this case, prepayment meters or credit meters without AMR support are best suited. These installations tend to be rural with low average consumption.

In urban areas, the communication infrastructure is better developed, and it is therefore less challenging to implement system requiring reliable and secure communication. AMI systems offer the flexibility of both credit and prepayment modes, with the added benefits of load control, customer management and on-line tamper functionality. This does however not mean that prepayment systems are no longer a viable solution, rather a supplementary technology which is able to be rolled out at low cost.

Interval and time-of-use metering with supporting AMR systems, are by virtue of their design, well suited to installations where the cost of communication infrastructure is small with respect to the value of electricity consumption metered – typically large power users. Service providers may be commissioned to manage the AMR systems, allowing the utility to obtain the data, without the overhead of an IT system.

References

[1] NRS 057:2005 Edition 1, Code of practise for electricity metering, Standards South Africa, Pretoria.

[2] NRS 049:2008 Edition 1, Advanced Metering Infrastructure (AMI) for Residential and Commercial Customers, Standards South Africa, Pretoria.

[3] G Calò, F Fiamingo, and G Veca: Electronic Meters and Automatic Meter Reading Systems, Department of Electrical_Enerfy, University of Roma, Rome.

[4] K van den Berg: Integrating electricity prepayment systems into the REDs environment (Energise December 2005), Centlec, South Africa.

[5] www.ekurhuleni.gov.za\Ekurhuleni Metropolitan Municipality – Address of Executive mayor.htm accessed 10 June 2010.

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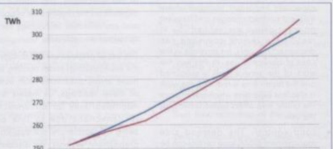
Utility load manager position paper on the ULM system and future application

The current system constraint that has seen load shedding implemented as a necessary means of stabilising the national grid, is set to continue until the new build programme is completed.

by Dr. V Lawrence, Eskom

The power conservation program (PCP) calls for a sustained national load reduction of 3000 MW over the next four years in order to avert load shedding, the effects of which are negative to the economy and national growth and also to the Eskom brand credibility. Demand is expected to outstrip supply with the situation only marginally improving after 2015 as shown in Fig. 1. Several countries face a similar energy crisis but ageing power plants that are rapidly approaching their full life expectancy and challenges with funding models for new build capacity compounds the problem for Eskom. The utility is thus faced with the following options – either to increase the supply capacity by investing in new power plant or put in measures to decrease the demand by effective demand management measures. As Eskom has an immediate capacity shortfall both scenarios will need to be addressed. These solutions are both necessary to ensure a combination of long and short terms strategies in dealing with the current energy crisis.

DMP and power purchase options also provide short term solutions but may have an economic impact on Eskom and the South African economy in the long run.



	2010	2011	2012	2013	2014	2015	2016
Demand Line (TWh)	251.4	258.3	265.9	275.3	281.8	291.5	301.2
Supply Line (TWh)	251.4	257.3	261.9	271.3	280.8	292.5	306.2

Fig. 1: Supply and demand projections 2010 to 2016.

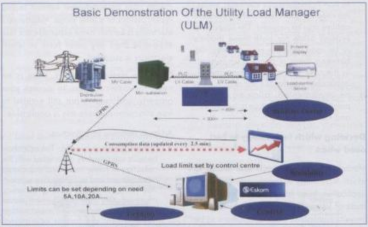


Fig. 2: Functional layout of ULM systems.

The utility load manager (ULM) is an innovative device that has been developed entirely in South Africa jointly by Eskom Sustainability and Innovation and EON consulting. The ULM was principally developed as a total solution to assist in alleviating generation capacity, network and system constraints by limiting the residential sector's load and averting any future load shed conditions.

The system control methodology is patented locally and is regarded as a world first. A global patent application has also been awarded.

The ULM system is designed to operate as a virtual power station (a stand-alone fully integrated system) that is capable of integrating all end-use consumption data with Eskom systems and infrastructure. It is a real time, residential load management system that allows the utility to limit residential loads as opposed to block load shedding. This provides an effective demand response (DR) mechanism to the utility that is flexible, scalable and interoperable across regional and national control centres. The residential sector represents 17 – 20% of the total system load and is a significant contributor to both

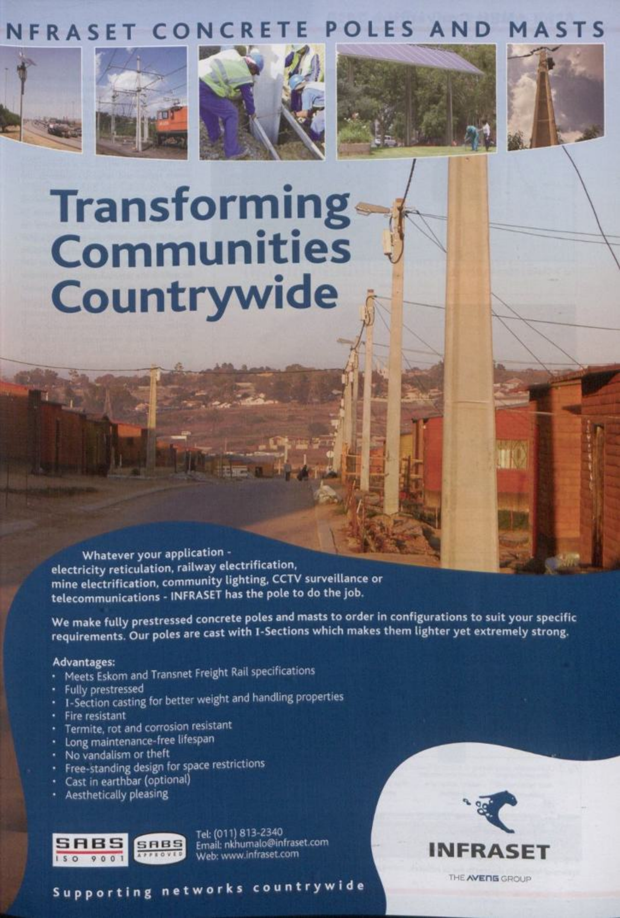

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Fig. 3: Display unit located in household.

Fig. 4: ULM Remote master installation in Kiosk or stubby box.

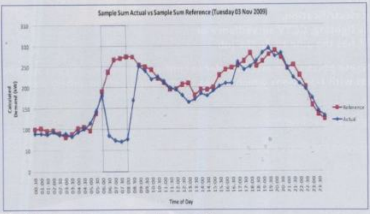

Fig. 5: ULM system used during a morning system peak period.

the morning and evening peak resulting in an overall national load factor of 72%. The ULM targets the residential sector by actively engaging the customer and installing a system of hardware devices in the LV network.

Basic operation of ULM system

Fig. 2 is a schematic layout illustrating the principles of operation of the ULM. The system will comprise a backend system, field hardware as well as a customer display unit. The ULM enables load to be limited at end-user level via central control point that will be located at Eskom National Control. More than 6740 MW of load can be displaced during network constraint periods with the national implementation of the ULM in the residential sector alone.

During periods when Eskom is experiencing severe system and network constraints, the system controller can limit the supply to the residential sector to any predetermined value (between 5 and 60 A) in terms of the load reduction required to stabilise the network at that particular time. The signal is immediately sent via general packet radio service (GPRS) to a master controller unit located in the mini-substation. The master controller unit then sends a signal via power line carrier (PLC) to remote master located in the kiosk or stubby box. The remote master controls the respective individual home and sends the message to a display unit located in the home (Fig. 3) notifying the customer that he is entering into a load limiting period and that load needs to be switched off to meet the required limit. The display units show the instantaneous consumption of the household as well as the kWh consumption in "real time". This allows the household to see the consumption of the household change as and when electrical devices/appliances are switched on and off. When the power utility has a supply or network constraint, a message can be sent to the display unit, instructing the household user to limit their power usage. If the household conforms to this limit, by switching off appliances and conforming to the required power limit imposed, the household will continue to get this limited power for the duration of the load limit period (the period whereby the supply constraint is experienced). However, if the household does not conform to this imposed load limit, and continues to exceed the limit in terms of power usage, that household will be automatically disconnected from the electrical network. The household can then SMS to a specified number and get reconnected for a few minutes and then has to conform to the imposed limit, or will get cut off again for non-conformance. This process may take place a few times; the household will get cut off for the duration of the load limiting period The power limit or ration drives behaviour and allows the customer to operate low consumption appliances like CFL lighting, fridge, television set, alarm system etc. whilst keeping off high consumption stoves, space and water heaters in order to conform to the set limit.

The signal process takes microseconds from control to end-user and the end-user has five minutes (duration can also be predetermined by control) to respond in terms of curtailing load. The entire network response in terms of total load reduction can be achieved with 15 – 30 minutes.

The ULM system has also been designed specifically to ensure a very quick implementation rollout, with minimal impacts to the existing network design and specifically for use on all existing reticulation networks. The system is also not installed in the end-user's house or even on the said property which makes it very easy and accessible for installation teams to ensure fast roll out as it is installed in the mini substation and the Kiosk or stubby box as shown in Fig. 4.

The research pilot project which consisted of 20 000 ULM units installed in the Midrand area resulted in a total load displacement achieved of 15 – 20 MW. The project has been hugely successful and as a result the technology has been identified as the technology option for national implementation. National implementation (large scale roll out) of the ULM system in over eight-million residential customers will displace in excess of 6750 MW of load and will cost R8- to R12-billion to implement.

The results from the pilot project and the resultant benefits derived from the implementation are above expectations proving that the original savings were calculated conservatively. Fig. 5 – 7 show the achieved capacity reduction during morning and peak loading. The most exiting part of the pilot project is that the ULM system algorithm ensures that the come-back load is totally in line with the existing or reference load on the network, this will ensure a large degree of network stability unlike other relay type systems which compound the problem.

Phase 1 of the ULM pilot project involved the installation of 20 000 units in the Eskom installed base for LSM 8 to LSM 10 customers. Fig. 5 shows the results from a recent pilot run of the system during the morning peak. 143 customers were selected within the pilot and given a load limit of 2 kW. An average reduction of 1,3 kW per customer was achieved with the system resulting in total reduction of 185 kW off the system peak for the sample. This can be projected to over 5200 MW of system peak reduction for four million customers.

Fig. 6 shows the system in operation during an evening peak in a summer month. During this pilot, 134 customers were given a load limit of

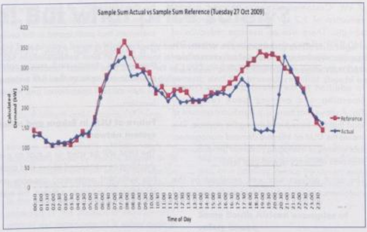

Fig. 6: ULM system used during an evening system peak period.

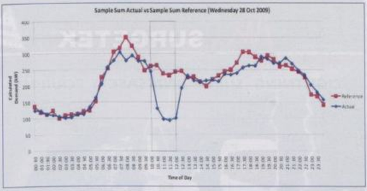

Fig. 7: ULM system used midday peak period.

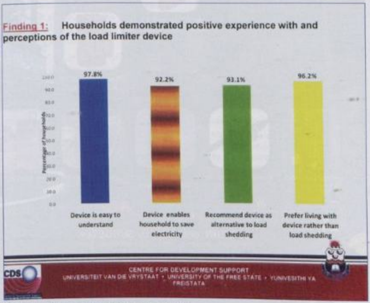

Fig. 8: Household perceptions of the load limiter device.

2 kW. Customer response showed a total reduction of 1,2 kW per customer across the sample. There was an average reduction of 160,8 kW off the system peak for the sample. This can be projected to an average reduction of over 4800 MW of system peak for four million customers.

In addition to the intended design criteria (morning and evening peak reduction) Fig. 7 shows that there is a significant amount of load that can be reduced during the daytime. This makes the ULM an effective demand management tool in terms of managing customer behaviour and improves efficiency at end-user level.

The pilot project was well received by the customers and an independent audit conducted by the University of Free State shows the technology's acceptability by the end-use customers that participated in the project.

It is envisaged that Eskom Distribution and the various metros and municipalities will maintain and operate the ULM systems as part of their current operational and maintenance function.

Future of ULM in Eskom and other system networks

The ULM will be used as a tool to avert load shedding as mentioned above and once Eskom has sufficient generating capacity and load shedding is no longer a threat, the system can be used to its full potential as per design functionality. Eskom and the various metros and municipalities have a significant problem in terms of revenue management and South Africa currently experiences non technical losses of between R5- and R9-billion per annum in this regard.

The ULM system is designed specifically to assist in managing revenue and energy streams with real time reconciliation of all parameters. The system will enable and facilitate the following:

- The ULM system is able to capture near real time load flows at a LV level. This is a first for Eskom as traditional energy balancing methodologies relied on statistical metering data reconciliation with monthly sales data on a retrospective basis. Energy losses determination with automated energy balancing at end-user and bulk levels.
- Revenue management and reconciliation of energy consumed.
- Energy protection against theft with tamper proof and tamper alarms notification.
- Create a direct communications platform into the house (bi-directional communication system) for customer communications and notifications.
- Accessible and available data from the consumer base that can be used for ISEP, network planning, demand forecasting, and consumer behaviour understanding.
- Assist Eskom field services in terms of maintenance and problem solving as it enables low voltage customer network link data and network fault finding at real time. This will also improve distribution field service response time to fault conditions as the system will identify the fault before the consumer calls the call-centre.
- TOU metering data – check meter facility.
- Enables the utility to reduce carbon emissions.

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More regulation! But what price safety?

Safety in the electricity distribution industry has always been a high priority but with the overwhelming skills shortage in the industry and the shortfall in funding for maintenance and replacement of old assets, safety standards have slipped and accident statistics are worrying. The Occupational Health and Safety Act of 1993 and the regulations prescribe both the standards to be applied in order to ensure the safety of persons and equipment, and the procedures that should be followed to monitor this.

by R Millard and L Fourie, PB Power.

Safety in the electricity distribution industry should be, by the nature of the industry, a high priority. A high level of technical skill is required for the workers in the industry and specific safety related training is essential to ensure that all workers are familiar with the dangers associated with their work and are trained in how to manage and mitigate these risks.

The management of electricity transmission and distribution assets is a complex operation, giving rise to a range of significant risks. The transmission and distribution systems have been constructed and developed over many decades and some current distribution assets are 80 years old or more. The expected life of many of the assets in question is extremely long and, inevitably, assets with such lengthy lives require significant routine maintenance to be undertaken to ensure that they continue to function reliably and as intended.

The overwhelming skills shortage in the industry and the shortfall in funding for maintenance and replacement of old assets will no doubt have an effect on safety standards and accident statistics.

Little data is available in the public domain on incident statistics in the electricity supply industry in South Africa. In previous years NOSA was very active within both Eskom and the municipalities and safety statistics were available to monitor safety performance.

The 50-year-old occupational safety company was originally a non-profit (Section 21) company, dependent on state funding but in the early 2000s state funding was withdrawn and the operations of NOSA as a Section 21 company were sold to a new entity – NOSA International – with the Section 21 company as its sole shareholder. Attempts at restructuring did not prove successful, and NOSA incurred significant losses in the ensuing period. As a result, further restructuring was undertaken but the situation eventually came to a head when, at the end of January 2005, NOSA was unable to pay its employees' monthly salaries. JSE Securities Exchange-listed company Micromega Holdings (MMG) stepped in, acquiring a 90% shareholding in NOSA for a nominal amount. Unfortunately all of the records maintained by NOSA were destroyed.

Today NOSA is a wholly owned subsidiary of Micromega Holdings, a leading global supplier of occupational risk management services and products. Unfortunately no municipality currently obtains support in its safety management from what is perhaps the only professional safety adviser in South Africa.

In this paper we discuss some of the issues observed in the municipal environment, recount our experience of a safety audit in Australia and explore an alternative approach that may be more cost effective in improving safety performance.

South African legislation

The Occupational Health and Safety Act of 1993 and the regulations prescribe both the standards to be applied in order to ensure the safety of persons and equipment and the procedures that should be followed to monitor this.

The OHS Act is to: "provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work..."

Clearly, the act provides for the safety of employees of the company as well as the general public. In the case of a distribution utility the exposure of the public to the operation of, and equipment owned by, the utility is considerable.

Deterioration of safety standards and performance will therefore impact on both employee and public safety. In Victoria, Australia the Electricity Safety (Network Asset) Regulations were revoked in December 2009 and it is now mandatory for distributors to have an all-embracing Electricity Safety Management Scheme (ESMS) in place. This represents a major shift from largely prescriptive legislation to safety management schemes. The ESMS requirement constitutes an example of "process-based" regulation. That is, it is based on mandating a risk management process, constituting risk identification, risk assessments and the implementation of risk controls, as well as record-keeping, auditing and updating requirements. The regulations are essential to give full effect to the amending legislation.

The underlying rationale for moving to a regime of compulsory ESMS requirements is that the nature of the risk profile in this area is such that it is likely to be more efficient and effective to rely more heavily on process-based regulation and, as a corollary, reduce the current extent of prescriptive regulatory requirements in this area.

Some South African examples of safety issues

PB has been involved in several asset valuation exercises and technical audits in South Africa and other southern African countries. The condition of the assets will affect the life of the assets, and hence the value on a depreciated replacement cost basis. To a large extent the "condition" is a function of the quality of the operations and maintenance experienced by the asset and the following are some of the general points considered when assessing the "condition" of a utility's assets for valuation purposes:

- The general condition of the substation equipment and the associated overhead circuits
- The standard of maintenance that has been carried out
- The level of skill of the maintenance staff
- The degree to which procedures are being followed
- The quality of the procedures
- The performance of the network, which will provide an indication of the quality of the maintenance.

Our condition assessment checklist uses the above criteria in a question and answer style spreadsheet in order to quantify the likely condition of the assets.

Some of our observations in the industry include the following:

- Many utilities are operating without the appointment of the appointees required by the General Machinery Regulations. In some cases the highest skill level in the electricity department is supervisor or technician. According to recent presentations by EDI Holdings on average 50% of critical technical staff positions are vacant across 36 municipalities in South Africa. The consequence of this is that OHS Act "issues" are often not dealt with properly due to the lack of experience and knowledge of the requirements of the act.
- Switching, linking and earthing operations are not undertaken in accordance with any written procedures. No records are maintained of operating procedures or

operations and Permits to Work are not issued on assets isolated for work. More importantly, training in high voltage operation was not being undertaken.

- No complete and up to date single line diagrams are available of the networks. This invariably results in incorrect operations leading to unplanned outages and accidents.
- Access to outdoor high voltage substations was in some cases completely unrestricted. This not only allowed access by unauthorised persons including children but also made the theft of copper earthing conductors very easy.
- 11 kV networks were out of phase with adjacent interconnected networks. This was of particular concern in that no single line diagrams were available or used-during switching operations.
- Ground clearance of newly constructed high voltage lines were below statutory requirements. In some cases there was under clearance by 2 m.
- No routine maintenance was undertaken on the high and medium voltage equipment. Due to the shortage of staff, equipment was only attended to when faults occurred.
- No regular maintenance was done on circuit breakers and protection equipment, including batteries and AC/DC power supplies, resulting in extensive blackouts due to the mal-operation of protection devices.
- Few, if any, spare parts were held for any equipment resulting in "temporary" unsafe repairs. In one instance a ring main unit had failed and temporary "repairs" were made by exposing and tying together the 11 kV cable ends and covering the "joint" with a plastic bag. This on a busy street with pedestrians passing by.

According to recent presentations by EDI Holdings, on average 50% of critical technical staff positions are vacant across 36 municipalities in South Africa. In addition and on average, these municipalities were only spending 60% of their budgeted capital expenditure.

The above focuses on issues relating to the general safety of operators and the general public and are specific to municipal distributors. For the same reasons that these issues are not being addressed it can be assumed that many other aspects of compliance are also not being followed.

Some background to the ESI in Victoria

The development of the electricity supply industry in Australia was not dissimilar to the development of the industry in South Africa.

In the Australian state of Victoria, when electricity generation first became practicable, the main uses were lighting of public buildings, street lighting, and later electric trams. As a result electricity generation and distribution tended to be carried out by municipalities, by private companies under franchise to the councils, or by joint private-public bodies. Electricity was generated and distributed by a number of private and municipal generator and distribution companies. The main municipal-owned power station in Victoria was operated by the Melbourne City Council, which generated electricity from its Spencer Street Power Station for the city's residents, as well as being a wholesale supplier to other municipal distributors. The main privately owned company was the Melbourne Electric Supply Company which was established in the 1880s and operated under franchise arrangements with a number of other municipal distributors.

Legislation passed in December 1920 resulted in the formation of the State Electricity Commission of Victoria (SECV) from the Electricity Commission.

The SECV took over a number of small municipal electricity distributors during the 1920s, and in the 1930s the Melbourne Electric Supply Company was acquired along with their street tramway operations. Despite these acquisitions, municipal controlled distribution companies known as Municipal Electricity Undertakings (MEUs) in the inner urban areas of Melbourne remained outside of SECV control until the privatisation of the industry in the 1990s.

In 1994, the Kennett government disaggregated the SECV into five distribution and retail companies (absorbing the MEUs in the process), five generation companies, and a transmission company. Along with other state-owned utilities (such as the Gas and Fuel Corporation of Victoria), these businesses were all corporatised, then privatised between 1995 and 1999.

Today the Victorian Electricity Supply Industry (VESI) comprises five distribution networks namely CitiPower, Powercor, SP AusNet, Jemena and United Energy, with the transmission network owned and operated by SP AusNet (the network operators). The VESI takes its energy supply from the various generation sources in Victoria and through interstate connectors.

There is total separation between the retail and wires businesses, and the Essential Services Commission of Victoria (ESC) is responsible for the regulation of retail businesses and the Australian Energy Regulator (AER) is responsible for regulating the distribution, transmission and wholesale electricity market.

Today Energy Safe Victoria is Victoria's statutory independent electricity, gas and pipeline safety and technical regulator. It regulates the safety and technical compliance of energy supply, installations, appliances and pipelines, and raises industry and community awareness of electricity, gas and pipeline safety.

A memorandum of understanding sets out the arrangements to promote effective communication, cooperation and co-ordination between Energy Safe Victoria and the Australian Energy Regulator.

Case study – the safety audit

Under the Electricity Safety Act 1998, the Office of the Chief Electrical Inspector (the office, now Energy Safe Victoria) had a responsibility to ensure the electrical safety of electrical generation, transmission and distribution systems, electrical installations and electrical equipment and to control the electrical safety standards of electrical work carried out by electrical workers in Victoria.

In 2002, the office commissioned PB to conduct a safety audit of the Victorian electricity distribution and transmission network operators against the regulatory framework.

The purpose of the safety audit was to assess the transmission company and each of the distribution companies in Victoria for the following:

- Compliance with Sections 75 and 149 of the Electricity Safety Act 1998.
- Management of the exemption process to meet the requirements of Part 1 of the Electricity Safety (Network Assets) Regulations 1999.
- Accuracy and validity in reporting and recording of electrical incidents to meet the requirements of Part 2 of the Electricity Safety (Network Assets) Regulations 1999.
- Existence of satisfactory plans to meet the requirements of Part 3 of the Electricity Safety (Network Assets) Regulations 1999.
- Mechanisms within the network operator's business to effectively protect persons from risk and property from damage, associated with network assets, to meet the requirements of Part 4 of the Electricity Safety (Network Assets) Regulations 1999.

The objectives of the audit were:

- To improve the level of electrical safety of the Victorian transmission and distribution networks.
- To ensure that network operators have appropriate policies, procedures, processes and compliance systems in place (including appropriate forward planning initiatives) to achieve the required compliance with the regulations.
- To determine whether legislation and regulations are effective to achieve the safety outcomes.
- To verify the level of network operators' knowledge and acceptance of their safety responsibilities.
- To increase public understanding of and confidence in the safety of the electrical transmission and distribution systems, the regulatory framework and the safety management practices of the distribution and transmission network operators.
- To provide a sound basis for the development of electrical safety compliance programmes in conjunction with the network operators.

The audits focussed on key areas of the network operators practices that were considered to have an impact on electrical safety as required by the relevant clauses of the Electricity Safety (Network Assets) regulations 1999 and other

CONCO builds state-of-the-art R42-million Eastgate substation

In a public-private partnership between Ekurhuleni Municipality and Liberty Properties, the electricity network around the Eastgate shopping centre was recently upgraded with CONCO being contracted for the project.

The official opening of the 44/6,6 kV substation took place on 27 August and was attended by Ekurhuleni mayor Ntombi Mekgwe who hailed the successful completion of the project as "a strategic undertaking that will respond to not only today's but all also future challenges".

Isaac Tlale, CONCO project manager describes the project: "CONCO constructed a new substation building within the Eastgate shopping centre premises, and installed 44 kV underground XLPE cables in the vicinity to connect the new substation to the existing underground cable network.

"The substation consists of two 30 MVA transformers which provide a firm 30 MVA capacity. The Eastgate centre requires 20 MVA which leaves 10 MVA available for further development in the area.

"The building is compartmentalised into six separate chambers, two for the transformers, one for the 44 kV GIS, one for the 6,6 kV switchgear, one for the DC supply units and batteries, and the last for the protection and control room.

"The equipment procured by CONCO for the substation utilises gas insulation technology (GIS) that enables the high voltage (44 kV) equipment to have a much smaller footprint than conventional outdoor substations, thus the whole substation could be housed indoors. This reduced the required space within the Eastgate Centre to an absolute minimum, and also enabled minimal interruption to the normal trading of the shopping centre.

"The medium voltage (MV) distribution to the centre is achieved via 6,6 kV cables, energised from a 19-panel, air insulated indoor circuit breaker switchboard (metal clad switchgear).

Front from left: Stuart Michelmore (director: substations, CONCO); Clr Mthuthuzeli Siboza (MMC for Community Safety, Ekurhuleni Metropolitan Municipality); Clr Michelle Clarke (ward councillor for Ward 20), Fani Xaba (AME business development manager, Aurecon Group); Clr Ntombi Mekgwe (Executive Mayor, Ekurhuleni Metropolitan Municipality); Clr Aubrey Nxumalo (MMC for Water and Energy, Ekurhuleni Metropolitan Municipality). Back from left: Ramatseliso Matji (technical director, Aurecon Group); Mel Urdang (divisional director: Retail, Liberty Properties); Bernard Berelowitz (CEO, CONCO); and Isaac Tlale (project manager, CONCO).

"The substation is remotely monitored by the Ekurhuleni Metropolitan Municipality, using cellular and optic fibre technology, to ensure that any potential problems can be addressed speedily, thus ensuring efficient service delivery to consumers. The station is equipped with a local SCADA master station, and the complete station automation solution provided by CONCO was achieved with the DNP3 protocol which fully complies with IEC 61850," concluded Tlale.

appropriate legislation. General areas of concern identified in the audit were as follows:

- The audit confirmed that in most areas the network operators were complying with the requirements of the act and regulations. All of the network operators appeared to have comprehensive structures and supporting policies in place, but the manner in which compliance matters were separated and brought to board attention needed some improvement.
- Certain areas of non-compliance were common across the (distribution) network operators. Some network operators had specific areas on non-compliance that were identified in the audit.
- In order to ensure a uniform approach across the business all of the distribution companies had either developed or were developing a formal risk management framework in relation to safety and the management of network assets. One network operator had no formal risk assessment framework in place at the strategic level in relation to safety and the management of network assets.
- In order to ensure that procedures and processes were adequately applied, the audit included a review of quality systems. All of the distribution companies had quality management systems in place of some form or other, although some were better than others. Certain network operators quality management systems did not cover all of the documents used in their asset management programmes.
- All of the distribution companies had introduced both internal and external auditing of work practices. In most cases the extent to which auditing was undertaken was considerable and appeared to achieve good results. In the case of two network operators, some improvement in auditing processes was indicated.
- All network operators maintained incident registers for the notification and reporting of incidents in accordance with the requirements of the regulations. In the case of three network operators, it appeared that tighter control would be appropriate in order to ensure strict compliance with the regulations.
- All of the distribution companies had a number of the "old type" overhead service lines in place within their network and many of these were past their serviceable life and prone to failure. The companies had different strategies to manage this, which were mostly reactive and included replacement on failure or replacement on detection.
- All network operators had procedures for identifying, prioritising and addressing low conductor clearances during the routine inspections of the lines, however the audit clearly identified the fact that all of the distribution network operators had service lines that did not comply with the requirements of the regulations with respect to clearances above ground.
- The audit included a review of field type activities in an attempt to assess the extent to which the network operators' policies, procedures and work practices were being followed by field staff and contractors. Without exception, at least one "issue" was identified at each network operator during site visits; this would indicate that all the network operators were using some work practices that did not comply with the regulations, or in some cases with their own internal procedures and that in certain cases an improvement in the internal auditing of work practices was indicated.
- With some exceptions, housekeeping at substations was found not to be in accordance with good industry practice.
- There was no requirement in the Green Book (the HV operating rules for the VESI) to "phase out" after breaking HV bridges and general practice was to rely on the operator remembering the connection sequence. It was recommended that this and other operational issues were addressed by the Green Book committee.
- The condition and storage of portable earthing devices in some of the network operators was not in accordance with good practice. In addition, the current rating of portable earths in use in the substations of all of the network operators, where the fault levels have increased in recent years, was considered to be questionable.

There is no doubt that the audit was extremely useful in identifying issues of concern within the VESI. When one considers that the audit was conducted over a two month period by some six engineers from PB, the results for both the office and the industry, and the general approach can be considered to be very cost effective. The VESI supplied power to some 3,5-million domestic, commercial and industrial customers in 2002.

The impact of privatisation had been to produce a "lean and mean" workforce and skills shortages were apparent in many areas. The benefits of the audit were seen as the following:

- Increased acceptance by network operators of their electrical safety responsibilities
- Reduced number of deaths and serious incidents of electrical nature
- Provide confidence in that there are appropriate asset management plans to achieve compliance with electricity safety regulations
- Provide confidence in the existing legislative approach and/or a revised approach
- Reduced number of electrical safety issues raised by the public which require active involvement by the OCEI
- Implementation of programmes to ensure compliance with the legislation

The legislative situation in Victoria, Australia pre-2010

The opportunity for the five Victorian electricity distributors to implement electricity safety management schemes (ESMSs) has existed since 1999 with the passing of the Electricity Safety (Management) Regulations 1999. It then took some years for the distributors to implement safety management schemes, which have only been partial schemes. The main regulatory instrument for the distributors was the Electricity Safety (Network Asset) Regulations (together with the associated Electricity Safety (Network Assets) Code) which represented a prescriptive approach to regulation. The distributors' electricity safety management schemes applied only to limited areas covered by the Network Asset Regulations and Code.

The ESMS allowed for variation to the regulations, which may provide a more flexible method of operation. The objective was for network operators to maintain the same or a greater level of electrical safety with the ESMS as that achieved under the regulations.

The ESMS was completely voluntary and was a form of self-regulation. An economic evaluation was needed to be carried out by the network operator to assess the benefit of such schemes. An ESMS had to demonstrate appropriate proven procedures and policies to achieve the required level of safety.

The current position

The Electricity Safety (Network Asset) Regulations were revoked in December 2009 and it is now mandatory for the distributors to have an all-embracing ESMS in place (the transmitters have a grace period to do this). This represents a major shift from largely prescriptive legislation to safety management schemes.

These legislative amendments came into place on 1 January 2010 and it is therefore far too early to tell statistically what effect these changes have had (if any).

The ESMS requirement constitutes an example of "process-based" regulation. That is, it is based on mandating a risk management process, constituting risk identification, risk assessments and the implementation of risk controls, as well as record-keeping, auditing and updating requirements. The regulations are essential to give full effects to the legislation. The regulations set out in detail the required content of an ESMS.

The underlying rationale for moving to a regime of compulsory ESMS requirements for certain electrical operators is that the nature of the risk profile in this area is such that it is likely to be more efficient and effective to rely more heavily on process-based regulation and, as a corollary, reduce the current extent of prescriptive regulatory requirements in this area.

Cost implications

The expected cost impact of the regulations was estimated by surveying all seven of the major electricity companies (MECs) that are required to comply with the ESMS requirement. These survey responses indicated that the seven MECs are expected to incur costs associated with ESMS development, implementation, monitoring and review totalling $16,8-million in present value terms over the expected 10-year life of the regulations. In addition, regulatory administration and enforcement costs of $0,6-million were expected to be incurred by ESV over the same period.

However, it should be noted that these constitute the gross costs associated with the regulations. Five of the seven affected MECs were currently operating under voluntary ESMS arrangements that have been in place under the auspices of the Electricity Safety Act 1998 for several years. This group would inevitably have continued to incur ESMS related costs even in the absence of the recent legislative change in the legislation and the proposed regulations.

In addition to these direct compliance costs, it can be anticipated that substantial costs will be incurred as a result of the implementation of the risk controls determined to be appropriate through the risk identification and assessment process. The Essential Services Commission (ESC) has estimated these costs at approximately $140,8-million during the current five-year pricing period. This is equivalent to approximately $291,6-million over the expected 10-year life of the proposed regulations. The implementation of the regulations is expected to increase the substantial costs to a significant degree. This reflects both the fact that two MECs will be subject to ESMS requirements for the first time, and the fact that ESV expects to require more detailed and wider ranging ESMS to be prepared under the new mandatory arrangements than have been adopted in practice under the current voluntary scheme. While no precise quantification of the likely size of the substantial cost increases is possible, an indicative estimate is that the current level of substantial costs could increase by a factor of up to 100% following the implementation of the mandatory ESMS arrangements.

Again, however, it is necessary to emphasise that these constitute the gross costs associated with the proposed regulations. That is, the affected parties already bear a significant proportion of these costs.

The adoption of the new regulations must be compared to a base case. With the sunsetting of the Electricity Safety (Network Assets) Regulations, the base case could be defined as the situation that would exist in the absence of these regulations as well as the Electricity Safety (Management) Regulations. However, the alternative approach is to consider the base case as one in which the prescriptive requirements of the current Electricity Safety (Network Assets) Regulations 1999 would continue, rather than being allowed to lapse at the time of their sunsetting in late 2009. This latter approach is considered to better reflect the reality of the current policy context, in that the network assets regulations would be unlikely to be allowed to lapse in the absence of the new regulations.

The estimates prepared by the ESC suggest that the substantive costs to the electricity transmission and distribution sector of moving toward full compliance with the Electricity Safety (Network Assets) Regulations could be as great as $1,7-billion and would, almost certainly, substantially exceed the total costs incurred in complying with the proposed regulations. This means that the costs of the new regulations could be interpreted as a saving of up to $1,2-billion on the cost of achieving full compliance with the current Electricity Safety (Network Assets) Regulations.

Practical implications

Inadequate electrical safety performance among transmission and distribution companies can result in three major types of harm. These are:

- Death and injury due to electrocution
- Economic loss due to reliability problems
- Efficiency/cost of maintenance practices and impact on consumer prices

	AGLE	CP	PC	TXU	UE	Ttl
Risk management approach	23,1	20	80,6	57,3	45,2	226,2
Literal compliance	270,0	143,0	742	480,0	74,0	1708,0

Table 1: Comparative costs ($-m).

The mandatory ESMS arrangements are expected to address all of these dimensions of the problem.

Substantial parts of the electricity transmission and distribution network do not comply with various elements of the Electricity Safety (Network Assets) Regulations 1999. This non-compliance reflects the fact that the existing stock of network assets has been installed over a period of decades and that safety standards have evolved over this period.

The safety risks associated with instances of non-compliance with the regulated standards by network assets vary significantly according both to the type of non-compliance and the location of the non-compliant asset (and related circumstances). Given this, the approach of ESV to compliance issues has been to attempt to take a risk-based approach to requiring electricity network operators to improve the compliance of existing assets with the regulations over time. The new mandatory ESMS is the logical extension of this approach.

In recent years, electricity distribution businesses have argued strongly that the substantial non-compliance of their network assets with the regulatory requirements requires them to undertake a significant programme of additional capital expenditures to move toward full, or "literal" compliance with the Electricity Safety (Network Assets) Regulations, and that these expenditures should be reflected in the decisions of the economic regulators responsible for price setting in the industry.

To illustrate this aspect the electricity regulator summarised these two scenarios (in US$-m) in the 2004 Price Review Position Paper as seen in Table 1.

While the OECI (now ESV) rejected these claims the fact remained that there was considerable non-compliance in many areas and that compliance for compliance's sake was wasteful. A risk based approach such as that laid out in the new ESMS regulations would be more cost effective.

Some distributors also noted in their submissions to ESC that there was significant legal doubt as to the ability of (the then) OCEI to grant exemptions from aspects of the network asset regulations pursuant to its approval of a voluntary ESMS and argued that this was a further factor underpinning the need for distribution companies to increase capital expenditures to move toward "literal compliance".

In the event, the ESC did not accept the above arguments put forward by the distribution businesses and did not, as a consequence, build additional capital expenditure, as would be required to move toward literal compliance with the network asset regulations, into the pricing model. Instead, it argued that:

"All distributors proposed capex for electrical safety compliance under the regulations, including the implementation of their electricity safety management plans. Although there is doubt in some or all distributors' minds over whether they ought to rely on their plans as opposed to budgeting to undertake sufficient work to bring all the network into compliance (referred to elsewhere as the literal compliance option), it appears that all distributors consider that, from a technical and safety standpoint, the safety management plan approach is a pragmatic solution to the issues that have been identified. We considered that our assessment ought to be based on the implementation of these plans, not on literal compliance costs, and we have followed that approach".

The Essential Services Commission had not allocated sufficient funding to enable the network operators to comply with the current regulations. Instead the price review relies on each of the network operators having an ESMS that analyses and addresses the risks at hand.

The ESMS in summary

Electricity safety management schemes must formally identify both the person responsible for the relevant electricity supply network or installation and the person responsible for the electricity safety management scheme itself. It must describe the electrical work or electrical installation to which it relates in sufficient detail as to allow ESV to identify its location, extent and scope and assess the risks that are associated with it.

The regulations also require that a formal safety assessment be undertaken and specify the required content of that safety assessment. The scheme should also identify all elements of the regulations made under the authority of the Electricity Safety Act 1998 and from which the scheme operator seeks exemption.

The regulations provide for the requirements, procedures and other matters relating to the acceptance of electricity safety management schemes.

Conclusions

There is ample evidence that the skills shortage, backlog in maintenance and replacement of aged assets and the low levels of capital and operations expenditure in the municipal electricity environment in South Africa is affecting the safety and technical performance of the industry.

Year	DIFR
2007	0,82
2008	0,63
2009	0,68

Table 2: NOSA disabling injury frequency rates.

Statistics are not available to prove this claim; however, all involved in the industry will confirm a decline in technical performance in most utilities. Ringfencing exercises by EDI Holdings confirm that the shortage of skills is affecting performance and spending is below par.

NOSA disabling injury frequency rates for all industrial categories are shown in Table 2.

Although not statistically significant these figures do indicate that NOSA intervention, which includes the implementation of safety management schemes, is producing results.

It is too early to see the results of the implementation of a mandatory ESMS in Victoria, Australia but certainly the logic applied in taking this route, as opposed to the requirement for the strict compliance to the regulations, make good common sense.

Parallels between the municipal electricity distribution industry in South Africa and the Victoria ESI, in terms of ageing assets and the requirements for considerable expenditure in the management of these assets into the future, are clear. The justification for a similar intervention would therefore be the same.

To summarise, the mandatory ESMS proposal has been developed primarily as a safety related initiative which seeks to address the problem that network asset operators are not using best practice, management-based approaches to ensure that dangers to workers and the public arising from network assets are minimised. Thus, while it is acknowledged that the level of fatalities and injuries associated with network assets is currently low, it is expected that the introduction of mandatory ESMS will further lower the incidence of fatalities and injuries.

