AMEU PROCEEDINGS

19th Technical Meeting

30 September to 01 October 2002.
Hosted by the Municipality of
//Khara Hais in Upington

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The Association of Municipal Electricity Undertakings (Southern Africa)

19th Technical Meeting
Hosted by the Municipality of
//Khara Hais in Upington

Official Proceedings

Monday 30 September to
Tuesday 01 October 2002

Theme: "Back to Basics: Successful Electricity Distribution Practices"

From Left: Peter Fowles, Clr Gift van Staden, John Ehrich, Jean Venter, Trevor van Niekerk

TABLE OF ATTENDANCE

Affiliate Members	107
Councilors	35
Engineering Members	93
Honorary Members	5
Non-Members	10
Ordinary Members	15
Retired Members	6
Accompanying Persons	84
Total	**355**

Association of Municipal Electricity Undertakings (Southern Africa)

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Opening Session

WELCOME BY THE PRESIDENT OF THE AMEU—JOHN EHRICH

The most cursory glance at our program for the 19th Technical Meeting will reveal that our members are required to grapple with a wide range of subjects in their day by day management of electricity undertakings. From such highly technical matters as live line maintenance practices, developments in high voltage outdoor substations and new technologies to communicate over power line circuits, our management skills are required to cope with environmental issues, new anti- theft systems and preparations for changes in the organizational structures of our utilities.

As in past technical meetings, conventions and our even branch meetings, the Association strives to equip our members and colleagues to be able to cope more effectively with the endlessly changing demands on their knowledge and expertise. By so doing we believe that this results in both smoother operating and more efficient undertakings, as well as better service to our customers.

It is my firm belief that this meeting will continue this tradition and will help to equip all delegates to better cope with the pressures being faced in our dynamic industry.

I wish you a stimulating, enjoyable and fruitful meeting.

John Ehrich : President

Welcome to our Honorary Members

C Burchell
MPP Clarke
E de C Pretorius
AHL Fortmann
HD Whitehead

Welcome to our Foreign Visitors

Ferdinand Diener - City of Windhoek, Namibia
Cyprian Muzamwese - Piesa Workgroup Member, Zimbabwe
Bo Westerholm - ABB, Finland
Wiseman Molatzi - Oshakati Premier Electric, Namibia
Paul van Niekerk - Central Electricity Board, Mauritius
Daniel Sichela - Zesco, Zambia
Kelvis Kasonkomona - Zesco, Zambia

With Special thanks to:

Kobus van den Berg—SARPA President.

The Meeting was opened by the Mayor's Chaplain

A Prayer and Scripture reading was presented by Robert Stretton.

Special Welcome to our Retired Members

B Boshoff
S Bridgens
A Greyling
C Vosloo
A Wearne

Obituaries

Mr GS de Vries - A Retired Member
Gawie Theron - Past President and Honorary Member
Bunny van der Walt - Past General Secretary
Mr. Meyer - Industrial Poles and Masts

Welcome by the Mayor of //Khara Hais Municipality
Clr Gift van Staden

Organising Committee from the Municipality of //Khara Hais

Mr Hennie Auret	Chief Electrical Engineer - Electrical Services (Municipality of // Khara Hais)
Councillor Gift van Staden (Mayor)	Opening and closing ceremonies
Councillor Jan Isaacs - Chairman	Organising Committee
Tilla Losper	Administration Desk
Koos Myburgh	Catering
Frans Cronjé	Transport
Bernard Fourie	Meeting Venue
Thekiso Sekate	Security
Vanessa van Wyk	Public Relations
Frikkie Coetzer	Decorations
Jeanette Sevenster	First Aid
Naomi Francis	Civic Reception
Peet van Schalkwyk	Sports day, Civic Reception, Meeting Venue
Gert van Wyk	Meeting Venue and Sound System

Key Note Address: Peter Riley - Group Executive Powertech

Transformation
People in the Change Process

In RSA it is my sense that we have good management capability at the executive level and we are proficient at strategic planning however not so good at implementation of strategies and managing – following up to ensure we achieve objective goals on the road map to achievement of change management.

Why is it that we cannot manage the paradime shifts as effectively and efficiently as other parts of the world?? We have strong leadership capabilities, we have effective boards? We strategise well, conceptually and academically. However we don't appear to get our heads around the importance of selecting the right people to key positions to drive the change process within the organisation, it is crucial the driver (CEO) or team of drivers (champions) within a task group, are in fact change agents. Sometimes we select change agents based on their past history of good performance, i.e. great sales management record, good manufacturing results, marvelous service delivery etc. More than likely these people will not necessarily be good change agents! (They may have fixed mindsets with their functional responsibilities). People need to be assessed for their capability in terms of change – it is crucial.

One of many personal experiences was specific to a company within the Altron group a couple of years ago, this business was in dire straits and it was impacting on the Altron share price and it had high media exposure. A Sales Director was considered core to the business, after a six month period as MD of the business we began to get an uneasy feeling, the individual was competent technically, presented himself well with the customer base, however it became apparent he was not a change agent and he was poor at follow up and managing shift in the way we were changing the business and operating profile. We had missed this when we went through the initial assessment of potential champions of the change process. When I addressed the Board on this issue they were horrified as he was perceived as a solid team member and performer. However based on our assessment we had to make the change and we were fortunate in recruiting a near perfect fit relative to our person specification, for this change agent role. After three months the impact began to show and our strategic plan/ implementation began to happen with a paradigm shift on the sales line. We initially had a round peg in a square hole, the decision over time proved to be correct, we began to encroach on our competitor's market share and they became concerned, they made an offer and bought the company, which was in line with the group's strategy, as the business was not core to the group – **success; we got the correct person in a key position.**

People issues – some say we in RSA haven't the talent in the market place, or some blame it on historical issues, which bears some truth. Unfortunately the world is not going to wait for us to catch up, its dog eat dog in the international market place, our global competitors perceive we already have a competitive edge now, with the value of the Rand relative to other currencies, so don't look for sympathy when negotiating with international buyers because of our recent past.

Let me illustrate what we at Altron face in terms of international competition via U.E.C. a company within the Altech Division who transformed themselves into an international player, manufacturing T.V. digital set top box decoders, and addressing the opportunities in the convergence of technologies.

In 1996 this company was in a loss position; in 2002 it has transformed itself and has profits well in excess of R100m.

To give you an idea of how fiercely they have to compete on costs never mind technology a digital set top box in 1996 had a sales price of US$500, today the range of boxes has sales prices of US$95 to US$150, a dramatic price reduction, which the market forces demand if you are to stay a global player. How was this achieved – well the product and manufacturing process had to be re-engineered and costs taken out to remain competitive, or the business wouldn't have survived, you know the business has grown expotentially, and to see how the people have changed is amazing. They are proud to be apart of a winning team, proud to be members of a company which has received high media exposure.

Success; Yes; How; PASSION. The management team had a passion a focused passion. They charted a route for change, they re-engineered processes, took costs out, with a strong team, the champions being change agents, with constant communication of objectives throughout the organisation. They managed through the change shifts formally, measuring their progress and communicating the same; in the process creating a learning organisation who have become nimble and readily accept and introduce modifications to product and processes to take advantage of market niches worldwide. They encompass change as a part of their daily work ethnic, receptive to new ideas, and giving freely their own experiences to contribute to the change process.

DON'T DISREGARD THE OPERATIVES WHO MAKE THINGS HAPPEN. THEY ARE PEOPLE!! SUCCESS OR FAILURE IS BASED ON PEOPLE! AND THIS IS THE HARD FACTS WHICH HAVE TO BE MANAGED. THE SOFT ISSUES OF STRATEGY PLANNING; WE DO WELL. TO SUCCEED THERE NEEDS TO BE A PASSION. A PASSION TO SELECT THE RIGHT PEOPLE TO MANAGE CHANGE, THE CHANGE AGENTS. THEN THE MANAGEMENT OF STAFF AND EMPLOYEES. I WILL REFER TO PASSION AGAIN LATER. IT IS NOT EASY! BELIEVE ME I KNOW.

Another experience I will share with you; to illustrate, that you must not disregard your lower structure employees in the change process.

I had a period of my career as a manufacturing director within a Japanese automotive company in RSA. At the time a very confrontational environment existed between management and the unions. We had an assembly problem when building the car bodies, a dimensional problem, which prevented a first time fit of trim parts later in the assembly process. Production Engineers, quality engineers all analysed this problem. A lowly paid operative pointed out to me after I had gained his confidence after a long period of daily discussion that a clamp arrangement didn't hold the assembled components stiffly enough and he thought this may contribute to the problem. "CONTRIBUTE IT WAS THE PROBLEM". He had been aware of this for years!! and was frightened to mention it! It was unforgivable to me, the Engineers were too arrogant to ask the operator's opinion, prior to their analysis.

When you go through change, communicate, discuss – ISSUES OPENLY!!

CONFRONTATION

Don't shy away from confrontation, if it has to be faced – face it. But ensure of the facts, the CEO/ MD must drive these issues and be aware of the facts creating the confrontation, and the process managed delicately if possible – some situations require more than diplomacy and how these are addressed is dependent on the circumstances and situation. EXPLORE WAYS OF AVOIDING CONFRONTATION, BUT DON'T WALK AWAY IF THERE ARE NO ALTERNATIVES. MANAGEMENT MUST RETAIN RESPECT EVEN THOUGH YOUR ANTAGONISTS DON'T SHOW IT.

Can you imagine trying to increase production output again in an automotive assembly plant in the 89/90 period in a period of political strife, and unionised politics. No good holding your hands up and proffering the concept its impossible!! There was still a business to run with local and international shareholders; when the bottom line isn't achieved do you think they thought of politics!! NO WAY!

On the one hand you had management and staff from a predominant Afrikaans background. Labour from a Black disadvantaged background and highly sensitive politically.

HOW TO MAKE IT HAPPEN AND IMPROVE PRODUCTION THROUGH PUT.

Communication of targets, requests at formal weekly Union meetings, appeals to district and local area union officials bore no fruit!!
THE SIMPLE ANSWER; GET BOTH SIDES TALKING ON THE ISSUE AT THE SAME LEVEL!!

To the angst of operating management we brought the senior shop stewards into the morning management operations meetings.

Informed all, there was no distinction between management and Union officials representing labour in this forum.

The target focus was set: increase production without negatively impacting the quality of the assembly process.

Can you imagine sitting at the head of a large board room table with the two groups just mentioned on either side of you!! You could taste the environment. (N.B: There was also humorous moments). Days/ weeks went by before a breakthrough; it eventually came from the Union. But with this breakthrough came a change in the environment in the conference room, the tenor of conversation changed. When focussing on bottleneck problems I sometimes had to pinch myself. Management highlighting problems, Unions challenging the real issues in an air of co-operation; on would you believe, first name terms, we were hitting the root causes of problems on the second and third reviews. Some problems in management areas, i.e. incompetence, and lack of communication, other issues highlighted salient labour negligence and sabotage. But through perseverance and passion the end result was achieved with a 35% increase in volume throughput!! Was it sustained – NO. It could have been the case. Just lets say the politics of the time prevailed.

What changed; "people changed" – with face to face dialogue

The point I'm making if you want success that badly, and there is a passion to achieve it, it can be done BUT NOT EASILY AND IN SOME CASES NOT WITHOUT CONFRONTATION!! BUT IN SOME IT CANNOT BE AVOIDED. BE PREPARED TO FACE IT.