However, while the primary driver of the mandatory ESMS proposal is a safety based one, the proposal is also expected to address two other significant problems associated with the operation of network assets. First, it is expected that the adoption of a mandatory ESMS will address the problem of the extremely high compliance costs that would otherwise potentially be incurred by network asset owners in order to bring all aspects of their asset base into full compliance with the prescriptive. Secondly, it is expected to make a relatively small but nonetheless important contribution to improving the reliability of supply of electricity thereby reducing the current substantial costs experienced by consumers as a result of unplanned electricity supply outages.

What is further required is the appointment of an energy safety regulator to regulate the process.

Acknowledgement

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Substation explosion

An authorised person closed an 11 kV oil circuit breaker (OCB) on to a fault at a main substation. The OCB exploded and the force of the blast blew off the substation doors, seriously damaging the building. The authorised person broke his right arm when the door behind which he was standing was blown open. The fire that followed destroyed all the equipment within the substation. This paper looks at the incident, the cause and the actions to be taken to prevent a recurrence of a similar incident.

by B Gass, Actom Protection & Control

An authorised person had to close an 11 kV OCB feeding a mini-substation (MSS) at a main substation after it had tripped on a fault.

A risk assessment was conducted, as required by the company rules and regulations and the authorised person decided to eliminate the risk of injury by performing remote switching of the circuit breaker.

The OCB was not equipped with electrical closing, but it did have the facility to operate remotely by tying a lanyard on to the mechanical closing lever and pulling it from outside the substation. As an added precaution, the authorised person decided to wear a flash suit. This was not a requirement in terms of the company's safety rules and operating regulations, as the authorised person was standing outside the substation. Another electrician, who was present, stood further away as he was not wearing a flash suit.

The authorised person stood behind the substation door (which was unbolted at the top and bottom) for further protection, not by the open door looking into the substation. The OCB exploded, probably due to mechanism failure, seriously damaging the structure of the building. The explosion that followed blew off the main central doors of the substation, through a metal link fence, ending up about 20 m away. The authorised person broke his right arm when the door behind which he was standing was blown open, but he was saved from further injury as he was not in line with the blast and did not feel the full force of the explosion. The fire that followed destroyed all the equipment within the substation.

Cause of incident

The cable that was feeding the MSS from the OCB in the main substation faulted. The electromechanical relay protecting the cable did not flag to indicate what the fault was. No cause was found for the breaker to trip, so it was decided to close the breaker. However, the fault was still on the cable so the breaker failed mechanically, and the circuit breaker exploded. The resultant fire spread to the rest of the circuit breakers, causing the destruction of substation equipment and extensive damage to the substation building.

Root cause

The medium voltage (MV) contacts inside the OCB did not latch or unlatch correctly in time to prevent extended arcing and subsequent oil vapourisation. This led to a violent explosion, splitting the circuit breaker tank, releasing the oil. The resulting force caused the destruction of all equipment inside the substation.

Contributing factors

- The age of the OCB
- The original fault caused the electromechanical relay to operate, but the relay did not flag, indicating the original cause of the trip prior to the incident occurring.
- The risk assessment only took into account the danger of arc flash. The result of the power released by the blast of the OCB exploding was not considered.

Conclusions

The OCB was closed on to a fault, the electromechanical relay sent a trip signal to the circuit breaker, but it failed to trip, probably due to lack of maintenance. Because the breaker was an OCB, it was more susceptible to fire and explosion.

Action

- All existing circuit breakers are to be fitted with remote operating devices, to facilitate operation from outside a substation building, at a safe distance.
- All general risk assessments must be reviewed, especially where OCBs are presently used, to include strategies to mitigate the risk of explosions. Controls must be put in place and applied. Procedures to be revised accordingly and all operating staff (authorised persons) trained on them.
- Regular maintenance to be carried out on all switchgear, a maintenance schedule compiled and complied with.
- Old OCBs are to be replaced with new vacuum circuit breakers (VCBs) or sulphur hexafluoride (SF_6) breakers. A replacement schedule is to be compiled and monitored.
- All circuit breakers to be trip tested once a year. It is recommended that timing tests are carried out at the same time.
- Relays to be secondary injected and calibrated every two years.
- A mini-risk assessment (Take 5) must be carried out at the work site, over and above the existing general risk assessment, as the risk changes at each work site, although the task remains the same.
- Medium/high voltage (MV/HV) operating training must be conducted and reviewed every two years (refresher courses conducted).
- Full flash suits must be worn when racking in or out of the circuit breaker, spring charging and any other local operations, including tests for zero potential and live electrical phasing.
- Flash suits to be worn during all MV/HV switching operations. Personnel to stand away from any open door and in such a position that they cannot be injured by the blast from an explosion or from doors being blown open.
- Arc flash calculations to be conducted and an arc flash matrix compiled and applied to each circuit breaker.
- Batteries and battery chargers to be maintained and calibrated.
- Batteries to be load tested on entry into substation, if load test facilities exist.

General

The question is – how many times can you close a circuit breaker after a fault? There is no definitive answer to this question, as there are so many variables:

- How old is the breaker?
- When was the breaker last maintained?
- How many times has the breaker operated since the last maintenance was carried out?
- How many times has the breaker tripped on fault since the last maintenance was carried out?
- What protection scheme is installed on the circuit breaker and when was it last tested?
- What is the insulating medium?
- If it is an OCB, what is the condition of the oil?

You should always consider what can go wrong and what the consequences will be. In this situation, what is happening inside the oil in the circuit breaker tank? The insulating properties of the oil are reduced after a fault current passes through it and the flash point of the oil is reduced.

Codes of practice (COPs) should be drawn up with the above in mind when planning the maintenance schedule. It is a misconception, that, if the circuit breaker or MSS is vacuum or SF6, an explosion will not occur during operation. In fact, if the integrity of the SF6 or vacuum is lost, the operator is opening/closing the circuit breaker/MSS in air and a flashover could ensue. For instance, when operating with SF6 filled equipment, the authorised person must always check the SF6 gas level on the gas pressure gauge (if one exists). This should always be in the green zone. If it is in the red zone, then the unit should be completely isolated from all sources of supply, operated and the supply switched back on.

The Occupational Health and Safety Act (OHS Act) requires that a Hazard Identification and Risk Assessment (HIRA) be conducted to identify the dangers of each task. A COP should be in place for all tasks to be performed and thereafter, mitigate the risk before resorting to Personal Protective Equipment (PPE).

The flash suit provides protection for arc flash only and will give the operator very little physical protection against the force of a blast; therefore, remote tripping must always be the first option, before resorting to PPE. When looking at flash suits, it is important that the correct type and "cal" rating is selected (a low voltage flash suit, for example, is not suitable for use on medium or high voltage).

All other staff in, or working in the vicinity of the substation or equipment, should move away to a reasonable distance while the operation is being carried out. It is also important to call the relevant control centre when entering substations, so that they do not operate switchgear remotely, via Supervisory Control and Data Acquisition (SCADA), while the operator is in the substation.

Arc flash calculations can be carried out and the maximum fault current and heat generated can be worked out (with the circuit breaker door open or closed). Once the distances have been calculated, an arc flash matrix can be compiled, listing the required PPE and the safe distances to be away from the equipment. Nowadays, circuit breakers can be designed to have arc spaces in the switchgear, so that the breaker must be opened, closed, racked in or racked out with the door closed and any explosion contained in the chamber. Protection systems have also become more sophisticated and faster, but the clearance time is still dependent on the actual circuit breaker tripping time.

Abbreviations used	
COP	Code of practice
HIRA	Hazard Identification and Risk Assessment
HV	High Voltage
MSS	Mini-Substation
MV	Medium Voltage
OCB	Oil Circuit Breaker
OHSAct	Occupational Health and Safety Act
PPE	Personal Protective Equipment
SCADA	Supervisory Control and Data Acquisition
SF6 Gas	Sulphur Hexaflouride Gas
VCB	Vacuum Circuit Breaker

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Political trends and issues relating to 21st century municipal service electricity delivery

Historically only 12% of South Africa had access to electricity, namely industries, mining and white urban areas. In 1993 this number grew to 36% (EFA–Electricity for All). By 2003, 70% had access – a success rate of over 250 000.

by Councillor Visvin Reddy, eThekwini Municipality

The Bill of Rights provides for the right to have access to housing, healthcare, food, water, education and social security. The act further goes on to say, "The State must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of this right."

Observations: Electricity is not regarded as a basic right, and the constitution gives government an "outclause" by using the words "reasonable" and "available resources".

Public expectations

Electricity is regarded by the population as being a basic right – this is further entrenched by the Department of Energy's (DOE) issue of Free Basic Electricity (FBE), the government's EFA campaign in the 1990s (2,5-million households connected). Alternative energy is frowned upon as being sub-standard, dangerous, ineffective, costly, and inconvenient.

The constitution may not entrench electricity as a basic right, however it is generally accepted as a crucial right by the population – the government needs to deliver on this mandate. Whilst significant strides have been made through the EFA campaign, rural and informal settlements are greatly lacking in service delivery – eThekwini backlogs stand at approximately 200 000 informal dwellings.

Electrification in eThekwini informal settlements

Electrification in informal settlements was discontinued in the past owing to high cost and the temporary nature of the dwellings. Often shacks crumbled around the electricity connection and informal dwellings generally sprang up anywhere. The situation is now quite different as informal dwellings are numbered and controlled by the housing unit

Present predicament

The Zuma administration heralded a new "hope" for the majority in SA. Service delivery was a key element of Zuma's presidential campaign. We can no longer delay services with the "excuse" that these will be provided when formal housing is established. The reality is that services are required immediately and it is government's obligation to provide these services. Housing, which is a provincial function has not been delivering – eThekwini has built over 100 000 low cost serviced houses and boasts the most successful housing delivery programme nationally.

Implications of non-delivery

Violent service delivery protests, last seen in pre-1994 years, are becoming the order of the day. Councillors are the first to receive the backlash. The public is impatient and cannot be placated any longer. This results in theft and deaths, mostly vulnerable children, in recent years. This is often not reported (>R120-million losses per annum). The government is now under pressure more than ever to deliver, and the relationship between councillors and the communities they serve has become strained.

Pilot projects

We are currently embarking on pilots in Kenville and Redcliffe involving over 1600 connections. Requirements are that the area must be scheduled for formal housing, and the land must be owned by municipality. Access roads need to be cut and tarred/gravel. Shacks that are in access paths need to be relocated and community buy-in obtained to prevent tampering. Water and sanitation are also provided.

Not all sections in chosen areas can be reticulated. Despondent residents may sabotage the project or encourage theft. Relocation of shacks for access may be problematic. There are expectations of theft from public lighting and legal connections. Areas that cannot be electrified will not accept alternative energies. Residents expect services overnight and are not sensitive to budget constraint. There is also the risk of issue of DoE subsidies for the same family twice, once for informal dwelling and second when relocated to formal housing.

Mitigation strategies

- Continuous engagement with the communities to build trust and a sense of ownership.
- Communities are involved in the implementation, and projects largely depend on them to facilitate relocation of informal dwellings in access routes etc. Financial contribution comes from the municipality or DoE.
- It is necessary to emphasise that tampering will affect reticulation, and encourage the community to report on theft.
- Source DoE subsidies for alternate energies viz. gas, gel, solar. Set up informal retailers in each area to provide these services.
- Partner with informal dwellers.

Free basic electricity

eThekwini has approximately 74 000 qualifying customers, but only approximately 64 000 collect their FBE tokens. Possible reasons are that customers are not aware of the rules of FBE, theft of electricty and that vending points are expensive to access. Mitigation actions include continuous public awareness campaigns, continuous meter sweeps and removal of services. The introduction of Super-Vending and cell phone vending may improve access. The issue of FBE according to social grants is an issue under investigation.

High cost of electricity

The poor need to be protected against the 25 to 30% increases. The mechanism to be implemented is the inclining Block-rate Tariff (IBT) and FBE. Challenges are that most poor households rent to multiple tenants, have extended families, and are the most vulnerable to high consumption costs. This could be mitigated by individual meters per rental space, special concessions for extended families, or installing separate meters per family/rental unit.

Mitigation of high cost of electricity

Encourage reduction of consumption-rewards for reduction such as Inclining Block Tariffs. Inform and educate consumers on climate change and impacts such as Cyclone Gumede.

Power to the people: the future

Electricity is the only acceptable solution to the majority. Recent regulation of pricing will influence greater use of gas as electricity prices go up. The public remains cautious about alternative energies. Government needs to seriously look at effective means of enabling energy availability to the poor. Cheap renewable energy is a "must". (Will be realised through increasing electricity prices.) Serious research needs to be done to provide cost effective solutions. The poor do not have the luxury of contemplating the future – now is what counts!

The government needs to deliver... to an increasingly aware constituency!

Strategic approach to skills development and staff retention

An electrical engineer was asked why he was leaving for London to take up a managerial position in an electrical supply company. His answer was that he desired a professional working environment so that he could grow, be a better engineer and have a sense of fulfilment. These desires probably hold true for most of us. The question then is: how do we create and sustain a professional working environment that inspires staff and produces the desired results?

by A Vermaak, Nelson Mandela Bay Municipality

When I hear the word "professional" I am reminded of the sporting world. What was once an amateur environment has now evolved into a powerful professional world of sport. How things have changed! Salaries of significant worth, high standards of coaching and the critical importance of achieving are characteristics that have emerged in the professional era. One just has to look at video footage of games played in the distant past and compare them to games played now. A significant difference has been the growth in expertise and the advancement of equipment. This growth can be attributed to an increase in expert coaching, advanced equipment and highly motivated and skilled players focused on performing.

In the light of these thoughts, one should ask the following questions:

- Is the environment professional?
- Are the salaries competitive?
- Are there structures and systems in place to afford expert coaching and specialised training?

The working environment should be assessed with reference to these questions clarifying the critical obstacles in achieving positive results. Strategic solutions can then be implemented aimed at developing a successful and professional working environment.

The following has been summarised in this respect:

Skills lost to South Africa

It has been commonly recognised and accepted that value is added to organisations primarily through people and information and not, as was thought in the past, through the four Ms: money, man, machinery and materials.

Immigration and emigration statistics indicate the net loss of economically active professionals, engineers, technicians, architects and related occupations to South Africa. (The figures in brackets indicate immigration minus emigration data.)

2001: -6638 (953 – 7591)

2002: -6280 (1054 – 7334)

2003: -9529 (1011 – 10 540)

Submission of immigration data is obligatory and the figures are therefore considered reliable. Emigration data, however, is less reliable as some emigrants do not complete paperwork or are not specific as to their intentions. The above statistics are therefore conservative and the net losses are probably greater. The documented total emigrants was 25 465 for the years 2001 to 2003.

The financial implications for the country reach into the billions of rand.

Staff turnover and its financial impact

Research in the UK indicates that staff turnover by 2012 will cost businesses at least £6,2-billion and these unacceptable levels of turnover impact significantly on employer finances. This negative impact can primarily be attributed to skill shortages and demotivation of existing staff.

Research suggests that in response to the question of why people leave, employers answer "money", whereas employees cite other reasons such as: career development; unresolved problems; working hours; and staff shortages.

Although career development is a key contributor to staff retention, the employer should remain positive in providing competitive packages and scarce skills allowances to staff members.

Employers should focus their efforts on establishing systems that would discourage high levels of staff turnover, maximise potential profits and promote effectiveness in core functions.

If employees are nurtured and made to feel that their career development is important to the employer then they will tend to remain loyal to their employer.

From these findings it is clear that skills development contributes significantly to the success of an organisation and the country.

This paper therefore aims to propose strategic solutions in overcoming the skill losses to establish and sustain a professional working environment. These solutions should provide a momentum in developing a stable skills base that can be relied upon to achieve the objectives of the organisation. The principles of skills development are easily understood but not always easily initiated and sustained because of time constraints and the lack of staff capacity.

Strategic solutions

A major concern in the light of the skill losses is that a window period of opportunity may be lost for ex-experienced and experienced personnel to impart their knowledge to the next generation of inexperienced engineers. The consequences of the above could lead to a serious lack of experience and expertise required to manage the industry effectively for the next 20 to 30 years. The fact that a number of active engineering personnel have emigrated and the reasonable assumption that a high percentage of experienced engineers is nearing retirement may result in a radical shortage of experience within the industry.

The following strategies are considered key in sustaining acceptable levels of engineering skills:

Organisational structures

Once the objectives of an organisation are established, structures can be created with effective systems that encourage personnel to fulfil these objectives effectively. The problem comes in when the structures are established but are not flexible enough to accommodate new technology, improved methods and latest trends. This results in the organisation being ineffective and irrelevant, thus losing its competitive edge.

Here are some important aspects, for supply authorities in particular, to consider regarding the wellness of the organisation's structures, systems and their effectiveness in long-term planning of electrical networks; methods and standards; renewable energy; energy efficiency; demand side management; equipment maintenance and skills development and staff retention.

With regard to skills development and staff retention, it has become necessary to introduce innovative methods of developing personnel. One approach is to employ mentors who would create an environment of excellence, professionalism and develop a skills base that would secure the organisation with enough competencies to fulfil its objectives. This skills base should include contracted trainees who can be equipped to fill vacancies within the organisation and industry. Below is an example of a modified structure embracing the above.

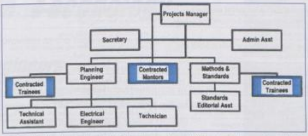

Fig. 2: Skills development and staff retention require a skill base including contracted trainees.

Contracted mentors

The Nelson Mandela Bay Municipality (NMBM) electricity and energy directorate recruited mentors on a contract basis who would focus their efforts on building a culture of learning to develop personnel to their full potential. These contracts have given flexibility and are a positive approach in relieving management and staff of the full burden of developing staff according to skills development principles. With the efforts of the manager and mentor, the company skill levels can increase at a faster rate.

The rewards of the above boost the morale of staff, reduce staff turnover and develop the necessary skills to provide a quality service. Ultimately the above approach promotes and contributes towards making the electrical engineering industry attractive.

The following are achievements as a result of the appointments of mentors in the NMBM electricity and energy directorate:

- Only one staff member has resigned over the past three years within the technical sections of the projects division where high staff turnover has been experienced in the past.
- A marked improvement in the number of applicants applying for engineering positions. Just prior to the introduction of the skills development structures in 2006, only ten people had applied for engineering positions within the projects division in response to a national advertisement. In 2009 an advert for those same positions was published and in excess of 90 applications were received. In addition, a number of engineers have contacted our offices looking for opportunities to work within our utility.
- One of our trainees resigned in response to a better financial package at a bigger engineering institution. After one day at that institution, he realised that it would be more beneficial for him to be within our environment in terms of his career development and he returned to us.
- Five trainees who went through the processes of development outlined above were successful in interviews and have been appointed within the directorate. As a result, five critical vacancies have been filled and retained.
- There is a positive working environment that exists across different race groups and genders.

Developing a skills base

Once mentors are appointed there is a capacity to manage the development of a skills base. A skills base is about establishing and sustaining the expertise and experience the organisation requires to fulfil its objectives.

Achieving a skills base entails appointing mentors; creating a skills development culture; recruitment of trainees; exposing personnel to a wide range of technical and managerial practices; delegating responsibilities to personnel; and affirming personnel in their progress.

Required attributes for good mentors	Objectives to be set for mentors
A good understanding of the functions and systems	Creating a learning culture
A desire to develop staff	Establishing a solid skills base
Experienced enough to transfer skills to junior and senior members of staff	Creating a positive working environment and camaraderie among staff
Good teaching and public speaking abilities	Producing excellent teams
Versatility and flexibility	Providing incentives for staff to achieve e.g. presenting awards for the best team
A team person	Building a full staff complement
Willingness to learn and embrace new ideas	Developing the expertise and technical depth required
A strength and support to management	Developing future managers
A good leader and administrator	Networking with the wider body of engineers to remain in touch with the latest technical developments
Good interpersonal skills	Providing support and strength to management in the roll out of the organisation's objectives
Good character	Lecturing on the fundamentals of electricity and management
Well respected	On-site practical demonstrations
Not threatened or intimated by the progress of staff beyond their own skill levels.	Career path mapping by creating mentoring relationships among all staff

Table 1: Important aspects to consider when appointing mentoring personnel.

The following are key development vehicles in achieving a skills base:

- Foundational lectures during the week
- Training to accommodate all staff, especially the more senior staff, addressing managerial and higher level technical issues
- Scheduled ECSA – accredited professional training comprising of two to three day courses covering key engineering applications such as protection and renewable technologies
- Mentor – trainee relationships based on formal agreements established among all staff
- Design and research projects accommodating tertiary institutions' requirements and encouraging better practices within the organisation
- Organising opportunities for staff to engage with other companies to learn and grow in experience
- Managing the personnel well and developing morale. An important aspect in maintaining high staff morale is to ensure that there are sufficient skills in spreading the work load. A shortage of skills leads to competent staff being overloaded with responsibility. A good strategy in overcoming this is to recruit a team of trainees who can be developed and nurtured to be credible applicants for employment opportunities within the organisation and to the industry as a whole. This strategy provides extra hands and a good succession plan to replace personnel who leave the organisation.
- Assessing staff with the aim of encouraging growth. The obstacles are clarified in the light of the goals aimed for and the personnel are motivated to overcome. The personnel have a sense of purpose in this process and a good work ethic is established. Mentoring is very helpful in the fulfilment of this process.
- Monthly team building events to cultivate healthy relationships, camaraderie and unity to maintain a positive working environment.
- Establishing accountability with the working teams to apply the principles taught and for the team leaders to ensure that junior members of staff are coached in this process.

General

The strategies outlined in this paper do not happen unless there is effective leadership. Coupled with this is exposure to the wider body of engineering to learn and grow in step with current trends and better practices in which the industry is moving forward.

Leadership

"Leaders establish the vision for the future and set the strategy for getting there; they cause change. They motivate and inspire others to go in the right direction and they, along with everyone else, sacrifice to get there." John Kotter.

There is excellent material on how to lead effectively but it's not always all that easy to apply. In simple terms, leading is about inspiring, influencing and motivating personnel toward something better. Once this "better" stage is reached, it has to be managed well, sustaining growth in the organisation. Establishing a culture of learning, employing mentors and developing a solid skills base is the "better" but it has to be managed well in terms of:

- Keeping the teams focused on the objectives
- Ensuring that the right people with the right gifts and right talents are involved in the correct functions
- Maximising every team member's contribution
- Evenly distributing the workload so that morale stays high and burnout stays low
- Facilitating communication so that all teams remain in the information loop
- Nurturing healthy relationships

Industry involvement

Organisations such as AMEU, Cigré, ECSA and NRS working groups amongst others are excellent environments in which to expose personnel. This exposure allows for a greater understanding of the bigger picture and results in the development of versatile personnel.

Conclusion

Whilst I was preparing this paper a journalist contacted me and asked if I could respond to a few questions. His timing was opportune because the response to his questions serves as a useful summary and conclusion for this paper.

The questions and answers are as follows:

What are the main causes of current skills shortages in the SA energy industry?

An engineer was asked why he was leaving to London to take up a managerial position in an electrical supply company. His answer was that he desired a professional working environment so that he could grow, be a better engineer and have a sense of fulfilment. In light of the above and the results of research, I believe that one of the main reasons for skill shortages is the lack of professional working environments. Other factors that contribute to this problem are: extensive times to resolve issues, staff shortages and uncompetitive salary packages.

How does this impact on the industry?

It can have significant financial implications for the industry with regards to:

- Equipment failure due to lack of maintenance
- Effective organisational systems breaking down
- Staff turnover
- Insufficient skills to deliver a quality service

How serious is this problem?

Statistics indicate that we have lost unacceptable numbers of skilled personnel, which now need to be replaced. I understood these realities better when I discovered that two key sections of high profile organisations together require at least 35 personnel and have only ten at present. If I just consider this scenario and the statistics that are available then the problem is very serious.

How should this problem be addressed?

- A collective and united effort from all industry stakeholders
- A strong leadership approach applying strategic solutions in reversing the negative cycles. These solutions should include: developing a learning culture, employing mentors and recruiting trainees who can be developed for job opportunities within the organisation and industry as a whole.

References

[1] The Department of Statistics South Africa
[2] Courageous Leadership, Bill Hybels

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Skills Development Act and staff retention

The Skills Development Act was developed in response to the way companies operated in the past. Employers used to employ people without skills and then teach them or just develop skills via experience. These people were then given certain responsibilities without adding any incentives and formal education.

by M D Mokoala, Polokwane Municipality.

As time went by employers would train people and utilise them in more responsible areas, without any incentives, and they could not compete in the future when a position opened up. They would then have to teach people on higher levels which demotivated them. People could not expand their knowledge and their contribution towards the work itself was limited. This led people to work through their experiences which was attained over long periods of time without any formal training and thus employers lost productivity. After realising the urgent need for training, government had to motivate employers to participate in training and they introduced the Skills Development Act.

This is Act Number 97 of 1998, and it is there to provide an institutional framework to devise and implement national, sector and workplace strategies to develop and improve the skills of the South African workforce, and to integrate these strategies within the National Qualification Framework contemplated in the South African Qualifications Authority Act (1995). The aim is to provide learnerships and finance and to regulate employment services.

Purpose of the act

To develop the skills of the South African workforce which will result in: improved quality of life; improved productivity; promotion of self-employment; and improved social services.

To increase the level of investment in education and training in the labour market and to improve the return on the investment.

To encourage employees to: use the workplace as an active learning environment; acquire new skills; and be employable.

To encourage workers to participate in the learnerships and other training programmes; redress disadvantages of the PDI (previously disadvantaged individual); ensure the quality of education and training in and for the workplace; assist learners with learning opportunities and to provide and regulate employment services.

How to achieve the purpose

Through the establishment of the following institutional and financial framework comprising:

- The National Skills Authority
- The National Skills Fund
- The Skills Development Levy (Skills Development Levies' Act)
- SETAs
- Labour centres
- The Skills Development Planning Units in workplaces

By encouraging partnerships between the public and private sectors, and co-operating with the South African Qualification Authority.

National Skills Authority

This is a body established in 1999 to advise the minister on: developing policy; developing strategy; providing guidelines for implementation; acquiring funds from the National Skills Fund; and providing regulations.

To liaise with the SETAs on policy and strategy; report to the minister on the progress made in the implementation (monitoring and evaluation), and to exercise powers over the purpose and within the act.

Composition of the National Skills Authority and term and vacation of office

The National Skills Authority consists of:

- A voting chairperson appointed by the minister
- Twenty four voting and three non-voting members appointed by the minister
- Its non-voting executive officer appointed in terms of section 8(2)(a)

The members referred to above are:

- Five voting members nominated by NEDLAC and appointed by the minister to represent organised labour
- Five voting members nominated by NEDLAC and appointed by the minister to represent business
- Five voting members nominated by NEDLAC and appointed by the minister to represent organisations of community and development interests (which include a woman, youth and disabled individual).
- Five voting members appointed by the minister to represent the state
- Four voting members appointed by the minister to represent education and training
- Two non-voting members with expertise in employment services
- A non-voting member nominated by the South African Qualification Authority and appointed by the minister to represent that authority

The minister must designate four members as deputy chairpersons representing organised labour; organised business; organised community and development; and the interests of the state.

Constitution of the National Skills Authority

The National Skills Authority must as soon as possible after appointment of its members, adopt its constitution which must provide for:

- Procedure for nominations
- Establishment of committees
- Rules for members
- Voting rights
- Code of conduct for members
- Dispute resolutions
- Procedure for amending the constitution
- Delegation of powers

A member of the National Skills Authority who is not in the full employment of the state may be paid the remuneration and allowance determined by the minister with the approval of the Minister of Finance.

Sector Education and Training Authority (SETA)

SETAs are established in to provide for:

- The education and training needs of employers and employees that use similar material, processes and technology (e.g. metal industries); make similar products (mines); and render similar services (municipalities).
- The potential for coherent occupational structures and career pathing
- Economic growth and development

Functions of SETA

- To develop a sector skills plan
- Implement its sector skills plan
- Establish and promote learnerships
- Apply for accreditation from SAQA.
- Collect and distribute the Skills Development Levies in its sector
- Liaise with the National Skills Authority
- Report to the director-general
- Liaise with the employment services of the department
- Appoint staff necessary for the performance of its functions

Finances of SETA

- Collected from its sector
- Money paid to it from National Skills Fund

- Grants, donors
- Income from investments
- Income from services rendered

Taking over the administration of SETA

The minister can direct the director-general to appoint an administrator if the minister feels that:

- The SETA fails to perform its functions
- There is mismanagement of its finances
- Its membership no longer substantially represents the composition contemplated in section eleven

Learnerships

What is a learnership?

- A learnership is defined as a learning programme with a structured learning component and practical experience that leads to a registered qualification relating to an occupation
- A learnership includes practical work experience of a specified nature and duration
- A learnership leads to a qualification registered by SAQA and is related to an occupation
- A learnership should be registered with the director-general in the prescribed manner
- A learnership must not be confused with practical exposure
- Learnerships must be related to the old apprenticeship

Learnership agreements

This is the agreement which is entered into a specific period by the learner; the employer or group of employers; and a training provider accredited by a related body.

The terms of the learnership agreement must oblige:

- The employer to employ the learner for a period specified in the agreement; provide the learner with the specified practical work experience; and release the learner to attend the education and training specified in the agreement.
- The learner to work for the employer and attend the specified education and training
- The training provider to provide the education and training specified in the agreement, and the learner support specified in the agreement.

The learnership agreement must be in the prescribed form and registered with a SETA in the prescribed manner and may not be terminated before the expiry period of the duration as specified in the agreement unless:

- The learner meets the requirements for successful completion of the learnership
- The SETA which registered the agreement approves of such termination
- The learner is fairly dismissed for a reason related to the learner's conduct or capacity as an employee

The employer or training provider that is party to a learnership agreement may be substituted with:

- The consent of the learner
- The approval of the SETA which registered the agreement

Contract of employment with learner

- If the learner was in the employment of the employer, the learner's contract of employment is not affected by the agreement.
- If the learner was not employed by the employer, the employer must enter into a contract of employment with the learner.
- The contact of employment must be within the guidelines of Basic Employment Act
- The contract of employment may not be terminated before the period of learnership ends
- The contract of employment may expire at the same time as the learnership agreement period

Financing skills development

The National Skills Fund was established using 20% of the Skills Development Levies as contemplated in the Skills Development Levies Act.

Budget for training by service employers

Each public service employer in the national and provincial spheres of government, must budget for at least 1% of its payroll for the training and education of their employees with effect from 1 April 2000, and may contribute funds to a SETA.

Staff retention

Background

We at Polokwane municipality have lost twenty skilled artisans between the years 2005 to 2009. We are the biggest municipality and the biggest town in the province wherein everyone is keen to reside. Staff retention is a problem as smaller municipalities are paying better incentives than us, e.g Tzaneen. We have filled the vacancies but there is always a gap during the transitional period until the new person can perform their duties fully.

We all know that electrical skills are scarce. Other municipalities and Eskom came up with a idea of training their staff immediately after appointment. This motivates people who are working there as they view it as a possible growth opportunity. When posts are advertised we always require significant working experience which we struggle in most cases to obtain. Nowadays we resort to employing people with National Certificates up to N6 without experience but they leave after receiving their Trade Test Certificates.

The artisans we have lost are categorised in the following way: artisans (7); supervisors (2); inspectors (3); line workers (6); and SCADA officials (2).

Seven of our artisans went to Eskom, three to other municipalities, two to mining and eight to the private sector. During the exit interviews, we received the following as some of the reasons for leaving the municipality:

- Better income (salary)
- Training and educational opportunities
- Benefits (housing, traveling, medical etc.)
- Unequal treatment by supervisors

Other reasons why people leave their employment areas are:

- Lack of succession planning
- Better working conditions
- Basic needs
- Shifting of partner and or family
- Cases of corruption or misconduct

What can be done to retain staff?

- Pay reasonable salaries
- Have reasonable and acceptable benefits
- Encourage good working environment
- Set clear working conditions
- Maintain discipline
- Recognise and reward employees who go the extra mile in executing their duties
- Encourage skills development
- Recognition of related academic qualification (e.g once off payment if one obtains a related trade, diploma or degree)
- Have a succession plan
- Organise work related workshops and courses
- Make frequent risk assessments
- Provide adequate working materials and equipment
- Recognise the working experience of employees
- Give internal candidates advantage when filling vacant positions
- Have monthly or weekly competitions for the best performer
- Fill vacant positions immediately

Conclusions

It was found that the Skills Development Act is an act that can be used to address the skills shortage issue in the working environment. Each employer becomes responsible for developing the skills of his people, thus generating a pool of skilled people. The skills development programme is initiated by employer, developed and implemented by SETA, limited or directed by SAQA, and funded through the South African Levies Act to establish learnerships. Educated learners are motivated, employable and can be retained.

Acknowledgements

[1] Act 97 of 1998 Skills Development Act, 1998.
[2] Act 56 of 1981 Manpower Training Act, 1991.
[3] Act 41 of 1985 Local Government Training Act, 1985.
[4] Version 1 Guide for the Learnership and Implementation Process E- SETA.
[5] Polokwane Municipality.
[6] Tzaneen Municipality.

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Provision of bulk municipal infrastructure by developers – a model that works

This paper proposes three funding models for the provision of mainly primary infrastructure by developers. These models are based on the experience gained and lessons learnt with several privately funded municipal primary infrastructure projects.

by R E Zietsman, Geopower

The provision of bulk municipal infrastructure by a developer, on behalf of a municipality, normally takes place when it is practical for the municipality to incorporate the scope of the shared external service with the installation of the developer's internal service, or when the municipality lacks the financial and/or personnel resources to undertake the external works. In the majority of instances when a developer expedites the provision of an external service for a development, it is limited to the external secondary cable network. The typical capital expenditure related to an external secondary cable network required to supply a development is usually less than or equal to the applicable service contribution, enabling such expenditure to be either partially or fully offset against the contribution.

This scenario changes somewhat when the scope of a shared external service includes a secondary switching station and its associated main feeder cables. The capacity of a switching station, in nine out of ten cases, will substantially exceed the capacity allocation of the development, under which service agreement is to be provided by the developer. The capital expenditure incurred in providing a secondary switching station ordinarily exceeds the service contribution, and most municipalities have devised refunding mechanisms for compensating the developer for the additional expense.

The past five years have witnessed an increase in the phenomenon whereby "larger" cash-strong developers are compelled to fund and construct primary infrastructure in order to expedite the desired capacity and electricity supply network to their developments. Primary (high-voltage) infrastructure is considerably more expensive and poses greater construction and safety risks than its secondary (medium-voltage) counterpart.

While the development of municipal primary networks should remain the responsibility of a municipality, there will continue to be instances when a private developer is confronted with the need to provide primary networks in order to facilitate and create an electricity supply with sufficient capacity for a specific development. It is conceivable that there needs to be a benefit for a developer to accept the additional financial liability, in excess of the service contribution and the associated risks of constructing high-voltage primary infrastructure, besides the assurance of capacity for a development.

Bulk municipal infrastructure

For the purpose of this paper, bulk municipal infrastructure is defined as the external shared primary and secondary electricity networks, which service numerous developments and customers. Bulk municipal electricity infrastructure therefore consists of the primary (high voltage) source in-feed stations, primary distribution lines and primary distribution substations as well as the secondary (medium voltage) main feeder cables and switching stations.

Electricity infrastructure components are manufactured mainly from copper, steel and aluminium. Price fluctuations in these materials invariably influence the cost of bulk service infrastructure and service contribution tariffs alike. The cost of electricity infrastructure has soared over the past decade mainly due to the increases in the price of steel and copper. The cost of a firm 40 MVA and 120 MVA primary 132/11 kV substation, based on a conventional outdoor, double bus configuration, is in the order of R48-million and R78-million respectively, excluding land cost. The approximate cost of a double 300 MVA circuit 132 kV power line is currently in the region of R3-million/km, assuming the right of way servitude is available.

Fig. 1 illustrates the upward growth trend and fluctuations in the copper price over the past decade. It is evident that the copper price has increased by R40 000/t since the turn of the century which is a staggering 200%. The price of a 40 MVA, 132/11 kV power transformer in 2005 was R2,6-million as compared to R7,8-million in 2008.

The supply capacity of a primary substation is determined by the size and number of its power transformers, ie. its transformation capacity. The majority of larger municipalities have standardised on power transformers rated above 30 MVA, with 40 MVA being the norm. Whilst 20 MVA units were common in the past, experience during the foregoing development boom, which ended abruptly in 2008, has shown that the firm supply of primary substations with 20 MVA transformers, especially in areas displaying high growth potential, are impractical as the firm station capacity is prematurely exceeded. The former Johannesburg City Council and City Power today have standardised on primary substations with 45 MVA units. The former Pretoria City Council opted for 35 MVA units while Centurion standardised on 20 MVA units. The City of Tshwane has subsequently standardised on primary substations with 40 MVA units. Ekurhuleni Metropolitan Municipality prefers 30 MVA units for its primary substations. Tlokwe City Council has recently standardised on 40 MVA units for its new 132/11 kV primary substations as opposed to the 20 MVA units on the existing 66 kV system.

Development of bulk municipal infrastructure

The development of bulk municipal electricity infrastructure by a municipality is normally undertaken in accordance with the guidelines of a master infrastructure development plan. The master plan is normally included in the IDP and the capital funds for the construction of the infrastructure is budgeted annually in accordance with the approved IDP. Municipalities tend to apply emphasis on creating infrastructure in so-called priority areas and "zones of choice". The development priorities of a municipality and that of private developers are not always in harmony.

The provision of secondary bulk electricity infrastructure, including 11 kV main feeder cables and switching stations, by developers is reasonably common and is often included in the scope of works for a shared external network to be provided by a developer.

Fig. 1: Trend in copper price.

Fig. 2: A primary substation.

The provision on the other hand of primary bulk electricity infrastructure by a developer is neither unique nor ideal for various reasons addressed in this paper. The development of capital-intensive primary electricity infrastructure, by a developer providing the initial capital expenditure, can only take place on the basis of a "willing developer, willing municipality". This is because the capital expenditure for a primary substation is required well in advance of the legal obligation for the payment of the ensuing service contributions for the developments yet to be established and proclaimed by the developer.

A ten year expiry period for the allocation of capacity to a developer who wishes to expedite the provision of a primary substation is advisable The securing of the capacity allocation, assigned to a developer, within the ten year restriction period could however pose a risk of under-utilisation. Experience during the past development boom period has shown that typically seven years is required for a relatively "large" developer to take up and utilise a 40 MVA capacity.

The provision of primary infrastructure by developers can become complicated and problematic, if the capacity created in a primary substation is exclusively allocated to the developer who expedited the provision thereof. The notion by some developers that "they own the capacity" of the primary substation which they have provided is incorrect as once the infrastructure is energised it automatically becomes an asset of the municipality. There is an old adage that states "He who owns the gold makes the rules". There are some opportunistic developers who, given the chance, will interpret this adage as "He who owns the power (MVAs) makes the rules".

The provision of bulk municipal infrastructure by developers must be undertaken in strict accordance with the standards and technical specifications of the municipality. The procurement procedures should be adopted where possible.

Primary bulk municipal electricity infrastructure should therefore ideally be developed and paid for by a municipality and the capacity created in turn allocated to developments against the levying of a service contribution.

Examples of primary infrastructure provided by developers

One of the first privately developed primary substations in Pretoria was the Kosmosdal A (20 MVA) substation in 1996. Other substations which were developed by real estate developers in Pretoria include the Raslouw (40 MVA) in 2006, Kosmosdal B (120 MVA) in 2010 and currently the Cornwall Hill (40 MVA) substation. The Highlands substation is in the process of being reconfigured by a developer in order to create an additional 35 MVA station capacity, thereby freeing up capacity for the developer's development. The reason for the success of these privately funded projects is due to the appointment of a competent team and through intimate involvement in the design and execution phases by representatives of the City of Tshwane.

The development of primary substations is more complex and intricate than that of medium voltage reticulation projects and necessitates expert and professional contracting crews and the dedication and commitment of the representatives of the electricity division of the municipality.

Service contributions

Service contributions originated from section 121 of the ordinance on town planning, and comprise the once-off, pro-rata engineering contribution made by a developer towards the capital costs of a shared bulk engineering network to meet the needs of a development. The municipal policy pertaining to the service contribution for the provision of an electricity service must, in addition, be consistent with the directives and requirements of NRS 069: 2004. The contribution for electricity is to be calculated in accordance with the tariff policy of the municipality in terms of the Local Government: Municipal Systems Act 2000 (Act 32 of 2000) and NRS 069: 2004.

Service contributions and the ordinance on town planning

The ordinance on town planning, 1986 (Ordinance 15 of 1986) distinguishes between township establishment on the one hand and sub-divisions, re-land use change and consent use on the other. The ordinance defines the following responsibilities and statutory requirements:

- The scope of the works for the engineering service to be provided.
- The classification of the service as an external and an internal service respectively.
- The responsibility of the municipality and the developer for the provision of each service.
- The mutual capital contribution to the service by both the municipality and the developer towards the cost of the service.

Type of service: In terms of section 117 of the ordinance, the classification of a service as external or internal is to be by agreement between the municipality and the developer. This is normally endorsed in the service agreement. In the event that an agreement cannot be reached, the parties may refer such matters to the Services Appeal Board.

Responsibility for the provision of the service: In terms of section 118 of the ordinance the developer is responsible for the provision of the internal engineering service, and the municipality is responsible for the provision of the external engineering service. Notwithstanding the foregoing, with agreement any of these services may be provided by either party.

Contribution towards the cost of the service: In terms of sections 120 and 121 respectively of the ordinance, the municipality has the responsibility to contribute towards the provision of a part of the internal service and the developer has the responsibility to contribute towards the provision of the external service, i.e. service contribution.

Sub-divisions, consent use and land-use change: The ordinance makes provision that the principles which prescribe township developments apply equally to sub-divisions and change in land-use.

Service contributions and NRS 069:2004

NRS 069 refers to service contributions as capital contributions. This code of practice includes the network standard for determining the kilovolt-ampere (kVA) capacity of the network to be adopted by municipalities. Deviations from the network capacity standard should be motivated to developers and NERSA. SANS 204-1: 2008 must be considered with any amendment to the network capdcity standard.

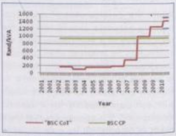

Fig. 3: Trend in service contribution tariffs.


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External service

An external service includes the entire electricity system external to the boundary of the development required to service the development with a reliable and continuous electricity supply, against the capacity limit agreed in the service agreement. The external service therefore encompasses the Eskom-municipal point of supply interface (HV in-feed station); the primary distribution line network, the respective primary distribution substation and the secondary network. In the majority of instances the external service is not dedicated to any one development but comprises a shared service which supplies several townships and developments with electricity.

It is therefore necessary that the service contribution includes a part contribution towards the cost of each element of the primary and secondary systems from which systems the capacity for the development is derived. The part contribution should be calculated on a pro-rata basis of capacity allocated to a development/township versus the total supply capacity of the specific element of the external system.

Policy for levying of service contributions

Municipalities are to ensure that their policy for the levying of electricity service (capital) contributions is consistent with the code of practice for the recovery of capital costs for distribution network assets, NRS 069: 2004. The policy of most municipalities does not make allowance for the provision of primary networks by developers. A few municipalities have recently amended their respective policies to include the provision of primary distribution networks.

It is prudent to conduct a public participation process with developers and engineers to explain and invite comments on the proposed amendments to a service contribution levying policy. Any significant deviation from the code of practice needs to be motivated to all relevant parties including NERSA.

Service contribution tariffs for electricity

The network capacity standard rate is the R/kVA tariff at which a municipality, by virtue of its officially promulgated electricity contribution tariff policy in terms of the Local Government Municipal Systems Act 2000 (Act 32 of 2000), from time to time charge service contribution charges in respect of kVA/MVA external electricity service to developers within its licensed area of electricity supply and distribution.

At the turn of the century, the bulk contribution tariffs of several municipalities were not in line with the cost of electricity infrastructure. Service contribution tariffs have since increased significantly to counter act the effect of the increase in the copper and steel prices.

In the case of the City of Johannesburg, the service contribution has remained constant at R942/kVA, irrespective of the level of connection. The service contribution of the City of Tshwane for a connection directly from a primary substation has increased from R106/kVA in 2003 to R1428/kVA in 2010. The typical trends in the service contribution tariffs of municipalities in Gauteng are approaching values of R1500/kVA as depicted in Fig. 3.

Payment of service contributions

Service contributions are the main component of a developer's financial obligation towards a municipality. Service contributions are normally payable prior to the proclamation of a township but at least prior to the energisation of the external and internal services.

The City of Tshwane for instance is only prepared to issue a section 101 certificate for township proclamation once the service contribution is paid or alternatively if the external service, which was agreed to be provided in lieu of payment of a service contribution, has been installed. The City of Johannesburg on the other hand enables the early proclamation of a township prior to the payment of the service contribution, but withholds the section 82 certificate until the external and internal services have been installed and any service contribution has been paid. This arrangement is in line with the ordinance and is considered by many developers as the preferred process.

When a developer agrees to provide external infrastructure in lieu of partial/full payment of a service contribution it becomes necessary for the developer to finance and incur costs in respect of the infrastructure in advance of the specific municipality's legal obligation for the payment of the service contribution. The advance payment of capital costs in lieu of offsetting future service contributions is to be treated as legal service contributions from the onset as such amounts should be determined in a binding agreement. Interest on such amounts prior to the date upon which the payment of a service contribution is enforceable must be considered. This is especially the case when a developer provides a primary substation as in most instances the developer will only conclude the subsequent service agreements for all the developments to be supplied from the substation after at least a five year period. This time period is dictated by the market and other factors.

Service contribution tariffs versus actual costs for primary electricity infrastructure

Service contribution tariffs for new townships should be based on the kilovolt-ampere (kVA) zoning ADMD standard for urban areas at the transformer LV bus and not at the MV bus of the primary substation. The proposed network standards are provided in Annex B of NRS 069: 2004 although each municipality is required to compile its own standards according to its particular circumstances. The provisions of SANS 204-1:2008 must also be considered.

The approximate cost of the initial stage of a conventional 40 MVA firm primary substation is R50-million. The average cost per kVA for the initial stage of the primary substation based on the foregoing values is R1250/kVA. The incremental cost for provision of an additional 40 MVA stage is R15-million. The average cost per kVA for the extension of a primary substation, in the case where the earth-works are completed is substantially lower at R375/kVA. The reason for the difference in the average costs for the initial and subsequent extension of a primary substation is due to the fact that a firm capacity is required from the onset which necessitates the provision of two 40 MVA transformers for one effective 40 MVA stage. The entire earthworks, incoming line bays, bus coupler/section and the control building are normally essential for the initial stage. The average cost for the construction of a 120 MVA firm primary substation is R666/kVA.

From the foregoing it is evident that the average cost of the construction of the primary substation diminishes as the installed firm capacity is increased. The capital cost however increases with the provision of additional capacity. The average cost of a primary substation compares favorably with the service contribution tariffs, especially considering that in most cases the developer will need to establish the initial stage of the substation.

Conventional compensation for the provision of an external service

In terms of the ordinance a developer is responsible for contributing towards the external service, which under ideal circumstances should be provided by the municipality, unless the development is classified as a "leapfrog" development. A leapfrog development is defined as a development outside the urban edge. In the case of a leapfrog development, the developer is obliged to pay for the full cost of providing the external service to such a development even if the cost exceeds the normal service contribution calculated in accordance with the capacity required for the development.

Offsetting capital against bulk contributions

The electricity tariff policy of most municipalities makes provision for the offsetting of service contributions against the cost of providing the external service or any part thereof. In most instances the service contributions are offset against the cost of the secondary network which is considerably more affordable than its primary counterpart. A developer is normally refunded by the municipality if the capital expenditure exceeds the applicable service contribution. It should, however, be noted that it is becoming increasingly difficult for a municipality to refund a developer, and such refunds are normally budgeted for payment in subsequent municipal financial years.

The conventional financial mechanism of providing "copper" in lieu of the payment of service contributions is possible if the external service is limited to the secondary network. It is furthermore usually possible to install a secondary external service with just the required capacity to supply the development. This flexibility, however, does not apply in the case of a primary infrastructure due the standard power transformer capacity ratings and relatively high cost of primary infrastructure.

Secondary versus primary infrastructure

The typical external secondary service provided by a developer consists of the supply and installation of cabling between a substation and the boundary of the development. The cost of such infrastructure is dependent on the location of the closest substation to the development and the availability of spare capacity on the existing secondary network. In most instances, the cost of the external secondary service is less than the applicable service contribution and the cost is easily offset against the service contribution payable to the municipality. The balance is then paid directly to the municipality.

In limited cases the municipality will require a developer to establish a switching station and the associated secondary main feeder cables. The municipality will normally only burden a developer with such a requirement if the capacity of the development necessitates the creation of a switching station. The municipality will normally refund a developer for the excess cost incurred in the provision of a switching station, unless it is dedicated to the development.

As previously stated the provision of primary infrastructure by a developer is rare. However there are instances when a developer is required to provide primary infrastructure which will be limited to providing the initial or a subsequent stage of a primary substation. The cost of the initial stage of a 40 MVA substation is about R50-million. Due to the magnitude of the capital contribution, It is not always possible to apply the conventional method of financial compensation to the provision of primary infrastructure and an alternative compensation model is required.

When is it viable for a developer to construct a primary substation?

In short, it boils down to a business decision for a developer to decide to fund the construction of a primary substation to create capacity for a development.

While many developers may initially indicate their willingness to provide primary infrastructure in order to facilitate the creation of capacity to supply their developments, experience over the past ten years has revealed that only a handful of developers have in actual fact contracted with municipalities for the construction of primary substations and primary line networks. The typical cost of a conventional 40 MVA firm primary substation is in the region of R50-million. An initial capital investment of R50-million, even if the service contributions for the entire ultimate development equate to R50-million, is excessive and will negatively impact on the feasibility of the development.

A R50-million investment for 40 MVA equates to an average cost of R1250/kVA which is in line with some typical service contribution tariffs as illustrated in Fig. 3. The R50-million is based on the existence of an existing powerline to connect the substation and excludes the cost of land for the substation. Despite the fact that the cost/capacity may equate to the current service contribution tariffs, the need for the total capacity created will not be current and will probably take some five to ten years to realise. Unless the compensation model successfully addresses the "capital investment for future service contributions" it will usually not be feasible for a developer to provide a primary substation.

Factors that improve the feasibility

- Availability of a high-voltage primary line, i.e. not necessary to construct a powerline to connect the substation to the system.
- Developer owns the land for the substation and does not need to purchase it.
- A relatively high initial capacity requirement.
- An ultimate capacity requirement for the development that exceeds or equals the initial substation capacity.
- Relatively short development horizon.
- Willingness by the municipality to provide the power transformers as free issue items.
- The purchase price of the land for the development was below market price and the full/partial cost of the substation can be factored into the land cost.
- It is essential for the developer to proceed with the development, irrespective of cost, to make capacity available.

Financial models for compensating a developer for the cost of providing primary infrastructure

This paper proposes the following three models for the provision of municipal primary electricity infrastructure by a developer:

- Capital contribution rebate model
- Capital contribution offset model
- Capital contribution loan model

The first model applies equally to the provision of secondary infrastructure, while the second model is the preferred and dedicated model for the provision of a primary substation. The second model has been utilised successfully for the construction of three municipal primary substations with a firm capacity rating of between 40 MVA and 120 MVA.

While the developer is actively involved with the construction and project management responsibilities in accordance with the first two models, the third model makes provision for a developer instead to loan the required capital funds to the municipality without becoming actively involved in the construction and project management of the project, which in turn is undertaken directly by the municipality.

The advantages and disadvantages are listed for each model.

Capital contribution rebate model

This model is based on the conventional method utilised by municipalities to refund developers for the provision of shared networks. In the case of the provision of primary infrastructure, the magnitude of the refund is substantially larger than that of secondary networks and normally takes place over an extended period. This model is rarely applied to the provision of primary infrastructure due to the magnitude of the capital investment and hence the municipal refund.

Capacity allocation: The capacity allocation is based on the sum of the kVA zoning ADMDs of the erven of the development at transformer LV bus level, in accordance with those specified in the municipal policy document which should be consistent with SANS 204-1:2008 and NRS 069: 2004.

Service contribution: The service contribution for the developer's developments, included in the service agreement for the provision of the infrastructure, is to be calculated as the product of the capacity allocation for a specific development and the service contribution tariffs applicable at the time of signing of the individual service agreement for the specific service agreement for each ensuing development.

Scope of primary works: Determined by the municipality in order meet at least the overall capacity requirement of the relevant developer's development/s.

Capital expenditure by developer: The capital expenditure is equal to the cost of the primary works as defined by the scope of works, excluding any land cost, but including interest and all professional fees.

Capital expenditure by municipality: Normally no initial capital expenditure, besides future capital refunds.

Source of initial capital: The developer who agrees to expedite the installation of the primary infrastructure, and who accepts the responsibility for the capital expenditure.

Service contribution tariffs: The service contribution tariffs are to be the applicable tariffs at the time of signing the individual service agreements for each ensuing development of the developer providing the capital expenditure. The service contribution tariffs ruling at the time of signing the agreement for the provision of the municipal primary infrastructure must not be fixed as the developer is entitled to a refund plus interest.

Rebate: The rebate is determined as the difference between the capital expenditure by the developer and the sum of the relevant service contributions for the developer's developments, which is to be calculated using the applicable service contribution tariffs at the time of signing the individual service agreements.

Source of refund: The municipality's own funds or from new customers/developers when they share the networks.

Interest: The municipality must contract to repay such funds including interest, in accordance with clause 6.6.10 of the special circumstances in SANS 069:2004.

Capital contribution offset model

This model is based on offsetting the cost of the primary works against the future service contributions payable to the municipality for the shared external service by the developer who has agreed to expedite the installation of the networks.

Capacity allocation: A fixed capacity allocation determined by the sum of the zoning ADMDs of the erven of the townships/developments, but not exceeding two thirds of the new/additional firm transformation capacity of the primary substation in order to reserve capacity for other developers/customers.

Scope of primary works: Determined in conjunction with the municipality, but restricted to the capital expenditure which is a function of the fixed capacity allocation.

Capital expenditure by developer: The capital expenditure is to be limited to the product of the fixed capacity allocation and the contribution tariff at the time of signing the contract.

Capital expenditure by municipality: The municipality must provide the power transformers as free issue items, and must purchase or expropriate the land for the primary facility.

Source of initial capital: The developer who agrees to expedite the installation of the primary substation, and who agrees to provide the full upfront payment thereof including professional fees.

Service contribution tariffs: The service contribution tariffs shall be those in force at the time of signing the agreement for the provision of the primary works.

Source of refund: No physical cash refund is applicable and the service contributions for the developer's future townships are waived by the municipality until the capacity allocation is depleted by means of individual signed service agreements.

Interest: Interest is not applicable to this financial model as the developer is guaranteed a specific capacity against zero service contribution which hedges against future increases in the standard tariffs for service contributions.

Capital contribution loan model

This model is similar to the capital contribution rebate model, with the exception that the developer or customer loans the capital to the municipality for the funding of the works, without becoming directly involved in the execution of the works.

Capacity allocation: The capacity allocation is based on the sum of the kVA zoning ADMDs of the erven of the development at transformer LV bus level, in accordance with those specified in the municipal policy document which should be consistent with SANS 204-1: 2008 and NRS 069: 2004.

Scope of primary works: Determined by the municipality in order to meet at least the overall capacity requirement of the relevant developer's development/s.

Capital loaned by developer: The capital amount loaned to the municipality is to be by mutual agreement but typically will equal the cost of the primary works less the capital expenditure of the municipality. The inclusion of land cost and professional fees is subject to negotiation.

Capital expenditure by municipality: Determined by the availability of municipal funds.

Source of initial capital: The developer who agrees to expedite the installation of the primary infrastructure, and who agrees to loan the full/partial funds.

Service contribution tariffs: The service contribution tariffs are to be the applicable tariffs at the time of signing the individual service agreements for each ensuing development of the developer providing the capital expenditure. The service contribution tariffs ruling at the time of signing the agreement for the provision of the municipal primary infrastructure must not be fixed as the developer is entitled to the loan repayment plus interest.

Loan repayment: The loan amount is determined as the difference between the cost of the loan and the applicable service contribution, which is to be calculated using the applicable service contribution tariffs at the time of signing the individual service agreements.

Source of repayment: The municipality's own funds or from new customers/developers when they share the networks.

Interest: The municipality must contract to repay such loan including interest, in accordance with clause 6.6.10 of the special circumstances in SANS 069:2004.

Conclusions and recommendations

Municipalities need to ensure that they have a valid promulgated policy for the levying of service contributions for the provision of electricity services. The policy should be consistent with the requirements of NRS 069:2004 and SANS 204-1:2008. It is advisable to make allowance in such policy for a developer to provide primary (high-voltage) infrastructure on behalf of the municipality. It is prudent to follow a public participation process with developers and consultants in order to motivate significant amendments to any existing policy.

Municipalities should be familiar with trends in the increase of the prices of copper, steel and aluminium when designing their service contribution tariffs. Service contributions tariffs need to be consistent with the actual cost of primary and secondary infrastructure.

While a municipality should as far as possible be responsible for the supply and installation of primary infrastructure, there will continue to be occasions where a developer is required to provide primary infrastructure on its behalf.

The success of the implementation of the process whereby a developer is tasked with the responsibility of constructing a primary substation begins with a comprehensive but straightforward agreement. The agreement should be based on a feasible financial model. The capital contribution offset model has proven to be successful. It is essential to stipulate time periods for the expiry of the capacity allocation and refunds in the agreement, typically ten and five years respectively.

Should a new primary substation need to be provided by a developer, it should be restricted to the initial stage, comprising one service and one backup transformer. The municipality should consider providing the power transformers as free-issue items, especially if the capital offset model is adopted.

The land cost for the substation erf must be excluded from the financial offset and the municipality should ideally purchase or expropriate the land. A developer does not have the advantage of expropriating private land.

The standard and technical specifications of the substation must be in accordance with the standard requirements of the municipality and the design of the infrastructure must be undertaken in conjunction with the municipality.

The normal procurement procedures should be followed as far as practically possible and public tenders for the works should be advertised.

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Spreadsheet tool to compare metropolitan municipal tariffs and Eskom large customer tariffs

The purpose of this paper is to point out the close relationship between the various large power user electricity tariffs, and those of municipalities. These tables were compiled in an attempt to compare tariff on the same basis. Increases in tariffs, or tariff structural changes following the date of this paper, may not be reflected. In this paper the author basically used two group sets of actual large power user data, as well as electricity purchases for the City of Ekurhuleni. The results of the data sets are then applied to the various municipalities to compare the possible revenues that will be generated.

by Stephen Delport, Ekurhuleni Metropolitan Municipality

For many years, the AMEU conducted an annual survey amongst a selection of municipal electricity distributors, Eskom and a Namibian utility, in order to attempt to establish a comparison of cost to a sample of domestic consumers (four assumed levels of consumption) and demand related (30% and 60% load factors at four assumed demand levels), based on the electricity tariffs levied by these distributors.

As most of the electricity is purchased via Eskom, the tariff comparison also indicates the Eskom prices as reference. However, the Eskom prices may not be a fair reflection as these prices will not reflect all the additional costs to convert cost components from the transmission level to distribution level. The matter of cross-subsidisation between different groups of customers is one that will probably be a controversial issue on the table. The author is also of the view that future tariff re-design should be so balanced, that it prevents, as far as possible, the exploitation of tariffs by consumers. The tariff structures should encourage consumers who want to change, to take the effect of pricing signals into consideration.

Inclining block rate tariffs (IBT)

One of the next big issues that will need more debate, relates to the NERSA proposed inclining block rate tariffs. At the NERSA public hearing for municipalities, those applying for an average increase above the guideline of 19% and 22% held on 3 June 2010, and from the well informed presentations, it was clear that there are concerns in this respect. From the issues raised the following are to be noted:

- IBT issues were not debated during the NERSA hearings.
- IBT proposals have been solely made by NERSA.
- IBT proposals should not be done without the establishment of a subsidy framework.
- Data is not readily available to enable municipalities to do an accurate calculation of the revenue impact of the proposed IBT tariffs.
- The practical implication of applying IBT tariffs has not been considered.
- With manual processes, reading period of 3 – 5 week becomes very important.

One of the reasons for stating a point on the IBT tariff, is to highlight the fact that data is not readily available. The author has obtained sufficient data from the City of Ekurhuleni financial system to enable the extraction of meaningful data with the following standard Excel spreadsheet formula (Table 1 and 2).

The first row in the table indicates that a total of 218 customers used a combined value of 4107 kWh units per month. The average consumption for this group, therefore, is 19 kWh units per month. This may either be related to houses that are not occupied permanently or other reasons, e.g. tampering, faulty meters, etc.

From the results obtained, the City of Ekurhuleni was able to structure an IBT tariff, although the tariff levels at c/kWh had to be higher than the NERSA guideline in order to protect the city revenue stream.

Revenue requirements

The starting point for a tariff study is to determine the fair revenue requirements of a municipality. The revenue requirements will then be calculated by applying the new increased tariffs by the forecasted various consumption quantities. Cognisance should be taken that NERSA is in the process of considering the application of a new type of revenue requirement regulatory method. This may be similar to that applied by Eskom and is based on a return of assets methodology.

Ave kWh	Number
=SUMIFS(F2:F250000,F2:F250000,">0",F2:F250000,"<50")	=COUNTIFS(F2:F250000,">0",F2:F250000,"<50")
=SUMIFS(F2:F250000,F2:F250000,">=50",F2:F250000,"<350")	=COUNTIFS(F2:F250000,">=50",F2:F250000,"<350")
=SUMIFS(F2:F250000,F2:F250000,">=350",F2:F250000,"<600")	=COUNTIFS(F2:F250000,">=350",F2:F250000,"<600")
=SUMIFS(F2:F250000,F2:F250000,">=600",F2:F250000,"<60000")	=COUNTIFS(F2:F250000,">=600",F2:F250000,"<60000")

Table 1: Standard Excel formulae used to extract IBT tariff data in spreadsheet according to the NERSA benchmarks and consumption levels.

Tariff	Alberton 2008/09	Ave kWh per month	Number of customers	Ave consumption per customer per month
ELBDOM	=">=0","<50")/12	4107	218	19
ELBDOM	=">=50","<350")/12	248 739	1106	225
ELBDOM	=">=350","<600")/12	973 582	2013	484
ELBDOM	=">=600","<6000")/12	14 746 245	10 723	1375

Table 2: Sample of results obtained with abovementioned formulae.

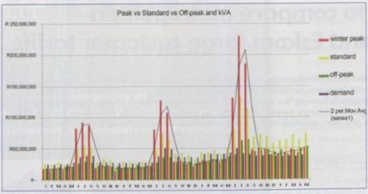

Fig. 1: Total revenue generated.

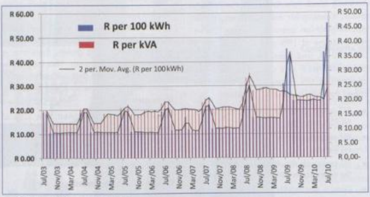

Fig. 2: Cost per kVA vs. cost per kWh.

The completion of a cost of supply study is a complex undertaking. The objective is to establish what the costs are of supplying different types of customers at various points on the electricity network. It is made complex because of various factors and one of them to be mentioned is the "unpopular results" that may emanate.

EDI Holdings and REDs "call for reform"

For many years now it was highlighted that the current electricity distribution industry structure within South Africa does not further the government social and economic development objectives. The South African electricity distribution industry is seen to be highly fragmented with electricity being provided to customers by Eskom and approximately 187 local authorities.

The cabinet has recognised and responded to the need for reform by approving the blueprint report on EDI restructuring in February 2001, stipulating that the electricity distribution industry be restructured so that it is able to:-

- Provide low cost electricity to all customers
- Provide a reliable and high quality supply and service to all customers
- Operate in a financial and efficient manner.

One of the compelling reasons for the REDS restructuring drive was the disparity and lack of transparency in electricity tariffs in South Africa. Due to the difference in tariff structures and tariff levels to the end customers it is, and will remain important to set up a strategy to move the different utilities towards cost reflective and standardised tariffs.

On 6 December 2000, the recommendations of the Municipal Demarcation Board came into effect where two or more municipalities were merged to form one. This process meant that some municipalities distributing electricity at lower prices may have merged with some doing so at higher prices. In the process, electricity prices were either increased or decreased.

Unfortunately it seems that not much has happened over the past years in standardising electricity tariff structures. In fact, in comparing the number of different tariff structures, from 1985 until 2000, it may be concluded that the tariff schedules that were in place in municipalities have "grown" into their different forms over many years and are, in most cases, extremely complicated. A general characteristic of most of them was that they favour the domestic customer at the cost of the business and industrial ones.

Compliance to legislation and National Treasury circulars

This paragraph is not meant to provide an exhaustive list of legislative matters that need to be complied with. It is, however, necessary to highlight that tariffs need to be sustainable and need to be at a level which enables a municipality to meet its financial commitments.

The Local Government Municipal Systems Act (Act 32 of 2000) states, amongst other things, the following:

74.(2) A tariff policy must reflect at least the following principles, namely that –

(d) tariffs must reflect the costs reasonably associated with rendering the service, including capital, operating, maintenance, administration and replacement costs, and interest charges

(e) tariffs must be set at levels that facilitate the financial sustainability of service, taking into account subsidisation from sources other than the service concerned...

The Municipal Finance Management Act (Act 56 of 2003) states, amongst other things, the following:

135.(1) The primary responsibility to avoid, identify and resolve financial problems in a municipality rests with the municipality itself.

(2) A municipality must meet its financial commitments.

(3) If a municipality encounters serious financial problems or anticipates problems in meeting its financial commitments, it must immediately –

(a) seek solutions for the problem;

(b) notify the MEC for local government and the MEC for finance in the province, and

(c) notify organised local government.

The National Treasury's Annexure to MFMA Circular No. 51, dated 23 March 2010, amongst other things, states the following:

...However, in their tariff applications to NERSA municipalities may motivate for higher increases, after considering all factors that impact on their electricity services, including:

- *ensuring a reasonable rate of return on electricity assets*
- *previous under or over-recovery due to last year's increase being less than or greater than the actual 31,3 % increase*

- *the cost of capital expansion programmes and repairs and maintenance*
- *the labour (i.e. the wage agreements with unions) and other input costs or services provided by the municipality or entity*
- *the need to ensure financial sustainability*
- *local economic conditions and*
- *the affordability of electricity services, taking into consideration the municipality's indigent policy.*

In the case of the City of Ekurhuleni it is clear from the graph in Fig. 1 that the total revenue generated by Eskom tariffs during the winter peak hour periods is at least twice as much as the standard time and at least four times the cost of off peak or demand charges. This may also be the case at other municipalities and a clear signal in what direction municipal TOU tariffs should move.

Furthermore, if one analyses the City of Ekurhuleni electricity purchase cost from Eskom, which is made up from approximately 94% on the MegaFlex, 5% NightSave and 0,5% MiniFlex tariffs, over the last six years, it should be noted how sudden the impact of Eskom pricing signals have changed towards a much stronger emphasis on "energy" (kWh) rather than demand. This emphasis on "energy" also has to guide tariff designers and/or finance personnel in municipalities towards new sets of tariffs and/or tariff structural changes.

The graph in Fig. 2 clearly indicates that for the very first time in many years, the energy pricing signal per rand value of 100 kWh vs. the rand value per kVA demand costs are higher than those of previous years. The data is based on the City of Ekurhuleni and indicates the stronger weight on energy for electricity purchased since July 2003 till June 2010. If this fact is missed and kWh and kVA costs are only increased by the same proportion as required by the normal revenue requirements, it may result in extremely skewed tariff signals which may have negative results on certain customers, once tariff rationalisation and standardisation are realised in the South Africa distribution sector.

In Fig. 3 the green bars clearly indicate that for the period July 2009 to June 2010, in terms of percentage increases/decreases, that the demand (kVA) purchases cost for the City of Ekurhuleni actually decreased in comparison with the period July 2008 to June 2009. The red bar indicates a shift in emphasis towards demand (kVA) costs during the month July 2010.

Fig. 4 clearly indicates for the period July 2009 to June 2010, in terms of percentage increases/decreases, the energy (kWh) purchases cost for the City of Ekurhuleni actually increased more than kVA cost and thus clearly indicates that there was higher emphasis placed on energy cost during 2009/10 than previous years. The red bar indicates a 23% increase for the current year July 2010.

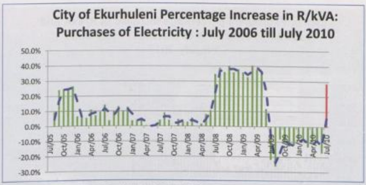

Fig. 3: Percentage increase in R per kVA July 2006-July 2010.

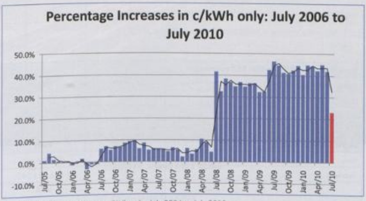

Fig. 4: Percentage increases in c/kWh only: July 2006 to July 2010.

Fig. 5 is a combination of Fig. 3 and Fig. 4 and depicts the difficulty that municipal tariff designers may experience due to unpredictable pricing signals over the past years. The last two bars clearly indicate that the pricing signals for demand (kVA) and energy (kWh) during 2010/11 now have again put more emphasis on kVA charges than kWh.

Tariff comparisons:

Only the following main categories of tariffs will be briefly compared and discussed in this paper:

Ekurhuleni Metropolitan Municipality 2009/10

- *Tariff C:* (kWh and kVA – demand tariff) and
- *Tariff D:* (TOU tariff > 100 kVA)

City Power Johannesburg 2009/10

- *Large customer demand tariff (medium voltage):* (kWh and kVA – demand tariff) and
- *Large customer time-of-use tariff (medium voltage):* (TOU tariff > 100 kVA)

City Of Tshwane Metropolitan Municipality 2009/10

- *11 kV supply scale tariff:* (kWh and kVA – demand tariff) and
- *11 kV supply scale time-of-use tariff* (TOU tariff > 750 kVA)

Ethekwini Electricity Tariffs 2009/10

- *Obsolete large power user tariff LV3:* (kWh and kVA – demand tariff) and
- *Industrial time-of-use* (ITOU tariff > 100 kVA)

Nelson Mandela Bay Municipality Tariffs 2009/10

- *Large busness* : (kWh and kVA – demand tariff) and
- *Large busness 6600 and above TOU*

Eskom 2009/2010

- *NightSave Urban:* Supply voltage >500 V and <66 kV, and transmission surcharge 0% (kWh and kVA – demand tariff) and
- *MegaFlex* supply voltage >500 V and <66 kV, (TOU tariff > 1000 kVA).

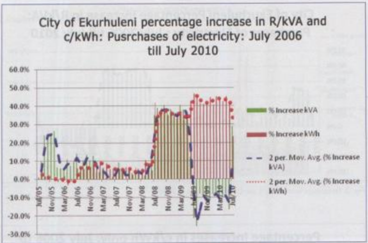

Fig. 5: Percentage increase in R/kVA and c/kWh: July 2006 to July 2010.

Base data for TOU tariffs: 550 customers		
June, July, August	**% kWh**	**kWh**
Peak	16,1	130 633 897
Standard	40,5	327 754 878
Off-peak	43,4	351 860 618
September to May	**% kWh**	**kWh**
Peak	15,8%	402 386 421
Standard	40,0%	1 016 111 240
		kVA
June, July, August (kVA)	Max. kVA demand	1 937 371
September to May (kVA)	Max. kVA demand	6 286 918

Table 3: Base for TOU tariff – 550 customers data.

	Eff. kWh unit cost (inc. VAT)	**Total kWh**	**Account total (inc. VAT)**	**Increase vs. Eskom (percentage)**
Ekurhuleni TAR-D-2009/10	R0,56595	3 351 456 705	R1 896 742 739,89	49,81%
eThekwini-ITOU LPU-2009/10	R0,50500	3 351 456 705	R1 692 471 681,43	33,68%
Tshwane-11kV TOU-D-2009/10	R0,50614	3 351 456 705	R1 696 304 121,48	33,98%
Cape Town Very LPU-TOU-2009/10	R0,68680	3 351 456 705	R2 301 787 833,69	81,80%
City Power-TOU-2009/10	R0,66511	3 339 183 469	R2 220 932 717,73	76,06%
NM Metro (PE) -TOU-2009/10	R0,58767	3 351 456 705	R1 969 555 919,92	55,56%
Average	**R0,58611**		**R1 962 965 835,69**	**55,15%**

Table 4: Comparason of tariffs.

Comparative tariffs when benchmarking with other cities

Two datasets were taken and the tariffs of each of the cities indicated in Table 4 were applied to these datasets. The results indicate the relevant position of the City of Ekurhuleni when benchmarked against these cities.

This is a theoretical exercise, however, it is clearly showing tariff levels for time-of-use customers (using an actual database of 550 customers) and demand tariff levels (using an actual database of 2790 customers). However, it is important to note that whenever any time-of-use (TOU) tariffs are compared that one should use the exact same proportional units for peak, standard and off-peak periods.

However, if the data in Table 4 is further analysed and broken down into the two main cost components that affect electricity purchases from Eskom and are then ranked in terms of the "energy" costs, e.g. R/100 kWh, the City of Ekurhuleni will be in number one position, as indicated in Table 5 and highlighted in yellow, which is the best position to be in.

If the data in Table 7 is further analysed and broken down into the main two cost components affecting electricity purchases from Eskom and are then ranked in terms of the "energy" costs, e.g. R/100 kWh, Nelson Mandela Bay Municipality will receive the number one ranking and the City of Ekurhuleni will be ranked number four, as indicated in Table 8 and highlighted in yellow.

Based on the results in Table 8 and the higher emphasis on energy costs purchased from Eskom, the Ekurhuleni three part tariff, (Fixed, kWh and kVA), the kVA component has been decreased as shown in Table 9 for the 2010-2011 year to put more emphasis on higher cost of energy (Table 9).

And the c/kWh energy component has been increased for the 2010-2011 year to reflect this higher cost towards energy (see Table 10).

The effect of re-balancing the Ekurhuleni Tariff C, to place higher emphasis on energy and decrease the cost on kVA, is depicted in Fig. 6. The red line clearly indicates that the lower load factor customer will benefit in that they will experience a lower than normal increase and at an extreme low load factor may even benefit more. On the other end, the higher load factor customers will experience a higher than normal increase when more emphasis is placed on energy (kWh) charges relative to demand (kVA) charges.

Note: Possible temporary special conditions may be put in place for high load customers who will experience a higher than normal increase e.g. a rebate, based on the merits of each case. The rebate will only be valid for the current financial year. The rebate will be applicable to the current financial year for a maximum of two months preceding the month in which application is made. Spreadsheets providing substantial proof, using valid and similar consumption values on both the previous and new tariffs, to be attached to the application. Example of rebate to apply.

Increase of 40% to 44,9%	Rebate of 5%
Increase of 45% to 49,9%	Rebate of 7,5%
Increase of 50% and higher	Rebate of 10%

Theoretically, should other municipalities add 30% to the normal required percentage

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- High brightness
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- Public Lighting

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	kWh cost [R]	kWh	Energy cost [R/100 kWh]	kVA cost [R]	kVA	Demand cost [R/kVA]	Relative energy ranking based on R/100 kWh 1=best, 6=worst
Tshwane-11kV TOU-D-2009/10	R750 557 019	3 351 456 705	22,39	R732 866 407	8 224 289	89,11	6
eThekwini-ITOU LPU-2009/10	R979 481 124	3 351 456 705	29,23	R493 833 200	8 224 289	60,05	5
Cape Town Very LPU-TOU-2009/10	R1 080 249 147	3 351 456 705	32,23	R312 522 988	8 224 289	38,00	4
NM Metro (PE) -TOU-2009/10	R1 150 068 749	3 351 456, 705	34,32	R571 176 882	8 224 289	69,45	3
City Power-TOU-2009/10	R1 270 215 795	3 339 183 469	38,04	R631 107 631	8 171 533	77,23	2
Ekurhuleni TAR-D-2009/10	R1 339 390 815	3 351 456 705	39,96	R319 138 606	8 224 289	38,80	1
Eskom MegaFlex 500V to 66kV-2009/10	R944 218 465	3 351 456 705	28,17	R152 478 321	8 224 289	18,54	

Table 5: Comparitive costs of electricity R/100kWh: dataset 1.

increases to their tariffs for 2010/2011, and not do as Ekurhuleni has done, e.g. increase energy c/kWh price and decrease R/kVA prices, Ekurhuleni Tariff C may be placed in the number one position regarding the weighted energy price component to its customers on this tariff structure (see Table 11).

From the issues raised at the NERSA public hearing it was clear that many role players in the distribution industry are well informed on the socio economical issues as well as maintenance and future refurbishment challenges we are faced with. To name a few issues raised:

- Percentage funding of operational budget normally allocated for maintenance now gets distorted due to the high percentage increases of purchases of electricity even if it is substantially increased.
- That the negative growth in the economy be expressed in the budget preparations as a negative value that represents "income forgone".

Base data (typical kWh & kVA tariffs): 2790 customers					
Winter kWh	Winter kVA	Summer kWh	Summer kVA	Total kWh	Total kVA
581 242 830	1 728 075	1 531 646 482	4 866 436	2112 889 312	6 594 511

Table 6: Base data (typical kWh & kVA Tariffs): 2790 Customers

	Eff. kWh unit cost (inc. VAT)	Total kWh	Account total (inc. VAT)	Increase vs. Eskom (percentage)
Ekurhuleni-TAR-C-2009/2010	R0,7324	2 112 889 312	R1 547 495 099,22	66,68%
eThekwini "Obsolete"-TAR-C-2009/2010	R0,7531	2 112 889 312	R1 591 133 642,25	71,38%
Tshwane -11kV Supply Scale TAR-C-2009/2010	R0,6220	2 112 889 312	R1 314 121 410,30	41,54%
Cape Town LPU TAR-C-2009/2010	R0,6681	2 112 889 312	R1 411 665 858,95	52,05%
City Power MV LPU TAR-C-2009/2010	R0,8097	2 136 453 979	R1 729 988 756,40	8428%
NM Metro (PE) Tar C-2009/2010	R0,6863	2 112 889 312	R1 450 085 028,82	56,18%
Average	**R0,71193**		**R1 507 414 965,99**	**62,02%**

Table 7: Comparison of tariffs.

	kWh cost [R]	kWh	Energy cost [R/100 kWh]	kVA cost [R]	kVA	Demand cost [R/kVA]	Relative energy ranking based on R/100 kWh 1=best, 6=worst
Tshwane -11kV Supply Scale TAR-C-2009/2010	R541 956 109	2 112 889 312	25,65	R587 636 912	6 594 511	89,11	6
eThekwini "Obsolete"-TAR-C-2009/2010	R561 227 772	2 112 889 312	26.56	R819 329 795	6 594 511	124,24	5
Ekurhuleni-TAR-C-2009/2010	R618 315 898	2 112 889 312	29,26	R705 229 871	6 594 511	106,94	4
Cape Town LPU TAR-C-2009/2010	R641 895 773	2 112 889 312	30,38	R596 407 612	6 594 511	90,44	3
City Power MV LPU TAR-C-2009/2010	R776 163 589	2 136 453 979	36,33	R688 597 223	6 629 821	103,86	2
NM Metro (PE) Tar C-2009/2010	R773 211 844	2 112 889 312	36,60	R457 988 818	6 594 511	69,45	1
Eskom-N/S Urban -2009/2010	R508 640 943	2 112 889 312	24,07	R305 786 383	6 594 511	46,37	

Table 8: Comparative costs of electricity: Dataset 2.