"ALSO THINK CREATIVELY" AND DON'T BE AFRAID TO CHALLENGE THE "STATUS QUO"

From what I am informed there are many of you in this room who are going to face managing change. Not necessarily the same environment and industry that I've just mentioned. But you will face similar problems. I am led to believe that strategic items in the form of:

Low cost electricity
Financial health
Quality of service and supply
Remain under public ownership
Supervision of distribution of electricity have been identified

I believe:

There is a restructuring blue print/ model
There will be a holding Company
There will be subsidiary companies
There is an index for the role out of projects
There is a revised organisation structure for the holding company
There is a phased restructuring programme through to phase 6 in 2007
There is a board structure
There is a route map through to 2005/ 2007

Sounds like a serious strategic plan; focused at the conceptual/ academic level at present.

Forgive me I hope the hard issues have not been forgotten. You can create an impressive organisation at the executive level with all the right bells and whistles, but don't forget your middle management and supervision in this change and how they communicate with the operating levels at the planning stage as to what is required of them.

REMEMBER!

People change what they do less because they are given analysis that shifts their thinking; than because they are shown a truth that influences their feelings.

This is especially so in large scale organisational change, where you are dealing with new technologies, mergers and acquisitions, restructurings, new strategies, cultural transformation, globalisation, and E-Business. Whether in an entire organisation, an office, a department, or a workgroup. In an age of turbulence, when you handle this reality well you win. Handle it poorly you loose, and it can drive you crazy, cost a great deal of money, and cause a lot of pain.

Successful large-scale change is a complex affair that happens in eight stages. The flow is:

PUSH URGENCY UP
PUT TOGETHER A GUIDING TEAM
CREATE THE VISION AND STRATEGY
EFFECTIVELY COMMUNICATE THE VISION AND STRATEGY
REMOVE BARRIERS TO ACTION
ACCOMPLISH SHORT TERM WINS
KEEP PUSHING FOR WAVE AFTER WAVE OF CHANGE UNTIL YOU'VE MET YOUR OBJECTIVES
FINALLY CREATE A NEW CULTURE TO MAKE NEW BEHAVIOUR STICK "YOU WILL HAVE A LEARNING ORGANISATION"

The central challenge in all eight stages is changing peoples behaviour. Really the central challenge is NOT STRATEGY, NOT SYSTEMS, NOT CULTURE. THESE ELEMENTS AND MANY OTHERS ARE VERY IMPORTANT, BUT THE CORE OBJECTIVE WITHOUT QUESTION IS BEHAVIOUR – WHAT PEOPLE DO, AND THE NEED FOR SIGNIFICANT SHIFTS IN WHAT PEOPLE DO.

CHANGING BEHAVIOUR IS LESS A MATTER OF GIVING PEOPLE ANALYSIS TO INFLUENCE THEIR THOUGHTS THAN HELPING THEM TO SEE A TRUTH "TO INFLUENCE THEIR FEELINGS"

Both thinking and feeling are essential, and both are found in successful organisations, "BUT THE HEART OF CHANGE IS IN THE EMOTIONS". THE FLOW OF SEE – FEEL – TOUCH IS more powerful than that of analysis – think – change!!

The distinctions between seeing and analysing, between feeling and thinking, are critical because, for the most part, we use the latter much more frequently competently, and comfortably than the former.

Think of this for an example.

A mining corporation in RSA had a decentralised procurement function which required to be transformed to improve efficiency. A major item purchased was gloves (working protective gloves). Yes there was a specification and it was adhered to by 30+ different purchasing locations in this organisation.

A bright executive was selected as a change agent: To provide an example to illustrate why change was required within the purchasing area he was investigating high volume purchased items. He identified that his organisation was purchasing 42 different variations of the required specified glove. At prices ranging from R5 to R72 in some cases the same glove manufacturer was selling the same glove to different procurement sites with price variation of R5 – R48. The total stock inventory of gloves of this specification throughout his organisation amounted to a total of R1,2 million?? This total stock position provided the group with gloves of this specification for the next five years, yet orders were still being placed for significant volumes. To ensure the full impact of this one situation would contribute to the justification for change, all available stock was brought to one central area from the 30 different procurement/ store locations. Can you imagine the mound of gloves with the different purchase price highlighted from the 30 purchase locations.

CAN YOU IMAGINE THE SURPRISE THE IMPACT, THE EMOTION, THE SEE, FEEL AND REASON FOR CHANGE TO TAKE PLACE BEING CONFIRMED TO VERY CONSERVATIVE MINING PROCUREMENT PERSONNEL, WHO WERE VERY ADVERSE TO CHANGE!!. RESISTANCE WAS MINIMISED!! URGENCY WAS PARAMOUNT, FACTS AND OBJECTIVITY WON THE DAY. THIS IS A GOOD ILLUSTRATION OF MY POINT. SEE – FEEL – AND I SUPPOSE TOUCH.

ALBERT SCHWEITZER ONCE SAID "EXAMPLE IS NOT THE MAIN THING INFLUENCING OTHERS. IT IS THE ONLY THING"

Successful see – feel change tactics tend to be clever not clumsy and never cynically manipulative. They often have an afterglow, where the storey of the event is told again and again or where there is a remaining visible sign of the event that influences additional people over time.

Jack Welch is stated to have talked about change when he was CEO of G. E. virtually every second of every day. G.E. was very successful in making operating transitions – communication!! – communication!! He admitted he went over the top sometimes.

Lets come back to the eight stages of change, and lets briefly look at what works, and what does not work in relation to the eight step changes.

1. Increase urgency

What works:
Showing others the need for change with a compelling object that they can actually see, touch, and feel.
Showing people valid and dramatic evidence from outside the organisation that demonstrates that change is required.
Looking constantly for cheap and easy ways to reduce complacency.
Never underestimating how much complacency, fear, and anger exists, even in good organisations

What does not work:
Focusing exclusively on building a 'rational' business case, getting top management approval, and racing ahead while mostly ignoring all the feelings that are blocking change.
Ignoring a lack of urgency and jumping immediately to creating a vision and strategy.
Believing that without a crises or burning platform you can go nowhere.
Thinking that you can do little if you're not the head person.

2. Build the Guiding Team

What works:
Showing enthusiasm and commitment (or helping someone do so) to help draw the right people into the group.
Modelling the trust and teamwork needed in the group (or helping someone to do that).
Structuring meeting formats for the guiding team so as to minimise frustration and increase trust.

What does not work:
Guiding change with weak task forces, single individuals, complex governance structures, or fragmented top teams.
Not confronting the situation when momentum and entrenched power centres undermine the creation of the right group.

3. Get the Vision Right

What works:
Trying to see – literally – possible futures.
Visions that are so clear that they can be articulated in one minute or written up on one page.
Visions that are moving – such as a commitment to serving people.
Strategies that are bold enough to make bold visions a reality.
Paying careful attention to the strategic question of how quickly to introduce change.

What does not work:
Assuming that linear or logical plans and budgets alone adequately guide behaviour when you're trying to leap into the future.
Overly analytic, financially based vision exercises.
Visions of slashing costs, which can be emotionally depressing and anxiety creating.

4. Communicate for Buy-In

What works:
Keeping communication simple and heartfelt, not complex and technocratic.
Doing your homework before communicating, especially to understand what people are feeling.
Speaking to anxieties, confusion, anger, and distrust.
Ridding communication channels of junk so that important messages can go through.
Using new technologies to help people see the vision (intranet, satellites, etc.)

What does not work:
Under-communicating, which happens all the time.
Speaking as though you are only transferring information.
Accidentally fostering cynicism by not walking the talk.

5. Empower action

What works:
Finding individuals with change experience who can bolster people's self-confidence with we-won-you-can-too anecdotes.
Recognition and reward systems that inspire, promote optimism, and build self-confidence.
Feedback that can help people make better vision-related decisions.

What does not work:
Ignoring managers who seriously disempower their subordinates.
Solving the managers problem by taking away their power (making them mad and scared) and giving it to their subordinates.
Trying to remove all the barriers at once.
Giving in to your own pessimism and fears.

6. Create Short-Term wins

What works:
Early wins that come fast.
Wins that are as visible as possible to as many people as possible.
Wins that penetrate emotional defences by being unambiguous.
Wins that are meaningful to others – the more deeply meaningful the better.
Early wins that speak to powerful players whose support you need and do not yet have.
Wins that can be achieved cheaply and easily, even if they seem small compared with the grand vision.

What does not work:
Launching fifty projects all at once.
Providing the first win too slowly.
Stretching the truth.

7. Don't let up

What works:
Aggressively ridding yourself of work that wears you down – tasks that were relevant in the past but not now, tasks that can be delegated.
Looking constantly for ways to keep urgency up.
Using new situations opportunistically to launch the next wave of change.
As always – show 'em, show em' show 'em.

What does not help
Developing a rigid four-year plan (be more opportunistic)
Convincing yourself that you're done when you aren't.
Convincing yourself that you can get the job done without confronting some of the more embedded bureaucratic and political behaviours.
Working so hard you physically and emotionally collapse (or sacrifice your off-the-job life).

8. Make change stick

What works:
Not stopping at step 7 – it isn't over until the changes have roots.
Using new employee orientation to compellingly show recruits what the organisation really cares about and has achieved
Using the promotions process to place people who act according to the new norms into influential and visible positions.
Telling vivid stories over and over about the new organisation, what it does, and why it succeeds.
Making absolutely sure you have the continuity of behaviour and results that help a new culture grow. A LEARNING ORGANISATION!!!

What does not work:
Relying on a boss or a compensation scheme, or anything but culture, to hold a big change in place.
Trying to change culture as the first step in the transformation process.

I now refer back to PASSION; passion to succeed. I met with a visiting professor of Humanics, Bob Massam at Dukes business School in Chicago in the mid eighties. He was an impressive man physically and had a real presence about him. Over dinner one evening he was telling me about his wife who was an Operations Manager at a Ford Plant in the U.S. in Louisiana. I had read of the achievements of this particular operation in the media, it had gone through huge change and dramatically improved efficiencies. I had the pleasure of meeting his wife the following evening, she also was a very attractive and impressive woman. They had lived in Louisiana all their lives and raised five sons into adulthood and each one of them in successful careers.

I was aware Bob's wife Bridget was the executive responsible for achieving these dramatic results. I enquired over drinks how she had accomplished so much i.e. raising five children and achieving such highlights in her career.

Bob interjected fiercely in his Southern U.S. drawl. MY WIFE ONCE SHE'S GOT FOCUS CAN SUCK A GOLF BALL THROUGH 100 YARDS OF GARDEN HOSE PIPE IF SHE HAS A MIND TO DO IT. THAT'S HOW!!!

THINK OF THAT, GENTLEMEN, HAVING A WIFE LIKE THAT!

I asked Bob if he ever got irritated, yes he replied, but passion in another context eased my irritation.

May I take this opportunity of wishing you all a very successful technical conference.

Thank you for inviting me to address you today.

PC Riley

ESI Africa Excellence Awards presentation at the 19th AMEU Technical Meeting

ESI Africa was proud to present the third annual ESI Africa Excellence Awards at the 19th AMEU Technical meeting held recently in Upington.

In 2000, Spintelligent, the publishers of ESI Africa, recognised a need to introduce an Award, acknowledging companies in the utility market. This award was to be based, not on their financial performance or the number of contracts awarded, but on the **quality of service** they provide their clients.

The survey groups traditionally have been municipal engineers, randomly selected from the ESI Africa database. For the 2002 awards, large industrial users and Eskom regional offices were added to this group. The survey groups were asked a series of questions posed to them as follows: "Who do you consider the best ...?" in a variety of categories.

ESI Africa is pleased to acknowledge the following companies who ESI Africa Excellence Awards for 2002:

Contractors:	Consolidated Power Projects (Pty) Ltd	Gold
	K Bond Single Phase cc t/a Dynamic Electrical	Silver
Consulting Engineers:	Kwezi V3 Engineers (Pty) Ltd	Gold
	Ballenden & Robb Consulting Engineers (Pty) Ltd	Gold
	C & V Consulting Engineers cc	Silver
	Merz & McLellan (Pty) Ltd	Bronze
Maintenance Support:	Relay Settings (Pty) Ltd	Gold
	Rotek Engineering, a division of Rotek Industries (Pty) Ltd	Silver
Cable Manufacturer:	Aberdare Cables (Pty) Ltd	Gold
	African Cables Limited	Silver
Switchgear Manufacturer:	ABB Power Technologies Medium Voltage	Gold
	Alstom Switchgear	Silver
	Circuit Breaker Industries Ltd	Bronze
Transformer Manufacturer:	Alstom Distribution Transformers	Gold
	Yemurai South Africa incorporating Hawker Siddeley Electric Africa (Pty) Ltd	Silver
	Power Engineers, a division of Desta Power Matla (Pty) Ltd	Silver
Electricity Distributor:	Eskom	Gold
	City Power (Pty) Ltd	Silver
Metering Company:	Actaris Measurement Systems (Pty) Ltd	Gold
	Alstom Protection & Control	Silver
	Energy Measurements (a Siemens Company) Bronze	
Pre-payment Company:	Merlin Gerin SA (Pty) Ltd t/a Conlog	Gold
	Energy Measurements (a Siemens Company)	Silver
	Actaris Measurements South Africa	Bronze

ESI Awards

For more information about the ESI Africa Excellence Awards, please contact Claire Volkwyn, ESI Africa: 021 700 3500 or claire@spintelligent.com

ESI AFRICA
THE POWER JOURNAL OF AFRICA

spintelligent

Case Study On EBSST Implementation In Cape Town

Author & Presenter: Neil Ballantyne Pr Eng, B.Sc (Elec Eng)
Assistant City Electrical Engineer (Customer Services)
City of Cape Town

Pre-implementation stage:

Rationale behind the introduction of basic free electricity:

The Council of the City of Cape Town decided to implement the issue of free basic electricity early in 2001. The prime aim of the decision was to provide a monthly quota of free electricity to alleviate the plight of the poorest of the poor, and to improve their quality of life by providing an alternative source of energy for lighting and entertainment (TV and radio), thereby reducing the threat of fires from open candles.

Due to the difficulty in determining who the poorest of the poor are, it was decided to provide a free quota of electricity to every municipally metered domestic customer in the Metro area. This unfortunately had to exclude Eskom customers as Eskom was still planning to run pilot sites to test their systems for the issuing of free basic electricity. Also excluded were the dwellers in informal areas who do not have a formal electricity supply connection. The policy for the electrification of informal areas which only allows for supply connections to dwellings adjacent to access ways into the areas was broadened to allow as close to 100% penetration of connections as possible, thereby allowing all residents to benefit from the free quota of electricity. This electrification is an ongoing project that will take years to complete.

Implementation principles:

The principles governing the issue of free electricity are:

- 20kW.h per month to each municipally metered domestic point of supply
- One allocation per month per supply point
- Bulk metered premises could, by way of an affidavit, claim a quota for every dwelling unit
- No accumulation from one month to the next ("use it or lose it" for billed customers and claim it or lose it" for prepayment customers)
- Supplies cut off for non-payment don't qualify for the free quota.

Funding the basic free electricity:

A source of funding had to be found to finance the provision of the free basic electricity. It was calculated that the cost in the first year for a free quota of 20kW.h per month to all domestic customers would be R34m. The decision was taken to fund this from a general across the board increase in the electricity tariff of 1,6%. A free quota of 50kW.h as proposed by Eskom was deemed to be too costly to implement in Cape Town at the initial stage.

Impact of 20kW.h free issue on poor electricity consumers:

Although the Rand value of the 20kW.h free issue of electricity can only buy two loaves of bread, a pack of candles, two litres of paraffin or two torch batteries, it will operate:
a 60W lamp for 333 hours,
a 1kW kettle for 20 hours,
a fridge for 133 hours (10 days),
a television set (150W) for 133 hours,
a sewing machine for 235 hours or
an iron for 40 hours.

This is of decided advantage to the poorest of the poor living in informal dwellings, whom this initiative is primarily aimed at assisting.

Methods of issuing the free units:

The two available methods for issuing the free units were examined.

The static token was only available at the time for STS meters and so excluded the 80 000 proprietary meters installed in the Cape Town metro area. This method relies on a date and time stamped token which will only be accepted once by any meter. Duplicate issues of such a token in any month would be rejected by the meter.

The other method uses the block or stepped tariff principle with the first 20 units being the first block at zero cost. The vending system tracks the number of units issued each month and automatically charges for any units issued over and above the first 20.

Both these methods had perceived downfalls. It was thought likely that the use of the static token would result in customer complaints necessitating costly house calls when the second and subsequent tokens entered into a meter were rejected by the meter. (This perception has subsequently be shown to be unfounded by other electricity utilities who have used this method).

The stepped tariff method has the downfall that with off-line vending systems it is possible to purchase more than one free issue token on one day before the data at the vending outlets is uploaded to the system master station. These duplicate free issue tokens would be accepted by the meter. A means to detect these additional free issues and recover the cost of the extra units issued had to be found. Software was developed by the vending system supplier which enabled the system to detect these multiple issues and claim the cost back before the system would issue any further credit for that particular meter. Proprietary meters could accept stepped tariff tokens. With this method no house visits are necessary and the over issue of free units is self correcting.

Systems considerations:

3 000 magnetic card meters had to be replaced before the launch of free basic electricity as the old vending system supplying these meters could not vend stepped tariffs.

The vending system in three areas in the metro had to be upgraded to handle the stepped tariffs and the recovery of the cost of multiple free issues. These upgraded system had to be fully tested and debugged before going live.

The cost of these changes amounted to R2,3m.

The billing systems for billed customers were able to handle stepped tariffs, so that the monthly free issue did not present a problem. Multiple free issues per account for bulk metered premises could also be accommodated in the billing systems.

Public awareness campaign:

It was deemed important to inform both staff dealing with the public, and the public of the launch of the basic free electricity and to explain how the system works and who would receive the free quotas. "Frequently asked questions " were developed and pamphlets sent out with every municipal account in the month prior to the launch. Copies were also made available at public counters, libraries, etc. Radio spots on popular radio stations were aired.

Implementation:

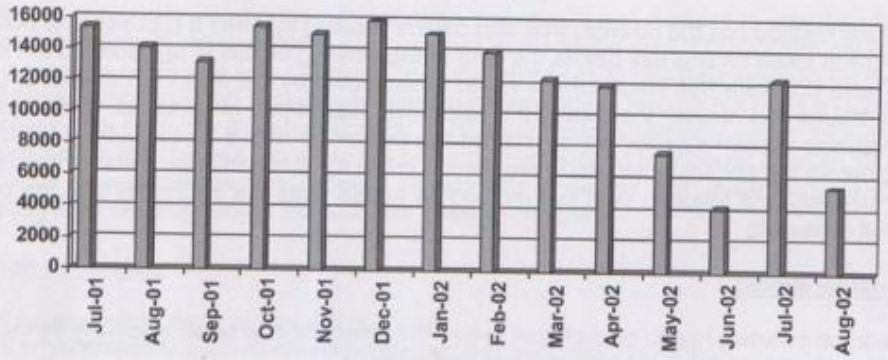
Experiences:

Basic free electricity was launched in Cape Town on 1 July 2001. The advertising campaign had successfully done its job as long queues were experienced at vending outlets on the first few day of the month, especially in the poorer areas. To reduce the length of queues at vendors that were particularly hard hit second vending machines were installed.

Many multiple issues were also experience in the first few days of the month. People somehow got to know the one weakness of the system and cashed in – only to be surprised on their next visit to a vendor when the cost of the additional free units issued were claimed back from them before they could buy more units for their meter!!

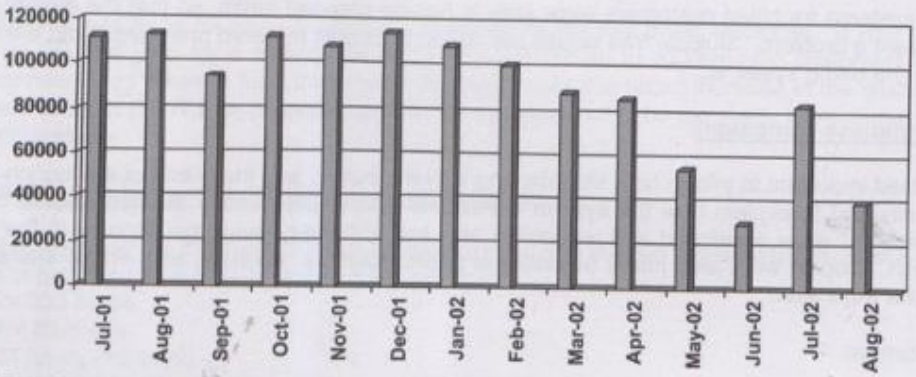
It was expected that this tread would reduce as people realised that they had to pay for the extra free units, but the experience in the following months show that this was not to be the case. In May 2002 the ability to buy from any off-line vendor where the consumer had not bought before was switched off due to the planned introduction in July 2002 of a second domestic tariff which included a service charge. This was necessitated due to the tariff index being delinked from the tariff price on the vending system, thus avoiding the need to enter key change tokens into 200 000 meters when the new tariff was introduced. This resulted in fewer people "vendor hopping" to obtain additional free units at the start of the month. This can be clearly seen on graphs A & B below. On the first week of July 2002 when implementing the new electricity tariffs there was a

Amount of Excess Free Issues



GRAPH A

Rand Value of Excess Free Issues



Total Rand Value Of Excess Free issue = R1 250 132
Total Amount out Standing as at 3 September 2002 = R4 214,60

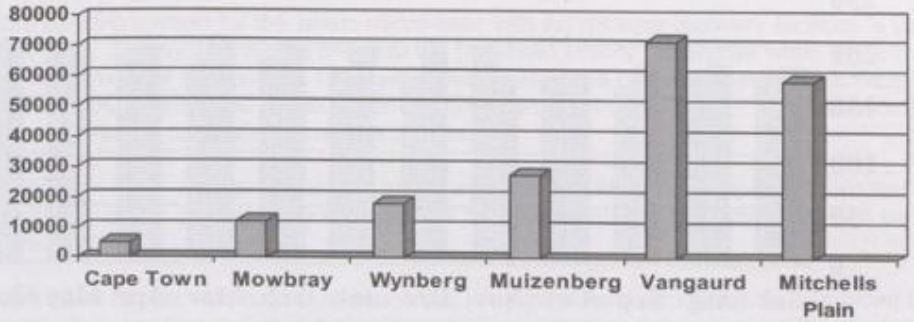
GRAPH B

software corruption problem that caused the sharp increase in the issue of excess free units in that week.

It seems that people in poorer areas chose to use this "facility" to obtain more units at the start of the month knowing that they would have to pay up later. This tread is continuing.

The areas where there is higher trend for people to claim multiple free issues is show on graph C below. The areas of Vanguard and Mitchells Plain have a higher proportion of poorer families than the other area depicted on the graph.