C.2. Demand charge, per kVA registered, per month, per point of supply							
C.2.1. High demand season (June, July and August)				C.2.2. Low demand season (September to May)			
	Voltage	2009-2010	2010-2011		Voltage	2009-2010	2010-2011
C.2.1.1.	230/400 V	R111,16	R67,20	C.2.2.1.	230/400 V	R91,84	R56,00
C.2.1.2.	230/400 V, direct from substation	R109,18	R66,00	C.2.2.2.	230/400 V, direct from substation	R90,20	R55,00
C.2.1.3.	>230/400V & < 11kV	R107,19	R64,80	C.2.2.3.	>230/400 V & ≤11kV	R88,56	R54,00

Table 9: Ekurhuleni Tariff C: Demand harge (Rand/kVA).

C.3. Energy charge, per kWh consumed							
C.3.1. High demand season (June, July and August)				C.3.2. Low demand season (September to May)			
	Voltage	2009-2010	2010-2011		Voltage	2009-2010	2010-2011
C.3.1.1	230/400 V	R41,55	R89,60	C.3.2.1.	230/400 V	R26,10	R53,80
C.3.1.2. See note 2	230/400 V, direct from substation	R40,80	R88,00	C.3.2.2. See note 2	230/400 V, direct from substation	R25,60	R52,80
C.3.1.3.	>230/400 V & ≤ 11kV	R40,07	R86,40	C.3.2.3.	>230/400 V & < 11kV	R25,16	R51,80

Note 2: The much higher than normal price increase in c/kWh during 2010/2011 compared with 2009/2010.
Table 10: Ekurhuleni Tariff C: Energy charge (R/100kWh).

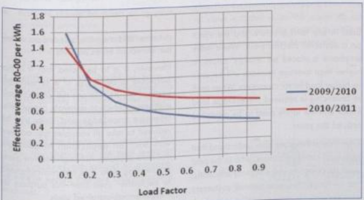

Fig. 6: The effect of re-balancing tariff C.

- Revenue is under pressure due to increased levels of customers defaulting on services payment, as well as increased levels of tampering.
- Critical skills shortages.
- What is the correct level of cross subsidisation? Are we moving in the right direction?
- Rate payers – War on Waste (WoW).

Historical developments of tariffs

The first commercial tariff was derived by Thomas Edison in 1882, that is, eight years before electricity was introduced in South Africa in Kimberley. This was a flat-rate tariff which persisted for many years. Electricity during the early years was used for only part of the day. Outside this, the generating facilities were idle. It was not long, however, before industrial and motive power were found to take up some of the unused capacity during daytime.

The fact that the same plant was used for different consumers at different times of each day presented a cost-allocation problem, that is, the electricity became diverse. The origin of a new costing philosophy for designing a tariff for time-of-the-day customers can be traced to 1882 when an electrical engineer, Dr. John Hopkinson proposed the division into two sets of costs of supplying the customer with electricity:

- The "running costs" which he regarded as those incurred in the actual operation of the plant.
- The "standing costs" which he called the cost relating to the readiness to supply electrical energy.

The cost to the customer for the first service is entirely dependent on the amount of energy (kWh) consumed (variable cost), while the cost to the customer for the second service is fixed in the short term in that it is not dependent on whether that particular consumer purchases energy (a fixed cost). The fixed cost is largely dependent on the cost of necessary generation, transmission and distribution equipment. These costs are, in turn, influenced by the kVA capacity of the plant equipment, and hence, it is reasonable to specify the fixed costs per unit of electrical capacity (kVA).

RRM implementation guidance for municipal electricity businesses

The purpose of the regulatory reporting manual (RRM) implementation guidance is to highlight only (but not all) those significant areas where there are differences in accounting calculations between the standards of Generally Recognised Accounting Practice (GRAP) framework and the regulatory reporting manuals (RRMs) requirements prescribed by NERSA for the electricity distribution business.

This guidance is organised in two parts. The first part comprises of this high level summary of the significant areas of the differences and suggested resolution of the differences. The second part is the main body that contains this guidance that contains an introduction for context and then a more detailed comparative table pin-pointing: areas of significant divergence; the GRAP framework provision, RRM prescription and a resolution that envisages building from the GRAP framework financials to RRM regulatory financial reports.

The RRM cost allocation manual (CAM) outlines the expected principal features of a cost allocation manual. It will also enable regulatory department analysts to evaluate in a systematic manner the CAM submitted by licensees to NERSA. The CAM can ensure that more direct cost assignments are made and should ensure that separation and no cross-

Theoretical exercise to prove how a municipality may be in the number one position with more emphasis on energy charges assume Ekurhuleni restructure tariff and others only add 30% to both kWh and kVA charges							
	kWh cost [R]	kWh	Energy cost [R/100 kWh] Ekurhuleni 2010/2011 higher emphasis on energy	kVA cost [R]	kVA	Demand cost [R/kVA]	Relative energy ranking based on R/100 kWh 1=best 6=worst
Tshwane -11kV Supply Scale TAR-C-2009/2010	R704 542 941	2 112 889,312	33,35	R587 636 912	6 594 511	115 843	6
eThekwini "Obsolete"-TAR-C-2009/2010	R 729 596 103	2 112 889 312	34,53	R819 329 795	6 594 511	161,52	5
Cape Town LPU TAR-C-2009/2010	R 834 464 505	2 112 889 312	39,49	R596 407 612	6 594 511	117,572	4
City Power MV LPU TAR-C-2009/2010	R1 009 012 666	2 136 453 979	47,23	R688 597 223	6 629 821	135,02	3
NM Metro (PE) Tar C-2009/2010	R1 005 175 397	2 112 889 312	47,57	R457 988 818	6 594 511	90,29	2
Ekurhuleni-TAR-C-2009/2010	R1 295 586 683	2 112 889 312	61,32	R374 766 826	6 594 511	56,83	1
Eskom-N/S Urban -2009/2010	R 661 233 226	2 112 889 312	31,30	R397 522 298	6 594 511	60,28	

Table 11: Ekurhuleni Tariff C may relatively well be placed in the number one position regarding the weighted energy price component to its customers on this tariff structure.

subsidisation occurs between regulated and non-regulated lines of businesses. It will also assist a licensee to identify areas of weakness in its cost allocation.

In theory, the calculated revenue requirement of a municipal distributor should be divided by the projected volumes of electricity sold, in order to produce the average price to be charged per unit sold to its customers to recover the required revenue.

Challenges of the rate of return (RoR) methodology:

- How the methodology should be implemented.
- The differences between current revenues from different customer classes and the calculated revenue requirements per customer class, per municipality.
- The approach NERSA needs to follow when introducing the RoR method of regulation.

By applying the rules for qualifying expenses contained in NERSA's regulatory framework and the RRM, an exercise conducted at a metropolitan municipality that has undergone the EDI Holdings ringfencing exercise will assist a long way to learn from the results.

The broad categories of fixed and variable expenditure data to be gathered include energy purchases, operating and maintenance costs, customer service costs, other overhead costs, depreciation on assets, bad debts and revenue from other sources.

Load factor

It is important to understand how the load factor impacts on the various tariffs used in any tariff structure and the effect on a customer electricity bill. When more emphasis is placed on "energy" prices, a higher than average increase will be seen by higher load factor customers. When tariff re-balancing is required the average load factor and the tariffs need to be modelled around this point.

One should therefore also understand that high load factor customers, who in the past were perceived to use electricity efficiently, are no longer the most optimal customers as they consume large quantities in the high priced season and periods. In fact, the City of Ekurhuleni 2010/2011 electricity tariff increases on lower load factor customers may have an effect that they will probably experience that the percentage increase on their accounts are more favourable towards them than towards high load factor customers.

Municipal tariff comparison with profile data

The author developed a set of spreadsheets to simultaneously calculate ten different electricity tariff accounts for various metros, e.g. Ekurhuleni, City Power, Tshwane, Nelson Mandela Bay, eThekwini and Eskom and will demonstrate its application.

The author wishes to enhance municipal tariff comparisons through the application of the spreadsheet in order to assist members of the AMEU in interpreting the results with exactly the same data. In generating bills from the same sets of data, it is hoped to enable the AMEU members ensure that customer bills are more fairly and accurately compared, as far as possible.

However, it is to be noted that it is not advisable to make use of a spreadsheet application, as it is not the correct tool/platform in which to generate actual bills. Intensive knowledge and skills will be required to take all variables into account with such an application to generate accurate accounts. Although this may assist in checking data it is not recommended to be further used than this purpose by inexperienced/untrained users.

At least, spreadsheet applications is viewed by the author as the best way to analyse the impact of current and future tariffs and what the impact will be on customer accounts.

Conclusion

It must be noted that electricity related revenue is under pressure due to increased levels of customers defaulting on services payment, as well as increased levels of meter tampering. Although processes are in place to cope with these challenges, and more processes are being put in place, the negative effects associated with the current poor economic conditions, are bound to persist for most municipalities.

A large scale loss in jobs creates further difficulties for municipalities. It may be assumed that most jobs lost belonged to Municipal residents, who are then no longer able to pay for municipal services, hence start defaulting on payments.

Municipalities, therefore, do not only lose the sales to the industrial customer, but also the income from the residential customer (who still uses the services, but now without paying and by means of illegal reconnection).

It is a fact that our fossil fuels, the prime source of our power, are running out. The cost of energy, coal, as the demand rises and the basic resources decrease, will continue to rise. We have a serious responsibility to ourselves and to our future generation to manage this commodity wisely and effectively

Developing new electricity tariffs and standardisation processes based on NERSA guidelines will have to consider the following:

- Tariff increases should be stable, gradual and predictable.
- Tariffs should be as cost-reflective as possible.
- Tariffs should be affordable to all customer categories.
- Account should be taken of revenue neutrality principles.
- In accordance with the NERSA directive only one price increase is allowed per year.
- Tariff adjustment should be done in accordance with the recommendations and policies described in the Interim National Distribution Tariff System guideline issued by the NERSA in 1995.

In terms of the Electricity Amendment Act 1994, any changes to the tariff levels or tariff structures are subject to approval of NERSA before they are applied to any end-user.

Reality is that some will win and some will lose. It just seems that all of us will have to work together to achieve realistic goals where everybody shares and carries some load. I am confident that if we work together by openly sharing and debating information real progress can easily be made through the AMEU(SA) and its tariff committee.

Anyway, the intention of this year's convention theme is for members and stakeholders to share problems and be able to openly discuss the impact and possible solutions to the many challenges municipalities are facing in areas such as the effect of bulk purchase tariff increase on setting municipal tariffs, and others.

The total Eskom increases in the price of bulk electricity will in most municipalities result in a 28,9% increase as of 1 July 2010, valid until 30 June 2011. Vulnerable customers are to be protected from the high increases, in line with NERSA instructions.

To reduce financial risk to municipalities, some future tariffs may need to be re-balanced to reflect the Eskom higher emphasis on "energy", rather than on demand. One will also have to keep a close eye on when this emphasis may be change again towards demand costs in future.

The future economic regulation of the electricity distribution industry could be made easier through a standardised method of allocating the revenue requirements and related tariff calculations by means of applying the principles in the RRM and when the RoR methodology is applied.

In all instances, tariffs should be, uncomplicated, understandable, acceptable by the customer, feasible in application and interpretation, effective to yield the total revenue requirement, stable from year to year, fair in apportioning cost amongst customers and promote efficient use of energy.

Note

The author and presenter wants to make it clear that the content, discussions, comments or views included in/on this paper do not necessarily represent the position or views of Ekurhuleni Metropolitan Municipality.

Acknowledgement

The author wishes to acknowledge and thank Dr. Freddie Fryer, director: revenue services, from the City of Ekurhuleni, for his comments and editorial contributions provided.

References

[1] Actual data from the City of Ekurhuleni Metering On-line system.

[2] Actual data from the City of Ekurhuleni purchases of electricity.

[3] The Municipal Finance Management Act (Act 56 of 2003).

[4] The Local Government Municipal Systems Act (Act 32 of 2000).

[5] Edi Holdings: Draft project charter for the pricing sub work group rev 13 June 2005.

[6] Interim National Distribution Tariff System document (NER guideline on electricity pricing in South Africa December 1995).

[7] Tariff History 2002-2007, compiled by Bolden Romokgopo Eskom tariff history.

[8] NERSA RRM Cost Allocation Manual Evaluation Matix (CAMEM).

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An analysis of municipal tariff determination

Municipal distribution is in a challenging environment. This paper will throw some light on the challenges faced by some municipalities on some of the realities, challenges and solutions to this challenge with specific reference to tariffs and pricing.

by Hendrik Barnard, Elexpert

The following events form the background to electricity pricing in the distribution industry. The lack of an Eskom price increase announcement in time for the 2008/2009 increase; the National Treasury guideline stipulating that municipalities should use an increase of 34%; the lack of guidelines from NERSA to municipalities in terms of price increases; the high Eskom price increase of 25% that was only announced by the end of June 2009; the application of average price increases of 34% and more by the majority of municipalities; the high increase of 25% announced by Eskom for 2010/11 for municipalities by the end of April 2010; the guideline increase from NERSA of 18% for those who applied 34% the previous year, etc; the NERSA dictated inclining block rate tariff without consultation and against many current policies.

This caused price increases that were too high to be applied in 2009/10 and lower increases being applied in 2010/11, lower increases for poor customers and the introduction of inclining block rate tariffs by some. All of these have serious financial implications, which will be highlighted later.

These steps will be analysed with a view to understanding the underlying challenges and then to propose solutions for these. Proof of these changes is given below:

From Eskom tariff book

Price increase

On 25 June 2009 NERSA approved a average tariff increase of 31,3% for Eskom effective 1 July 2009. To protect the poor the NERSA determination includes a lower increase to the Eskom Homelight customers that results in the following price increases:

- *The average price increase for tariffs to customers directly supplied by Eskom, excluding local-authorities (municipalities) and the Homelight 1 and 2 tariffs is 33,6%.*
- *The average price increase to the local-authorities tariffs is 31,3%.*
- *Homelight 1 and 2 tariffs will experience a price increase of only 15%.*

From NERSA media statement

3. In order to provide for cross-subsidies for low income domestic customers, as required by the Electricity Pricing Policy (EPP[1]), implement residential inclining block rate tariffs concurrently with this price increase. The structure of the inclining block tariffs, together with the average c/kWh and percentage price increases, are as follows:

From NERSA media statement 24 February 2010

7. For those municipal distributors who implemented the 34% increase in the 2009/10 financial year, a municipal guideline of 15,33% is approved for implementation with effect from 1 July 2010 followed by 16,03% from 1 July 2011 and another 16,16% from 1 July 2012. For those municipal distributors who implemented a different increase the Energy Regulator will consider applications on a case by case basis.

NERSA media statement 14 April 2010

7. For those municipal distributors who implemented the 34% increase in the 2009/10 financial year, a municipal guideline of 15,33% is approved for implementation with effect from 1 July 2010 followed by 16,03% from 1 July 2011 and another 16,16% from 1 July 2012. For those municipal distributors who implemented a different increase the Energy Regulator will consider applications on a case by case basis.

Analysis of increases

The first statement is one of great disappointment for the players in the industry, and has put municipalities in a difficult financial situation:

- Eskom for breaking the law and not announcing its price increase in time
- NERSA for not doing anything such as getting into discussions with municipalities or issuing temporary guidelines
- NERSA for applying bullying tactics to get the inclining block rate tariffs approved and applied
- National Treasury for not liaising with NERSA and SALGA and then issuing unclear guidelines
- Municipalities/AMEU who did not seek clarification on what to do
- Many municipalities for applying the inclining block rate tariffs without realising the true impact

Despite all these negatives, the industry has shown a reasonalbleness in reaching meaningful solutions. The impact of the current legal dispute between municipalities and NERSA about the right to set tariffs has probably worsened this situation.

Response to the increases

In view of the guidelines from National Treasury for a 34% price increase, the majority of municipalities applied an average increase of 34%. A few municipalities did however do the logical interpretation and applied an increase which catered for an increase in Eskom purchase cost of 34% which meant an average increase of about 25%.

When the Eskom increase of 31,3% for municipalities was announced by the end of June, not a single municipality that I know of, realised the true impact and adjusted the tariffs down. The average impact on municipalities of the above actions is shown in Table 1.

The first impact according to the guideline issued 24 February and the second based on guidelines issued 14 April 2010.

The initial guidelines show the claw-back intended by NERSA, but an over claw-back. The later guideline yields a more lenient claw-back of the initial over-recovery. From this it can be concluded that the later guidelines from NERSA in this respect, are reasonable.

Analysis of municipal impact

Before criticising any of the parties, it is necessary to assess the actual impact on municipalities. Table 2 shows the impact on an average municipality when applying the Eskom increase exactly to their customers with increases to the poor limited to 15%, and making up the lost revenue from other customers.

Eskom price increase impact				
	2009/10	**2010/11**	**2011/12**	**2012/13**
Eskom increase for LG	27,50%	28,90%	29,90%	30,00%
Purchase cost % of total	58,00%	59,00%	59,00%	60,00%
Other costs and profit	42,00%	41,00%	41,00%	40,00%
Other cost increases	10,00%	10,00%	10,00%	10,00%
Impact due to purchase cost increase	15,95%	16,93%	17,69%	17,93%
Impact due to other cost increase	4,20%	4,14%	4,08%	4,02%
Total increase applied	20,15%	21,07%	21,77%	21,95%
Inital guideline				
Increase applied	34,00%	15,33%	19,03%	16,16%
Over/(under) recovery	13,85%	-5,74%	-2,74%	-5,79%
Cumm: Over/ (under) recovery	13,85%	8,11%	5,36%	-0,43%
Later guideline				
Increase applied	34,00%	19,00%	19,76%	20.00%
Over/(under) recovery	13,85%	-2,07%	-2,01%	-1,95%
Cumm: Over/ (under) recovery	13,85%	11,78%	9,77%	7,81%

Table 1: Impact on an average municipality when applying the Eskom increase exactly to their customers with increases to the poor limited to 15%, and making up the lost revenue from other customers.

The impact is staggering. It shows the following:

- The cumulative increase on non-poor customers of 329,9%. This is definitely not sustainable
- This exceeds the increase in costs to the municipality by 216% cumulatively and cannot be defended based on cost of supply
- The surplus increase going from 20% to 31,7%. The dependency of the municipality on electricity surplus going from 22% to 85%. This is going to complicate the forming of REDs.

Action required

The important message from this analysis is that municipalities have to apply cost reflective increases to the various customer categories and that subsidies should remain within the national guidelines rather than arbitrarily set limits. This includes stipulations made by NERSA.

Problematic practices

The question recently being asked, is why municipalities cannot survive with the increases granted by NERSA. The previous section suggests that they should be able to. This section will highlight some other aspects which illustrate the problem for electricity departments specifically.

The first problem relates to municipalities that compile budgets for the electricity departments which are used as a basis for the application of electricity price increases to NERSA, but then a large portion of this money is not spent because of the following:

- Municipal management do not approve the appointment of electricity staff
- Expenditure on electricity capital projects is simply stopped
- Very restrictive measures are applied to electricity departments in running their daily businesses

The second big problem is that municipalities are embarking on massive non-electricity capital projects with revenue requirements that exceed by far that of the municipality. What is happening now is that the capital projects of the electricity department are being cut and the money is used for non-electricity capital. Examples of this are the purification of sewerage water for drinking purposes, the building of high speed bus services, etc.

The next big problem relates to practices to hide non-electricity expenditure in the electricity budget. An example was identified in one municipality where the cost of public lighting, which up until recently was part of the municipal budget and electricity was compensated to provide this service. A strategy has now been approved to move all these costs to electricity without any compensation. This increases the net cost to electricity with no adjustment in electricity revenue.

The extract from the EPP clearly shows that the above practice is a contravention of the EPP

Policy position: 40

Public lighting including street lights, high mast lights, parking area lights and traffic lights are considered as consumers of electricity and are not part of electricity supply. The associated charges must cover capital and operating costs associated with energy, electricity network, dedicated lighting networks and lighting services. Such services may be provided by electricity utilities, but such costs must be charged to the appropriate owner, in most cases the municipality. The municipality can in turn fund such services from the MSOE.

Another problem that has been identified, relates to the provision of and write off of bad debt. A few cases have been found where the outstanding debt of the total municipality, of which typically more than 80% relates to non-electricity services, are being written off to all services on a ratio of total revenue rather than actual outstanding debt. In this way the electricity ends up with a very large cost which has no relationship to unpaid electricity.

The big problem with these practices is that the municipalities are increasing their dependence on electricity profits beyond the levels allowed in LG legislation in a hidden way. Furthermore, the problem of arrear electricity infrastructure maintenance and refurbishment is being exaggerated. When major network faults occur, which cause long outages because of non-maintained networks, the damage and losses to the town and thus the municipality, would be very serious and claims for damages due to negligence could become a serious problem.

Proposed actions

- National Treasury once and for all needs to set the rules for ringfencing of electricity from the rest of the municipality
- National Treasury then also needs to set the limits/proposed levels for the municipal surplus on electricity
- Municipalities then need to stay within these levels and NERSA must regulate the electricity tariffs to remain within these levels
- Electricity managers can then take responsibility within normal budget constraints to run their businesses with a high level of quality

Large customer tariffs

The high Eskom price increases have a significant impact on the tariff structures to be applied by municipalities. The main changes are as follows:

- The energy cost component of the municipal tariff becomes a larger portion of the total tariff
- This means that the costs for customers at higher voltages, would increase closer to the Eskom increases rather than the municipal tariff increases

Eskom price increase impact	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13
Electricity revenue (zero growth) [R-million]	(10,00)	(13,59)	(17,84)	(23,00)	(29,88)	(38,84)
Purchase cost (zero growth) [R-million]	6,00	8,15	10,71	13,80	17,93	23,30
Other costs [R-million]	2,00	2,20	2,42	2,66	2,93	3,22
Purchase cost % of revenue	60,0%	60,0%	60,0%	60,0%	60,0%	60,0%
Eskom average increase for munics		35,9%	31,3%	28,9%	29,9%	30,0%
Cost increase due to Eskom		21,5%	18,8%	17,3%	17,9%	18,0%
Electricity other costs % of rev		40,0%	40,0%	40,0%	40,0%	40,0%
Own cost inflation		10,0%	10,0%	10,0%	10,0%	10,0%
Cost increase due to own cost		4,0%	4,0%	4,0%	4,0%	4,0%
Total effective cost increase		25,5%	22,8%	21,3%	21,9%	22,0%
Cumm cost increase		25,5%	48,3%	69,7%	91,6%	113,6%
Actual increase applied		35,9%	31,3%	28,9%	29,9%	30,0%
Cummulative increase		35,9%	78,4%	130,0%	198,8%	288,4%
Surplus	2,00	3,24	4,72	6,54	9,02	12,32
Surplus % of revenue	20,0%	23,8%	26,4%	28,4%	30,2%	31,7%
% Surplus increase		61,8%	45,8%	38,6%	38,0%	36,5%
Municipal rates revenue [R-million]	(9,00)	(9,90)	(10,89)	(11,98)	(13,18)	(14,49)
Surplus % of municipal rates revenue	22%	33%	43%	55%	68%	85%
Tariff restructuring						
Differential increase to poor		-21%	-16%	-14%	-15%	-15%
Cumm. differential increase to the poor		-20,9%	-33,8%	-43,0%	-51,5%	-58,8%
Differential increase to other customers		3,5%	2,7%	2,3%	2,5%	2,5%
Cumm. differential increase to other customers		3,5%	6,3%	8,8%	11,5%	14,2%
Price increase to the poor		15%	15%	15%	15%	15%
Cummulative increase to the poor		15,0%	32,3%	52,1%	74,9%	101,1%
Price increase to other customers		39%	34%	31%	32%	33%
Cumm. increase to other customers		39,4%	86,6%	145,1%	224,5%	329,9%
Cumm. additional increase to non-poor customers		13,8%	38,5%	75,4%	132,9%	216,3%

Table 2: Impact on an average municipality when applying the Eskom increases exactly to their customers and increases to the poor limited to 15%, but making up the lost revenue from other customers.

These dynamics were studied in some municipalities. Fig. 1 shows the % mark-up in energy prices for the large customers in the 2009/10 tariffs.

The large majority of municipalities are selling the energy at prices lower than the Eskom purchase costs. This is by no means saying that these customers are being cross-subsidised, as the demand charges by far exceed the municipalities' other costs. Fig. 2 shows the total mark-up on the average Eskom purchase costs at a load factor of 60%.

At least one municipality is selling its electricity at below cost to the majority of its large customers. The majority of municipalities are however making significant profits from large customers.

Action required

Municipalities need to undertake some form of cost of supply analysis with a view to at least determining the relationship between energy and other costs and to restructure the tariffs accordingly. While the very high Eskom price increases are taking place, this should be done every year.

Time-of-use (TOU) Tariffs

Eskom introduced its TOU tariffs more than 15 years ago. The majority of municipalities are purchasing their electricity from Eskom on either Megaflex or Miniflex. Despite this the state of TOU tariffs in municipalities is appalling. The reasons for this are as follows:

- Many municipalities have not yet introduced TOU tariffs for their customers
- In many cases the TOU tariffs are more expensive than the non-TOU tariffs
- In many cases the process to convert to TOU involves a long process of analysis, a very high conversion fee, revenue neutral surcharges and in some cases very little support from municipal staff.
- The tariff structures are set contrary to the cost of supply and without an understanding of the underlying principles and consequences
- Customers are not provided with the required meter and data support
- In many cases the meters are not available

The bottom line of all of this is that a very small portion of municipal customers, specifically large customers, are on a proper TOU tariff. One of the underlying problems relates to the belief by many municipal staff, that only those customers who can benefit from load shifting should be on TOU. This is proof of the lack of understanding and appreciation of the reasons for TOU tariffs:

- The first and main reason for the application of TOU tariffs is to be more cost reflective. Customers have very differing load profiles and thus different usage percentages in the different TOU periods. When only one energy rate is applied, the tariff is not reflective of the big cost difference.
- The second reason is to enable load shifting. There is a perception that customers must first prove that load shifting can be done, before being converted. Experience in South Africa and worldwide proves that customers start reacting when they receive the time differentiated price signals.

Fig. 3 shows the c/kWh mark-up on the Eskom energy prices for some of the municipal TOU tariffs at MV.

ELECTRICITY IS A SCARCE RESOURCE... USE ENERGY FROM THE SUN TO REPLACE COAL FIRED ELECTRICITY

Ekurhuleni
Electricity & Energy

reliable and economical, our electricity future in good hands.

City of Ekurhuleni

a partnership that works

IN TERMS OF CLIMATE CHANGE MITIGATION

OUR COMMITMENT	101% ✓	100%	50%	ZERO
YOUR COMMITMENT	101%	100%	50%	ZERO

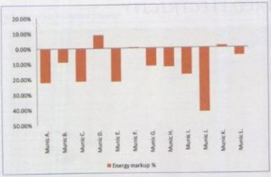

Fig. 1: % Mark-up in energy prices for the large customers in the 2009/10 tariffs.

Fig. 2: The total mark-up on the average Eskom purchase costs at a load factor of 60%.

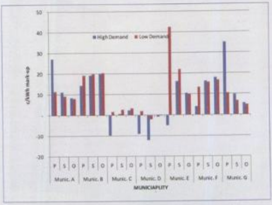

Fig. 3: The c/kWh mark-up on the Eskom energy prices for some of the municipal TOU tariffs at MV.

The following observations can be made from this:

- Of the 14 municipalities analysed only seven offered TOU tariffs to their large customers
- The number of TOU customers in the majority of these municipalities are less than 10% of the large customers
- Some of the energy prices are less than that of Eskom in three municipalities
- The c/kWh mark-up in the different TOU periods is very different
- The TOU periods differ from that of Eskom in the case of one municipality

These facts clearly show that the design and roll out of TOU tariffs is problematic. This is despite the fact that electronic meters with TOU features and in many cases the presence of remote features exist for a very large percentage of the larger customers in these municipalities.

Proposed action

The following actions are proposed in this respect:

The EPP makes the following stipulations in this respect:

Policy position: 31

Tariffs must include TOU energy rates as follows:

- *all customers supplied at MV or above within two years;*
- *all customers above 100 kVA within five years;*
- *all cases where the metering provides such features within five years; and*
- *all other customers where it is warranted*

TOU tariffs should be rolled out as follows in all municipalities:

- To all customers at MV by 1 July 2011
- To all customers > 250 kVA by 1 July 2012
- To all customers > 100 kVA by 1 July 2015

This roll out should be compulsory for all customers in the category. The tariff should be set to be revenue neutral with the demand and single energy rate tariff for all customers in each category being converted. In this way, no further analysis is required and no revenue neutral surcharge is required and the municipality will not lose any money when customers convert to TOU.

The tariff must be structured as follows:

- The same structure as that of the Eskom Megaflex applicable to that municipality or the average in the case of various supply points with different tariffs
- The c/kWh mark-up must be the same in all periods to ensure that the municipality does not lose any contribution (revenue minus cost) when customers shift load from one to another period
- Ideally the mark-up on energy, the demand charges and fixed charges, should reflect the cost of supply as determined through COS studies
- The rates need to be analysed and be set based on these principles every year and not by the application of an average increase on all the rates

If TOU tariffs are structured and rolled out in this way, the large customers, that all have a different potential to shift load, will be charged fairly and will have the opportunity to start managing their businesses, to shift load and apply strategic conservation in the more expensive time periods. All of this can be done without putting the municipality under a massive administrative or financial burden or causing it to lose any contribution.

Domestic tariffs and subsidies

The majority of players in the industry know the impact of subsidies and cross-subsidies being applied to the poor customers in South Africa.

The main strategy being applied by Eskom and municipalities, is the application of a single energy rate tariff without any fixed or capacity charges. This provides significant subsidies to the low usage customers.

The information from the EPP (see Fig. 4) shows the proposed break-even between a cost reflective tariff and a single energy rate life line tariff.

Table 3 shows a comparison of standard domestic tariffs with life line tariffs in a few municipalities.

What this is showing is as follows:

- The break-even points between the standard domestic tariff and the life line tariffs are either much higher than prescribed in policy documents or no break-even is ever achieved

Domestic tariffs break-even analysis

Municipality	Standard domestic tariff			Life line tariff	
	Basic charge [R/month]	20 A capacity charge [R/Amp/month]	Energy charge [c/kWh]	Energy charge [c/kWh]	Break-even [kWh/month]
Munic A	R103,42	R0,00	64,440	53,900	Never
Munic B	R87,36	R0,00	64,290	55,070	Never
Munic C	R13,50	R30,00	64,600	70,000	806
Munic D	R0,00	R0,00	68,940	68,940	NA
Munic E	R0,00	R0,00	61,344	49,233	Never
Munic F	R20,40	R0,00	70,741	54,428	Never
Munic G	R180,76	R45,80	80,520	53,070	> 5000
Munic H	R0,00	R28,57	50,100	73,180	124
Munic I	R0,00	R0,00	64,296	58,590	Never
Munic J	R0,00	R79,68	34,623	63,780	273
Munic K	R0,00	R0,00	74,200	71,760	Never
Munic L	R70,50	R0,00	65,250	65,250	Never
Average	R39,66	R15,34	63,612	61,433	Never

Table 3: A comparison of standard domestic tariffs with life line tariffs in a few municipalities.

- It must also be remembered that many of these customers also receive free basic electricity (FBE) which increases the break-even points even further
- This means that the extent of cross subsidisation of poor domestic customers, far exceeds national government intentions

This problem has been exaggerated by the NERSA rulings that the poor customers should receive maximum price increases of 15%.

Inclining block rates (ICBR)

Despite the massive cross subsidies already provided to poor domestic customers, NERSA ruled that poor domestic customers should be provided with subsidies (apparently totally unaware of the current cross subsidies) by way of an inclining block rate tariff. It goes on by not saying that the inclining block rate tariff be applicable to poor domestic customers only, but that it should be the only domestic tariffs to be applied by Eskom and municipalities.

Eskom reaction

Eskom did not seem to make any objection in this respect, but only applied it to the billed customers and not to pre-payment customers, due to vending problems.

This impact plus that of low increase for rural, on non-domestic, non-local government customers was an additional increase of 4,6% in 2010/11. See abstract below.

- *Inclining block rate tariffs*
  The objective of the inclining block tariff was to provide protection for lower usage customers against high price increases resulting in a reduction in tariff to these customers.
- *The shortfall (R1,32-billion) as per NERSA's decision is to be recovered from Eskom's urban no-municipal bulk tariffs, (excluding residential and rural tariffs). This added 4,6% to the increase applied to these tariffs.*

SALGA reaction

Compliments to SALGA who did object to this ruling by NERSA. The problem is that NERSA has been applying ongoing pressure on municipalities to apply these tariffs, despite an agreement with SALGA that it would not.

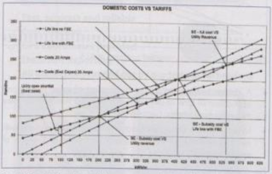

Fig. 4: Proposed break even between a cost reflective tariff and a single energy rate life line tariff.

Various municipalities did however apply inclining block rate tariffs to their domestic customers, in line with the NERSA ruling.

Fig. 5 shows the comparative revenue from the current Eskom domestic tariffs vs the recommended NERSA inclining block rate tariff.

It clearly shows the following:

- Further increasing cross subsidies to the poor
- Introduction of cross subsidies for very large/wealthy domestic customers
- Additional increases for some high usage domestic customers

The impact of the proposed NERSA inclining block rate tariffs are as follows:

- Increased cross subsidies for poor domestic customers beyond national government targeted levels. The impact has been quantified, but not very accurately, due to massive data requirements for Eskom, but not for municipalities
- Introduction of very large cross subsidies for non-poor customers specifically those with irregular usage

The impact on those municipalities that have a significant number of customers with irregular usage such as holiday homes or lodges and empty stands will lose a lot of revenue and this burden will be placed on the permanent residents unfairly.

- Introduction of unfair problematic practices in pre-payment customers

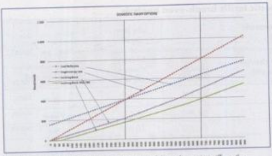

Fig. 5: Comparative revenue from the current Eskom domestic tariffs vs the recommended NERSA inclining block rate tariff.

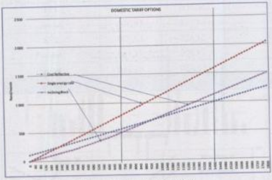

Fig. 6: Situation for typical municipal customers at 60 A.

- A change in the need for the application of smart meters and application of time of use tariffs and demand side management measures for domestic customers
- Massive negative financial impact on municipalities associated with reduced consumption due to high price increases and roll out of energy efficiency measures

Fig. 6 shows the situation for typical municipal customers at 60 A

Where a customer installs a solar water heater, some efficient lights and is generally more aware and saves 300 kWh/m, when normally using 1000 kWh/m, the savings will be as follows:

- On the cost reflective tariff: 26%
- On the ICBR tariff: 33%
- On cost as % of revenue: 16%

As energy efficiency strategies are rolled out, municipalities will increasingly come under pressure, because the loss in revenue will exceed the savings in purchase and other costs significantly. This is because the tariff is now not cost reflective and there are no fixed charges to cover the fixed costs.

The NERSA proposed application of ICBR tariffs for all domestic customers does not comply with various national policies such as the ones below:

The Electricity Pricing Policy (EPP) of South Africa as approved by cabinet 19 December 2008 states the following:

Policy Position: 2

Electricity tariffs must reflect the efficient cost of rendering electricity services as accurately as practical.

- *The average level of all the tariffs must be set to recover the approved revenue requirement*
- *The tariff structures must be set to recover costs as follows:*
  - *The energy costs for a particular customer category*
  - *The network usage cost for a particular customer category and*
  - *Service costs associated therewith.*

Policy Position: 36

Domestic tariffs to become more cost-reflective, offering a suite of supply options with progressive capacity-differentiated tariffs and connection fees:

- *At the one end a single energy rate tariff with no basic charge, limited to 20 A and nomimal connection charge (details under section on cross-subsidies):*
- *At the next level a tariff which could contain tariff charges to reflect a basic charge, customer service charge, capacity charge and energy charge with cost-reflective connection charges, and*
- *At the final level TOU tariffs must be instituted on the same basis as above, but with TOU energy rates.*

Policy Position: 48

Qualifying customers shall be subsidised through the application of a line tariff:

- *a single energy rate tariff;*
- *with no fixed charge;*
- *limited in capacity to 20 A and*
- *nominal connection fee*

Policy Position: 49

The level of the life time tariff should be set to breakeven with the cost reflective tariff of the license for a 20 A supply at a recommended consumption level of 350 kWh per month.

Policy position: 50

The shortfall in revenue between the life line tariff and the cost of supply after deducting the electrification capital grant shall be addressed within the distributor. The impact of such cross-subsidy must be pooled over all customers in the licensee, not only on domestic customers and should be shown transparently as a c/kWh levy on consumption.

National retail tariff guideline of NER Aug 2004

The inclining-block tariff was decided against by the NDTS working group for two principle reasons: Firstly it is structurally non-cost-reflective. The average cost of supplying a customer decreases as consumption increases and hence an inclining-block tariff where the tariff rate increases as consumption increases is contrary to the cost of supply and hence contrary to the key elements of the electricity pricing philosophy as described earlier i.e. that tariffs must be structurally cost-reflective. Secondly, the implementation of an inclining block tariff on prepayment electricity meters – which are widely used – is at best, impractical.

The distribution tariff code makes the following key statements:

General tariff principles

(3) The structure of tariffs (the balance of fixed and variable components) should reflect the costs drivers.

(8) Cross-subsidisation between and within electricity tariffs shall be applied to all electricity users in accordance with government's policy and NERSA's cross-subsidy framework. This process will be informed by Distributors calculating current levels of cross-subsidisation (total cost reflective tariffs versus current tariffs).

Cost reflective tariff structures

(2) The tariff charges (rates) shall be calculated based on the approved revenue requirement, volume forecast for demand and energy and customer numbers.

(4) A cost-reflective tariff structure will:

(a) Align with the purchase structure and cost of energy.

(d) Include differentiation to take into account: Retail charges that reflect the size of the supply and the services being provided to the customer.

Proposed action

In view of the serious implications of the proposed NERSA ICBR tariffs the following action is proposed:

SALGA to undertake a detailed study on the proposed ICBR tariffs in respect of:

- Compliance with national government policy
- Extent to which it achieves national objectives
- The short term and long term financial implications
- The practical implemental problems

SALGA can then call for a national workshop with DoE, DPLG, National Treasury and NERSA to debate these issues and come up with a new policy that complies with ESI requirements.

That NERSA be forced to reverse the unilateral decision in respect of Eskom and municipal application of inclining block rate tariffs.

Resellers

In South Africa there are an estimated 2-million domestic customers being supplied with electricity through electricity resellers. Although some municipalities see them as a threat, the majority of them are supplying a good service and the customers are generally happy.

These resellers are viable because of the mark-up made on electricity sales, as done by municipalities. The Electricity Act used to contain a section, stipulating that resellers could not charge more than the end use customer would have been charged, had it been a customer of the licensed distributor. This stipulation has been removed from the act, but many municipalities now have stipulations to the same effect.