Area Distribution of Second Free Issue July 2001 to August 2002



GRAPH C

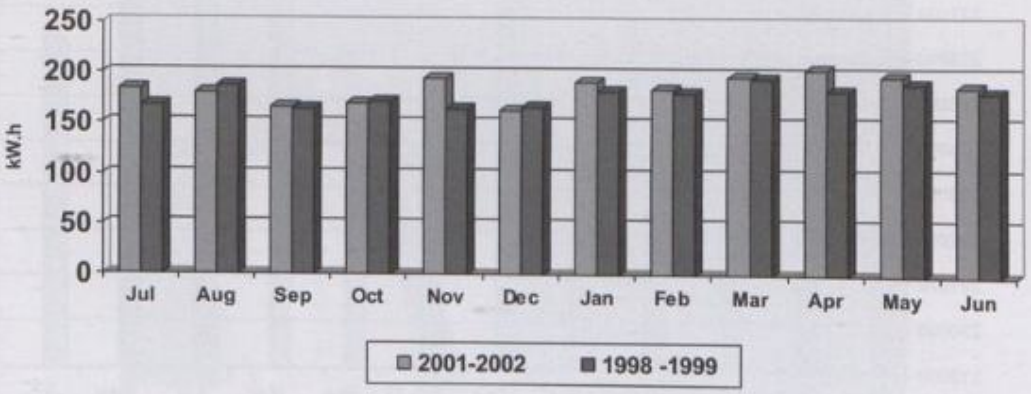
Impact on sales:

In areas where the average monthly consumption is 600 to 700 units the 20 free units has had no effect on consumption levels. The only benefit to these consumers was the saving of about R7 on their electricity bill.

In the poorer informal areas the issue of the free units as not resulted in a sustained increase in monthly sales levels. This can be seen on graphs D and E for two different areas.

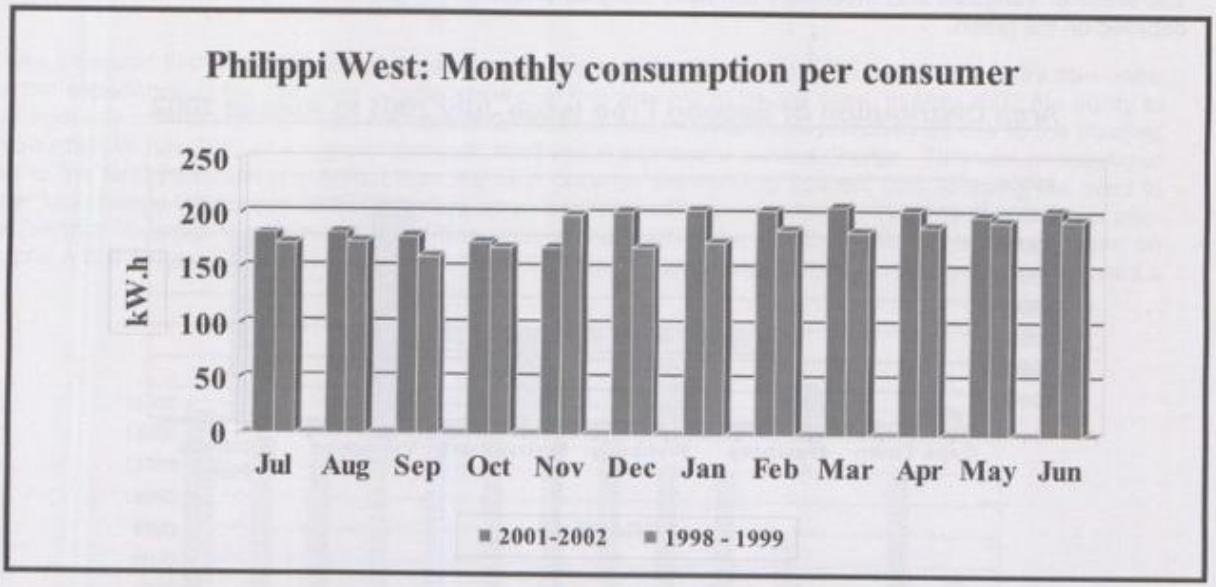
KTC
Average consumption increased by 6,9 kWh(including free 20 kWh) since 1998

KTC: Monthly consumption per consumer



GRAPH D

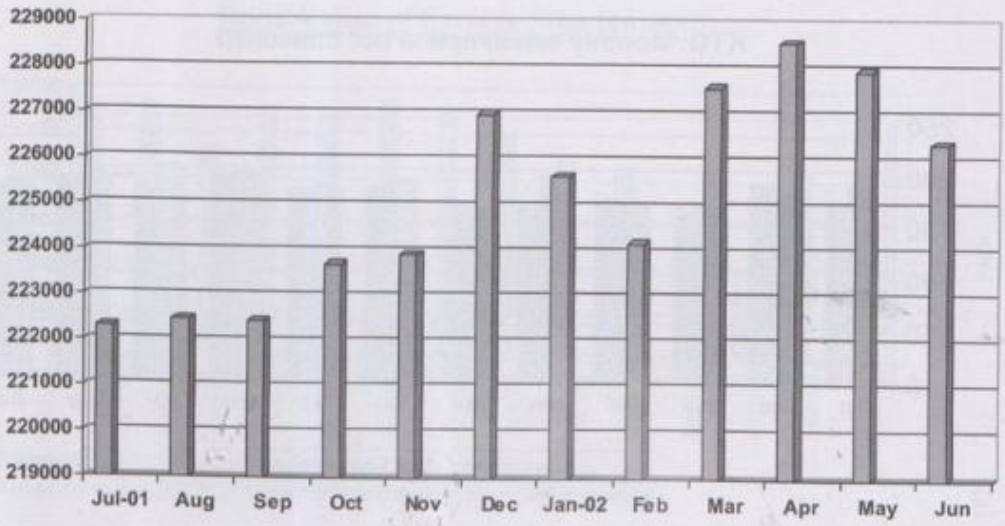
Philippi West
Average consumption increased by 12,8 kWh(including free 20 kWh) since 1998



GRAPH E

The total number of customers who received free units each month climbed steadily as the months progressed. This is attributed to those customers who previously did not purchase each month and realised that they were loosing out on their free units by not doing so. The marked increase in December 2001 can be attributed to the many holiday dwellings where purchases are made only during holiday periods. There is no obvious explanation for the relatively lower figure in February 2002 nor for the decline in May and June 2002. This is shown in graph F.

Total number of consumers who received 20kW.h free electricity



GRAPH F

Observations from the informal area of Joe Slovo, Langa:

The area of Joe Slovo is a newly electrified informal settlement with 4 500 shack dwellings. During the official "switch on" ceremony when visiting dwellings (shacks) it was found that many occupants were still running on their free 20kW.h issue after two weeks of the month. This shows the low consumption patterns of occupants in newly electrified informal areas, and the assistance the free 20kWh gives them for the provision of light and television in such dwellings.

Future plans for electricity vending in Cape Town:

A single on-line vending system for the whole metro area with full disaster recovery facilities is planned to be introduced next year. This system will be linked to the proposed Unicity "enterprise wide" system that is to be commissioned over the next 12 months. This system will enable one customer database to be established, a subset of which will be downloaded to the vending system on a continual basis. This will avoid the need to enter data into two different databases as is now the case.

This on-line vending system will have strategically placed vendors with off-line capabilities so that in the event of a complete failure of the communication system to the master station customers will still be able to buy electricity tokens.

The system will allow for the recovery of all municipal account arrears which will be interfaced to the billing system accounts, thus avoiding the need for a separate accounting module in the vending system that is currently the case.

Free basic electricity will be issued as a stepped tariff at zero cost. With an on-line vending system it is not possible for customers to obtain multiple free issues, as in the case of an off-line system using this method, because the encrypted code for the tokens is vended from a central point – the system master station.

Neil Ballantyne

Design Crimes in Electricity Distribution

Author & Presenter: P Crowdy M.Eng.
Network Services Manager, Central Region, Eskom Distribution

Introduction

For any business to remain competitive it must ensure that it obtains the maximum return on its investment and that the value of its product exceeds the price paid for it. This implies that the infrastructure that is developed by a business must be able to undertake the objective for which it was developed at the least cost. The cost must be the least cost over the life of the infrastructure including capital, operating, maintenance, support, safety and disposal. The majority of the costs are committed by the stage that the infrastructure is designed. As a result if all the consequences of the design have not been taken into account at this stage, the life costs will not be minimised and the return less than it could have been. In the case of an electrical utility, whose job is to transport electrical energy to the customer, capital utilised to develop the transport infrastructure, maintainability, operatability and failures contribute to the costs and should be minimised.

This presentation is a composite of slides that show some aspects that have contributed to extra costs to the business which should have been eliminated in the development of the infrastructure. The purpose of the slides is to sensitise the audience to some items that should be considered in the design stage to reduce costs. The slides are taken from the electrical utility environment but similar examples are evident in other businesses, often they have contributed in the bankrupting of the business. This is by no means a complete library of incorrect items on the system.

Slides

The slides that shown in the presentation illustrate examples of:
Problems due to poor layout planning, Infrastructure not contributing to maximising investment return,
Wastage due to poor project management,
Failures due to poor design or implementation,
Failures due to incorrect voltage protection,
Failure due to low clearance,
Failures due to incorrect consideration of creepage,
Failures due to incorrect consideration of partial discharge,
Poor construction practices,
Poor maintenance practices,
Poor risk mitigation.

Planning

The first slide illustrates an example of a larger customer in an electrified area. This customer was placed at the end of a LV system resulting in low voltage at the supply terminals. A preliminary survey of the area prior to layout design would have resulted in a more optimal placing of the transformer. Supply- system losses increase with distance from the transformer and by having this power consuming customer at the end of the LV system both increased system losses as well as an unhappy customer. The second slide is an indication of a similar occurrence resulting from poor re-engineering as a system load increases.

The second series of slides illustrate where capital has been spent on infrastructure were it has not been necessary. In these cases more care in the design stage would have resulted in reduced capital expenditure for the same revenue. The extra capital is due to utilising extra service poles, oversized service cables, arbitrarily installing service boxes, building three phase lines where only one was needed and building longer lines than needed and using extra stays.

The third series of slides refers to the choice of structures. Guidelines show the correct choice of structures for specific situations. Choosing a structure designed for short spans for use in long spans will result in outages due to clashing, customer spikes, excessive maintenance costs and unhappy customers.

Construction

The fourth series of slides shows incorrect construction methods. These will again result in maintenance expense and in some cases create a safety hazard. Note that the creation of a safety hazard can result in a considerable expense to the business.

The fifth series show the result of poor construction practices. Should the jumpers around a strain pole be poorly placed there will end up a low BIL structure. In the case of poles being planted to an insufficient depth or poor backfilling the result is leaning / broken poles. Underground cables are a broblem should the construction practice not be carefully monitored. Cables that were to be placed with suitable spacing will be seriously de-rated should the spacing be compromised. In addition the poor laying methods will result in later cable failures. This is especially the case with rocks in trenches. Finally in project management there will be a tendency for wastage if proper controls are not in place. This will tend to increase the project cost for which there is no return.

Surge Protection

The sixth series of slides show how the positioning and connection of surge arresters will reduce the protection for equipment. An increased probability of failure will result from the incorrect positioning of surge arresters, in turn resulting in increased maintenance expenditure and a reduced quality of supply. What is often ignored in the placement of surge arresters is the volt drop along the surge arrester leads. This volt drop is in addition to the surge arrester voltage. The surge arrester/lead voltage should be kept to a minimum to maximise the protection level. This is especially relevant as the protected unit's BIL reduces with age.

Creepage

Equipment on the system should be designed, taking account the creepage distances between any live terminal and ground, the air gap between any live terminal and ground and any air gap breakdown for a shrouded connection. Often one of these is compromised in the design of equipment. The problem is that generally the type tests that are specified will not pick up these deficiencies and the "latent defect" will only result in failure years later. The slides in this series show the results of these types of failure.

The seventh series of slides shows the effect of insufficient clearance and creepage within equipment. If there is insufficient clearance there will be a breakdown between the live part and ground or another phase. In the case of insufficient creepage tracking will begin along the insulation surface which will result in a flashover.