The NERSA strategy of domestic increases to the poor limited to 15% and the introduction of inclining block rate tariffs is a serious threat for resellers. This is because the resellers' purchase costs are going up with the very high Eskom or municipal increases and the selling prices are remaining at the low levels or are reducing significantly.

In Eskom and municipalities, the revenue lost due to the lower increases to the poor and the introduction of ICBR tariffs, are recovered from other customers. Resellers do not have that option.

Some municipalities have passed by-laws to allow resellers to sell at a price equal to their average purchase costs from the municipality. Although this will help, the lack of a basic/customer service charge in domestic tariffs to cover the network and customers service costs, will make it impossible for resellers to be viable.

The solution to this problem is contained in all the energy policy which has been set to date, except for the latest NERSA rulings on lower increases and ICBR tariffs. It is contained in the following:

- Electricity tariffs must be based on cost of supply
- Any subsidies should be measured and be transparent
- Subsidies should be targeted at the poor

If this was applied, resellers would have a mark-up in the standard domestic tariff because of the cost differences and this would be viable. Where there are specific transparent cross-subsidies, it should be applied consistently within a municipal boundary as is required by law. This would mean that the municipality, being considered to be the body to distribute electricity cross-subsidies, should collect revenues and distribute cross-subsidies and subsidies to all the residents in its area of jurisdiction. This is for example the case in respect of FBE, where municipalities distribute the funds also to poor customers supplied by Eskom.

If the trend of less than average increases is continued for the poor and ICBR tariffs are introduced, resellers will be under severe financial pressure. Their possible actions to survive could include:

- Applying tariffs that are higher than that applied by the municipality/Eskom. This could cause a retaliation by the customers of the resellers, which could cause a demand to become direct customers to the municipality. Although some municipalities would like this, it will increase their subsidy burden and will increase their total resource requirement which is already under severe constraint.
- An alternative is for them to apply to become licensed distributors of electricity in which they can apply their own set of tariffs. This is unlikely due to the massive admin burden and some municipalities withholding consent. If NERSA continues with the imposing of an ICBR tariff only for domestic customers, this will not provide any relief.
- Another alternative is to take municipalities to court to subsidise the difference between the cost of the resellers and the ICBR tariff of the municipality.

None of these actions will be good for our industry. The most viable solution is to apply the good policies that have been developed over the past years:

- Eskom and municipalities apply cost reflective tariffs
- Specific provisions be made for the poor within the EPP and other policies
- Where there are poor people qualifying for the specific provisions for the poor that are supplied by resellers, such funds need to be channelled to these poor people by the municipality

Results of financial crisis

When the financial crisis becomes more apparent, one begins to wonder what happens in respect of some of the very important deliverables of municipal electricity departments such as: DSM and energy efficiency, reducing energy consumption to reach the savings targets, addressing the maintenance backlogs, preparing to be more ready for possible future load shedding, etc.

I want to start off by saying that I applaud many municipal electricity staff for their efforts and will to do what is required, despite the serious constraints under which they work. The current structures and rules in municipalities make it very difficult to do their jobs effectively and efficiently. A few examples provide proof of what I mean:

- One of the municipalities has installed various electronic meters with remote reading features. When I asked whether I could obtain the load profiles for the last year, I was told that they did not have the money to download the data. This was because the two cell phone sim cards being used were held by finance and these were limited to R500 per month each.
- I have seen many detailed capital and refurbishment budgets, catering for the absolute essentials and for the normal requirements, being prepared by electricity staff annually and simply not being approved.
- The tender requirements in municipalities are so stringent that it makes it very difficult to undertake the basic functions. In one municipality a tender had to be prepared to purchase a few 11 kV fuses. The particular feeders are currently running without protection, because the tender process will take 6 months.
- The introduction of the so called infrastructure managers, in many cases has been disastrous for electricity departments. Firstly this has effectively pushed the whole electricity department down one level further from the municipal manager. This has made it almost impossible for many municipalities to employ quality engineers /technicians. One infrastructure manager asked my opinion about advertising the post, "head of electricity", holding a government certificate of competency, with a salary of R150 000 per year. In a few municipalities, especially the smaller ones, the infrastructure managers are a major stumbling block to delivering quality electricity service.

Conclusions

The subject covered in this paper is a highly complex one and the situation and solutions for each municipality is not the same. The objective of this paper is to highlight some of the key issues which municipalities should give attention to.

The conclusion with respect to electricity pricing, policy formulation and delivering a quality service is that very serious changes are required.

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Measures taken to address skills shortages from an eThekwini perspective

Attraction and retention of scarce engineering skills is identified as the greatest risk to the sustainability of the industry and the delivery of services to communities. It must therefore become a strategic imperative.

by Sandile Maphumulo, Ethekwini Metropolitan Municipality

The main challenges in a municipal environment are a bloated bureaucracy and centralisation of functions, which prevent effective responses to challenges and threats from the private sector. Management of diverse industries (electricity, water, civil engineering, etc.) with one set of strategies, policies, procedures and practices. Shackles of collective bargaining process with very limited dead-lock breaking mechanisms (for example, resolving appeals on TASK grades still outstanding since January 2009). Not viewed as a career option by scarce engineering personnel, due to general public perception of inefficiency and poor remuneration. Management is accountable for service delivery but has limited authority to make decisions in some important areas.

Perception surveys amongst technical personnel show low morale (affirmative action and other issues). High vacancy rates (engineers: 33%, technicians: 40%, electricians: 45%) lead to employee fatigue and inability to meet service delivery targets. Matters of a consultation nature are viewed as negotiation by unions.

Make critical skills a strategic imperative

Attraction and retention of scarce engineering skills is identified as the greatest risk to the sustainability of the industry and the delivery of services to communities. It must therefore become a strategic imperative. Scarce skills should be a standing item on the agenda for meetings of the top executives.

Lobby and submit motivations to top city management to pay remuneration packages which create a competitive advantage. Have an open jacket system to allow applicants to apply for engineering positions and then match qualifications and experience for relevant positions. Unblock internal recruitment processes to fast-track approval to fill, advertising, selection and appointment process. Create specialist engineer posts to prevent personnel with sound technical skills being lost to management ranks.

It is clear from Table 1 that the intervention process is working.

Year	Termination
2004	30
2005	43
2006	55
2007	62
2008	45
2009	40
January to June 2010	10

Table 1: Terminations of technical staff.

Consequences of not responding

Inability to meet service delivery needs and implement the integrated development plan. Protests by customers and the public on lack of service delivery. Lower staff morale due to work overload. Increase in staff separations and loss of institutional memory. Reduced ability to attract and retain professional staff due to poor reputation of municipalities. Higher operating costs caused by an increase in the number of faults (due to lack of maintenance) and higher overtime costs. Inability to drive business improvements (too much fire fighting).

Note: Blunders/errors made by municipal engineers are invariably public knowledge due to extent of outages (due to poor protection settings or maintenance backlogs) or inability to supply power (due to system constraints caused by poor planning) which has greater economic consequences. There is a greater need to attract the best engineers into municipal environments.

Create an attraction

There should be a willingness to back-pay financial commitments and buy out bursary commitments of students who excell. Offer incentives to candidate engineers (car allowances, cellphones, laptops, excellent training programmes, etc.). Pay relocation expenses similar to those in the private sector (such as bond transfer costs). Undertake or subscribe to annual salary surveys to keep abreast of market forces and pay competitive packages (50th percentile packages do not result in a competitive advantage). Introduce progression grades for each engineering level (for example engineer/senior engineer/chief engineer) to mitigate staff turnover thereby creating stability and specialisation. Provide assisted education to enable employees to further their studies at recognised institutions. Provide excellent training facilities with the best trainers.

Meet essentials prior to advertising posts

Finalise essentials such as: office space; furniture; PC or laptop; company vehicle; parking space, etc. Obtain blanket approval of locomotion allowances for identified scarce skill posts. Compile careers brochure to explain: career pathing; talent management system; and training and development opportunities.

Utilise broad-spectrum advertising

Aggressively advertise through available channels, such as: academic institutions (universities and universities of technology; technical tours of facilities offered to students; local metro newspaper national newspapers; national technical magazines (*Energize*, *Vector*, etc.); schools; websites; and word-of-mouth (through existing bursary students and employees).

For schools, leverage existing communication channels and contacts between school principals and marketing officers (who normally have meetings with learners to discuss energy efficiency and electrical safety) to promote careers in the municipality.

Improve selection process

Utilise specific criteria to select graduate BSc engineers, namely: duration of studies ≤ 5,5 years; number of failed subjects ≤ ⅓ of total subjects; pass design project at first attempt (to demonstrate ability to apply theory). Do well in important subjects (such as High Voltage Engineering and Power Systems for the Electrical Degree).

Short-listed applicants must then pass technical tests to confirm understanding of engineering fundamentals and pass interviews. Use psychometric assessments for supervisor and manager levels.

Some cautions on selection: verify authenticity of qualifications prior to offering letter of appointment. Confirm knowledge of Section 28 Electricians through proper technical and practical tests (too many shortcomings identified).

Support and maintain employer-employee relationship

Provide support to experienced N6 staff, who have relevant experience, to apply to ECSA for Professional Technician status. Pay all application and annual registration fees for membership of professional bodies (ECSA and SAIEE) in the interests of continual professional development. Provide clear guidelines for supervisors and managers. Provide guidance on career pathing – access to assisted education. Have succession plan in place – identify employees to potentially fill vacant posts due to retirements. Conduct proper exit interviews (preferably undertaken by top management) of incumbents in critical posts and have authority to make counter offers. Arrange meetings between senior management and staff on a quarterly basis, to maintain contact, identify challenges and emphasise key business drivers.

Transfer and develop the skills

It is important to ensure buy-in at all levels. Create appropriate organisation structures and increase training resources (additional training officer posts) to improve training capability. Have large pool of apprentices (100), candidate technicians (40) and candidate engineers (30) in the system to work with experienced staff. Have well-documented training programmes (such as Candidate Engineer Training Programme) with explicit outcomes and assessment processes. Document all unique and critical technical and operational areas. Develop internal training courses and training workshops to fast-track skills transfer, with a focus on specialised technical training. Identify mentors and provide clear outcomes from mentor-ship interventions. Engage retirees on a contract basis to mentor and train new appointees.

Introduce operational and miscellaneous interventions

Recent introduction of a comprehensive employee wellness programme across the municipality, demonstrates a caring employer. Creation of supernumerary manager posts, when retirements are imminent, to ensure transfer of skills and smooth handover to new manager. Recruitment of engineering retirees to assist with executing special projects and sharing knowledge with less experienced engineering personnel. Establishment of technical forums amongst engineering personnel to share experiences and include invited presenters on specific topics. Conduct intensive in-house training and assessment of candidate technicians and candidate Engineers (includes presentations to executive and panel reviews). Regularly compare output from training programmes and vacant posts. Timeously advertise internally to allow trainees to apply and appoint through competitive process to ensure best fit. Have performance management and incentives for personnel.

Future interventions

Motivate 75th percentile packages for scarce engineering personnel. Pay flexible cost-to-company packages to scarce engineering personnel. This must include: paying a housing allowance irrespective of personal circumstances (spouse with subsidy, renting and not owning, etc.). Paying a locomotion allowance irrespective of value of vehicle in the scheme, provided vehicle is suitable for performing duties. Create specialist engineer posts to retain highly skilled individuals. Introduce retention bonuses for shorter terms (3, 5, 10, and 15 years). Provide funding to academic institutions to subvent salaries to assist with recruitment and retention of experienced academia. Create electrical engineering science centre to create interest and promote careers in the electricity supply industry. Utilise recruitment agencies to head-hunt critical skills. Explore recruitment of engineering personnel from other countries. Consider creation of municipal entity, only if this will break the shackles of existing national collective bargaining processes.

Conclusions

The challenges in a municipal environment are immense, especially when electricity provision is an essential service and a cash-cow to many municipalities. Engineering remains a cornerstone to support economic development. Notwithstanding the payment of market allowances, the skills flight continues, attributed to various factors such as high crime rate, affirmative action, etc. The ageing electrical networks require more staff to operate and maintain these networks safely and effectively. Existing personnel are barely coping with the work load and demands from customers. Smart metering, smart grids, renewable technologies and embedded generation introduce more complexity into existing electrical networks. These require additional engineering personnel with a higher skill level. How to attract, develop and retain the necessary staff to manage more complex networks requires radical out-of-the-box thinking. It is the collective wisdom here, who have their hearts in the industry, that will craft the solutions to see us through the difficult years ahead.

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Challenges to city growth due to area of supply disputes

The face of South African municipalities has substantially changed over the last decade. Small municipalities have amalgamated into larger wall-to-wall municipalities and metros. This exercise reduced the number of functioning municipalities from over 1000 to 286 municipalities.

by Robert Ferrier and Erlin Moll, Buffalo City Municipality

In Buffalo City, the first phase was the formation of Transitional Local Councils in East London, King William's Town and the surrounding rural areas, which included the capital of the Eastern Cape, Bisho.

The inclusion of rural areas that are supplied by Eskom into the municipality does not in itself present major problems. It however becomes a problem when rural areas situated within the urban edge, or extended urban edge are re-zoned for urban residential development. This type of re-zoning is a normal process that takes place within any growing city in South Africa. Buffalo City has two previously smaller municipalities, Beacon Bay and Gonubie, which are in close proximity to each other.

The land between Beacon Bay and Gonubie is farmland which is known as Quenera. This farmland is being rezoned for urban development. This will ultimately join Gonubie and Beacon Bay, and the Quenera area will become a new suburb forming an integral part of Buffalo City.

As these new developments become an integrated part of the city, all services provided within these new suburbs should be provided by the municipality to ensure equitable services are provided to all suburbs. The rezonings are approved by the municipal council under the conditions that all services are provided by Buffalo City municipality. When Buffalo City approved the first development in Quenera, BCM requested Eskom to provide a point of distribution (POD) to the development. After a number of meetings with Eskom a final agreement was reached in writing, a POD was commissioned, in Buffalo City's name and has been in operation for a number of years.

Recently, in meetings with Eskom, there seems to have been a change in policy with a 180° shift, with Eskom now refusing to provide PODs for new developments. This has had a negative effect on developments within the city, as developments have been approved on the basis of provision of services by BCM and to BCM standards, therefore until the disputes concerning area of supply has been resolved, developments cannot take place.

Eskom's current point of view is that it historically supplied the previous rural areas and therefore is automatically entitled to supply the new suburban areas as well. Buffalo City Municipality (BCM) has made every effort to resolve the issue in an amicable manner, even resorting to NERSA for a dispute resolution hearing. The expansion and development of a city should be a positive sign, and should not be hampered by disputes between Eskom and municipalities.

Laws and regulations

The laws within South Africa support the municipality's right to deliver services within its area of jurisdiction.

The constitution vests these rights with the municipality in terms of Clause 156 "Powers and functions of Municipalities". Also, the Municipal System Act of 2000 states the following:

"Legal Nature, Rights and Duties of Municipal Councils:

2) A municipality – (a) is an organ of state within the local sphere of government exercising legislative and executive authority within an area determined in terms of the Local Government: Municipal Demarcation Act, 1998.

Rights and duties of Municipal Councils

4 (1) (b) exercise the Municipality's executive and legislative authority and to do so without improper interference.

4 (2) (d) strive to ensure that municipal services are provided to the local community in a financially and environmentally sustainable manner.

4 (2) (f) give members of the local community equitable access to the municipal services which they are entitled.

4 (2) (g) promote and undertake development in the Municipality."

Does this mean that municipalities should go out and take over all areas supplied by Eskom? – No it does not. The overruling factor should be the ability to provide and to maintain the required level of service to new consumers. Eskom has always been the supplier of rural electrification. This is not disputed but the developments under discussion are within the city's urban edge and will no longer be rural farmlands but will become suburbs within the city.

The standard of all services must be the same as any other existing suburb. For the municipality to be able to provide this standard of service, all services need to be provided by the city as some are not revenue generating and require cross subsidisation. Cross subsidising of other services by electricity sales is a reality within municipalities in South Africa. This fact is even accepted by the Department of Energy, the EDI and the Regional Electricity Distributor model, which the aforementioned are mandated to implement. The model allows for municipalities to be paid a surcharge from electricity sales made by the REDs entity.

In terms of the law, municipalities may charge the consumers within the Eskom supplied areas a levy for the services which would normally have been subsidised from electricity sales but this would create an inequitable situation within the city limits, which while justifiable would create dissatisfaction within the city.

Urban edge developments

Buffalo City has two areas under discussions with Eskom and NERSA:

- Rock Cliff is in the extended urban edge: Development of Rock Cliff within the Eskom disputed areas cannot commence until the "area of supply" issue has been resolved. The first phases of the development fall within Buffalo City's existing area of supply and therefore will go ahead.
- Quenera falls within the existing urban edge.

Development within the suburb of Quenera, started in April 2005 and discussions between Eskom and BCM were positive with Eskom agreeing to provide a POD to the municipality. A report was submitted to the BCM council to formalise the provision of services within BCM's urban edge. Buffalo City Council took a resolution in August 2006 which states:

"That all future electricity customers within the Buffalo City municipality's urban edge should be serviced by Buffalo City."

Correspondence received by BCM confirmed that Eskom had agreed to supply BCM with PODs for new developments within the urban edge.

All projects proceeded until BCM commenced negotiations for additional PODs for the Quenera area, as well as discussions on the future suburb of Rock Cliff. During the meetings Eskom stated that in its opinion BCM has no rights within these areas as they form part of Eskom's supply area therefore Eskom no longer was in favour of providing PODs to BCM. This was a complete turnaround from the previous negotiations. After a number of meetings, Buffalo City was informed by Eskom that:

- Eskom is no longer in favour of transferring existing customers
- Eskom will compensate BCM for the original Quenera POD connection and 18 months of Eskom billing for the POD (NMD, network charges etc.)
- The developer is to rebuild all networks to Eskom standards
- The network is to be handed over to Eskom
- BCM is to apply for connections for street lighting, sewage pump etc.

Further meetings have been held with Eskom to resolve the issues. The developer has installed the network to BCM standards and the network has been taken over by Buffalo City, which is now a BCM asset. By ignoring these facts it seems as if Eskom has not considered the following:

- As the agreement was already in place, the developer installed the network to BCM standards. To change them to Eskom standards will incur additional costs.
- The installation has been completed and taken over by BCM. Installation is a BCM asset.
- The agreement in place can only be changed by both parties, not Eskom alone.
- By not abiding to the agreement, Eskom is negatively affecting future developments within BCM.

Why BCM and not Eskom?

The areas under discussion should be supplied by BCM rather than Eskom for a number of reasons.

- Rezoning converts the rural area into a suburban area. Therefore BCM has to ensure the same level of services for all consumers.
- The new areas become an integrated part of existing BCM suburbs.
- The area falls within the urban edge.
- All existing customers in the area have sold customers properties to the developer. Therefore they are no longer Eskom customers. All customers in the area to be developed, will be new customers.
- Provision of equitable services (e.g. street lighting, roads, etc.) will require the cross-subsidy from electrical sales.
- Buffalo City is expanding and has an obligation in terms of the Municipal Finance Act to ensure the financial stability of the municipality.
- Most important of all is the MSA clause 4 (2) (d): *Municipalities must strive to ensure that municipal services are provided to the local community in a financially and environmentally sustainable manner.*

There are a number of services that are cross subsidised by electrical sales such as water, streetlights, solid waste removal and others.

It would not be in the city's interest to allow developments to take place that are not sustainable since electricity sales would have to cross-subsidise the other services. If the city allowed developments to take place, the only way to ensure the necessary income would be to levy a surcharge to the consumer for provision of services within municipal boundaries as allowed by the MSA.

Conclusion

In terms of the law, municipalities must provide equitable services to their communities, and this cannot be done without cross subsidisation.

If cities are to grow and be sustainable, they need to have an income base that will ensure cross-subsidy of non-income generating services, to ensure sustainable services are rendered to the consumer.

A levy could be charged on the service provided by Eskom but this is not a satisfactory solution as it would create an inequitable situation within the city. Hopefully, into the future, an amicable solution and way forward will be developed by Buffalo City and Eskom through NERSA.

Contact Robert Ferrier and Erlin Moll, BCM, Tel 043 705-9601, robf@buffalocity.gov.za

The impact of the Eskom tariff increases on municipalities

Ir L G Kritzinger, Centlec

The paper addressed a number of questions on the following matters:

- What was the tariff increase experienced?
- How much did the individual components increase – was it 29,9% or was it 300%?
- What was the financial impact of the tariff increases on the municipalities?
- What can municipalities do to adapt to the increases?
- Recommendations on what can be done in the future to address the cash flow problems caused by the tariff increases.
- What can other role players do to address the problems experienced due to the tariff increases?

CONVENTIONAL ELECTRICITY METERS

Elster Kent Metering (Pty) Ltd

Operating since 1964 in South Africa from its base in Johannesburg, manufactures and supplies a complete range of conventional electronic electricity meters for residential, commercial, industrial and mining applications. In addition we can provide a comprehensive range of AMR and Smart Metering solutions for residential and three phase applications utilising a variety of communication infrastructure options.

Residential

Elster Single Phase, 100 A residential kWh meters provide a variety of communication options for AMR and Smart Metering Applications:-

- A200 - Simple kWh Meter with Mechanical Register and Pulse Output.
- A100C - Simple kWh Meter with LCD and Irda Serial data Output.
- A220 - Complex kWh meter for Time of Use and Maximum Demand applications with Load Profiling, Serial RS485 2 way Communications and Pulse Output.

Three Phase Commercial and Industrial

Elster Three Phase meters provide a variety of communication options for AMR and Smart Metering Applications. Meters can be supplied in CT Operated or Direct Connected (100 A) configurations and can be supplied for a range of network configurations. Elster also supplies a range of supporting communication accessories such as GSM/GPRS Modems, Ethernet Modules, Flag Probes etc....

- A1100 - Simple kWh Meter with Mechanical Register option and Pulse Output.
- A1100 - Simple kWh Meter with LCD and Irda Serial data Output.
- A1140 - Multi Function mid range low voltage electricity meter with LCD, load profiling, time of use and maximum demand registration and RS232 Serial data port suitable for complex metering applications with supporting communication accessories.
- A1700 - Multi Function complex electricity meter for Time of Use and Maximum Demand applications with Load/Instrumentation Profiling, Serial Communication Port, Pulse Outputs, Instrumentation, suitable for CT/VT metering applications that require higher accuracy (Class 0.2 or 0.5) supported by a variety of communication accessories.

Smart Metering

Solutions for Smart Metering are available from Elster based on our strong tradition of conventional metering, load management (ripple control) and communication technologies such as RF or PLC which provide the building blocks for the provision of powerful, flexible and feature rich Smart Metering Solutions that enable operational efficiency optimisation through implementation of the latest tariffs and services.

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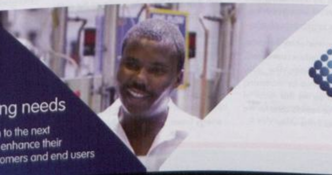
Elster Group



Elster, meeting changing needs

By helping our Customers transition to the next generation of metering solutions to enhance their interface and relationship with Customers and end users

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Leading the World in Metering Technology

Energy loss management as part of utility financial sustainability

In this paper the authors will explain the importance of such electrical losses and the losses value chain and how to analyse losses to its fullest content to utilise this as a management tool, to improve utility financial sustainability. By quantifying the different elements of losses and utilising the other business economic parameters of the utility, management can effect utility financial improvements to the advantage of all customers and ensure sustainability. In effect it provides a managerial performance roadmap for the utility.

by A J van der Merwe and L P P Fourie, NetGroup SA

Scenarios to simulate these business economic improvements have been developed for various utilities and the applicability of such approaches is applied in the South African context to indicate the relevance for such an approach in South Africa.

Utility financial sustainability in perspective

Utility financial or commercial sustainability means that the utility can maintain its operations in a financially and commercially sustainable way, where the cash returns from operations remain positive. This means that the cash received from operations, should be sufficient to pay for all cash expenses, which should include normal expansion programmes, debt repayments and alike. The cash required is therefore not the same as normal profit as we know from a business point of view. It can also be defined by the cash coverage ratio, which should be bigger than one for a healthy undertaking. Cash coverage ratio is defined as operating and other income (after covering operating costs and adjusted for net working capital and non-cash expenses, i.e. depreciation and bad debts, plus consumer deposits) divided by the sum of debt service liabilities, internal funds required for capital investment, and essential contributions such as for staff retirement funds.

For a utility to plan for financial "survival" or sustainability, it must understand the relationship between all utility activities affecting cash flow. To achieve financial sustainability, the utility needs to do proper integrated planning, by simulating and evaluating all the factors influencing cash flow, and to set appropriate targets accordingly.

To maximise revenue, the utility needs to improve cash collections (reduce cash losses), and curb non-technical losses. The utility could also increase revenue by increasing tariffs, but this should be the last resort of effort and should not be used to cater for the operational cash losses in the utility.

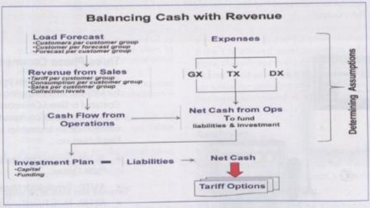


Fig. 1: Balancing cash with revenue.

In order to minimise operational cost, the utility needs to look at least cost generation (optimal generation mix); improving utility efficiencies like the correct level of utility operational costs per kWh sold; reducing losses, both technical and non-technical losses and improve quality of supply.

The reduction in technical losses will reduce the cost of energy available for sale (which includes the cost of generation), where the reduction in non-technical losses can improve revenues and/or reduce generation cost. It must be noted that technical losses are normally supplied by the most expensive generation, if a least cost generation strategy is followed. By reducing technical losses, one will directly reduce the cost of the most expensive generation and hence enhance the cash flow and the sustainability of the entity as a whole.

Losses value chain

Losses in an electrical utility are best described through the losses value chain, shown in Fig. 2.

From this it is clear that there are three components to losses, the first two being energy losses, and the third cash losses.

Energy losses are defined as the difference between energy available for distribution, and the actual energy billed to end customers and is given by the sum of technical and non-technical losses.

Cash losses are the difference between cash collected and the true sales (in Rands) to end user customers.

Technical losses are those losses experienced in an electrical system that are due to the loading and electrical characteristic of the electrical network (for instance the network and transformer impedance and no-load losses of transformers).

Non-technical losses are those losses of electrical energy that are caused by factors outside the electrical system. This could include inaccurate meters, inaccurate meter readings, technical problems with meter installations, billing errors, errors in record keeping, consumption by non-metered installations and energy theft. (Note that free basic electricity is included in sales.)

The flow diagram in Fig. 3 explains the various concepts and ratios in terms of overall losses. The grey area defines energy losses, where the pink area describes cash losses. From a management point of view, it is essential to develop a monitoring and reporting framework to be able to monitor the various KPIs that track losses.

The following typical KPIs should be monitored:

- *Energy in (EI)*: energy available for distribution in kWh.
- *Energy billed (EB)*: as obtained from the billing system in kWh.
- *Overall energy losses*: *EI* minus *EB* in kWh.
- *Overall energy losses %*: overall energy losses divided by *EI*.
- *Technical losses*: Maximum demand losses as a % of maximum demand and energy losses as a % of energy in.
- *Non-technical losses*: derived from overall losses minus technical losses in kWh.
- *Collection efficiency*: ratio of cash collected versus bills sent out (if there are also prepaid meters, the revenue received should be added to cash collected and bills).

There are two industry benchmarks for overall performance, the one being the Aggregate Technical and Commercial losses (AT&C), which aggregates the overall energy losses and cash losses, and secondly the average collection per unit available for distribution (CC/EI).

AT&C is calculated as follows:

$$AT\&C = 1 - (1 - \text{overall losses \%}) \times \text{collection eff. \%}$$

CC/EI is derived from the cash collected divided by the energy in and is given in cents per kWh.

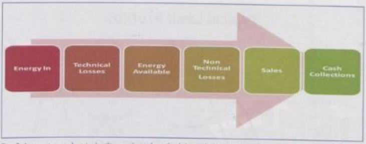


Fig. 2: Losses in an electrical utility are best described through the losses value chain.

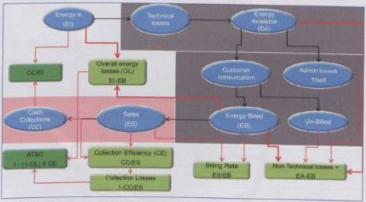


Fig. 3: Flow diagram explaining the various concepts and ratios in terms of overall losses.

Quantification of losses

It is important to quantify the components of losses, as this will enable management in their planning and decision making to decide on the correct strategies to curb losses, and to improve revenues. The process commences by calculating the technical losses; it is very difficult to calculate the non-technical losses accurately. The most common approach to follow is to calculate the technical losses, and derive the non-technical losses as the difference between overall energy losses and technical losses. The component of non-technical losses can then be established through various sampling methods (as a percentage of total non-technical losses).

For technical losses it is important to distinguish between demand losses and energy losses. One can derive the energy losses once the demand losses are known. Demand losses can be calculated through:

- A proper network model and configuration.
- Establishing the correct loading on the network, both in terms of maximum demand and the load profile of the various loads on the network.

The demand losses are then calculated by doing load flow studies on the network for the maximum demand conditions. This must be done for all the various voltage levels, from the low voltage network to the distribution/transmission system, and all the different feeders. This would normally entail various studies, as the modelling of the low voltage network and distribution network will not be done in the same model. Due to the vast volume of low voltage networks, normally some sampling of networks, representative of the network will be done, and will be used as benchmarks for determining the demand losses for the remainder of the low voltage networks.

The energy losses are derived from the demand losses by establishing loss load factors (*LLF*) for each network component. The energy losses are calculated as follows: demand losses in kW**LLF**hours in the period under consideration. The demand losses are derived from the load flow studies, and the loss load factors are derived from statistical metering and/or the load profile of the applicable load.

The *LLF* can be established from statistical metering as follows:

$$LLF = \sum_{n=1}^{35040} (Load_n{}^2 / Peak\ Load)^2 / 35040$$

where:

35040 = the number of 15 minute load recordings in one year

$Load_n$ = the 15 minute average load in the nth 15 minute period

Peak load = the highest 15 minute average load in the year (1)

This could also be done for shorter periods, say for instance for a specific month. However the more readings that are available, the more accurate the *LLF* would be.

The load factor (*LF*) is given as: Total Energy Available/(Maximum Demand in *kWh* in period) over the same period as used to determine the *LLF*.

If statistical measurements are not available, the *LLF* can be derived from the *LF* as follows:

$$LLF = k \cdot LF + (1 - k) \cdot LF^2 \qquad (2)$$

where the constant *k* is derived from empirical results. Where no data is available a value of 0,3 is normally used for *k*.

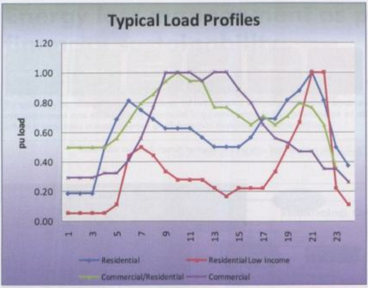


Fig. 4: Typical load profiles for specific customer groups.

	Residential	Residential low income	Commercial/ Residential	Commercial
LF	0,59	0,32	0,69	0,61
LLF	0,40	0,17	0,50	0,44
k	0,18	0,30	0,16	0,32

Table 1: Typical load profiles for specific customer groups.

The value of k can be derived for various load profiles if both the LF and LLF are known, by using the formula:

$$k = (LLF - LF^2)/(LF - LF^2) \quad (3)$$

The graph in Fig. 4 and Table 1 show typical load profiles, LF, LLF and k for specific customer groups.

Even in calculating the energy losses as described above, it still remains an estimation, as the transformer no-load losses remain constant. The only accurate determination of the losses would be through continuous measurement. From a management perspective, and to quantify the quantum of energy losses, the above procedure would yield accurate enough results.

Once the energy losses have been determined for a specific period, say a month, as described above, the non-technical losses are determined as being the difference between overall losses and the technical losses.

The cash losses are easy to determine, as this is the difference between the sales in Rands as determined from the billing system (including sales from a prepayment system if it exists), and the actual cash collected from sales (and sales from the prepayment system, if it exists).

From a management perspective, one would also like to distinguish cash collections from current debtors (and the type of debtors), versus the collections from old debtors (more than 30 days), as this could influence the revenue protection strategies.

Typical results from utilities in developing countries

Our experience has shown that most utilities do have huge energy losses, as well as poor cash collections. Energy losses are in the region of 20 – 35%, and collection efficiencies from 65 – 90%. What must be kept in mind is that technical losses will increase exponentially as load increases. So although it is normally easier to reduce non-technical losses, this saving is off-set by the increase in technical losses. This is evident from the results from Utility 2 (see Figs. 5a and 5b). Loss reduction strategies were in place for 3 years prior to the results shown for Utility 2, where as Utility 1 still has to introduce losses savings strategies.

Technical losses are dependant on the network characteristics and loading. The technical losses will therefore follow the same seasonal pattern as the demand of the utility. Technical losses increase with the square root of the increase in loading. Network overloading and unbalanced loads are the main contributors to excessive technical losses. Technical losses are given by the following formula:

$$Plosses = \frac{R}{|Z|^2}\left(|V_S|^2 - |V_R|^2\right) - \frac{2.R}{|Z|^2}(R.P_R + X.Q_R) + \frac{|V_R|^2.R.B.X}{|Z|^2} \quad (4)$$

From experience it became evident that it is easier to manage down non-technical and cash losses, but in a utility where there is growth, a lack of capital investment for electrical network expansion or network upgrading, will contribute to higher technical losses.

Non-technical losses are reduced through appropriate revenue protection strategies that should be tailored based on a thorough analysis of current revenue protection strategies. This should include appropriate systems (especially billing), metering and meter reading strategies, meter audits, organisational change to allow proper governance for the revenue protection value chain, cut-off and re-connection strategies to name some.

Other forms of losses which are not covered by the above, are losses due to poor system performance. This could be caused by poor or lack of maintenance, or poor design and construction, where unnecessary outages add to loss of revenue and customer dissatisfaction. This should be taken into account when addressing financial sustainability.

Holistic approach to utility financial sustainability

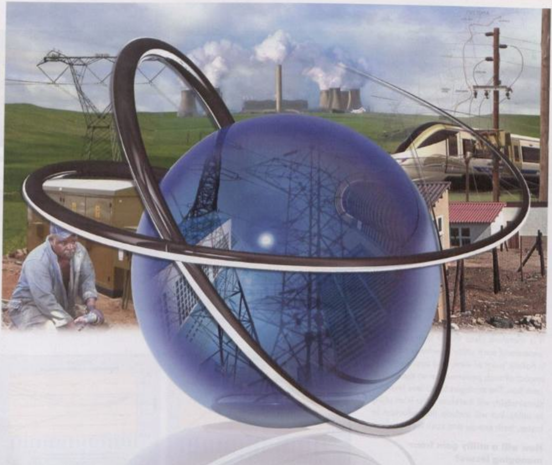
To achieve financial sustainability, one needs to follow a holistic approach, whereby all the various utility activities are modelled, to determine the impact thereof on future cash flows. This should include:

- Utility business economic modelling (BEM).
- Network modelling.
- Loss quantification modelling and monitoring and reporting through appropriate KPIs.

The two examples in Fig. 6 show typical results of BEM.

For Utility 1, the following strategies were applied to achieve financial sustainability:

- Reduce technical losses with from 16 to 14% and non-technical losses with from 5,5% to 2,5%.
- Increase the collection efficiency from 93 to 97,5%.
- Collection of old debtors over a 3 year period.
- Increase in operational efficiency with 40% (measured in kWh per employee or number of customers per employee).



This would mean the increase in the number of customers.

- Additional step tariffs above inflationary tariffs to cater for the increased investment programme not covered by inflationary tariffs.
- Monitoring and reporting through appropriate KPIs.

For Utility 2, the following strategies were applied

- Loss reduction from 26 to 20%.
- Maintain collection efficiency.
- Convert expensive generation, and optimise generation mix.
- Restructuring of debt.
- Increase the quality of supply and reducing outages.
- Increase sales through electrification and large mining loads.
- Additional step tariffs in short term.
- Overdraft to support short term cash deficit.

It is therefore clear that it is important to understand each utility's performance from a holistic point of view, and appreciate the impact of such performance on the overall cash flow. The strategies to achieve financial sustainability will therefore differ from utility to utility, but will include the reduction in losses, both energy and cash losses.

How will a utility gain from managing losses?

Technical losses

- Reduction of technical losses will reduce the cost of supply, as this will reduce the cost of generation and imports (or purchases where a utility only buys power from a bulk supplier).
- Least cost generation will save on the most expensive generation.
- Network optimisation (optimal switching arrangements, balanced loading, optimal voltage levels) will reduce technical losses but will not need capital investment (except if new switchgear is required to implement the optimal open points).
- Where network strengthening is required to reduce technical losses, the utility would need investment.

Non-technical losses

- A reduction in non-technical losses will either be converted to additional sales, or reduction in generation cost (same as for technical losses), or both.
- Normally the reduction in non-technical losses will not need huge investments, but might increase short term operational expenses to implement the necessary strategies.
- It will also encourage efficient usage of electricity as customers will pay for what they consume (the quid pro quo principle) and tend to force average consumption down.

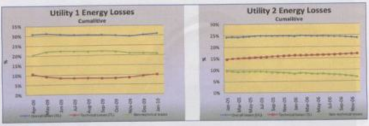


Fig. 5a: Energy losses.

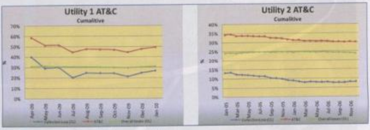


Fig. 5b: Aggregate technical and commercial losses.

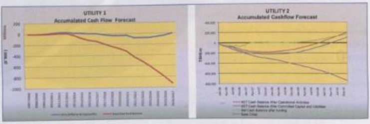


Fig. 6: Typical results of BEM.

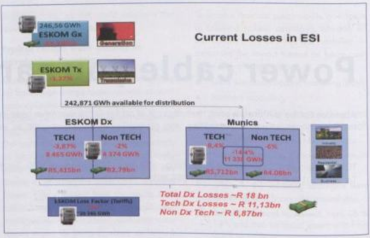


Fig. 7: Losses in the currant supply chain in the ESI.

The South African context

To quantify losses exactly for South Africa is not straight forward, due to the availability and discrepancies in available data. Fig. 7 indicates the losses in the current supply chain in the ESI which is estimated at R10,1-billion (excluding the generation losses), with a split between technical and non – technical of R3,2-billion and R6,9-billion respectively. If one assumes that with the suitable mitigating strategies improvement can be achieved, approximately 12% of technical losses through network optimisation, as well as reducing non-technical losses to 2%, possible savings of between R3,9-billion and R4,68-billion respectively can be achieved.

Conclusion

It can be concluded that utility managers must see loss management as part of a holistic approach to ensure utility financial sustainability. All utilities will have losses, which could be managed down to sustainable levels, by implementing custom made strategies.

In South Africa there are also many ailing utilities, where unnecessarily high losses contribute to their woes. Management can take up this challenge by implementing a proper monitoring and reporting framework, by understanding the utility from a financial point of view, quantifying these losses, and applying appropriate strategies to become financially sustainable and still charging market-related tariffs.

If the potential savings as estimated above can be achieved, this can contribute towards addressing the current estimated backlog of R 28-billion in refurbishment and maintenance, as well as assisting in maintaining tariff levels in the short term.

The revenue or cash loss should be solved by first segregating the revenue cycle, analysing it, measuring the performance and optimising the process before relying on tariff increases.

Always bear in mind: You cannot manage what you do not know.

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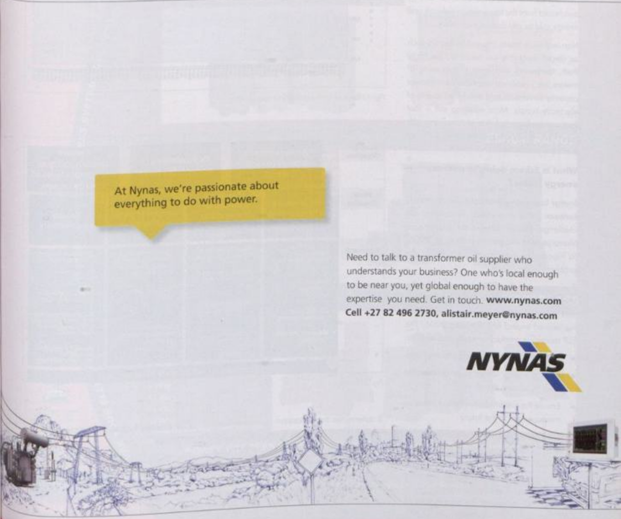

Energy loss management programme: Eskom Distribution

Energy loss is of concern across South Africa and is an issue that many utilities around the globe face. This paper will explain how Eskom is addressing the energy loss issues experienced, what lessons have been learnt over the past few years, and what will be the areas of focus going forward.

by M Maphaka, Eskom,
S Naidoo and V Moodley, EON Consulting

In July 2006, Eskom Distribution's total energy losses were approximately 6%. Approximately 2,34% were technical and 3,66%, non-technical losses. This represents a 40/60 split. A 1% loss in energy equates to approximately R400-million (based on average tariffs for 2006), thus energy losses are of great concern to the distribution business.

Energy losses for Eskom Distribution are defined as the difference between energy purchased from the transmission network and energy sold to distribution customers.

Non-technical losses (caused by factors such as illegal electricity connections, electricity theft, tampering with meters, bypassing of meters, etc.) continue to contribute to current capacity constraints and a reduced quality of electricity supply. More worrying still is that lives are endangered due to tampering with electrical installations and exposure to unsafe electrical connections.

What is Eskom doing to address energy losses?

Energy losses have increased almost linearly between 2002 and 2006. To combat this challenge, Eskom initiated the Energy Loss Management Programme (ELP) in 2006, to vigorously investigate and address the problem.

The success of the ELP is measured by the impact on the energy loss trend on a national and regional level. Successes so far reflect the desired impact of ELP during 2006. The ELP strategy is producing results and aims to:

- Arrest the increasing energy losses trend
- Reduce energy losses to an acceptable level by various means
- Ensure the sustainability of effective losses management in the future

Arresting the increasing trend and reducing it to an acceptable level have been achieved, as is evident in the trend line (Fig. 1). The remaining challenge is to sustain the gains made moving forward. Sustainability is critical to the success of the programme as it determines the successful hand-over from project-based initiatives to normal business operations. Currently, the key focus of the programme is to gear the business towards building this sustainability to ensure that the energy losses handover process will be as seamless as possible.

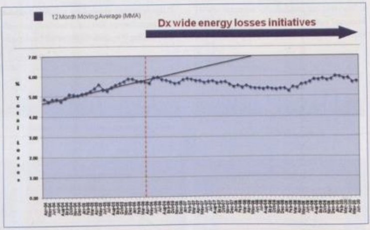

Fig. 1: Trend of total distribution energy losses.

Fig. 2: Strategy.

The energy losses management strategy

The "audit, measure and fix" workstream uses business intelligence to identify and target customers that are high loss, and hence high risk, customers. Customer audits are prioritised using anomaly reports such as

customers that are consuming very little in comparison to other customers in the same category, or customers consuming even though their accounts have been terminated. The results of audits are measured on the ELP scorecard where the number of audits done per month and number of problems fixed per month are tracked and measured.

The 'ringfence electrical networks to balance energy' workstream focuses on the identification of network boundaries, installing statistical meters to measure energy flows and to balance energy inflows and outflows so that all anomalies can be identified. The results of statistical meter installations and feeder balancing data are also measured on the ELP scorecard, to ensure timeous installation and accurate data and reporting.

The "implemented tested technologies workstream" focuses on investigating technology options to reduce energy losses, piloting and testing these technologies and measuring the benefits.

The "ensuring sustainability through resourcing" workstream focuses on detailed business and environmental analyses to determine gaps in the business – these gaps could be process, people and technology related. The programme has developed an energy loss management process that is currently being integrated into the business.

The "communications" workstream focuses on both internal communication as well as communication to the general public. Internal staff is educated on what energy losses are and the impact their work activities have on energy losses. A public engagement drive has been initiated using a social marketing approach that encourages all South Africans to be or become legal power users. The ELP social marketing campaign objective is to influence the voluntary behaviour of consumers to be legal users by reducing the number of illegal electricity consumers, mobilising citizens to report and prevent tampering and illegal connections, and by building partnerships to deal with illegal electricity consumption.

Using advertising, social mobilisation, partner mobilisation, strengthened enforcement measures through criminal procedures, and engagements with stakeholders, this hard-hitting campaign targets Eskom staff and contractors, business, commerce and the public to become partners in a drive to reduce electricity theft and ensure legal power use.

The structure of the ELP

The structure of the ELP consists of a national programme management office (PMO) with all workstreams reporting to project and programme managers. The national sponsor is ultimately accountable for all deliverables of the national PMO. The ELP steering committee consists of executive members of Eskom Distribution. It is this committee that approves, supports and drives the ELP strategy and implementation approach.

All six Eskom regions also have regional ELP implementation structures in operation. There are task teams in place where regional project managers are responsible for all ELP-related activities. The project manager reports to the regional champions (revenue protection managers and energy trading managers), who then report to the regional sponsor who is ultimately accountable for all regional deliverables.

What lessons can be shared with the industry?

Successes in audit workstream

The ELP shifted audit attention to focused LPU, SPU and PPU meter audits. Regions were encouraged to target high risk customers as opposed to blanket audits, using tools such as customer stratification, customer billing reports and energy loss reports for projects balanced. Audit target setting and budget allocations were based on an energy losses analysis model, to target high-loss areas per region. Since the existence of the ELP, regional auditing involvement and enthusiasm have increased. All Regions have exceeded their LPU audit targets (high revenue source) for the past financial year.

The following list is a summary of the customer audits carried out since the start of the project, up to the end of June 2010:

- 19 298 LPU audits were done, with 1960 problems identified and 1913 problems fixed.
- 254 507 SPU audits were done, with 46 688 problems identified and 20 691 problems fixed.
- 2 117 977 PPU audits were done, with 240 300 problems identified and 168 062 problems fixed.

To date a loss to the business of over R120-million has been prevented as a result of the fixes done on problems identified from April 2009.

In addition, the ELP revenue recovery process has assisted the business to re-bill over R58-million from these audit findings.

This has been a result of dedicated and focused customer auditing and fixing from all the regions, particularly in the LPU and SPU customer domains.

Over and above the development of the standardised audit methodologies and data specifications, the ELP redefined the customer care and billing anomaly reports criteria in the LPU, SPU and PPU domains for improved usability and quality. These reports include customers that seem to have low consumption compared to others in the same category, or customers consuming even though their accounts have been terminated.

The ELP has also implemented quality assurance (QA) for customer meter audits. The regions are visited every three months to ensure data validity and authenticity, and to ensure compliance with the audit methodology.

Risk and mitigation on the audit workstream

The low fix rates of problems found through audits has been identified as an area that needs attention. Low fix rates occur as a result of departmental prioritisation and a general lack of departmental resources. The "resourcing for sustainability" workstream has done a detailed analysis of the resource gaps and resource requirements in the business, to ensure ELP is a success. The regions were asked to encourage stakeholders such as Engineering Delivery and Field Services to be more involved in the fix process, and to highlight the value of their involvement. Regions were also encouraged to make use of skilled and authorised contractors to overcome departmental resource constraints, and to "clean-up" the backlog of fixes that exists for LPU, SPU and PPU meter installations, picked up from audits.

Successes in the ringfence workstream

Regional statistical meter installation is underway in all the regions. The ELP has played a key role in the process to obtain financial assistance from the capital projects department in order to fast-track stats meter installations in the regions in the previous financial year. Stats meter installation targets were exceeded at distribution level for both the 2008/9 and 2009/10 financial years.

The energy losses model, which was developed by the ELP, is used by the business and regions to identify customer services areas that have high losses and should be targeted for audits. The results obtained from the model were also used for target setting for total energy losses for Eskom Distribution, as well as regional total energy loss targets.

Feeder balancing model (FBM) reports are now published on a monthly basis by all the regions.

The measurement of additional key performance indicators to track monthly statistical installations and FBM reporting progress was successfully introduced in the ELP Scorecard.

Risks and mitigation on the ringfence workstream

Departmental prioritisation may impact the number of statistical meters installed.

Adequate and focused compacting of relevant stakeholders must be applied to ensure that statistical metering targets are met. The ELP "ringfence" workstream continuously monitors and influences progress towards meeting these targets.

The accuracy of statistical meter information was also identified as an area of concern. The ELP has identified gaps in business processes allied to data management and data capture. Hence, alternate means of capturing information when sites are visited (e.g., using LPU audit teams) need to be investigated.

Successes on the technology workstream

The ELP "technologies" workstream investigated and participated with Eskom metering specialists to apply metering and meter installation technologies for reliable meter readings. This was done over the meter's life cycle and to reduce the possibilities of tampering with the meter.

In the prepayment metering environment, split meter technologies were found to be an appropriate solution in addressing the meter tampering problems. Installation costs were a concern, especially where unauthorised access to the meters needed to be prevented. Pole-top box installation for split meters promises to be a cost effective solution in the quest to limit access to the meter installation. Pilot initiatives are currently underway in some regions and a national roll-out project is currently under consideration.

The accurate capturing of field audit data is a major contributing factor to the successes of the meter audit drive. A suitable mobile computing solution with data dictionaries was selected to collect field audit data, recommended to the business and successfully implemented. The back office data management and data accuracy also required attention. The uploading of field audit data from the mobile computers to back office systems was also addressed and successfully implemented. However, before the data could be uploaded onto the Eskom mainframe systems, the field audit data needed to be verified and accurately linked to existing data on the Eskom systems. Requirements for such a verification system were specified and are currently being developed.

A key focus of the ELP drive is to establish sustainable solutions for energy loss management and much attention was devoted to the development and acquiring of an energy management system. The system should provide specific energy- and losses-related business management information (BMI), reconcile energy sales with energy distributed, and provide data verification and control. Due to the high costs of replacing existing Eskom systems with a system taking the needed energy loss management requirements into account, an approach was selected to develop a system which interfaces with the existing Eskom systems. The development of a system to verify the accuracy of customer data linked to the network data (customer network link (CNL) verification) has been done. This CNL verification tool is specified to accommodate future expansion into other loss management requirements, and to incorporate the field data verification and upload tool as mentioned above. Future phases will include energy related BMI and integrated energy reconciliations requirements.

Successes on the resourcing for sustainability workstream

The ELP "resourcing" workstream had the task of ensuring sustainability through proper structures and resourcing in the business.

Resource gaps were identified and a comprehensive analysis was carried out to determine what skills and amount of resources the business requires for energy losses management to be effective and successful. A resourcing plan was developed as to how to source the skills required and ensure full utilisation of resources towards energy losses management. The workstream also implemented measures to align the processes in the business and identify and address gaps in processes that impact losses management.

Risks and mitigation on the resourcing workstream

Current global financial constraints could affect budget availability and hence impact negatively on sources required for resources to manage energy losses.

Successes on the communications workstream

At the outset of the ELP it was recognised that once the internal challenges have been addressed, it would be necessary to launch a public communication campaign to engage with customers.

The ELP developed an external public communications and education strategy in conjunction with Eskom's Group Communications Department, with the aim of changing the public's behaviour towards legal electricity use. The programme garnered input and support for the strategy from various stakeholders.

In order to achieve the objective of reducing losses and encouraging people to stay and or become legal electricity users it was evident that a behavioural change approach was needed. The social marketing campaign provided the perfect vehicle to drive this change. The campaign further holds the opportunity for Eskom to partner with various corporates and organisations, thereby extending its reach.

The objectives of the ELP social marketing campaign are:

- To influence the voluntary behaviour of consumers to be legal users, by reducing the number of illegal electricity consumers.
- To mobilise citizens to report and prevent tampering and illegal connections.
- To deal with illegal electricity consumption by building partnerships.

Following months of analysis, planning, preparations, creative design and production, April 2010 saw the start of the phased roll-out of the energy losses public engagement initiative, aptly branded: Operation Khanyisa, The power is in your hands.

The word "Khanyisa" means" to give light" or "to enlighten". The name is ideally suited to the campaign, which is aimed at enlightening people about the need for all South Africans to become legal power users. The campaign will also address the impact and consequences of electricity theft for all South Africans. Operation Khanyisa will entice audiences to "wise-up" to legal, safe and energy-efficient electricity use.

Operation Khanyisa commenced phased roll-out at the end of April 2010 and will see a series of activities kicking in through to December 2010. Among the first activities were employee blitz awareness events: Eskom's tough stance on dealing with customers, contractors, employees and "street electricians" who are caught stealing electricity was emphasised through a mock arrest by the South African Police Service, DVD clips following an edutainment approach, and an industrial theatre production. The results of these events were very positive in that employees showed passion and willingness to participate in the campaign.

Following the introduction to staff, the social marketing campaign was introduced to the agricultural sector during the National Maize Producers' Organisation (NAMPO) annual harvest exhibition in Bothaville, Oranor Free State. NAMPO attracts farmers and agricultural suppliers from across the country and was a perfect opportunity to roll-out Operation Khanyisa to the estimated 64 000 visitors during May 2010. The stand at NAMPO was supplemented by live reads and radio ads on the RSG and OFM radio stations, internet banners on OFM news pages, and various radio and print interviews.

Next, Operation Khanyisa rolled out in Soweto at the end of May through a three-week radio ad campaign, supplements in the *Sowetan* and *Daily Sun*, taxi rank blitzes, mall activations and industrial theatre road shows, as well as 40 billboards including spaza billboards and wall murals. The aim of this roll-out was to clearly position this campaign as the real Operation Khanyisa and launch the drive for communities to stand together and promote legal power use. The roll-out created a first wave of awareness of the campaign and issued a call to action to report illegal electricity use by anonymous SMS tip-off to Primedia Crimeline at 32211.

A national launch and roll-out of various sub-campaign legs across all Eskom customer groups, stakeholders and partners will take place over the next six months.

Risks and mitigation on communications workstream

Due to the recent increase in electricity prices granted by the National Energy Regulator of South Africa (NERSA), in combination with the current economic situation, not only in South Africa but worldwide, the level of energy losses is at great risk of increasing. People are feeling the financial pinch, and may therefore be more susceptible to giving in to illegal activities, such as tampering with meters and illegal connections. This does not only apply to households, but also to businesses, small and large.

It is therefore crucial for the ELP to nationally launch its social marketing campaign in order to educate the public on energy losses and drive a behaviour change that speaks out against tampering, bypassing and illegal connections.

What does the future hold?

In conclusion we would like to share our focus areas for the year ahead:

Eskom utilises contractors to perform LPU, SPU and PPU audits in regions. Hence, it is imperative to control and monitor the work done. The contract management requirements for energy losses audits, which include contractor scope of work, audit quantity and rates for various areas, have been aligned and standardised in all regions. The next step is to train the regions on these requirements, this initiative has commenced in two regions, with other regions to follow.

The QA of audits will also be carried out on an ongoing basis to ensure that audit data quality and validity are prioritised by both internal staff as well as contractors. The scope of such QA includes work done in the field and corrections on the billing system, as well as across all types of customer audits (LPU, SPU and PPU). The ELP will also be increasing the focus on the SPU audit and fix domain in order to ensure sustainability of the gains made over the past few years.

As we move towards ensuring sustainability, QA becomes more important. Hence, it is also imperative that statistical meter installations are monitored and tracked. The ELP will emphasise the need for the involvement of the Capital Programme Department as funding and prioritisation are vital. The "ringfence" workstream will also focus on completing the analysis comparing technical and non-technical losses per Eskom region. This analysis will show what the acceptable and sustainable level of total loss is in each region and in the distribution business as a whole. Another focus area for the "ringfence" workstream will be to improve the accuracy of reported non-technical losses on feeders being balanced. Accurate measurement enables focus and the ability for the regions to prioritise actions to manage energy losses.

The ELP has identified all the roles that should be incorporated under an energy losses management function in order to ensure energy losses are managed effectively. When Eskom implements the proposed organisation transformation initiatives, energy losses management will be enabled in the long term through adequate capacity and capability and the Eskom regions will be able to deal sustainably with energy losses.

We plan to nationally launch the ELP social marketing campaign, Operation Khanyisa, within this financial year. Prior to the implementation of the public communications campaign, the creation of a wider internal awareness of the ELP has commenced, and will continue with ongoing initiatives within the Eskom business.

The ELP team is excited about the positive gains made to date and looks forward to addressing the challenges of the current year and beyond. In order to ensure that a programme of this magnitude is successful, it is vital that all stakeholders become part of, and are ambassadors for, the solution. Together we can make a difference!

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Benchmarking in the South African EDI context

The purpose of this paper is to discuss an approach to benchmarking distribution electric utility industry performance and contextualise the value add for the South African environment. In addition, given the performance data now available as a consequence of the 33 completed municipal ringfencing projects undertaken by EDI Holdings, the paper provides a contextualisation of the data and an interpretation of the relative performance of the ringfencing participants, by utilising benchmark data and best practice information sourced in the broader international distribution utility context.

by Dr. W J de Beer, N Waters, L Annamalai, EDI Holdings

The basic definition of benchmarking in a utility context that is applied in this instance is:

Measure performance against comparable utilities, using a predetermined set of indicators to understand relative performance and initiate performance improvement through pursuit of applicable best practices.

In the South African context, this performance comparison can be initially undertaken by using data available from the EDI Holdings ringfencing project. Aspects of the outcomes of such research are shared in this paper. However, in order to provide for a more comprehensive and balanced set of data for comparison, the intention is to encourage a sample of municipalities to actively participate in a survey in the fourth quarter of 2010, with results being made available, and best practices shared, in a conference scheduled for February 2011. In the longer term it would be wise to make operational benchmarking part of the SA Electricity Distribution Industry in a drive for continuous business performance improvement and move the EDI from current performance levels to real world class service delivery businesses, irrespective of any changes in the industry structure as a consequence of reform initiatives.

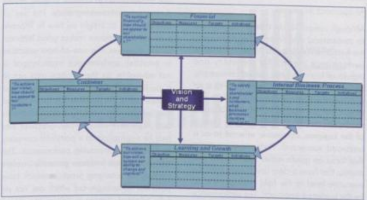

Fig. 1: Indicative balanced scorecard.

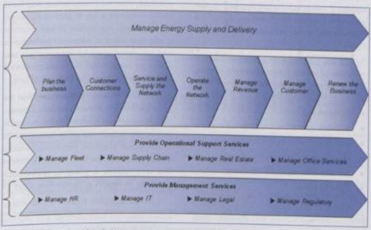

Fig. 2: Indicative utility value chain.

The benchmarking and best practice approach

Why benchmark?

Internationally, benchmarking of distribution companies has been applied to enhance efficiencies and by regulators to compare efficiencies of entities. Two well cited studies performed in 2001 and 2003 [5, 6] have indicated the value of international benchmarking, while stressing the importance of careful and proper variable selection. Similar studies have shown that information asymmetry can be reduced by cross country analysis. However international benchmarking studies raise important empirical and methodological concerns. The problems arise from the many practical and technical aspects of the definitions and fields of activities and responsibilities of the national distribution companies. Cullment, Crespo and Plagnet [4] site as examples of these challenges voltage levels, divisions between transmission and distribution activities, distributors that are not constrained by the same political and regulatory obligations, and variations in standards of quality.

The rationale adopted by most utilities in building a case for participating in a credible benchmarking programme includes the fact that benchmarking performance against other similar businesses can provide some insights into your business performance and best practices offer a perspective of what the leaders in the industry internationally are doing. The primary objection to comparing performance and practices against others is the argument of uniqueness. However

International utilities are remarkably similar in terms of business operations fundamentals and panels can be compiled to factor in certain differentiators such as geography, customer base, customer mix, density, climate, governance structure etc.

In the South African context, efficiency analysis through benchmarking is particularly important in identifying cost drivers and efficiency improvement opportunities to address shortcomings and limitations in the current practices and performance of the industry and also to prepare for the migration to a competitive industry structure with some form of market-oriented regulation.

An approach to process

Although companies use different approaches to understand and improve performance, the fundamental elements of setting baseline performance metrics for the utility and individual business units, reflect consistently. Performance metrics can be defined as a set of comprehensive quantitative measures and targets that are representative of the business results desired, balanced across all aspects of the business, commonly referred to as a balanced scorecard. Performance metrics that focus on results rather than activity, and metrics that have a clear line of sight from the executive level to the field manager should be the preferred approach. The performance metrics should be balanced so as to avoid sub-optimisation, i.e. balance cost goals/ metrics with customer goals. In addition, the approach needs to have balance and context within the broader vision and strategy of the business and across the entire business value chain.

Typical key performance indicators that are reflective of a balanced assessment of utility performance, irrespective of governance structure, would include:

- Network reliability
- Network operations and maintenance cost
- Restoration of supply efficiency
- Technical and non-technical losses
- Revenue management efficiency
- Cost to serve
- Service levels
- Safety
- Resourcing levels and efficiency

In addition to understanding the comparative business performance, the second fundamental component of a comprehensive benchmarking programme is the identification of best practices and trends in the sample of participating utilities. Best practices are tested business practices or methods that contribute to superior improved performance applicable to the participants. It is a relative term that usually describes innovative business practices or methods that have been identified and implemented to achieve tangible results during a benchmarking study. The use of best practices as insight on how to improve business performance makes good business sense. However, the use of best practices to establish performance expectations is not advisable, as the solution may not fit a particular business environment. The assessment of this business fit is thus a critical step in the decision making process to identify and implement industry best practices that may be appropriate to a particular company and helpful in improving performance. The selection of best practices generally involves looking for emerging practices which have potential advantage, but which are not yet fully adopted. Timing is critical to gaining competitive advantage. Once identified, implementation, consistent execution of practices, rigorous measurement and focus on the outcomes is key to gaining significant improvements. Application of best practices is also best linked to measured performance and associated areas for improvements and is thus an integral part of the benchmarking process, rather than a stand alone activity.

International experience has shown that the cross pollination of best practices between utilities, sometimes sourced from comparable businesses outside the utility sector, results in some best practices becoming standard industry practices over time. In some instances this may require a utility to review such practices to regain a competitive edge or keep pace with technological developments. In other cases, a best practice may remain a constant for decades, for example, a proactive and consistent vegetation management programme to keep tree and bush growth out of overhead lines will always be an industry best practice, but the differentiator that changes over time would be the use of innovative approaches to achieve this industry best practice.

The South African context

Benchmarking is currently treated with some trepidation and suspicion within the utility industry in South Africa. This concern is based on a number of factors, including availability of data, resource constraints to undertake the exercise and suspicion that the outcome will reflect poorly on the individuals and their electricity departments. In order to address these concerns, a serious change management exercise must be considered first and must be sustained to change the overall behaviour towards meeting the primary objective of improving overall industry performance and sustainability. However, a number of the municipal utilities have indicated an interest and willingness to participate in a pilot programme, which, with appropriate effort invested in data collection, will yield immediate insights and potential operational performance improvement opportunities to the participants.

A balanced scorecard is under development that contains a set of metrics that create a baseline measurement standard for the industry and which provide a balanced insight into industry performance. Participation in this process by multiple municipalities will lead to the establishment of a real data baseline of current performance across the electricity distribution industry. This scorecard will be based on the minimum number of data points that can provide a good indication of business performance across operational areas, with consideration being given to the nature of the municipal electricity business and availability of baseline data. A number of optional fields will also be created to afford participants who have access to a more indepth range of data to get more detailed and specific feedback and benefit from the programme. This programme provides the opportunity to achieve efficiency analysis gains from cross country analysis by providing a broader view of the industry performance, especially given a wide disparity in the operational performance of the South African entities.

Score card preparation will be based on experience gained and lessons learnt from the pilot programme run with the City of Cape Town, data fields that were successfully populated by a range of municipalities during the EDI Holdings Ringfencing exercise and more recent data collection exercises associated with EDI Holdings support to specific local municipalities. The scorecard will reflect why certain data points are critical and mandatory and what they reveal about the business operations, as well as regulatory compliance. Furthermore, consideration will be given to what data is accessible or retrievable from the municipalities, (which may involve some data collection or interpretation from other indicators; data cleanup and normalisation to the standards prescribed). Statistical information will also form part of the data set, in addition to the scorecard.

EDI Holdings will work with all stakeholders to implement a programme that meets the needs of the industry and that of individual stakeholders.

A sample of comparisons of South African performance, based on available ringfencing data, and the international mean

The bar charts in Figs. 3, 4, and 5 provide an example of the type of analysis that can be done once a more representative data set is available from South African utilities. In this instance, the EDI Holdings Ringfencing data has been used as a source and compared to an international mean. In a more comprehensive study, South African sample size and nature, as well as the sample that makes up the international mean, would be more refined and discreet. These graphs are thus illustrative of the type of analysis that is possible. In all instances, the conclusions drawn would need to be validated with individual entities and any strategies developed to address performance gaps, including the introduction of best practices, would need to be verified for local circumstances and application.

Preliminary analysis

Locally the actual total maintenance spend per MWh on distribution network is lower than the international mean (see Fig. 3). The local mean is drawn upwards by very high spend within some of the municipalities within the sample set. The sustainability of this low spend practice is questionable as maintenance of the network is a primary factor for sustainable business performance over the long term. It is also important to note that the international reference panel is not confronted with a maintenance, refurbishment and strengthening backlog to the extent of the situation in South Africa.

Actual maintenance spend per distribution customer, ignoring the current maintenance, refurbishment and strengthening backlog, indicates that there is not too much of a difference between the international benchmark mean and the local mean (see Fig. 4). However the local mean is definitely pulled upwards by the investment of a few municipalities while the majority are well below the bench mark. These statistics reinforce the need for addressing the backlog while investment levels in a number of the current utilities must be improved.

While there might be opportunities for some municipalities to review their asset investment approach, for the majority of the sample, attention will need to be given to the distribution infrastructure maintenance spend, as the network would be at risk.

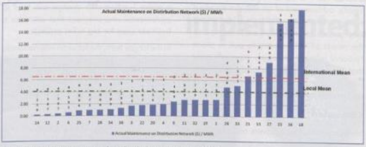

Fig. 3: Total maintenance spend on distribution network per MWh.

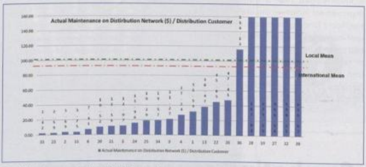

Fig. 4: Maintenance spend per distribution customer.

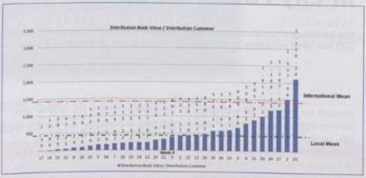

Fig. 5: Distribution network value per distribution customer.

Locally the distribution network value per distribution customer is substantially lower than the international benchmark (see Fig. 5). This indicates that either renewal of the network infrastructure is not occurring, or that the existing infrastructure is being used to service a large and growing customer base with little new asset creation.

Key opportunities

The most significant opportunity associated with benchmarking is to achieve sustainability and long term viability in the South African EDI through operational performance improvement.

Performance improvement areas can be identified through regular assessment of a balanced suite of performance indicators, both internally and relative to a comparable national and international panel. Analysis of the data collected within this balanced suit of indicators leads to an enhanced understanding of business imperatives and provides indications of where methods to identify best practices should be applied.

A second opportunity is the formation of a community of practice that facilitates structured interaction and sharing of best practices for best fit, the business case for implementation thereof and monitoring of results that yield business change.

Finally, achievement of an industry standard score card for data collection will go a long way towards assisting, from a common basis, the needs of the industry to put in place Nntional relevant strategies, especially ones that deal with human capital development, infrastructure maintenance levels, bad debt and energy consumption.

Conclusion

Identification of cost drivers and efficiency improvements can have an immediate impact on the operational performance of municipal distributors. Whilst it is acknowledged that a number of the improvement initiatives are likely to require significant funding, resources and a multi-year implementation plan, there are areas of best practice that only require a reallocation or refocusing of existing resource, budget and effort to effect an improvement. Adopting a mindset of effecting change and improving operational performance without a major funding step change can lead to incremental improvement that provides a business case for big ticket projects.

In the longer term, the focus on internationally accepted key parameters in the business, used to drive KPIs, efficiency improvements realisation through trend analysis and the application of best practices will yield more sustainable business improvement beyond quick wins.

An integrated approach can lead to industry performance optimisation where operational benchmarking is institutionalised as a preferred means of business performance improvement. Validated and credible data can be made available to the industry, the regulator and decisions makers to assess distribution performance and risks. In addition, a focused and consistently implemented benchmarking programme in the EDI will lead to improved business strategy formulation to address South Africa's socio-economic drivers, aligned to supporting the countries growth, rather than presenting a potential risk to that growth.

References

[1] EDI Holdings Ringfencing Programme.

[2] Polaris International Benchmarking Programme; A product of PA Consulting.

[3] R S Kaplan and D P Norton: The Balanced Scorecard: Translating Strategy into Action, Harvard Business School Press, 1996.

[4] Astrid Cullmann, Hélène Crespo, Marie-Anne Plagne: *International Benchmarking in Electricity Distribution: A Comparison of French and German Utilities*; October 2008.

[5] T Jamasb, M Pollitt: *Benchmarking and Regulation: International Electricity Experience*. Utilities Policy 2001;9; 107-130.

[6] T Jamasb, M Pollit: *International Benchmarking and Yardstick Regulation: An Application to European Electricity Distribution Utilities*. Energy Policy 2003;31; 1609-1622.

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Combating conductor theft in City Power areas

The incidence of conductor and material theft is on the increase. As with other electricity distributors, City Power (CP) has been proactive in dealing with the problem of theft and is using various methods to combat this scourge.

by Silas Zimu, City Power

Amongst the methods are technology solutions including products such as Cable Safe, monitoring of power installations and a pylon protection programme. Cable Safe and related products have been proven to work, as it takes too long to remove the rubber covering from around the cable. CP is using old vehicle tyres as well as the commercial product which prevents cables being dragged out of trenches. Power monitors are being installed on minisubs. These monitor a variety of parameters such as voltage drop on cables, which can be used to indicate theft.

Transmission lines are the backbone of any infrastructure and damage to pylons can cause major disruptions. Sensors and seismic transducers are being fitted to pylons to detect any unusual action which could be related to theft. Additional measures include sensors on manholes, movement (seismeic) sensors above cables and monitors on public lighting.

To combat criminals you need to think like criminals, even in the boardroom. The community takes theft seriously, and suspected thieves have on occasions been attacked by community members. Joint operations to combat cable theft are being undertaken with the National Planning Commision (NPC). Crime intelligence is important. In one case, 11 suspects were arrested as a result of information. There are numerous cases of heavily armed thieves threatening CP staff or security. CP has formed partnerships with security companies in an effort to combat theft as they have a presence in most areas and can easily report any suspicious activities.

Closing scrap dealers does not work as they simply open somewhere else. Copper should be treated as a precious metal to make its trading far more difficult and easier to control.

Another successful project has been the marking of cables with dyes that respond to UV light – making it possible to identify stolen cables that heve been recovered by police.

Contactors are often responsible for theft, primarily of scrap material but also of new cable. Experience shows that one person caught gives the names of ten others. Investigations have shown that copper theft is the work of syndicates – well organised gangs that plan theft and disposal of stolen cables. A number of these syndicates have been identified by police arising out of the work by CP and a number of syndicate members have been arrested.

CP is taking action to have certain installations classified as national key points in terms of the National Key Point Act. Key points can be guarded and secured.

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System performance (quality of supply, load shedding challenges)

Power system performance is influenced by many factors. This report is a simplified look at the impact of protection equipment and protection settings on the performance of power systems and areas where this may be mitigated and/or improved. This paper is of an academic nature and does not quantify the results before and after intervention.

by C L M Pierini, NETGroup

When looking at system performance, various indices are calculated to determine the status of the overall performance of a power system and will allow the engineer to perform a comparative analysis across the network.

Most metros are a result of the combining of various cities. Each city had their own standards and way of doing things, so with the combining of these cities into one large metro a mosaic of networks and methodologies is the order of the day.

Rationalising of the various standards is key to the future success of the metro, as well as the ongoing improvement in the operation of the power system. A key factor behind this is the optimising of the network connectivity as well as the protection settings. A single model of the power system enables the metro owner to better understand the power system interaction under normal and abnormal circumstances.

By addressing these issues, a step in the improvement of the overall system performance can be achieved.

Performance

Indices

The most commonly used reliability indices are *SAIFI, SAIDI, CAIDI* and *RSLI*. These indices provide information of the frequency and duration of system faults as experienced by the connected customer base.

The average interruption duration represents the average number of hours each customer is without electricity due to a network supply interruption.

The *SAIDI* index represents the system average interruption duration based on the total number of connected customers, while *CAIDI* represents the customer average interruption duration based on the number of customers interrupted.

SAIDI is a measure of how many interruption hours per customer served by a system (feeder, substation supply area or region) may experience during a supply period of a year.

SAIDI can be calculated as shown in Eqn. 1:

$$SAIDI = \frac{\text{Sum of customer interruption durations}}{\text{Total number of customers served}}$$

$$= \frac{\sum_{Inter=0}^{\text{Tot no. of Int for reporting period}} \text{(Restore time per interruption} \times \text{number of interrupted customers per interruption)}}{\text{Total number of customers served}}$$

$$= \frac{\sum_{i=0}^{Int\ Tot} r_i N_i}{N_T} \qquad (1)$$

A utility is expected to reduce *SAIDI* (the average number of hours each customer is without power per annum) through regulation by NERSA. A reduction in *SAIDI* is achieved by reducing the number of customers interrupted due to equipment faults or planned maintenance and also by reducing power restoration times to customers. *SAIDI* is influenced by the network configuration.

The Customer Average Interruption Duration Index (*CAIDI*) represents the time required to restore the electricity supply to the interrupted customers. It is a response time indicator of the average interruption duration in hours to those customers interrupted. However because *CAIDI* is a value per customer it does not reflect the magnitude (or extent) of the interruption event. *CAIDI* can be calculated as shown in Eqn. 2.

$$CAIDI = \frac{\text{Sum of customer interruption durations}}{\text{Number of customers interrupted}}$$

$$= \frac{\sum_{Inter=0}^{\text{Tot no. Int for reporting period}} \text{(Restore time per interruption} \times \text{Number of interrupted customers per interruption)}}{\sum \text{Number of interrupted customers per interruption}}$$

$$\frac{\sum_{i=0}^{Int\ Tot} r_i N_i}{\sum_{i=0}^{Int\ Tot} N_i} \qquad (2)$$

The system average interruption frequency is provided by the System Average Interruption Frequency Index (*SAIFI*), indicating how often the average customer experiences a sustained interruption over a predefined period. The SAIFI can be calculated as shown in Eqn. 3:

$$SAIFI = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers served}}$$

$$= \frac{\sum_{Inter=0}^{\text{Tot no. of Int for reporting period}} \text{(Number of interrupted customers per interruption)}}{\text{Total number of customers served}}$$

$$= \frac{\sum_{i=0}^{Int\ Tot} N_i}{N_T} \qquad (3)$$

From Eqn. 1, 2 and 3 it can be noted that the CAIDI can also be calculated from the ratio of the SAIDI and SAIFI (seen Eqn. 4).

$$CAIDI = \frac{SAIDI}{SAIFI}$$

$$= \frac{\sum_{i=0}^{Int\ Tot} r_i N_i}{N_T} \times \frac{N_T}{\sum_{i=0}^{Int\ Tot} N_i}$$

$$= \frac{\sum_{i=0}^{Int\ Tot} r_i N_i}{\sum_{i=0}^{Int\ Tot} N_i} \qquad (4)$$

The Reticulation Supply Loss Index (equivalent to the Average System Interruption Duration index, *ASIDI*) gives an indication of the average MVA lost due to interruptions during a period (month or annual).

Similarly to the *CAIDI*, a customer frequency index called the Customer Average Interruption Frequency Index (*CAIFI*) provides the average frequency of sustained interruptions for those customers experiencing sustained interruptions (see Eqn. 5).

$$CAIFI = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers interrupted}}$$

$$= \frac{\sum_{i=0}^{Int\ Tot} N_i}{CN} \qquad (5)$$

The most commonly used performance indices used by electrical utilities are the *CAIDI, SAIDI, SAIFI* and *CAIFI*. These indices are customer orientated indices to evaluate the utility's service reliability.

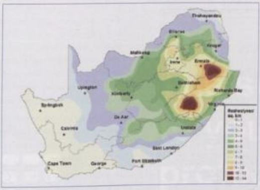

Fig. 1: Lightning ground flash density map.

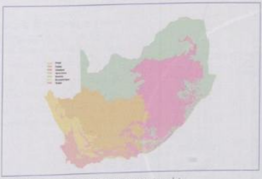

Fig. 2: Biome map based on CSIR vegetation type data.

Factors impacting the performance

Most metros have a diverse mixture of networks, the characteristics and performance of which are influenced by a range of factors including the customer population, load density and environmental factors i.e. vegetation (presence of forestry), the terrain's geography (presence of rivers, dams, mountains) and weather conditions (i.e. rainfall, wind and lightning).

All of these factors can influence both the network design and performance:

- Factors such as overhead lines or underground cables determine the degree of exposure to the elements
- A high load density will tend to result in short MV feeders as is the case in urban networks
- Low load density and rural areas tend to have comparatively long overhead MV feeders. The number of faults increasing with increased feeder length, resulting in reduced performance of rural networks when compared to urban networks.
- Very hilly terrain and poor access will increase the outage duration times
- Networks in dense vegetation or high lightning incidence areas will experience more faults compared to networks in low density vegetation/lightning areas
- The presence of forest, rivers, and dams, environmentally sensitive areas etc. influence the layout of the network which in turn affects network performance e.g. the ability to build inter-connectors between feeders will influence outage restoration times.

Impact of line length

Feeder length plays an important role in determining the probability of failure of a feeder. The overall influence of backbone/ total length on the customer interruption indices is a function of network configuration /topology, failure rate of equipment and restoration/isolation of faulty components in the network. The operating and maintenance of long feeders will hamper the optimal operation and restoration of supply, and results in an increase in O&M costs.

Minimising the exposure of a medium voltage feeder (reducing the length of the feeder) will result in fewer faults on the feeder and hence fewer interruptions or outages. This also affects the SAIDI of the line. There is a relationship between the number of medium voltage feeders at a prescribed length and the number of substations required to support these feeders. Feeder length is typically reduced via feeder splitting and additional MV sources.

Impact of reclosers, sectionalises and fuses

The installation of an additional recloser on an MV system can be used to reduce the MV line exposure. On an MV line without any reclosers, the installation of a recloser may improve the network performance by up to 50%. Note that the addition of an additional two reclosers on this line will not yield an improvement of 100%.

Similar to reclosers, fuses are also used to isolate faulted MV equipment (i.e. MV/LV transformer) thereby reducing the MV line fault exposure.

The customer numbers and the length of line are important considerations during the installation of a recloser and must be planned correctly to protect the overall customer base from the total exposed MV line length. For rural towns, large customers and bulk supplies, these must preferably not be supplied from the MV line backbone but via dedicated supplies.