Breakdown

The eighth series of slides relate to the effects of breakdown around shrouded parts. The breakdown referred to is generally in the air surrounding the shrouding. The permittivity of insulation material will determine the voltage ratios across different materials between two voltage points. When one of the materials is a solid dielectric and the other is air the greater voltage is invariably across the air. The air unfortunately will normally have the lower breakdown voltage. This will often result in breakdown of the air. This breakdown will generally cause the solid insulation to be gradually eroded and result in later equipment failure. The relationship between gap width and insulation thickness is illustrated for one case in the attached table.

Ds (mm)	Va (kV)	Va/mm
0	20.0	1.1
6	17.5	1.5
12	12.7	2.1
17	3.4	3.4
18	0	0

The slides illustrate the effects of this phenomenon in switchgear.

Safety of personnel is seriously compromised along with loss of supply and increased maintenance when a cable termination is not correctly made off or if a termination is utilised for connecting to a unit for which it was not intended. The slides indicate an incorrect termination utilised to connect to a switch along with the resultant hot spots being developed. Specification NRS 012 has been developed to give guidance as to the spacing to be utilised for a termination in air. Not complying with these termination clearances can result in dangerous breakdowns in the termination box. Note that in a termination box arcs are contained which can result in an explosion

Maintenance

The wrong things done during system restoration can also result in disaster. Protection is in place on a system to ensure that if a fault does develop then the rest of the system is not damaged. Should this protection not work or be shorted out, a minor fault can result in major consequences. The replacement of broken discs in an insulator string can also lead to unexpected failure due to the mismatch of the insulators. Flashover occurs across the clean insulators.

Weak points

Finally a point to think about in designing a system. Although the OHSAct and other codes specify the design criteria that should be utilised, the question should always be asked is what should fail if these limits are exceeded. Should there be a weak point designed to fail? Slides show the effects of failed towers and failed switchgear. Which has the best weak point?

Conclusion

For the system to operate to maximum productivity there needs to be a concerted effort to ensure that the consequences of all activities undertaken are considered. The slides shown in the presentation are a small sample of things that should be considered when running an electrical utility.

From Left: Cosmas Gutu, Ron Millard, Peter Fowles, Phil Crowdy, Sarel Esterhuizen

The Effective Management of Planned Network Interruptions

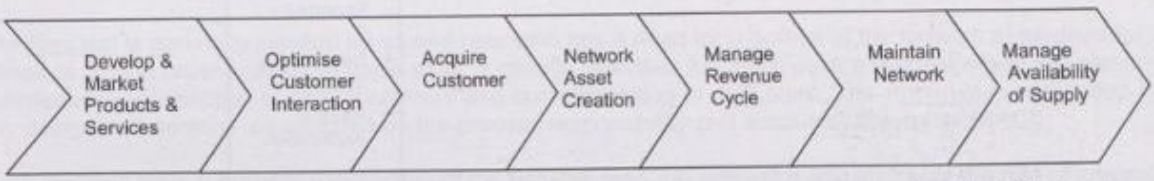
Author & Presenter: WJ de Beer – Electrical Engineer Certificate for Competency, Diploma Advanced Executive Programme, Diploma Management Development Programme, Mechanical Engineering Certificate for Competency, National Technical Diploma Electrical Engineering - Regional Engineering Manager, Eskom Distribution Division

Co-author: NB Waters – B.A., B.Ed., M.Ed., - Business Improvement Manager, Eskom Distribution Division

Introduction

This paper deals with the case for managing Planned Network Interruptions based on a standardised approach using project management principles. The findings are related to the practical experiences of Eskom Distribution Division, Southern Region and have been validated for relevance and consistency with other Eskom Regions.

Eskom's Distribution Division embarked on a strategy of creating a standardised approach to customer facing business processes in 1998 with a view to ensuring a consistent image and service offering to customers. The key value chains identified are as follows.



Within the Manage Availability of Supply Value Chain, numerous business processes were identified and mapped, including loss of supply, network management and the subject of this paper, the Management of Planned Network Interruptions.

The introduction of Value Chains represented a significant step change in the Distribution Groups approach to the Business Architecture and its customer facing processes. The leverage created by adopting such an approach enabled the creation of standardised business infrastructure and roles which enabled the potential for seamless service across Regional boundaries. On the Customer Interfacing part of the business, the creation of Contact Centres represented the most significant change, whilst on the Technical side, the concept of a Work Management Centre was introduced to manage field resources and outputs. The Work Management Centre deals with Dispatched work, which requires action within twenty four hours, and Scheduled work, which can be planned and executed outside the twenty four hour window. Planned Network Interruptions are catered for within the scheduling process at the Work Management Centre.

Management of Planned Network Interruptions – a historical perspective.

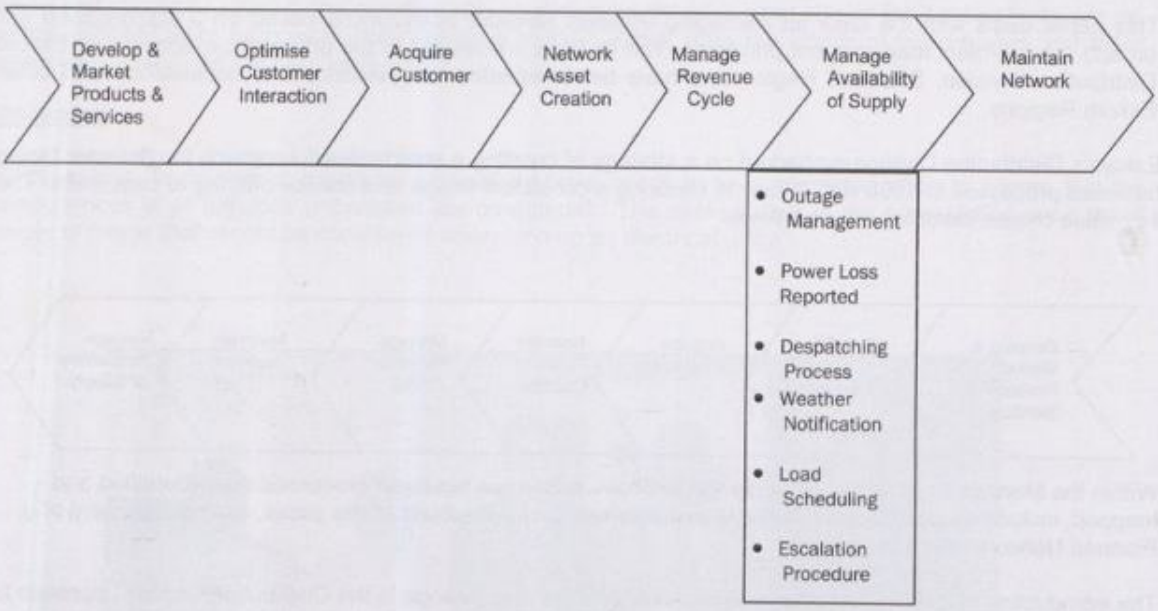
Prior to the introduction of the new business architecture, Planned Network Interruptions were managed in an ad hoc manner at Depot level. While such an approach was advantageous from an immediacy of planning and adaptation to changes perspective, the disadvantages outweighed this potential benefit. These included:

The lack of co-ordination – key stakeholders including Primary Plant, Secondary Plant, Capital Programme and Construction each developed and implemented their own plan and schedule of activities.
The lack of integration – above mentioned departments worked in isolation, leading to sub-optimal utilisation of resources and the time during which the network is dead.
Uncertainty as to customer notification of the Planned Network Interruption – dependency on local methodology, resources and competencies.
Focus on specific depot area and small customer base – created problems when bigger Planned Network Interruptions were required.
Success of the majority of Planned Network Interruptions was based more on luck than planning. Depot Supervisors that were 'natural' project managers did well, but those that weren't, failed dismally.
Uncertainty as to how successful the Planned Network Interruptions were – no effective measurement to assess start and end times, extent of work done and number of outages postponed / cancelled.

It was thus apparent that there were significant potential advantages in developing a standardised process and methodology to deal with Planned Network Interruptions.

The Process Approach Methodology

The Manage Availability of Supply Value Chain was developed to cater for all major business processes associated with restoration, reliability and continuity of supply. The process to effectively deal with Planned Network Interruptions is one of these processes.

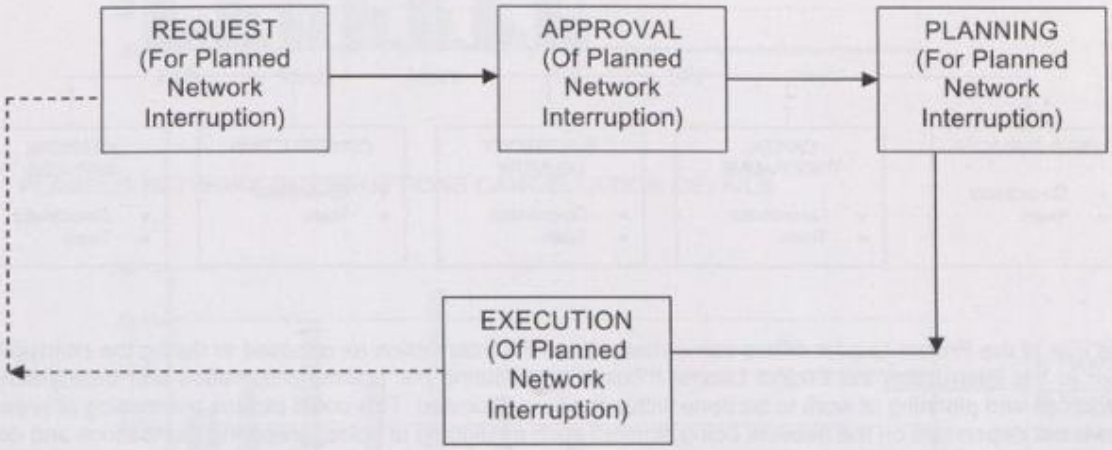


All process development work is designed and developed at a Group level, using a standardised methodology and the ARIS process modelling tool. The Aris tool is internationally acknowledged as the best of breed and allows for the creation of a Meta model of integrated processes, modelling of individual processes, linking of resources to process activities, identification and monitoring of data control points, system integration and other detailed functionality. Regional representation in process development is provided for through Regional Value Chain Owners, who are typically senior line managers in the business discipline for which the process is mapped. Once the process is developed and approved, Region's are expected to implement and utilise such in a standardised manner. Institutionalization is the accountability of the Regional Value Chain Owners.

Such an approach does not imply that Business Processes are cast in concrete. Mechanisms have been put in place to ensure ongoing refinement of all business processes through a standardised review methodology, which enables the identification of best practices and optimisation of business processes. In instances where fundamental shifts in business strategy and architecture occur, business processes are reviewed, adapted and in some cases, replaced, to ensure alignment.