The installation of reclosers or fault path indicators on tee-offs with relatively short line length or for tee-offs for which faults impact on relatively few customers may still be justified in cases of poor performing lines or limited access.

The successful isolation of faults is very dependent on protection co-ordination between the series connected feeder breaker and recloser. The addition of too many devices requires a longer clearing time subjecting the primary equipment to undue fault currents and the system to longer duration voltage dips.

Impact of lightning

The impact of lightning is a major fault contributor. The lightning ground flash density provides a good insight into the regional distribution of lightning. See Fig. 1.

Impact of vegetation

Vegetation management is also a major cause of line outages as well as the single biggest maintenance budget line item for most utilities. For the purposes of this study, a vegetation map for South Africa based on data published by the CSIR was used to classify all blocks.

There are 68 types of vegetation indicated, starting with coastal forest and ending with sand plain fynbos. For each vegetation type a biome classification (fynbos, forest, grassland etc.) is also indicated.

Impact of corrosive pollution

Corrosive pollution is the destructive reaction of material (e.g. copper, steel, aluminium) with its environment. This erosion of the

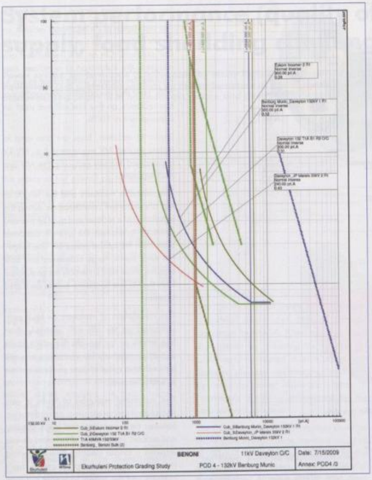

Fig. 3: Sample grading curve.

material could manifest as rust and other forms of corrosion or polluting deposits. In electrical systems corrosive pollution can cause flashovers and one of the ways to counter its effects is to design networks that use components designed for corrosive environments such as for example silicone coated insulators as opposed to uncoated porcelain insulators. Flashovers are typically associated with network interruptions and also influence equipment life expectancy.

Protection equipment and settings

General

To analyse and understand power system performance and the impact protection systems have on system performance, a power system network model is required to be built and studies performed. This model must incorporate a wide range of power system parameters in order to perform such a study.

Modelling

The basic requirements for a power system model is to build a comprehensive network model for the whole utility and the more detail you have, the better – although after a fashion the returns do not justify the effort.

A typical model will include the sub transmission and distribution systems and normally focus on the HV and MV systems, but if data is available or can be captured, the LV as well. The studies are usually limited to the calculation of protection settings for current and time graded over-current and earth-fault protection only but unit protection such as Solkor is normally excluded as the normal assumption is that this protection will be operated before the backup protection.

Analysis

The existing protection settings are evaluated via the co-ordination study. Where the co-ordination was acceptable the settings were not changed. Where incorrect co-ordination is found, the relevant settings are adjusted, based on an agreed philosophy, to ensure acceptable co-ordination margins. Where correct grading was not possible, these instances are highlighted for further evaluation.

For instances where the existing or proposed settings might pose a problem under N-1 conditions, the instances are highlighted for further evaluation.

Problem areas such as CT saturation are also identified during the study. The importance of this is that a saturated CT does not result in a protection trip (with old technology relays).

Grading curves are generated for all substations, indicating grading margins, system fault levels and the applicable transformer/cable damaged curves.

By analysing the impact of tripping times and calculating the relevant indices as a result of the trips, the power system engineer can identify the priority areas which require attention.

Results

The outcome of the grading studies is illustrated in Fig. 3. Whereas previously, the curves would've criss-crossed each other in systems with incorrect grading margins (depending on scales etc.) the result is now a neat and uniform set of curves. This then implies that correct tripping will occur for a fault on the power system. It needs to be stated that the settings calculated are only for a particular network configuration – one setting for all configurations does not exist.

With correct tripping of the network, only the relevant portion of the faulty network is isolated which then affects a reduced number of customers. For example, a fault should be cleared by the protective device as close to the fault as possible. Should this not be the case, then at the next level of protection operated but the impact is greater as there are more customers affected. The more customers affected, the higher the SAIFI values.

Note that tripping times only reduce the duration of the fault and the overall stress on the primary equipment. There are no calculations for the time taken to return to service.

The next crucial step is to return the affected feeder back to service as quickly as possible. In the radial networks this is usually not

possible as there is a single point of supply. All that can be done to minimise the impact of the outage is to isolate the faulted equipment as quickly as possible and return the supply to the remaining customers. In networks that are interconnected, but separated by a normally-open point, the supply can usually be returned a lot faster after some switching. Naturally, the quickest return to service method is where auto-reclosing is possible and this depends on whether the equipment is damaged or not.

The impact of outages then is to affect the SAIDI values. Thus, the longer the outages are, the higher the index will be and the worse the performance of the supply.

Typical results from various studies conducted have identified a number of issues that need to be addressed:

- Over-current setting and earth-fault settings to be changed ensuring correct grading
- There are low ratio 5 A current transformers that will saturate under fault conditions
- There are some grading problems that cannot be resolved by altering the settings alone, and will require some network configuration
- There are Eskom settings which need to be raised and high-set elements to be disabled in order for the new settings to be effective

Improving performance

A lot can be done from a protection perspective to improve overall power system performance. From applying correctly calculated protection settings, to unit protection in order to improve fault detection and selection.

With a power system model, one can also predict the impact a fault can have on a section of network and determine the relevant indices based on an average number of faults/km. This allows the power system engineer to determine the best place to start with the preventative actions.

In addition, reducing outage times involves a number of decisive actions, some of which are listed below:

Early recognition of the escalating events: Obtaining data from an outage management system, a global view and real-time tracking of the current day's outage events is possible. For live systems, details of each event, how many customers are affected, event duration, whether a crew has been dispatched, and projected restoration time are possible. With this information available, the control room operators have a clear view of the emerging picture of outage activity as a basis for deciding how to respond.

Effective communications: A set of automated alerts through the paging system that triggers conference calls with the appropriate level of management as the size of outages increased and events became more widespread.

Better up-front decision-making: Early decision-making about whether to mobilise resources is critical to quick resolution of outages. Should we bring in additional crews and supervisors? Should we have tree crews on stand-by? Should we decentralise dispatching to the local area work centres? These are all tough decisions with resource and financial implications. Once a crew works an extended workday, it is not available for work the following day and schedules are disrupted. When making decisions in isolation, supervisors tended to hesitate, not wanting to do the wrong thing and hoping the situation would stay under control. With the right people participating in the early conference call, better decisions could be made.

Better coordination of field work: Outage minutes grow when a crew is dispatched to a site but when it arrives, finds that it is not able to perform the task at hand. To improve reconnaissance and problem diagnosis ahead of the arrival of a field crew, field supervisors should have the same information the dispatcher sees. With work underway at one site, the supervisor can move to the next site and do an early assessment. In a mid-sized storm, it is essential to work events in parallel and get the right materials and people on site so the crews can be fully productive.

Conclusion

Everything that has been stated above is not new or foreign to the power system engineer. Essentially, your protection system and associated protection settings form an integral part of the power system performance.

With the amalgamation of the various networks, opportunities exist to optimise the supply side of both from a system strengthening perspective as well as from the protection side.

By measuring outage events and calculating the various *SAIDI, SAIFI, CAIDI, CAIFI* indices, the power system engineer can identify the priority areas to focus on. These issues include, amongst other things, verifying that the protection setting is correct and suitable for the specific application, as well as whether the protective device is suitable for the duty at hand.

Experience from other utilities has shown that, while there is an improvement in the *SAIDI*, an unexpected outcome was that *CAIDI* actually increased. This is because the *CAIDI* measure improves when many customers go off line for a short period of time. The bigger events had provided a damper on the effects of smaller, longer outages. The reduction in the impact of the mass outage while a very good thing, meant that *CAIDI* performance became more vulnerable to how well the company responded to the remaining outages, highlighting an important customer service issue.

References

[1] CSIR – Vegetation map.
[2] South Africa Weather Service, Lightning Flash density map.
[3] IEEE.

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Electricity supply vs. demand scenarios for the medium term

It has been clear from events towards the end of 2007 and into 2008 that there is an inadequate supply-demand balance in South Africa. The global economic downturn during the second half of 2008 gave some temporary respite to the electricity system, but demand has already picked up to the 2008 levels and is growing, while we are not adding significant new generation plant to the system until Medupi's first unit is planned to come on line in 2012.

by Corrie Visagie, Eskom

Different measures have been used to describe the level of system inadequacy with the most common being the net reserve margin; the percentage of generation capacity over the highest demand in a year. The problem is not only dealing with shortages over the peak periods but over several hours in the day. What is required to address this imbalance is to introduce additional high load factor supply side options as well as to reduce energy demand across all hours through energy efficiency and conservation.

It must also be acknowledged that this crisis has provided the country with an opportunity to deal positively with energy efficiency in a decisive manner.

- It allows the country to re-look at how to use each kilowatt efficiently and productively
- It will accelerate innovation on demand side management and energy productive technologies
- It provides a platform to focus on climate change mitigation
- It provides an opportunity to make appropriate decisions on the new build programme
- It will have a positive impact on slowing the upward momentum of electricity prices

Current reality

In recent years, South Africa's electricity supply system has come under severe pressure:

- Due to limited new generation capacity, the power system reserve margin has reduced to unacceptable levels.
- The availability of generation plant has reduced because of the requirement to run it harder and the lack of space for essential maintenance.

The power system will remain under pressure until new base load power stations come on line. The recent economic slowdown has provided temporary relief, but electricity demand has recovered to 2008 levels. There seems to be no clear industry view on the extent of the problem, resulting in some apathy among key stakeholders and a lack of urgency from policy/decision makers to deal with the problem. The NERT process did not make any progress, and the situation is getting worse.

The creation of an inter ministerial committee (IMC) structure on energy may be better equipped to deal with the challenges and resulting from the detailed work required from work groups 4 and 6, a joint emergency response and business continuity technical task team has recently been set up between business, industry, Eskom, AMEU and government (DoE) to support the IMC process. Its first report on the challenge has been produced, and it now needs to progress to the next phase of "engagement and development".

Demand vs. supply analysis

In order to understand the challenge ahead, analysis of the supply and demand projections over the medium term has been done. This analysis is very dependent on the assumptions made on key variables over the period.

Key assumptions – demand (peak demand and energy consumption)

- The demand projection excludes the effects of demand side management, co-generation and solar water heating.
- Price elasticity will have a delayed impact which will not significantly reduce demand over the critical next 3 years
- Demand is based on a GDP ranging from 3 to 5% for the period 2010 to 2014
- There is an additional recovery of demand in 2010 due to smelters ramping up to full capacity after the economic recession
- Unconstrained growth is allowed for new connections ≥20 MVA

Key assumptions – supply

Table 1 shows the planned timing of supply capacity additions.

Further assumptions on the above are:

- Base load coal energy availability factor on the big ten coal fired stations: scenarios of 86% and 84%
- Expensive base load station (Grootvlei, Camden, Komati) load factor: 50%

	Eskom build						Country options										
	Grootvlei	Komati	Medupi	Kusile	Ingula	Sere	MSBLP	Nuclear	Regional	DoE OCGT	OCGT	MTPPP1	REFITT Wind	REFITT Other	Other	**Total new build**	**System capacity**
	MW	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**	**MW**
2009	570	202	0	0	0	0	0	0	0	0	0	0	0	0	0	**772**	**44157**
2010	380	303	0	0	0	0	0	0	0	0	0	168	0	175	30	**1056**	**45213**
2011	0	404	0	0	0	0	0	0	0	0	0	168	200	150	55	**977**	**46190**
2012	0	0	738	0	0	100	0	0	0	1020	0	84	200	0	0	**2142**	**48332**
2013	0	0	738	0	666	0	0	0	0	0	0	0	0	0	0	**1404**	**49736**
2014	0	0	1476	723	666	0	0	0	1858	0	0	0	0	0	0	**4723**	**54459**

Table 1: Generation supply options.

- Open cycle gas turbines gross load factor: 6%
- Energy utilisation factor: 95%

Medium term outlook

The assumptions listed above were predominantly used as the basis for the Eskom MYPD2 price application and have been summarised in Fig. 1. The shaded area indicates the sales projection, with and without the impact of DSM and solar water heating shown separately. The line graphs indicate the theoretical annual energy supply availability for the 86% and 84% energy availability factors. The system adequacy metrics used in the analysis are shown in Table 2.

Adequacy metric		Threshold	Detail
AM1: UE GWh	Unserved energy (UE)	<20 GWh per annum	The amount of energy in a year that could not be supplied due to system supply shortages.
AM2: GLF (OCGT)	OCGT Load factor	<6% per annum	The gross load factor (GLF) of the combined OCGT plant in operation in a year.
AM3: EL1 GWh	Emergency level 1 energy	<400 GWh per annum	The energy supplied in a year by generators operating above their continuous rating under instruction during supply emergencies. Interchangeable with OCGT generation.
AM4: GLF (EBLS)	Expensive base load stations (EBLS) load factor	<50% per annum	The Gross Load Factor (GLF) of the combined expensive base load Stations (typically Camden, Grootvlei and Komati) in a year.

Table 2: Adequacy metrics.

It is already clear from this analysis that the security of supply risk is high, peaking in 2012. What makes matters worse is that for this scenario to materialise, a lot of things have to go right. A number of contingencies have therefore been considered and additional scenarios developed to cater for some of the obvious risks facing the industry and to build some form of buffer to cope with unforeseen circumstances.

The following are key supply and demand assumptions that on aggregate will ensure sufficient contingency – over and above what was allowed for in the MYPD2:

- Allow for extended delivery dates of Eskom base load stations: assume delivery dates of 2013 and 2015 for Medupi and Kusile respectively.
- Plan for an energy availability factor of 84% (rather than 86%) to allow for sufficient space for maintenance.
- Apart from MTPPP, exclude all other non-Eskom generation options in the period until 2014.
- Postponement of the 1020 MW DoE OCGT from 2012 to 2014
- The MYPD2 sales assumptions allow for sufficient contingency and remains as-is
- Maintaining the current 5 TWh annual energy buffer into the future

Demand management solutions need to provide sufficient contingency in the supply/demand forecast to mitigate risk associated with:

- Reduced performance levels of current generation plant
- Possible delays in the delivery of the new large power stations (Medupi and Kusile)
- Higher than anticipated demand
- Possible delays in the delivery of non-Eskom generation options

In addition, the contingency will ensure opportunities for:

- Additional space for maintenance of generation plant

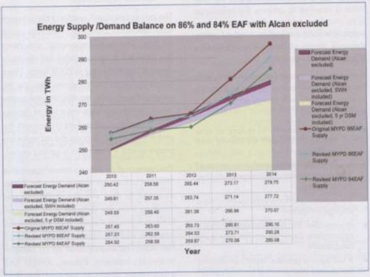


Fig. 1: MYPD2 analysis.

- Minimising the overall cost to the consumer by avoiding excessive usage of OCGTs
- Growth in electricity consumption, including large new projects

Although there is a 5 TWh energy surplus in the current year, the system nevertheless remains extremely "tight". It will therefore be appropriate to ensure that this buffer be maintained and planned for into the future.

Defining the problem

The graphs in Fig. 2 show the result of the contingency analysis and clearly indicate an energy availability problem rather than a capacity problem in the short term. The availability of the open cycle gas turbines and agreements with large customers give Eskom more flexibility to deal with peak demand challenges, but a shortage of energy can only be managed through the addition of base load generation or an overall reduction in consumption.

Implications if the gap is not closed

- The electricity supply system will be under severe pressure, posing a risk to security of supply.
- Using open cycle gas turbines to mitigate the risk is expensive, ultimately increasing the price of electricity.
- It will not be possible to connect large customers, negatively affecting economic development.
- South Africa's sustainability, reputation and competitiveness will be negatively affected.
- Pressure to reduce supply to neighbouring countries could have negative political implications.
- Further reputational damage to government and the electricity industry.

Eskom launches attractive new lighting incentive

Eskom has launched an attractive financial incentive scheme that rewards property developers for introducing energy efficient lighting into their developments over the next three years.

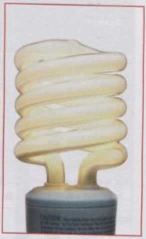
Hoping to drive rapid energy efficiency projects, the electricity utility will compensate companies for replacing traditional fixtures, re-lamping inefficient lamps and retro-fitting wasteful fixtures or lighting controls.

"Eskom's energy supply is still severely constrained and future demand will exceed supply unless energy consumers reduce their consumption," said Andrew Etzinger, Head of Eskom's Integrated Demand Management initiative.

"The local commercial property sector currently consumes up to 15% of Eskom's energy output. Lighting accounts for a substantial portion of this and is estimated to be responsible for between 35% and 45% of electricity consumption in office buildings. It is therefore imperative that we work together with property developers and owners to reduce lighting consumption," said Etzinger.
Under the scheme, known as Eskom's Standard Offer Pilot Programme, the utility will pay developers specified amounts for verified reductions in energy consumption achieved through the installation of energy efficient lighting technologies.

By participating in the programme, property owners also stand to benefit from a reduction in the energy consumed by their lighting systems. With electricity prices set to increase by a further 25% per annum over the next two years, replacing inefficient lighting fixtures with more efficient ones will help owners mitigate the impact of future price hikes. The programme is available to organisations with projects that have a minimum demand of 50 kW and a maximum demand of 1000 kW from Mondays to Fridays between 06h00 and 22h00. To participate, developers need to submit an application to Eskom which then goes through an eight week process which includes a technical evaluation and an initial measurement and verification report. Once Eskom has signed off the application, the project developer then implements the project at his own cost.

Eskom will pay an incentive of 34 cents per kWh saved over a period of three years according to predetermined savings targets. Payment is subject to a measurement and verification process, paid for by the utility, and the reward is capped at just over R4-million per project submission. Developers need to ensure that they dispose of obsolete lamps and inefficient ballasts in an environmentally sound manner, confirm that these items will not be



reused, and obtain an independent disposal certificate. In addition, lighting solutions must comply with the minimum requirements of the Occupational Health and Safety Act of 1993.

Eskom pays 40% of the initial purchase price to the project developer upon completion of the energy efficient installation, followed by three annual performance payments of 20% of the initial purchase price in year one, and concluded with a 20% payment of the annual adjusted purchase price in years two and three. The initial purchase price is adjusted based on the actual savings achieved. All payments are subject to review and verification carried out by independent measurement and verification professionals.

"This programe forms a key initiative in our overall drive to aggressively reduce energy consumption. We have allocated R30-million for its implementation. By enlisting the aid of electricity users, municipalities and energy services companies we intend achieving a demand saving of 7 MW, resulting in an estimated energy saving through this programme of 88,2 GWh by 2013," said Etzinger.

Interested parties may request the application forms from standardofferpilot@eskom.co.za, and can find a list of approved M&V entities at www.eskom.co.za under the load management menu.

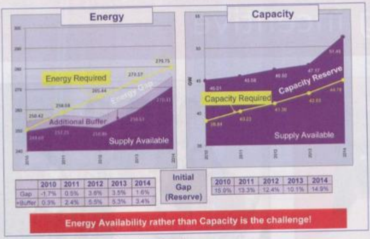


Fig. 2: Gap analysis based on additional contingencies.

Options	Savings - Energy	Savings - Demand	Easy Implementation	Bankability	Economic Implications	Eskom Control	Cost to Eskom	External Dependencies	Risks	Focus
Mass Market DSM	Green	Green	Green	Green	Green	Green	Green	Yellow	Green	**Energy Efficiency** and behavioural change initiatives provide deep energy solutions
Individualised Customer Energy Management	Green	Green	Yellow	Green	Green	Yellow	Yellow	Yellow	Green	
DSM (Solar Water Heating)	Yellow	Yellow	Red	Green	Green	Yellow	Yellow	Yellow	Yellow	
Communications (incl Power Alert)	Yellow	Yellow	Green	Yellow	Green	Yellow	Green	Red	Green	
Internal Energy Efficiency	Yellow	Yellow	Green	Green	Green	Green	Yellow	Green	Green	
Demand Market Participation	Yellow	Green	Green	Yellow	Green	Green	Red	Green	Green	Predominantly **Demand Response** initiatives with secondary energy efficiency benefits
Utility Load Manager	Red	Green	Yellow	Green	Green	Green	Red	Red	Yellow	
Advanced Metering Infrastructure	Yellow	Green	Red	Green	Green	Green	Red	Red	Yellow	
ECS : Energy Conservation Scheme	Green	Green	Yellow	Green	Yellow	Red	Green	Red	Red	**Risk Mitigation** solution

Green: **Favourable**   Red: **Problematic/Negative Impact**   Yellow: **Intermediate**

Table 3: Demand solutions.

- Lost opportunity to unlock economic efficiencies through more efficient use of electricity.

Proposed solutions

Most supply-side solutions are currently being pursued, but they are too late or too expensive. Demand-side solutions are more readily available in the short term, are less expensive and there is a strong business case for energy efficiency and energy conservation strategies to be implemented urgently. The ideal solution is of course a complementary approach to leverage both supply and demand strategies.

Many opinions have also been expressed about the potential impact of price increases. Eskom's treasury therefore requested a detailed analysis on this issue and the main findings were:

- Electricity demand is fairly inelastic to price changes in the short term, but there will be a longer term impact.
- Electricity demand is also sensitive to short term changes in income/commodity prices, which may negate the impact of price changes.

The likely impact on Eskom is:

- The MYPD2 price increases could reduce demand for electricity, but probably not immediately and will most likely be delayed beyond the critical period of 2012/13.
- Favourable economic conditions could result in a quick increase in demand prior to the critical period, neutralising the impact of price elasticity.
- Price elasticity will not provide demand reductions over and above the current demand management initiatives such as DSM.
- Initiatives such as DSM are enabling mechanisms to realise the price elasticity reductions.

Electricity price sensitivity can therefore not be seen as a "bankable" solution for the critical period of 2011 to 2013.

Table 2 shows the high level solutions analysis for the two categories of demand management, i.e. energy management and demand response.

Remaining gap

If all the demand related solutions are successful, there will still be a remaining gap over the next 3 to 5 years. The only remaining workable solution that has the ability to close the gap with the least impact on the economy is the Energy Conservation Scheme (ECS). The ECS will provide the appropriate pricing signal for investment in energy efficiency and supply options with customers, such as co-generation, self generation and renewable generation. There are however significant challenges to overcome and it is essential that government and key stakeholders such as customer representative bodies, AMEU and Eskom work together to make smooth implementation possible.

The detailed analysis of the issues and implications are outside the scope of this paper.

Key messages

The key messages emanating from this analysis are:

- South Africa has moved from a period of abundant, cheap electricity to a situation of looming shortages of supply and rising electricity prices.
- The shortage of electricity will probably last for at least five years and urgent decisions need to be taken to address this potential crisis.
- All generation options have largely been identified and are expensive, but need to be pursued for MT and LT solutions.
- Demand management options, specifically energy conservation and efficiency is the least cost, best environmentally friendly, short term solution to address a number of challenges facing South Africa.
- Creation of space for generation maintenance and new connections
- More time available for new generation decisions
- Positive impact to contain electricity price increases
- Positive impact on the environment
- All South Africans need to focus on energy efficiency to contribute to the solution.
- All the demand management solutions currently pursued will not close the gap, and urgent attention by decision makers and key role players are required to develop a workable Energy Conservation Scheme for the industry.

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Evolution of future electrical networks in Eskom

Eskom, the South African electricity utility, is facing a diverse range of social and economic challenges. This is hampering business progress and infrastructure growth, which are elements key to the long term sustainability of the utility. The key to having a sustainable business is the alignment of processes and technologies to meet the demands of present and future network uncertainties. Success will depend largely on the optimal use of assets and strategic investments.

by Amol Khatri, Eskom

Challenges Eskom faces include corporate social responsibility issues (like managing carbon emissions) and ensuring world class service delivery to key customers. The electricity system of the future needs to deliver high levels of customer service through providing reliable, accessible and flexible means to meet the changing demands from our customers. At the same time, Eskom needs to manage the consumption of electricity.

Traditional electrical networks deliver power through transmission systems which actively control the supply and demand process. The future of the electrical network will include renewable energy sources from both the supply side and distribution side. Generation sources will essentially fall behind the customer's meter. This would mean the future distribution network would have to be controlled actively.

Smart grid development is a global initiative in power engineering. The purpose of smart grids is to ensure that utilities start to provide a future systems architecture that will integrate all of the processes and systems required for a highly intelligent electricity network. The benefits of smart grids can be realised through the right investments by choosing appropriate technologies to meet business needs.

As Eskom embarks on the development of new power stations the sustainability of the existing electrical network remains crucial. The strategic choice of renewable energy and smart grid technologies will ensure that Eskom has a future network that will utilise its existing potential and be supported by new emerging technologies.

	Annual production (MW)	Cumulative total (MW)
1999	202	1405
2000	395	1607
2001	401	2002
2002	562	2403
2003	742	3145
2004	1256	4410
2005	1815	6216
2006	2536	8752

Table 1: Annual solar cell production and cumulative capacity (MW) 1999-2006 (source: Photon International, Business Insights).

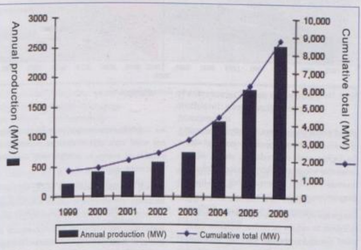

Fig. 1: Annual solar cell production and cumulative capacity (MW) 1999-2006 (source: Photon International).

Challenges going into the future of electricity provision

The present electrical network faces many challenges. Electrical networks have been designed with the purpose of providing electricity to the end user. Supporting technologies are growing to ensure that the system is no longer just an end to end connection from generation to the consumer but a more intelligent system managed by data flow within the different processes.

The present electrical network is limited by design and cannot provide the intelligence required to fully develop into a smart grid. Eskom's electrical network is supported by an interconnected telecommunication infrastructure which has both EMS and DMS functionality. This provides control and supervisory functions to the electrical network with SCADA.

The electrical network has only one interface with the customer – metering. The purpose of the existing metering system is to collect energy consumption data. This data is used for billing and basic load and forecasting analysis.

There is a gap between what is required to have fully integrated intelligent connectivity with the customer and the electrical network. The data network at present is limited. It does not provide bi-directional information about energy consumption patterns, which can be utilised for better decision making.

The constraint on the existing energy generation capacity and social pressure to replace or carefully manage aged existing infrastructure are further challenges in the South African energy market. Access to funding for these projects is a key issue. With

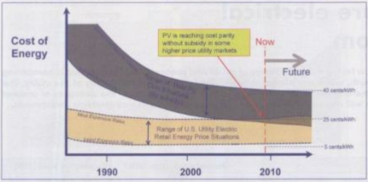

Fig. 2: The cost of PV power generation will soon reach an "ignition point" where PV will become a viable option.

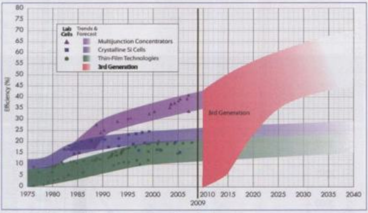

Fig. 3: The efficiency of PV systems is improving as the technology matures.

global trends showing an increase in the cost of producing energy (specifically dormant with the higher costs of producing energy from renewable resources), Eskom needs a significant revenue injection to ensure that any build programmes can be supported.

The global warming crisis adds further pressure to Eskom to reduce its carbon footprint. Each plant needs to reassess the way in which processes are managed.

It is clear that an holistic view is essential in steering the business forward in terms of managing assets responsibly, in a timely manner and with limited resources. The fundamental issue is deciding how Eskom should address these shortcomings and improve the present infrastructure to support growing demands.

Future energy sources impact on the electrical network

PV systems

The largest source of energy is the sun. Solar energy equates to over 700-million TWh of energy spread over the earth in a year. This equates to over 14 000 times more energy than we currently consume per year. Photovoltaics are solid state silicon devices that absorb photons of energy to energise and electrons to produce current.

PV will eventually reach a point where it becomes cost effective to use as a technology for both large scale implementation and particularly becoming an effective source of energy as a distribution power source. The cost per kWh of PV generated power is starting to reduce dramatically and will eventually reach an "ignition" point where PV becomes a viable option.

The trends in the utility industry show that it has become essential for utilities to be proactive on the opportunities for PV systems. As a business the large portion of customers are at risk moving towards PV systems. The efficiency of PV systems is improving as the development of the technology to new third generation cell systems starts to show efficiency of over 40%. The increased cost of energy would put utilities under pressure as a new market will be created for PV systems installed at home, causing a loss of market share. The electricity industry is evolving and will become competitive in nature with the risk that utilities will have to create value propositions for consumers specifically in the residential sector.

Traditional solar cells are made up of silicon, but research in the field of semiconductors shows that newer materials are being developed which will operate at better levels of efficiency. The PV is essentially an array of cells commonly known a solar panel usually rated between 5 W to about 200 W per panel. The power produced is DC in nature and converted to AC through an electronic inverter. These are usually deployed on rooftops or as large arrays for utility sources of generation. Rooftop installations are growing in Japan, Germany and California. These systems generate electricity during the day and use some form of energy storage (batteries). The distribution network will evolve and result in new challenges as we start to integrate intelligent technologies and renewable energy on the distribution side of the network.

The basic function of the distribution network is to ensure that the utility supplies stable voltage and frequency and copes with the demand while maintaining an acceptable level of power quality.

In traditional distribution systems, electricity flows from the transformer through a transmission or distribution network to consumers . Networks are either radial or ring systems and the flow is in one direction to the consumer. Once PV or any other source of generation is added to the distribution network there is a potential to change the flow and thus change the complexity of the network. An interesting situation arises when there is more generation capacity on the network from the consumer side compared to what the demand is at that moment. This would result in net flow back into the network which traditional systems are not designed to manage. This may affect the voltage levels and may increase voltages beyond acceptable levels.

When distribution networks become active the way the distribution network is controlled becomes a new challenge. Traditional SCADA systems operate to monitor and control the passive network and not power flow. In order to maintain stability on the network the distribution system operator would need to control and balance the network. As the PV equipment is owned by the consumer the distribution network provider would need to have some form of energy storage to control and have ability to absorb power from renewable sources which could be used on the power system for balancing when the need arises.

The benefits however are huge when it comes to present and future demand constraints.

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To catch that thief, ELM is available to send you an SMS when they strike

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ODLLS measure voltage by fixing distance of sensor to power line
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HV Personal Alert can save your life

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The dispersed range of distributed generation would support the system operator nationally in managing the reliability of the network by controlling the peaks and daily load management. The grid of the future is thus changing to a more intelligent system. This gives rise to "smarter" electrical networks. The source of power has the largest impact on distribution networks when embedded directly on the distribution network.

The grid of the future

What is it?

Several definitions exist on smart grids but they essentially all have the same meaning. Eskom's perspective on smart grids is summarised as follows: "Intelligence built into the existing electrical network to provide visibility, automatic control and intelligent decision making over the entire electrical architecture from generation to the end user."

Benefits

It is important to note that although a smart grid is a basket of potential technologies, it delivers more than just advanced technology to the business. The benefits include network optimisation, increased asset life cycle, better interfacing with customers, improved reliability of network, and flexibility and adaptability by intelligent decision making.

The full benefits of smart grids can only be realised through proper planning, design and strategic implementation. There are two fundamental blocks to ensure that a smart grid has a future in South Africa.

- Supporting telecommunication infrastructure and IT systems
- Strategic business model for utilising the right technologies

Despite all the benefits of transitioning to smart grid, it would not be viable for Eskom to deploy all smart grid type technologies. Technologically, the existing electrical network can be made smart, but financially it may not be viable, since the implementation of a smart grid would require a large capital investment.

The business needs to make a strategic decision on what technology is applicable. The value gained from implementing smart grid technologies must have a considerable benefit to the business and needs to demonstrate value to the customers. Fig. 6 illustrates the difference between the present and future grid.

Technology exists to address and optimise business processes. By providing enabling applications that will provide asset management across the entire value chain, the smart grid can aid the electrical network. The smart grid is a process underlying the network – it is an ecosystem supporting the different business operations by improving its present functionality and increasing the reliability of the network.

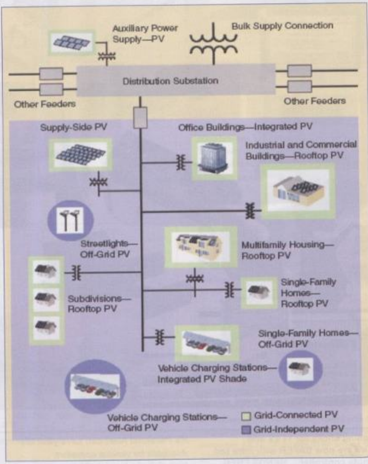

Fig. 4: The electrical network of the near-future.

Eskom and smart grids

The development of smart technologies is relatively new and several key issues need to be resolved within the different standards for interoperability. The level of risk is low as huge investments are made internationally on defining standards for interoperability between different vendors and technology concepts.

As Eskom would be a fast follower of these technologies it would assess those which are applicable and whether they make business sense before implementation.

Transition from today's grid to the future grid

The grid as we know it today will be very different in the next 15 years. This is largely due to the push of new technologies in the marketplace. It is also due to customers demanding a more efficient, reliable electrical network that can assist the customer in managing consumption.

The transition from the present network will largely depend on the deployment of an integrated communication platform. The platform will create the support required to exchange data in real time between plant devices, customers and intelligent software analysing the network.

The grid as we know it today is a combination of legacy technologies and new innovative applications which are used to control and manage the electrical network (SCADA). Eskom's network is controlled by Energy Management System (EMS) at system operator level and Distribution Management System (DMS) at an operational level. These technologies assist in managing the electrical network in terms of supervisory control and data acquisition. Eskom also has several technologies adding more intelligence to the network. These are being implemented and tested. Fig. 7 describes the present initiatives.

Fig. 4 describes technologies which are components of a future system architecture. All of these are being tested and implemented. The intention of the testing

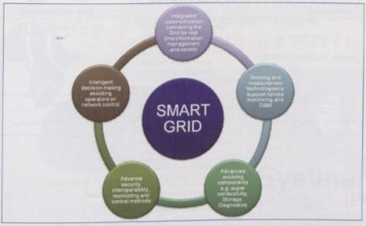

Fig. 5: The elements of a smart grid.

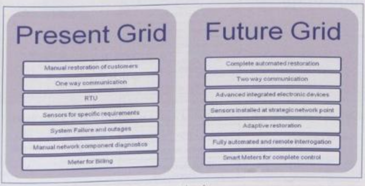

Fig. 6: Present grid versus future grid, outlining intrinsic benefits.

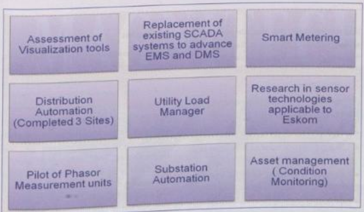

Fig. 7: Some of Eskom's current technology initiatives.

is for Eskom to have an appreciation of the potential of the technology – the research process will ensure close evaluation and in-depth analysis – before implementation on a larger scale to the rest of the electrical network.

There is a risk in implementing technology. Research will be responsible to manage the process to evaluate the different technologies.

One of the key challenges facing Eskom is to reduce the overall demand on the grid. This can be achieved through technology intervention, and communication and marketing.

The consumer of energy plays a vital role in the value created by the smart grid. The first step for Eskom in terms of a technology intervention is to understand customer behaviour and usage patterns. Eskom has embarked on two strategic projects to establish a data network between Eskom and it customers. These technologies include the rollout of advance metering infrastructure (AMI) and the utility load manager, both subsets of smart grids. AMI for Eskom customers is to encourage demand management and promote energy efficiency. The focus of the proposed implementation is in a phased approach to Eskom's qualifying customers whose average monthly consumption is in excess of 1000 kWh. A target of 10 000 installations is intended for the first phase while the remaining qualifying customers will receive installations in subsequent phases, allowing customers on AMI solution with time of use (ToU) and supply capability control.

The future grid will need to increase its grid efficiency to ensure optimal operations on managing the electrical grid in real time. The advancement of different sensor technologies will find its space within the electrical network for monitoring and control of the grid. Eskom is currently evaluating the potential options of different sensor technologies. These will provide nodes into the grid for predictive situational analysis, assessment of assets and early warning systems to model the impact if subtle changes on the electrical parameters of the network.

A flexible AC transmission system supports power flow and is now mature technology for higher power ratings with several applications in the business. This is becoming more important with the increase in distances of transmitting power at higher voltages. The technologies provide benefits of improving the voltage quality and increasing the stability of the electrical network. By correct application of SVC, series capacitors and deployment of new compensation technologies would allow for better voltage and reactive power control. These technologies supported by different sensor applications with provide real time information, modelling and optimised grid control. Phasor measurement units and wide area measurement are critical components of the smart grid from the perspective of grid control. They provide grid dynamics for improving the stability and reliability of the network.

Enabling technologies for smart grid applications

The future of smart grids lies in applications for the different business areas. The three essential areas of the utility are distribution, transmission and the customer. Various applications would provide the business with specific tools to deal with present issues both operational and strategic which affect the business. Table 1 highlights some of the applications that are essential for improving different areas of the business. It reflects some of the key areas that will need focus in Eskom at present and in the future.

Challenges in implementation of smart grids

Smart grids are being phased into the future of all electrical networks, internationally. The benefits will add value to a more intelligent network but the actual implementation and transition could pose serious difficulties within the South African context. There is a clear need to improve the existing infrastructure to meet the demands of the future. This, however, needs a clear strategic framework. The biggest constraints are cost of deployment and adequate resources. From a business perspective, it is only viable to implement technologies which have already indicated an improvement in business performance. This, however, becomes a challenge as old legacy systems cannot always be retrofitted with new technologies and may need an entire technology solution.

The future electrical network will run as an IT system managing and controlling the data from Eskom generation to the end user. Complex data and information processing will pose a real challenge in ensuring interoperability of different vendors as well as the ability to derive value from the data. The processing required and the supporting telecommunication backbone are two essential components of the smart grid. The present cost of telecommunication in South Africa is relatively high. The implication of deploying advance information architectures needs to be clearly understood from a business perspective, before next steps are taken.

Although most technologies are in the development phase, it would be prudent for the business to take an approach of implementing a technology only once it has sufficient market penetration. This allows for controlled risk when making large capital investments. The biggest impact is on the present business model and operations. A completely defined and implemented smart grid solution would change the entire value chain within the business. It would require extensive change management within the business and realignment of processes and functions.

With the world moving to cleaner energy sources the generation mix will now include multiple renewable energy sources. These technologies need to be understood clearly in terms of their impact on the electrical grid. Multiple stakeholders will also integrate into the bigger electrical network. The stakeholders will include municipalities, vendors, IPPs and consumers who could also feed energy back into the network. The multiple sources of energy lead to complexity in the stability of the network. This will require a detailed study on its implications towards the management of a smart grid.

Technology	Benefit	Key receivers
Variable frequency transformer	Power transfer between non synchronised grid	Transmission
	Power transfer not interrupted when part of the grid experiences disturbances	
	No harmonics	
Phase shifting transformer	Control active power flow	Transmission
Automatic capacitor switching	Remotely configured for voltage support on network	Transmission and distribution
Synchrophasor technology	High sample rate to measuring electrical quantities	System operator
	Validating the operational models	
	Measurement of stability margins	
	System-wide disturbance monitoring	
Condition monitoring technology	Transformer monitoring	Transmission and distribution
	Circuit breaker monitoring	
	Hot spot monitoring	
	Overhead lime monitoring	
Distribution and substation automation	Improve restoration times	Transmission and distribution
	Performance improvement SAIDI/ SAIFI	
	Asset management	
Advance metering	Energy management	Business value chain, DSM, planning, revenue protection
	Demand response	
	Energy theft	
	Emper detection	
	Usage managements (appliances)	

Table 1: Essential applications for improving different areas of the business.

In summary, the challenges foreseen by the utility are:

- Cost of deployment
- Multiple levels of stakeholders (consumers, vendors, municipalities, utilities)
- Complexity of smart grid and transition from legacy systems
- Security of system
- Finalisation of standards and interoperability
- Installation of "smart" equipment
- Communication systems to support smart grid
- Data management (collecting, storing, analysing, validation, accuracy, updating)
- Re-defining utility business models and incentives
- Consumer adoption of smart grid service

Conclusion

As Eskom embarks on the journey towards developing its future grid it needs to realise the potential of its existing network and to enhance present functionality intrinsic in the network. Leveraging the benefits of existing assets by fully utilising previous capital investments will provide the utility with the value inherent in smart grid type technologies. The implementation of a smart grid is an evolutionary process which will require a fundamental shift in the way the business in managed. The incremental changes to the network can be achieved by identifying key strategic investments to provide better customer value. Through research and collaboration with industry partners a strategic fit can be achieved for Eskom. The investment will require a phased approach with a large focus on driving training and change management to achieve a network of the future.

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Electricity supply challenges and lessons learnt from the 2010 Soccer World Cup

In June and July 2010 South Africa hosted a world class FIFA Soccer World Cup, with 32 teams competing in 64 games without any supply interruptions to key sites during critical times. This paper summarises the activities of the South African electricity supply industry to coordinate preparations and ensure that the event was supplied with reliable high quality power.

by Dr. C G Carter-Brown, P Fowles, G Francis, H Boshoff, R Du Preez, J Kalichuran, C Hempel, D Potgieter, D Zondi, G Booysen and S Bhana

The 2010 Soccer World Cup was broadcast to billions of fans across the world and was dependent on the supply of reliable high quality electrical power, which South Africa had committed itself to supply. The main electrical loads associated with the 2010 tournament included:

- The ten stadiums in nine host cities at which the matches were played
- Each of the 32 teams had a "base camp" in South Africa for the duration of the tournament
- Training venues located within the host cities
- FIFA fan parks located in the host cities
- Non-FIFA accredited public viewing venues set up by municipalities and private enterprise
- Hotels at which FIFA established its local offices and command centre
- Journalists hosted at the International Broadcast Centre which formed the hub for broadcasting and reporting
- The accommodation, tourism and transport needs of visitors

In relation to the South African peak demand, the magnitude of the additional electrical load due to the tournament was relatively small. Certain loads, such as stadium lighting and broadcasting, had onerous power quality requirements. A momentary power interruption or voltage dip could disrupt televised broadcast of the games.

The majority of these loads fell within the electrical supply areas of the host cities. Eskom was responsible for the supply of bulk electrical power to the host cities, but the networks between the Eskom bulk supplies and the venues (e.g. stadiums) were the responsibility of the host city municipal electrical sections. Furthermore, the venues themselves had their own internal electricity distribution networks.

A problem in the supply chain (Eskom, host city distribution or venue distribution) would reflect poorly on the entire electricity supply industry (ESI), South Africa and Africa. As such, it was critical that all role players in the South African ESI worked together to minimise risks and optimise approaches to ensure that the lights kept burning. Role players included host cities and municipalities, Eskom, owners of the 2010 event venues, the 2010 Local Organising Committee (LOC), the Association of Municipal Electrical Undertakings (AMEU), the Department of Energy (DoE), the National Energy Regulator of South Africa (NERSA), the South African Local Government Association (SALGA), the National Treasury and EDI Holdings.

2010 ESI forum

The inter-connected nature of the South African electricity network resulted in Eskom and The Association of Municipal Electricity Undertakings (AMEU) establishing the 2010 Electricity Supply Industry Forum (2010 ESI) which first met in August 2006. This voluntary forum met quarterly and enjoyed representation from all of the above mentioned stakeholders, with the objective of raising awareness of issues related to the provision of adequate electricity supplies during the 2010 World Cup tournament. Among others, matters such as readiness, project progress, supply reliability, incident reports, emergency response etc. were discussed in detail at the forum sessions and guidance provided to ensure a smooth delivery of the World Cup event from an electricity supply perspective.

The 2010 ESI coordinated national electrical preparations for the tournament via establishing close working relationships with the interested and effected parties. The games and associated activities occurred in the host cities and as such many of the preparations focused on those specific geographic areas. This necessitated the creation of regional task teams (RTTs) per host city consisting of host city municipal and Eskom electrical representatives. The RTTs were the "engine rooms" for tournament electricity supply preparations and RTT feedback to the 2010 ESI enabled preparation to be tracked and understood. The activities of the RTTs to ensure adequate supply throughout the tournament included:

- Identification and assessment of the condition of the electrical infrastructure that supplied stadiums, training venues and other key loads in their area of responsibility.
- Upgrading, refurbishment and maintenance of these networks.
- The requirement and availability of strategic spares for these critical networks were evaluated and deficiencies addressed.
- Critical loads were removed from automatic load shedding relays, and manual load shedding schedules were updated to minimise the impact on the tournament. No load shedding was anticipated during the period of the World Cup, and the revision of schedules was a purely precautionary activity.
- Contingency plans for supplies to the critical loads were prepared and extensively tested.
- The availability of critical staff was ensured via proactive leave planning and standby rosters.
- Deployment of operational teams at critical substations and sites (e.g. fan parks) during event days, including contractors being on standby e.g. cable joining.
- Restrictions on capital works and excavations near key networks to minimise the risk of cable damage.
- Enhanced security at critical substations with manned security personnel during event days. In some cases helicopters were used to patrol overhead lines.
- The establishment of clear communication channels using existing operational structures (Eskom and municipal network control centres) supplemented to ensure integration with Provincial JOC, City JOC, VOCs and the Eskom Regional Situation Awareness Centres (RSACs). This included sharing of communication mechanisms such as radio networks.

The 2010 ESI preparations implemented via the regionally focused RTTs complemented Eskom's own 2010 World Cup project and associated preparations, thereby securing the entire supply chain.

Highlights

The highlights of the 2010 ESI forum included the following:

The additional loads expected due to the World Cup were forecast and the ability to reliably supply this load was assessed across the entire supply chain. Capital projects (Eskom and municipal) were identified, and funding requirements were raised with stakeholders.

Capital projects were initiated and progress tracked to ensure delivery before the start of the tournament.

Detailed specifications on supply requirements for key venues such as stadiums were either not available or inadequate and, where appropriate, the forum provided recommendations for supply.

The activities of the forum were communicated to non-host city municipalities via the regular AMEU email news bulletin, and papers providing feedback from the forum and raising awareness on key issues were presented at the annual AMEU conventions in 2007 and 2009.

Linkages were established with other structures (such as the LOC Power Forum) to minimise duplication of effort and ensure that activities were coordinated. The forum also provided a mechanism to channel communication on issues of national importance to stakeholders such as the National Electricity Response Task Team (NERT).

International contacts were established with entities involved in hosting similar events (2006 World Cup Germany, 2008 Beijing Olympic Games, EURO 2008) and their preparation activities, results and recommendations were shared with the forum.

Host city and Eskom response teams were deployed at all critical areas and in time, according to each host city operational plan.

Although on a much smaller scale, the 2009 Confederations Cup was used to successfully test preparedness and operational plans.

Lowlights

Lowlights reported by the host city-focused RTTs included the following:

Although there were no major supply problems to critical sites on event days, minor faults such as MV cable and mini-substation faults and street lighting problems did occur, including supply problems at some PVAs. These faults are to be expected, and the enhanced operational focus ensured that faults were attended to promptly.

In some cases, the locations of fan parks and PVAs were only finalised shortly before the event which did not allow sufficient time to ensure adequate electrical supplies.

Accreditation of staff members took too long and delayed urgent work in the restricted areas around the stadiums and precincts.

In some cases, lighting levels at certain locations (such as park-and-ride sites) could have been improved. The use of hot re-strike lamps at one stadium resulted in unexpected harmonic distortion necessitating the installation of filters.

Illegal connections caused overloading on certain MV feeders and mini-substations. There were also instances of conductor theft, although levels were significantly reduced due to the additional security deployed during the event.

Despite efforts to manage the risk, HV and MV cables were damaged by contractors and other service providers during mechanical excavations.

The stadium overlay power magnitudes were overstated and the network to supply the overlay could have been rationalised.

Key lessons learnt

Key lessons learnt for the hosting of similar events in the future include:

The use of independent operators at the stadiums, fan parks and PVAs worked well and relieved pressure from the host city and Eskom officials.

Bans on construction works prior to the event helped to secure cables and other utilities and also enhanced the beautification of the host cities.

Formal effective communication channels and protocols between all parties are essential. The use of alternative communication systems is necessary to minimise dependence on cellular phone communication.

The support and commitment of top management is essential, as is team work and training.

Cooperation between the host cities and Eskom is critical, and can be effectively achieved via regionally focused task teams supported by a national structure such as the 2010 ESI forum.

Despite test runs prior to the event, the accreditation of operational staff and contractors (required to be on site for the final testing and commissioning work) did not live up to expectations. The time and process to perform accreditation should not be underestimated.

FIFA electrical requirements for the precincts and stadiums were finalised very late and resulted in short notice changes to infrastructure already installed. Requirements need to be presented well in advance with a design-stop early enough to allow time for the utilities to meet the required power supply deadlines. The locations of key sites such as fan parks must be finalised as soon as possible to allow for electrical infrastructure planning, design and installation lead times. Supply requirements should not be unreasonably overstated.

Provision must be made to accommodate unforeseen last minute eventualities.

Properly planned maintenance significantly reduces the number of unplanned outages.

Event preparations can minimise but not completely eliminate network faults. Strategies are required to ensure that faults are identified, located and repaired in the shortest time possible. Technologies such as fault indicators can assist in this regard.

2010 legacy

Host city and Eskom representatives reported a number of legacy issues arising from the work necessary for the tournament including:

- Significant additions to and upgrading of sections of the electrical distribution network.
- Upgrading of street lighting leading to the improvement of safety and beautification of some areas and the raising of living standards in others that would not have received this lighting under normal circumstances.
- Successful introduction of new technologies and systems such as the Tetra communication system for the City of Johannesburg.
- The successful testing of operational capacity and experience in dealing with international organisations and major events.
- Skills development and job creation.
- Improved cooperation with Eskom and government entities.

Conclusions

When the 2010 ESI forum was started in 2006 there were well over 1000 days to kick-off. The timely creation of the 2010 ESI and the associated RTTs directly supported efforts to ensure that the country was ready to welcome the world to South Africa in June 2010.

The 2010 ESI was a voluntary gathering of industry professionals committed to ensuring that the games and associated activities were powered. It was the only body looking at the broader power supply requirements covering all aspects of hosting a successful tournament, which extended well beyond the stadiums and included a number of other loads as mentioned earlier in this paper.

In recent years, generation capacity constraints, tariff increases and proposed industry restructuring tested the resolve and relationships of role players such as Eskom and the host city municipalities. It was extremely gratifying to see the members of the 2010 ESI forum treat the World Cup preparations as business unusual. They focused on the tasks at hand, putting aside issues that in the normal course of business may have shifted focus from these key activities. Preparations were approached from the perspective that success would only be achieved if all role players were successful. This spirit of cooperation was clearly evident and demonstrated in the offer of support provided at the April 2010 ESI forum meeting whereby Eskom and the host cities undertook to provide assistance to one another in the unlikely event that a major disaster should occur. Fortunately there were no disasters, largely attributed to the extensive preparations as coordinated via the 2010 ESI forum.

The 2010 World Cup was hosted without any serious supply interruptions, and all stakeholders can be understandably proud of this major achievement.

References

[1] 2010 ESI debrief reports: City of Cape Town, H Boshoff.

[2] Rustenburg Local Municipality, R C Du Preez, eThekwini Electricity, J Kalichuran.

[3] Nelson Mandela Bay Municipality, C Hempel.

[4] Polokwane, D Potgieter.

[5] City of Johannesburg, D Zondi, S Xulu, X Lembede and A Milne.

[6] City of Tshwane, G Booysen, P M Tlabela, J F Fourie, P Sivhada, K Leepile, M Rasetlola, B Tumagole.

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Removing obstacles for emerging contractors

At the 51st national ANC conference in December 2002 it was resolved that in the rationalising of electricity distribution, viable and affordable electricity supply should be ensured on the foundation of a minimum free basic electricity service to all households.

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According to the chairman of the South African Energy Association, Brian Strachan, 800-million people in Africa collectively use less energy than the population of Spain. Electrification of informal settlements, like the one focussed on in this paper, is therefore justified, if the installations are completed according to the SANS 0142 or updated SANS 10142 standard. On the other hand the Minister of Finance, Pravin Gordhan has severe problems to deal with; a R70-billion expected revenue shortfall for 2010/11, disastrous SETA governance and increasing energy costs, amongst others. This would make electricity unaffordable for the poor. Even with the aforementioned challenges, the government's objective of access to energy and electricity to all its citizens remains a national priority.

Economic growth is not a sufficient condition for economic development. Basic needs such as the minimum requirements for private consumption such as food, shelter and clothing, and essential services such as clean drinking water, sanitation, public transport, health and electricity are critical factors.

Most development economists are in agreement that development is stifled if the indicators of poverty, inequality and unemployment are not improved, even if real GDP is being achieved. People should have access to food, clothing, protection, potable water, sanitation and electricity for development to take place. The question is, "where will the resources required to achieve these goals come from?"

Low-income households make use of paraffin and wood as their primary energy source. The consequences are an increased risk of fire hazards, fire-related and ingestion injuries, respiratory problems and an increased environmental impact load. To prioritise the socio-economic upliftment of South Africa, one of the key factors in the CSIR's Integrated Energy/Economic Framework is sociological facilitation to ensure community ownership and sustainable enterprise management. This paper calls for an undertaking in line with the CSIR's framework to empower contractors and project managers to overcome numerous shortcomings.

The recent protest against poor service delivery in South Africa serves as a reminder of the strength of the voice of community members and the fact that consumers have rights. It is therefore imperative to respect their human values and cater for their needs. *Batho Pele* or "People First" is a very serious government initiative to motivate public servants to become more service orientated, to strive for excellence in service delivery and

Fig. 1: Mounting a pole in the electrification project at the Langrug informal settlement.

to commit to continuous service delivery improvement. The public regards the on-site electrical contractor as a municipal worker, requiring that he, his project manager and his labour force adhere to the principles of *Batho Pele*; to satisfy the customers' needs. It is therefore essential that installations and projects of this nature be completed in the most efficient way in the interest of all stakeholders – homeowners, the municipality or government, the contractor, the economy etc.

Densities of typical informal settlements in the Cape metropole vary between 150 and 200 families per ha. The ideal case would be to construct homes within the informal settlement area in the shortest possible time, without relocation. This is a daunting task. The only alternative is relocation to temporary accommodation as their shacks are sequentially demolished. Low cost houses and services are then installed. As the new units are completed residents are moved in and out of the temporary accommodation.

The case of the electrification of Langrug, a rural informal settlement in Franschhoek, is proof of the South African government's commitment to make electrification available to informal settlements in rural areas. A tender for the installation of 1200 prepaid electrical meters and ready boards in the informal settlement in Franschhoek was awarded to an established electrical engineering company. The company successfully completed the project within the agreed time. Locals were employed with the necessary skills transfer. This self empowerment was evident in the case of the electrification of the shacks in Langrug.

Each of these households was issued with a 20 A supply since the informal settlement was situated in a low income group. A split-type prepaid meter was installed in an enclosure mounted on a streetlight pole. Each prepaid meter was connected to a keypad installed next to the ready board mounted inside the dwelling. This averts meter tampering to a degree. Part of the contract was the compulsory use of local labour. The main contractor initially subcontracted the installations (labour only) to an emerging subcontracting company. The shortcomings of this subcontractor prompted the authors to address means of removing obstacles for emerging contractors.

Subcontractor skills deficiencies

During the first few days of the commencement of the project, it was requested of the sub-contractor whether he or his project manager had any training or experience related to the management of staff and/or skills in project budgeting and cost estimation, with particular emphasis on electrical engineering projects. Some of the shortcomings varied from arriving on site without tools to incurring huge daily overheads due to travel and other unwarranted expenses. During these discussions with the sub-contractor, it became obvious that not only were the higher level skills involved in proper project management absent, but the most basic of tasks were handled in a completely haphazard and ad hoc fashion. In these cases simple common sense would have sufficed in realising the completion of basic tasks. Whether these problems were due to a bad choice of sub-contractor or more widespread was of obvious concern. If the latter was indeed the case, as later ascertained through discussions with the municipality, our priorities for socio-economic development are seriously compromised through the lack of essential skills necessary amongst contractors.

In addition, a lack of these basic skills is often an obstacle in accessing finance. A small business corporation is a company or closed corporation that meets a number

Fig. 2: The planting of an electric pole by a local labourer.

of requirements in terms of ownership and maximum gross income levels. To qualify as a small business corporation, a business must have a gross income of R14-million or less per year. A small business corporation will pay income tax at a specified rate: the first R46 000 of taxable income is tax free; the next R300 000 of taxable income is taxed at 10%; and any further income is taxed at 28%.

In general, however, the local labourers are in a predicament when the emerging sub-contractors exploit them (by not remunerating them on time, as agreed upon etc.). They justify their action by falsely blaming the main contractor (in most cases an established company) for compensating them a few weeks after they delivered the service. The main contractor rightfully proves that the agreed upon contract fee was honoured at the stipulated compensation time as per their contract. The emerging company is in agreement with the terms before the start of the project, by signing the contract. This highlights the lack of business ethics by the emerging contractors, when they "do not understand" the contract when it suits them.

With inadequate funding, coupled with inadequate project management skills, the emerging contractor is often forced to abandon the project midway (normally after their first payment), resulting in major delays in the delivery of services and a bad reflection on the municipality.

Project management

Project management is the discipline of achieving targets by optimising the use of resources such as time, money, material, energy, space, etc. The project manager strives to maintain the progress and productive interaction of the various parties involved by executing all or some of five project stages – initiation, planning, execution or production, monitoring or control and completion. He should have three main objectives viz. performance, effectiveness and cost.

Constant problems of dealing with the different parties involved in the project i.e. the customer, the project team, the public, various forums and committees and management, require a special individual. The project manager is required to identify and solve any problem as soon as possible. If these problems are not resolved timeously, deviations to the project plan will result, with the consequences of late deadlines, over budgeting, penalties, etc.

Jack Welch, CEO of General Electric for more than 20 years, invested heavily in his project managers, equipping them with the skills and drive to follow suit with their own teams. In every potential leader he looked for his "E-to-the-fourth-power" i.e. enormous personal energy, ability to motivate and energise others, having a competitive edge, and the skill to execute on those attributes.

Peter Drucker is referred to as the man who invented management. What J Maynard Keynes is to economics or W Edwards Deming to quality, Drucker is to management. He was the first to assert that workers should be treated as assets, not as liabilities. Pinto and Slevin associated three strategies in the implementation phase of projects; project mission, management support and project action plan.

Project planning

An expert in organisational behaviour and leadership, Lize Booysen's response to what she considers to be her greatest strength as a businessperson was as follows: "I have exceptional planning skills." Planning is vital to meet project deadlines. Without a clear beginning, project planning and progress can easily go astray, so a project launch meeting is well worth the effort. The outcome of regular meetings should always be that; the technical scope is established, areas of performance responsibility are accepted, schedules and budgets are spelt out and a risk management plan is reviewed.

To meet project deadlines, the calculation or proper estimation of the most likely activity times is crucial. Actual activity times of projects are rarely less than the estimated time. This is attributed to Parkinson's law that states that work expands to fill the allotted time (Meredith & Mantel, 2003:395). According to Robinson, activities of daily living (ADL) are personal activities that are performed in the course of a normal day, including eating, ablutions, combing hair, brushing teeth, reading etc., but excludes hobbies and work related activities. These ADLs must be taken into account when compiling an estimate of actual working time.

Expected completion times of activities in a project should be derived by using three time estimates – optimistic, pessimistic and most likely times. These estimated times are expressions of risk associated with each activity time. Assume that all possible times are represented by an asymmetrical beta statistical distribution. The most likely time (m) is the mode of distribution. The project manager should select the optimistic time (a) so that the actual time required to complete the project is greater than (a) about 99% of the time. Likewise the pessimistic time (b) should be estimated so that the actual time required to complete the project is less than (b) about 99% of the time. The expected time (TE) is given by:

$$TE = \frac{(a + 4m + b)}{6} \qquad (1)$$

where

a = optimistic time estimate

b = pessimistic time estimate

m = most likely time estimate.

The beta distribution is highly flexible compared to a normal distribution (where $m - a = m - b$), since extremes such as $a = m$, $b = m$ can be catered for. The expected time is an estimate of the mean of the distribution. It is the weighted average of a, m and b with weights of 1:4:1. The actual activity time is rarely less than the estimate of the mode accounting for the right skew of the distribution. This is due to Parkinson's law. If unaccountable problems occur, the actual activity time may increase, but almost never decrease. The normal tendency to counter timing issues is to increase manpower. This can unfortunately backfire as some projects adhere to Brooks' law viz.: "Adding manpower to a late software project makes it later."

Peter Drucker is quoted on the issue of planning: "Plans are only good intentions unless they immediately degenerate into hard work." The primary purpose of planning is to establish a set of directions in satisfactory detail in order for the project team to know exactly what needs to be done, when it must be done, and what resources to use in order to produce the deliverables of the project successfully. In the planning process activities should be identified to be done sequentially and others simultaneously. The only certainty is that things will not go precisely as planned.

Break-even analysis and learning Curves

The starting point of financial planning should be simple break-even analysis. If a contractor is paid a price P per installation and pays a fixed cost F and a variable cost V. For n installations, the net revenue R received is:

$$R = nM - F \qquad (2)$$

where the contribution margin is the difference between the unit price and the variable cost ($M = P - V$). Break-even occurs at installation n_b where the net revenue $R = 0$. Eqn. 2 now becomes:

$$F = Mn_b \qquad (3)$$

so the number of installations to be made to reach break-even is:

$$n_b = \frac{F}{M}$$

Substituting (3) in (2) results in the total revenue R in terms of the contribution margin break-even point:

$$R = (n - n_b)\,M$$

In Fig. 4 the break-even analysis is illustrated by a plot of daily revenue versus volume (number of installations). In this example, it can be clearly seen that at a fixed cost of R325 the break-even point (n_b) is at three installations with zero profit. If 15 installations are made, the daily profit is approximately R1000.

However, this linear model can only be used for budgeting if the installations are done by an experienced team, where all the installation times are minimal. Measures of uncertainty of the duration of an activity are given by the variance:

$$\sigma^2 = \left[\frac{b-a}{6}\right]^2$$

where

σ = standard deviation (one sixth of the beta range)

$= \frac{b-a}{6}$

a = optimistic time estimate

b = pessimistic time estimate

Consider a project that requires 100 installations to be completed and through experience, a typical installation takes 1 hour of direct labour. If the labour rate is R20 per hour, and benefits equal 28% of the wage rate, the estimated labour cost would be (1,28)(R20/hr)(100 units)(1hr/unit) = R2560.

When so-called learning rates are included in this estimate, the above result would be an underestimate. Human performance normally improves when a task is repeated. Each time the output doubles, the worker hours per unit decreases to a fixed percentage of the previous value. This percentage is called the learning rate.

If it requires 10 minutes to accomplish a task (produce a unit) for the first time it is attempted and only 8 minutes the second time, the learning rate is 80%. Similarly, the 4th unit (doubling) will be produced in 8 minutes x 0,8 = 6,4 minutes.

The time it takes to produce one unit of output (one installation) is given by:

$$T_n = T_1 n^r \qquad (4)$$

where

T_n = the time required for the n^{th} unit of output

T_1 = the time for the initial unit of input

n = the total number of units to be produced

$r = \dfrac{\log_e (\text{learning rate})}{\log_e 2}$

The total time required to produce all units on a production run of size N is:

$$\text{Total time} = T_1 \sum_{n=1}^{N} n^r$$

Continuing with the example, if it has been found that the time per installation is constant at one hour/installation after the completion of 50 installations, the time can now be calculated that it would have taken for the initial unit:

$$r = \frac{\ln 0{,}8}{\ln 2} = -0{,}322$$

After 50 installations

$$1 = T_1\,(50)^{-0{,}322}$$

and the time taken for the first unit becomes

$$T_1 = 3{,}52\ hr.$$

The total time for the installation of 100 units is now:

$$\text{Total time} = (3{,}52 \sum_{n=1}^{50} n^{-0{,}322}) + 50 \times 1hr = 120{,}81\ hr$$

The estimated labour cost is then:

1,28 x R20/hr x 120,81 hr = R3093

or 21% more than the initial estimate.

Budgeting

Money is the life blood of business and is spent either as capital expenditure or operating expenditure. The sub-contractor in this case did not have funds for capital expenditure to acquire proper installation and safety equipment and expected an advance from the main contractor. This was an early indication that the sub-contractor project was heading for disaster. All projects are unique and their budgets are based on forecasts of resource usage and the associated costs. Therefore, estimating the cost for any project involves risk. Risks are significant with many challenges in project management, but at the end of the day, with proper budgeting and project success, the rewards are obvious.

A budget is a written financial plan for the future. It sets a framework to make forecasts and sets goals for a specific period. There are various types; the master budget, sales budget, production budget, materials budget, labour budget, admin and overhead costs budget, profit budget, cash budget, financial budget, capital expenditure and equipment budget etc. The most important control measure in budgeting is measuring the actual cost against the budgeted cost. This exercises control over the budget and cash flow.

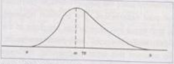

Fig. 3: Distribution of all possible activity times.

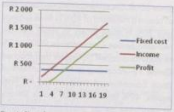

Fig. 4: Plot of revenue versus volume.

The difference between the forecast profit and cash flow has the emphasis on when cash will be received and when cash payments are made. The cash flow budget is the main lifeline of the business. It helps to make early provision for cash shortages due to over-expenditure etc. On the other hand it allows cash planning to take place, where the investment of excess cash can be made.

Besides inadequate business skills, the other common shortcoming is the inability to manage credit and debt due to the misunderstanding of the concept of cash flow.

Training

At the 22nd AMEU Technical convention it was noted that "our present workforce is uneducated, ill trained and poorly skilled". Salome Liebenberg, a sought-after project co-ordinator and consultant, revealed that many emerging black-owned companies do not have the infrastructure and resources to market themselves and complete projects without external assistance. This highlights the need to train project managers of SMMEs in South Africa. According to the South African Association of Consulting Engineers, companies with a healthy training culture acquire added benefits such as improved quality, increased productivity, less wastage, more staff commitment and improved morale. Most adults learn best when they are actively involved in the learning experience. This is beneficial since the project manager can build on past experiences. The problem however, is that many first experiences are done at the "deep end of the pool", with disastrous results. To prevent this from happening, trainees should be rated according to the following skill performances: quality, quantity, speed and sequence.

Since 2008, South African matriculants need to obtain a minimum of 40% in three subjects and 30% in three others to attain the new National Senior Certificate. In 2009, 43% of students dropped out before they reached Grade 12. According to the Department of Basic Education, of those writing the final exams, 49% have opted for maths literacy to capitalise on its practical orientation and possibly to avoid the more rigorous mathematics. However, only 46% who wrote mathematics in 2008 passed. This was a huge increase on the previous year. This led to doubts over whether it was pitched at the right level and whether those who enter the business and project management world are able to do straightforward calculations to find break-even points for estimates, budgets, costing etc. Some even question whether maths or maths literacy is needed for basic education, where it will not be used by learners progressing to higher education where maths is not in the curriculum. It becomes even more worrying, since the 2009 national matric pass rate dropped by 2% compared to that of the previous year.

Sector Education and Training Authorities (SETAs) are responsible for the development and implementation of sector skills training with funding made available via an employer skill levy. A R2,4-billion fund was made available for training of workers by the labour minister, Membathisi Mdladlana, before the SETAs moved from his ministry to the new Higher Education and Training (HET) Ministry, headed by Blade Nzimande. According to the labour committee chairman, Lumka Yengeni, the Construction Education and Training Authority (CETA) incurred R92,7-million in irregular expenditure during 2008 and is about to hire its third CFO in two years. According to CETA, it has R15-million to train 3000 workers under their scheme. This is proof that there are enough resources available for workforce training under HET.

According to Higher Education South Africa (HESA), there is a steady decline in the pass rate at universities since 2003. Interventions such as extended curriculum programmes or national benchmarking tests to assess whether students are best suited for a specific field, can help with the problems in basic education. This is to make the transition from high school level to tertiary level easier. The significance of maths (with physical science, accounting and agriculture) is critical to the economy of the country. Therefore companies should make full use of the services offered by SETAs (now incorporated under DoE) that provide the necessary training.

World Wide Worx MD and principal researcher, Arthur Goldstuck says that mentors contribute hugely to businesses' success. Although these business coaches add enormous value to a business, only 18% of small businesses make use of them. Mentors can guide the owners of small businesses with proper management skills such as skills in the development of optimal project plans, action plans and deliverable options etc. The mere fact that the Project Management Institute (PMI) was established in 1969 with the objective to initiate the areas of learning required for competent project managers, shows that there is a need for training in this area.

Another mechanism that will develop upcoming company staff, is training according to the requirements of ECSA. Mentoring is one of them.

A success story regarding skills transfer is that of Grant Louis, an electrical engineering graduate and project manager of Silver Solutions. Under his leadership the Franschhoek electrification project was successfully completed. He equipped many installers by means of on-the-job training.

The influence of black economic empowerment compliance

Broad-based black economic empowerment (BBBEE) was initiated by government to improve the then existing biased and unfair narrow-based black economic empowerment (BEE). BEE led to the enrichment of only a minority of the previously disadvantaged in South Africa. Today the goal of BBBEE is to empower a much broader South African society. The problem with narrow-based empowerment was that measures were only taken of equity ownership and management representation.

According to Act 53 (2003) Codes of Good Practice for Black Economic Empowerment there are three enterprise sizes according to different sets of measurement criteria: generic enterprises, qualifying small enterprises and exempted micro enterprises. They are categorised as follows:

Generic enterprises have a turnover of more than than R35-million. It is estimated that only 4% of South African enterprises fall into this category. They must apply all seven pillars of the BBBEE (Code 000-700 of the act).

Qualifying small enterprises (QSEs) have a turnover of between R5-million and R35-million. They apply code 000-800 to calculate their scorecards. QSEs can choose the best four of their seven elements, with each element accounting for 25% for their scorecard.

Exempted micro enterprises (EMEs) have turnovers of less than R5-million. It is not necessary for EMEs to be rated, but they need to be able to provide reasonable evidence that they are EMEs. If EMEs are greater than 50% black-owned, they automatically qualify as contributors towards preferential procurement.

This means a newly registered black-owned small business immediately qualifies for contributors towards preferential procurement as an EME. They normally have fewer overheads than bigger companies, giving them the advantage to tender lower prices, plus the 100% scored for black ownership tremendously increases their chances of winning tenders.

The Minister of Trade and Industry has published a sector code on black economic empowerment in terms of the BBBEE notice in Government Gazette 32305 on 5 June 2009. Companies are now invited to have their BBBEE Charter rating reflected on the Construction Industry Development Board (CIDB) Register of Contractors if they are in possession of a BBBEE certificate. These certificates are issued by the rating agencies accredited by the South African National Accreditation System (SANAS). The BBBEE rating will be automatically removed from the CIDB database after a year and needs to be updated by the company upon the certificate expiry date.

A survey done by Grant Thornton 2009 confirmed that 63% of private businesses finally regard the BEE compliance or BEE codes of good practice in the workplace important for winning business or tenders, especially from the state – many years after government first introduced it. BEE Rating Solutions received its accreditation from the SANAS. According to MD Johan du Toit there is a steep rise in the demand for verification certificates from the small and medium-sized enterprise market.

BEE Verification Agency CEO Willem Mostert stated that in certain industries, government applies pressure – for example the construction industry – where the state is most likely the awarder of tenders. Although there are seven aspects to the code, emphasis is placed on ownership and management only – the neglected ones are employment equity; skills development; preferential procurement; enterprise development and socio-economic development. DTI minister Rob Davies announced that only certificates issued by accredited BEE verification agencies will be valid from February 2010.

At the moment, government tender adjudicators give additional scores to black, female and disabled ownership of enterprises. This, however, does not mean they are competent to effectively manage a project. Many emerging businesses win tenders because of their BEE status, but fail to produce due to inadequacies discussed.

Conclusion

According to the Real Economic Development affiliation of the Department of Economic

Fig. 5: Grant Louis, project manager of Silver Solutions, at the Langrug site.

Development and Tourism, the survival rate of small businesses in South Africa does not compare favourably to that of similar developing countries. The failure of emerging companies is due to unprofitable quoted prices, technical inabilities and poor management. Financial problems and irrational decision making contribute to their failure. These companies would benefit tremendously from skills transfer if they could enter into a joint venture or partnership with established companies. BBBEE needs skills and capacity building in project management. With ECSA's requirements to provide staff with continuous professional development, financial rebates can be claimed for staff skills development through accredited training providers. Established business forums (WECBOF, Small Business Forum, etc.) could be instrumental in leading the effort toward the development of skills in these areas.

Lack of formal training and little or no relevant experience in project management are reasons to drive the launch of these forums where experiences in project management can be discussed. Besides training, upcoming companies also need mentors to guide them to ensure long term success. One of the biggest stumbling blocks that inhibits the development of upcoming companies is the lack of synergy between them and established ones.

References

[1] Anon (2007). To train or not to train. The South African Association of Consulting Engineers Inside Track: 1-10 November 2007.

[2] L Barbazette (2006). The art of great training delivery. San Francisco: Pfeiffer.

[3] J A Byrne (2007). Leadership power plays. New York: Mcgraw-Hill.

[4] W M Conradie, and C M W Fourie (2002). Basic financial management for entrepreneurs. Lansdown: Juta & Co.

[5] L du Preez (2008). How the new small business turnover tax will work. Personal Finance, Volume 37:12-15, 4th Quarter 2008.

[6] L Erasmus-Kritzinger (2003). Inspirational women at work. Pretoria. LAPA Publishers.

[7] R Ferrier (2009). Safety… can it be regulated? Energize – Special AMEU Proceedings edition "Improving the management of our electricity resources": 104, 28 – 30 September.

[8] D E Goldberg (2006). The Entrepreneurial engineer. New York. John Wiley & Sons Inc.

[9] J E Hunt (1997). Business and commercial Aspects of engineering. Bristol.

[10] G Lloyd (2010). Rethinking our unsustainable housing and urban design policies. PositionIT. The geo-informatics, surveying, GIS, GPS and location based services journal for southern Africa, Jan/Feb: 22-25.

[11] T Mabanga (2009). Labour training scheme – SETA weak link. Financial Mail: 23, 11 September.

[12] J R Meredith and S J Mantel Jr. (2003). Project Management, a managerial approach. New York: John Wiley & Sons Inc.

[13] P Mohr, and L Fourie (2006). Economics for South African students. Pretoria: Van Schaik.

[14] R Munshi (2009). BEE verifications starting to comply. Financial Mail: 26, 11 September.

[15] R Munshi (2009). Small business, profitable but no lift-off. Financial Mail: 26, 23 October.

[16] C Patin (2009). Matric exams in numbers. Financial Mail: 21, 23 October.

[17] C Patin (2009). Political economy. Big push from Pravin. Financial Mail: 36, 30 October.

[18] L Peyper (2010). Minister ontevrede oor uitslae dool. Die Burger, 7 January.

[19] C J Robinson (2000). Rehabilitation engineering, science, and technology. The Engineering Handbook. Boca Ratkon: CRC Press LLC.

[20] V Singh (2008). Residential Time-of-use tariffs and smart metering. Domestic use of energy conference. 19 March 2008. Cape Town: CPUT: 4-6

[21] A Stoner (2009). The evolution of pre-paid metering and load control systems. Energize - Special AMEU Proceedings edition "Improving the management of our electricity resources": 36, 28 – 30 September.

[22] B Strachan (2009). Interview on SABC2 Morning Live on 17 Dec 2009, Johannesburg.

[23] S Szewczuk (2009). Hybrid mini-grid systems – Distributed generation systems for communities based on renewable energy resources. Domestic Use of Energy Conference. 19 March 2008. Cape Town: CPUT: 4-6.

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62nd AMEU Convention 2010

LEADING THE ELECTRICITY DISTRIBUTION INDUSTRY
AMEU

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Drakenstein Municipality	Michael Rhode	P O Box 17, Stellenbosch, 7599	021 808-8333	021 808-8340
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Elundini Municipality	Luyanda Mlondolozi	P O Box 1, Maclear, 5480	045 932-8160	086 589-7751
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1917-1918	J Roberts	Durban
1919-1920	B Sankey	Port Elizabeth
1920-1922	T C Wolley Dodd	Pretoria
1922-1924	G H Swingler	Cape Town
1924-1926	J Roberts	Durban
1926-1927	B Sankey	Johannesburg
1927-1929	J Mordy Lambe	East London
1929-1931	R Macauley	Bloemfontein
1931-1933	L L Horrel	Pretoria
1933-1934	L F Bickell	Port Elizabeth
1934-1935	A R Metelerkamp	Bulawayo
1935-1936	G G Ewer	Pietermaritzburg
1936-1937	A Rodwell	Johannesburg
1937-1938	J H Gyles	Durban
1938-1939	H A Eastman	Cape Town
1940-1944	I J Nocholas	Umtata
1944-1945	A Rodwell	Durban
1945	J S Clinton	Harare
1945-1946	J W Phillips	Harare
1946-1947	G J Muller	Bloemfontein
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1950-1951	C R Halle	Pietermaritzburg
1951-1952	J C Downey	Springs
1952-1953	A R Sibson	Bulawayo
1953-1954	J C Fraser	Johannesburg
1954-1955	G J Muller	Bloemfontein
1955-1956	D J Hugo	Pretoria
1956-1957	J E Mitchell	Bulawayo
1957-1958	J L van der Walt	Krugersdorp
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1975-1977	E de C Pretorius*	Potchefstroom
1977-1979	K G Robson	East London
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1944	G H Swingler
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1955	W Ballad-Ellis
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	C Kinsman
1956	W H Milton
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	Major S G Redman
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1957	D A Bradley
1958	Col G G Ewer
	A Foden
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	R W Kane
1965	G Muller
1967	Clr J D Marais
	J R Telles
1969	W Beesley
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	D Murray-Nobbs
	E L Smith
1971	D J Hugo
	A C T Frantz
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	R Leishman
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	W Rossler
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	J F Lategan
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1975	Clr H G Kipling
	C Lombard
	D C Plowden
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	A A Middlecote
	G C Theron
	J C Waddy
1979	R W Barton
	Clr H J Hugo
1981	J D N van Wyk
	Dr R B Anderson
	J Morrison
1983	T C Marsh *
1983 & 1988	J K von Ahlften
1985	A A Weich
	KG Robson
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	E de C Pretorius
	W Barnard
1987	A P Burger
	J C Dawson
	D H Fraser
	P C Palser
1989	P J Botes
	M P P Clarke
	E G Davies
	J A Loubser
1991	A H L Fortmann
1993	F L U Daniel
	J E Heydenrych
	B van der Walt
1995	C E Adams
	B Madeley
1997	J D Algera
	H R Whitehead
	F van der Velde
1999	J G Malan
2001-2010	H D Beck
	C E Burchell *
2003	A J van der Merwe
2005	P E Fowles
	T van Niekerk
2007	D E T Potgieter
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