4. The Planned Network Interruptions Process – An Overview

The Planned Network Interruption business process, whilst mapped in detail, can be summated as follows:



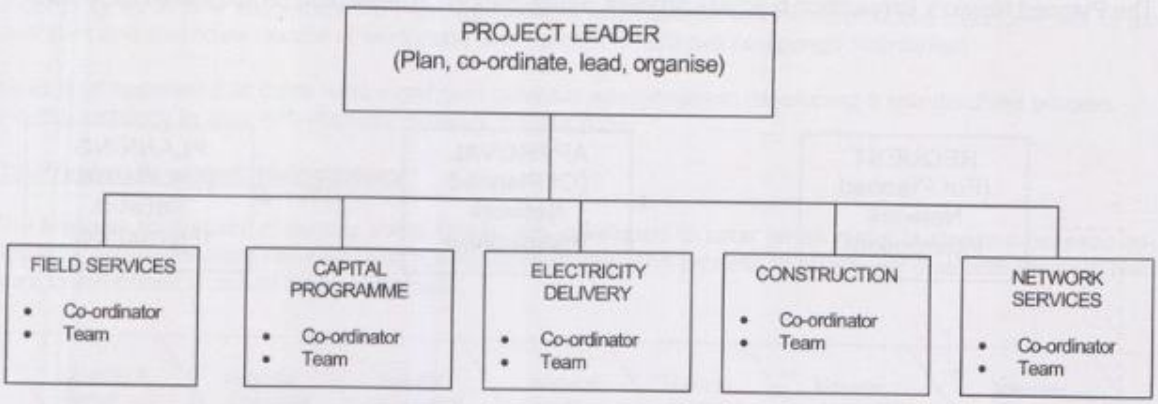
The Request is generally initiated by an end user who has a need for a portion of the network to be dead for a period of time in order to execute some work. Typically, activities for which such a request arises are planned maintenance, connection of new customers and commissioning of new plant. The Approval is authorised by key designated persons, as reflected on the process responsibility and accountability matrix (RACI).

Such persons have a broader perspective of the network than the requestor and also play the role of integrating the various requests into an annual outage schedule. At this point consideration is also given as to whether it would be possible to perform the required work live, thereby obviating the need for a Planned Network Interruption.
Planning is the key leverage area to ensure optimisation of resources, effective utilisation of the opportunity and integration of activities.
Execution deals with the effective project management of the Planned Network Interruption at the time of the interruption and includes control of start and end times, progress monitoring, contingency planning and troubleshooting.

5. The Project Management Approach to Planned Network Interruptions

As already highlighted, the key leverage area in this process is that of project management, in which planning is integral. The planning phase is initiated, in most instances, at least a year in advance of the actual interruption. The key input document for the process is the Planned Maintenance programme, which is used as a base for planning at the Annual Planned Outage meeting. At this meeting, other role players are able to submit their requirements, including consideration of customer requests for dates that best suit their needs, "red letter" dates such as special events, major sports finals etc. More detailed planning is done at Quarterly and Monthly Planned Outage meetings, which are geographically more focused down to Area level.

Accountability for the Project Management of each Planned Network Interruption is allocated to an individual. The magnitude of the interruption determines which role is accountable to be the Project Leader. In instances where the interruption is limited to one Technical Service Centre area, the Technical Service Officer is usually the Project Leader, but where interruptions span Technical Service Centre or Technical Service Area boundaries, the role is generally assigned to a more senior person.
The project leader has full accountability for managing the interruption and uses the following project structure:



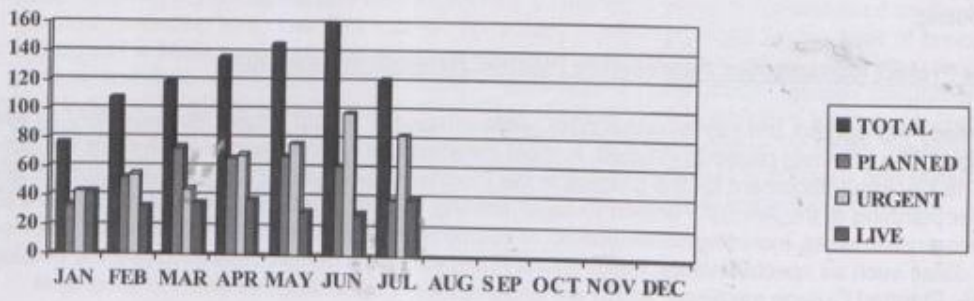
The role of the Project Leader differs somewhat prior to the interruption as opposed to during the interruption. Prior to the interruption the Project Leader focuses on ensuring the optimal preparation and deployment of resources and planning of work to be done within the time allocated. This could include overseeing of prework that is not dependant on the network being isolated such as digging of holes, preparing foundations and delivery of material to site. Consideration would also be given to the allocation of specific resources to specific sites, travel arrangements, availability of mission critical equipment etc.

On the day of the interruption, the Project Leader manages resources to ensure completion of the scope of work within the specified times scheduled for the interruption. This would include the managing of progress milestones and the reviewing of the scope of work should delays occur or the unexpected arise as the critical objective would be to not overrun the advertised restoration of supply time.

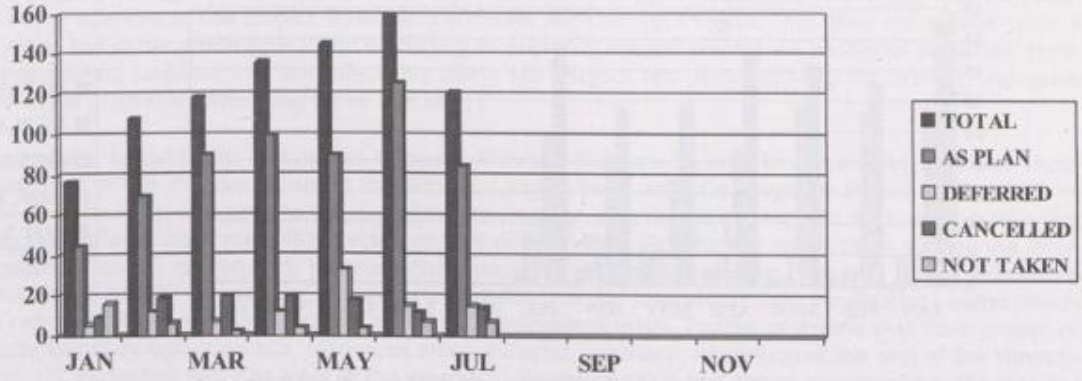
6. Measurement

Key to the success of the management of Planned Network Interruptions is effective measurement. Monthly Key Performance Indicators are produced for all Four Areas, summated to a Regional level. Indicators are as follows:

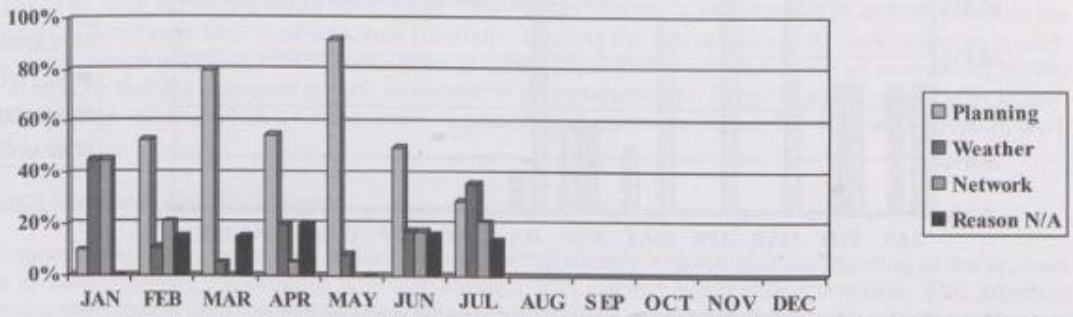
TOTAL PLANNED NETWORK INTERRUPTIONS



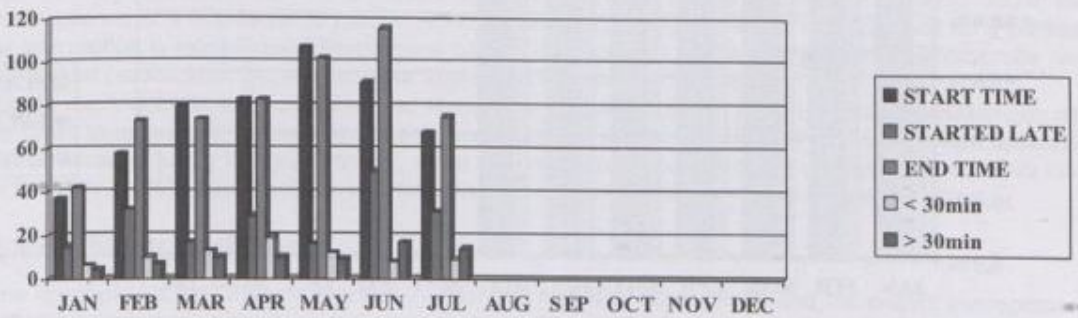
PLANNED NETWORK INTERRUPTIONS DATE ADHERENCE



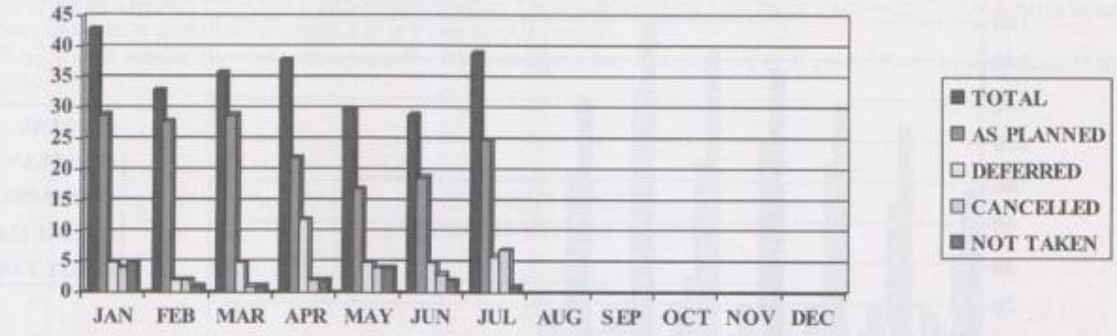
PLANNED NETWORK INTERRUPTIONS CANCELLATION DETAILS



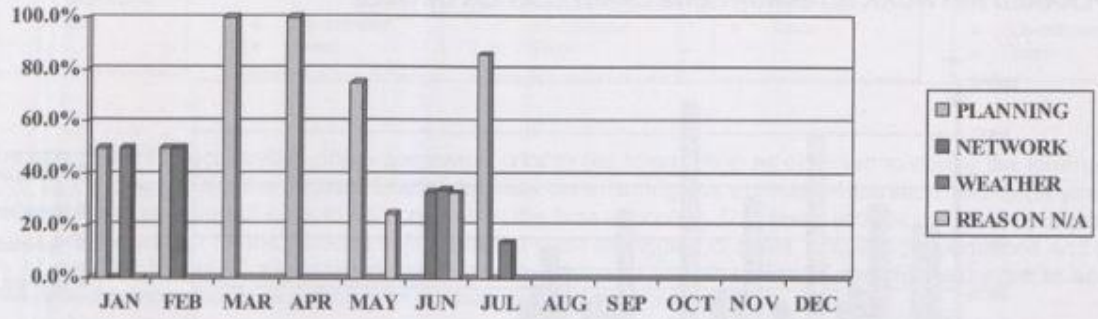
PLANNED NETWORK INTERRUPTIONS TIME ADHERENCE



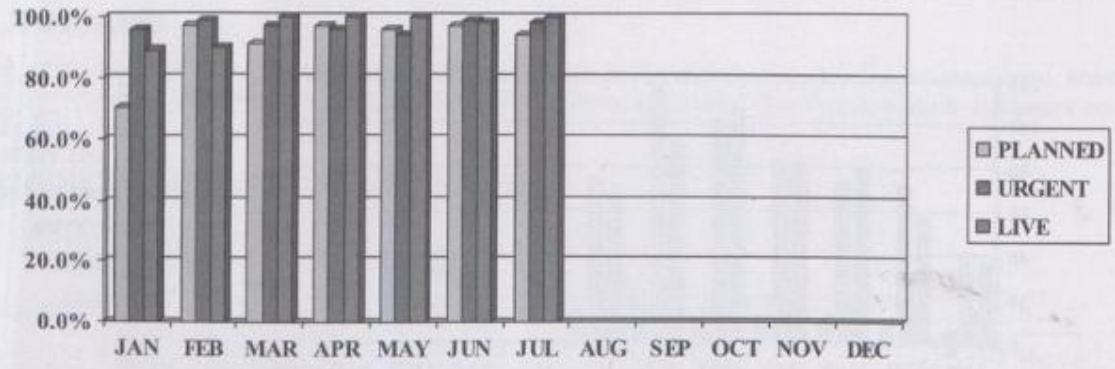
PLANNED NETWORK INTERRUPTIONS LIVE WORK DATE ADHERENCE



PLANNED NETWORK INTERRUPTIONS LIVE WORK CANCELLATION DETAILS



PLANNED NETWORK INTERRUPTIONS SCOPE OF WORK COMPLETED



The indicators, as reflected above, provide a reasonably comprehensive view of the manner in which Planned Network Interruptions are managed. Numbers of interruptions, adherence to plans, utilisation of live work, extent of work completed and adherence to advertised times are covered. However, it is acknowledged that indicators will need to be refined over time, and the acquisition of appropriate software will aid in the refinement of such.

7. Lessons learnt from practical application

While the project management principles have been effectively applied throughout, there has been a reluctance in some quarters to use project scheduling software such as MS Project. This does not appear to be a training issue, but rather a perception that managing through MS Project creates an additional workload. However, these Project Leaders that are effectively using MS Project are demonstrating the benefit and value added, which is positively influencing those that aren't.

- One of the fundamental differences between Planned Network Interruptions that work well and those that don't is the manner in which the Project Leader deals with Contingency Planning. This aspect needs to be dealt with prior to the day of the interruption with respect to aspects such as ensuring that key dependency equipment is reflected as part of the critical path for the interruption. During the interruption, effective contingency planning can make the difference between time and scope adherence and dismal failure. In essence, not every eventuality can be planned for and the Project Leader needs to react positively and appropriately as these eventualities arise. Typical problems that have arisen include key tools failing on site, resources being delayed, breakers not closing at the end of the interruption, CT exploding etc. The later in the course of the interruption that these events occur, the less the chance of getting the customer supply restored as per the advertised time. In such instances, a well prepared and effective Project Leader implements contingencies to minimise the impact of adverse and unexpected incidents when they occur, as they will from time to time.

The primary driver is restoration of supply at the advertised time in order to instill customer confidence in Eskom's ability to work within the advertised times. The Project Leader is empowered to ensure that any deviation from this objective is kept to an absolute minimum. Limiting the original scope of work, bringing in additional resources, where practical, moving resources to critical work and rescheduling are all seen as legitimate practices to ensure that the objective is met. However, in all instances, the Project Leader must be in a position to justify actions taken and as we have seen, measurement balances time adherence and scope of work completed.

8. Feedback from process participants

- Reactions have been varied, with a positive perspective usually a result of understanding of the process and its context within the broader business strategy with respect to network operations. Well informed process participants who understand their role add significant value to Planned Network Interruptions.
- The Project Leader role needs to be viewed as a positive one in order to attract the correct calibre of person to play the role. The role thus needs to be visibly supported by line management and the Project Leader must be empowered to lead the interruption to achieve its objective.
- Resistance to the role by front line junior management at the Technical Service Centres can be overcome through allocating the role to these managers where the bulk of the work to be performed in the interruption is of a maintenance nature. However, where the majority of the work planned for a particular interruption is more Capital Programme based, it is more appropriate to appoint an appropriate and competent person from this environment to play the Project Leader role.
- As our experience in managing Planned Network Interruptions in this manner grows, consideration will be given to appointing permanent Project Leaders. Such a decision will need to be based on appropriate workload to justify the appointment, value added in having permanent appointees and potential loss of flexibility and the opportunity to use this role as a development opportunity for a wider group.

9. Anticipated further development

While the concept of a well defined process for Planned Network Interruptions and the project management thereof is well entrenched in the business, opportunities still exist for further process and role refinements. In addition, the process is not adequately supported by appropriate software to allow for a greater automation. Unfortunately, off the shelf software is not readily available due to the fact that they concept of Planned Network Interruptions is relatively foreign in the international utility market, as network configuration limits the need to interrupt customer supply despite this. It is anticipated that significant automation of the process will be achieved by mid 2003.

10. Conclusion

This paper has highlighted the approach adopted by Eskom with respect to Planned Network Interruptions. The focus has been on developing and mapping a standardised process for application throughout the Distribution Group. The effective application of the process has been further aided by the utilisation of project management principles to both plan and manage Planned Network Interruptions. We have identified that the role of the Project Leader is the critical point of leverage and that meaningful measurement enables an improvement in efficiency and focus.

From a customer perspective the publication of details of annual Planned Network Interruptions on the Customer Service Online website enables a more proactive approach to customer interaction, negotiation and notification.

However, this paper has just scratched the surface of what is a relatively complex and detailed business process. Interested parties are thus invited to contact the authors for more comprehensive information, should this be a requirement.

W J de Beer

Thermal Monitoring of High Voltage (44kV – 132kV) Cables

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ABSTRACT

Since the Auckland disaster of 1998, which saw the CBD of New Zealand's capital without power for 21 days due to failure of critical high voltage underground cable links, there has been growing interest in thermal monitoring of cable circuits. In addition, the increasing requirements for better utilisation of existing and future power transmission links has further aided the development of this monitoring/management system based on thermal measurements. This paper indicates the current international trends in this field and includes the progress that South Africa has made over the past year in developing the use of real time thermal monitoring as applicable to local conditions.

A real time thermal monitoring system consists of four main components – the thermal sensor; the measurement equipment; the software package required to capture and view results, consisting of a SCADA controller and a Graphical User Interface; and the software package which manipulates the thermal measurements, via appropriate mathematical models, into meaningful data.

Theory and results, on work done in a laboratory environment and practical work done in the field, on fully operational high voltage circuits, are presented. Although this technology is locally still in its infancy, initial indications are that real time thermal monitoring is an excellent method of demonstrating the potential capability of a cable circuit.

Keywords: Power cables, Thermal monitoring, SCADA, Cable circuit management.

1. INTRODUCTION

The availability of power is increasingly becoming an issue that utilities have to guarantee to their clients. Lack of service has become totally unacceptable and extremely costly. Recent examples include the Auckland disaster of 1998, which saw the CBD of New Zealand's capital without power for 21 days and the black-outs experienced in California in 2001.

In addition, the installation of energy transmission links is an investment that must be exploited to its maximum extent and one which must be economically maintained and utilised for several decades.

In recent years, in response to utility requirements, a thermal monitoring system on underground cable links has been developed. The system, referred to as Real Time Thermal Rating (RTTR), uses thermal monitoring as a basis for calculating relevant operational parameters specific to cable circuits. It can be integrated into an existing SCADA system and utilised to constantly monitor the cable link, thereby avoiding unnecessary outages and maximising cable efficiency.

Being a relatively new technology, with no systems currently installed in South Africa, this paper is intended to give some insight into the operation of the system based on the theory. In addition, economical advantages of the system are demonstrated by means of typical examples and results obtained from installations in various other locations around the world.

2. The Real Time Thermal Rating System (RTTR)

The design and daily management of power transmission links relies on statistical assumptions, based on IEC specifications [3,4], regarding the operating conditions and the thermal environment of the link. This leads to cable systems that are designed with safety margins which do not compare favourably when evaluated against actual thermal conditions and the cyclic nature of the load. Consequently, the large economical investment associated with a high voltage power transmission link is not fully exploited.

In order to increase the link usage, without reducing the safety margins normally assumed, the real time measurement of environmental parameters and circuit loading conditions is necessary. Real time evaluation of the actual thermal conditions and their trends i.e. thermal monitoring, has been developed and installed on several links around the world. The use of this solution has demonstrated that it is possible to dynamically predict thermal instabilities and overload conditions thereby avoiding not only dangerous operating conditions but also unwanted outages.

Integration of the system into SCADA (Supervisory Control And Data Acquisition) has led to an advanced system that significantly aids in the management of a power cable transmission link. Following full scale, long term development tests [1] the RTTR system has gained acceptance with many utilities and is now installed on several operational links.

2.1) Scope of the system

The purpose of the system is to monitor and manage several parameters such as cable temperatures, circuit loads and environmental conditions on a continuous basis. The acquired data is input in to a mathematical model, and together with the physical parameters of the link i.e. geometry, captured into a database. The mathematical model evaluates, in real time, conductor temperature, thermal transients, permissible overloads, steady state ampacities, time to reach the design over temperature, and the moisture content and migration of the soil.

The system can be applied to: directly buried cables; cables in free air; cables in troughs or ducts; cables in tunnels; forced air-cooled cables and submarine cables.

2.2) System Components

The main components of the RTTR system are as follows (see Fig.1):

- the distributed temperature sensor instrument
- the optical sensor
- the mathematical model
- the SCADA controller
- the user interface

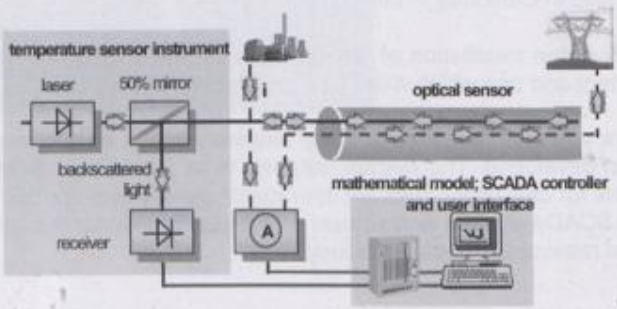

Fig.1: Components of the RTTR system

2.2.1) The distributed temperature sensor instrument (DTS)

The temperature is measured by means of a commercially available system using optical-fibre sensors. It is based on optical time-domain reflectometry and evaluation of the backscattered light, which is due to several mechanisms including density and composition fluctuations (Rayleigh scattering) and Raman and Brillouin scattering due to molecular and bulk vibrations respectively [2].

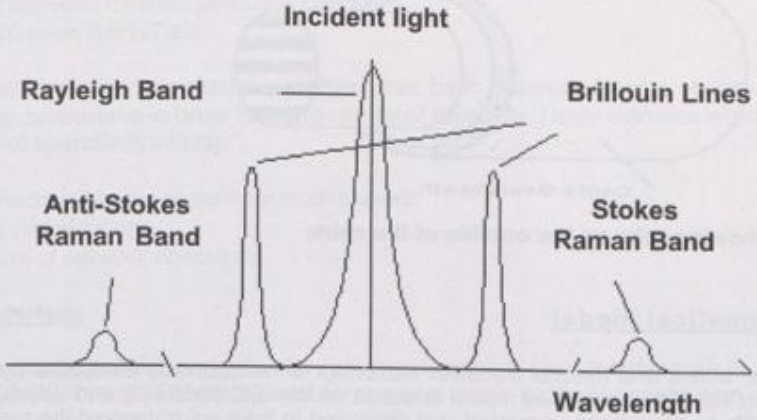

Fig. 2 : The backscatter spectrum

The amplitude of the Stokes and Anti-Stokes peaks correlates linearly to the local temperature of that portion of the fibre that has generated the backscatter. The time of arrival of the backscattered signal is also linearly correlated to the position that generated the backscatter. Combining the two pieces of information allows a full trace of temperature, as measured along the whole fibre, to be obtained.

2.2.2) The optical sensor

Two types of optical fibre can be utilised together with the DTS instrument: multi-mode and single mode fibres. Table 1 shows the different performance parameters associated with the two types of fibres.

Table 1 Performance parameters of different fibres

Fibre type	Multi-mode	Single mode
Max. length	12 km	30 km
Spatial resolution	0.25 - 1 m	4 – 10 m
Temp. resolution	± 0.2 °C	± 0.5 °C
No. of fibres	8	4

The approach to fibre placement varies. Placing the fibre in the conductor is not possible due to practical limitations during manufacture, jointing and terminating, and the voltage at which cable systems, equipped with DTS capability, normally operate.

Whilst having the fibre as an integral part of the power cable, other than in the conductor, does have its merits, problems such as how the fibre is treated in joints and terminations as well as interference with the integrity of the power cable, should a problem occur on the fibre, arise [8].

Experience has shown that the best position for the sensor is in fact on the outside of the cable, housed in a stainless steel or polyethylene tube (Fig. 3).

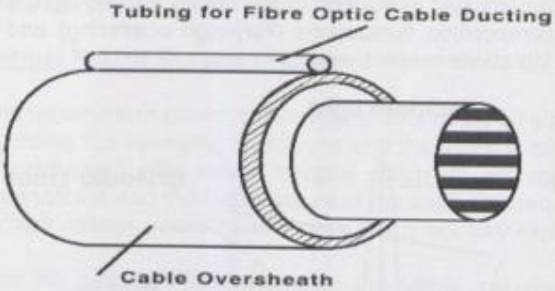

Fig. 3 : Schematic showing tube on the outside of the cable

2.2.3) The mathematical model

The monitored cables' status and thermal transient behaviour is continuously evaluated by means of an on-board mathematical model. The developed model is based on the IEC 60853 [3] and IEC 60287 [4] specifications where the algorithms have been upgraded and improved to take advantage of the real time capabilities and of the nature of that particular application.

The mathematical model is applied over the entire length of the power cable transmission link. Links are modelled by considering them as compositions of sequential lengths, described by common thermal behaviour. Each individual length's thermal behaviour is represented by a well-defined physical and mathematical model i.e. the model for tunnels is used where the cable runs through a tunnel. Worst case areas, commonly known as hot spots, on the monitored link, are used as load and boundary conditions for the sequential representation of the link, and for each one of the identified typical lengths.

To illustrate, consider a length of cable, between two adjacent joints that is buried in a constant characteristic soil. The worst operating condition in that part of the link, acquired in real-time and automatically identified by the system, is entered into the relevant mathematical model of that length to work out all evaluations. In parallel, a statistical analysis of the overall link is also performed. This method not only identifies the worst case but also any discrepancies in data received between each individual length of the link.

If too large a variation is monitored on the same part of the link then warnings and suggestions are issued to the user, in order to improve the knowledge on that particular part of the circuit. It is possible to generate a more precise analysis by adding "control" sections where large variations are present; this function can be performed while the system is running under normal operation.

As an example, this feature would be used when concentrated losses arise, possibly due to the appearance of a ferromagnetic object buried in close proximity to the cables, or a change in the environment due to a new building located close to the power cables. A localised discrepancy compared against average values, in that length, will be recognised by the system software. It is then possible to select a new length of section (dividing the actual existing length into multiple parts) in order to perform a more precise analysis in that particular length. The new analysis can be carried out using customised mathematical models that take into account the additional heat generated due to the increased localised cables losses or the modified cable environment. The system can therefore be easily adapted to changing operating conditions, unexpected events and post installation incidents.

2.2.4) The SCADA controller

The SCADA controller provides the interface to the system for both local and remote users. The controller is fully modular and upgradable to suit any particular installation. The system autonomously performs a wide range of functions that can be activated, disabled or upgraded, in real-time, according to various operator needs or requests or following changes in network operational policies.

Further to the already discussed data acquisition from the set of sensors, and the calculation by means of the mathematical models, the controller performs the following additional tasks:

- data validation and storing into the real-time database;
- alarm generation to highlight dangerous or above limit conditions;
- historical archiving of relevant trends;
- statistical analysis of historical data;
- data routing between different units and users;
- power transmission link control.

Fully automatic start-up and cold restart capabilities have been developed and embedded into the system as well as safekeeping procedures in order to improve overall reliability. Other activities which are possible during the normal course of operations include:

- remote connection into the system by mobile users;
- remote data visualisation;
- remote control of network operations.

2.2.5) The user interface

The man-machine interface (MMI) consists of a real time Graphical User Interface (GUI), an alarm server and historical data displays. The GUI is customised for the end-user's particular application and enables displays of the cable system capabilities.

As an example of the GUI, Figure 4 shows the screen containing the main data for four monitored cable systems. This monitoring system was the first commercially installed plant equipped with a thermal monitoring system [5,6]. The following data is displayed:

- the present load (measured current)
- the maximum admissible continuous load under present conditions (ground temperature and thermal resistivity)
- the admissible overload currents for 5h, 3h, 1h and 0.5h duration
- the calculated conductor temperature
- the time to achieved the admissible conductor temperature with the present load
- the maximum temperature within the optical-fibre.

The alarm server is capable of managing and generating graphical and visual alarms to warn the operator of dangerous or unusual conditions and of trends tending towards customer pre-set thresholds. All alarm statuses are stored on-board into a dedicated alarm historical archive for off-line analysis in terms of procedural control and contingency recovery.

The historical data displays enable the performance of on-line or off-line analyses of stored trends. Since all data access is performed on the client server, the user can request a connection through a dial-up remote connection and visualise, analyse and download any data required.

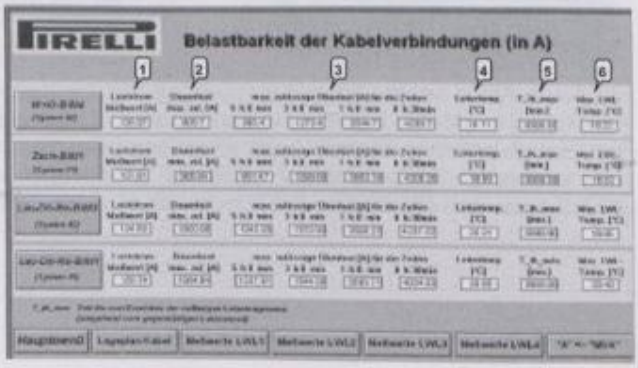

Fig. 4 : Main display of the MMI

3.) OPERATIONAL EXPERIENCE

During more than 5 years of field operations, in five different locations, the system has demonstrated the capability to calculate the desired information with a high degree of accuracy.

Typically, conductor temperature is calculated to within 1°C of its value (measured in field trials by appropriate sensors) [1]. The experience gained has enabled the successful introduction and demonstration of RTTR in live HV cable systems and will gradually develop an understanding of real cable environments as compared to theoretical designs.

An example of the value of RTTR has been where the system clearly indicated that the bottleneck in a transmission link was never due to the cables but instead due to the transformers that supplied the cables. The transformers are to be up-rated and the overall link transport capability thereby increased by more than 60%.

As an additional example, Fig. 5 shows a typical working day demand and a possible increase in energy demand due to new customers or additional requirements. The main circuit feeding this area is working close to its limit according to the "worst case" design criteria. The basic daily energy demand is 3680 MWh, the extra demand is 360 MWh per day. It is a difficult decision to accept the extra demand under these conditions and the investment associated with a new circuit has too long a pay back period.

By monitoring the circuit and associated environmental conditions accurate predictions can be made based on circuit performance. The decision to accept the extra demand can therefore be taken with virtually no additional risks. In addition, as an example, assuming a net margin of R50/MWh, at an increase of 360MWh per day, an extra profit of R18 000 per day can be generated.

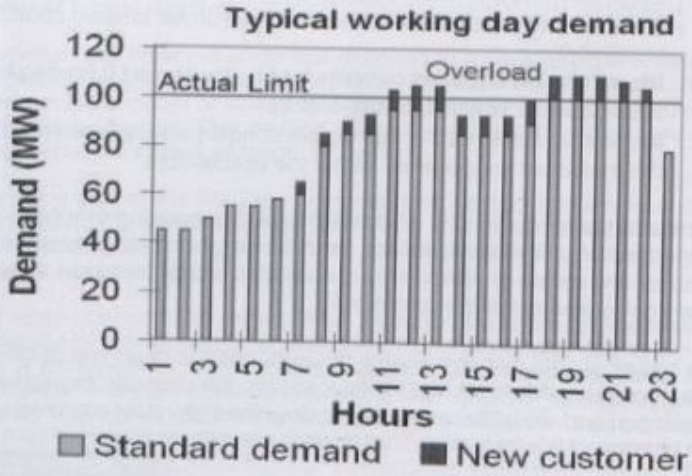

Fig. 5 : Additional energy demand

4) South African Experience

In South Africa several large municipalities and the major utility are considering the use of real time thermal monitoring in order to improve the performance of their assets and to increase their reliability. A complete system design including financial implications has been determined for local conditions. At the time that this paper was written, the first commercial installation of fibre optic in a stainless steel tube, strapped to the outside of a 132kV cable was proceeding. A 150m length of cable was chosen in order to perform the initial research.

In addition to the above, a preliminary study of fibre temperature measurement on installed cables, has been carried out on a cable in a tunnel. This involved application of an unclad multi-mode fibre to an 88kV cable. At the start of the tests the loading of the cable was however very low and the thermal profile did not significantly vary from the ambient temperature. Future testing is however planned.

5) CONCLUSIONS

The increasing requirements and specifications for a better utilisation of power transmission links, both existing and future, has in recent years led to a growing interest in advanced SCADA systems to analyse the status of and to control cable links.

An appropriate system has been developed with the capability to monitor cable and accessory temperatures, environment temperatures, cable load currents, voltages and other relevant parameters and thereby to effectively manage the operation of the cable circuit.

The developed system, after being successfully tested and validated in full scale, long term tests has been applied to several existing links employing a variety of laying conditions thereby demonstrating its applicability and advantages. The use of the monitoring system, apart from the obvious economical and reliability aspects in daily operations, enables the user to gain insight into the real time behaviour of monitored links.
The additional investment needed to install a RTTR system appears, after initial field experiences, to be acceptable and limited to a small percentage of the cost of the cable circuit. At the same time the demonstrated gains in daily rating, not considering the increased security obtainable with advanced monitored links, enables a very short pay back period.

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Mike Engelbrecht

The Lesotho Electricity Corporation: Improving its overall performance in preparation for privatisation

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Background

The right and obligation to supply electricity in Lesotho is vested in LEC, which was created by an Act of Parliament, The Electricity Act, No. 7 of 1969. This Act, despite a number of amendments and additions over time, still provides the legal basis for the supply of electricity in the country. The latter is the sole responsibility of the LEC, which has the right to undertake all tasks related to the generation, transmission, distribution and supply of electricity in the country. An important modification to the Electricity Act introduced a few years ago is the requirement that LEC should be financially self-sufficient and should be operated on a fully commercial basis. In terms of power generation, LEC's role is complemented by that of the Lesotho Highlands Development Authority (LHDA), responsible for the 'Muela hydropower plant developed as part of the Lesotho Highlands Water Project (LHWP).

Electricity is supplied to end-users by LEC, through a system of transmission and distribution lines operating at various voltages of 132 kV or lower. Until December 1998, when the 'Muela hydropower plant was commissioned, almost all the electricity supplied was purchased from Eskom. While LEC also operates four mini-hydro plants (less than 2 MW each) with diesel powered back-ups, less than 1% of total sales is accounted for by these plants, which operate from 12-24 hours daily.

The Government of Lesotho (GOL) has commenced the transformation of the electricity sector and intends to transfer responsibility for the supply of electricity to the private sector. The GOL will retain control of the strategic planning of the sector and will establish a regulatory body to regulate the sector.

One of the main challenges in the electricity sector is the need to increase access to electricity. At present, less than 3% of the population has access to electricity in their homes, and these electricity users are concentrated in the urban areas: some 75% of all electricity consumption takes place in Maseru.

Other challenges include the need to improve customer service and to address the financial problems existing in Lesotho Electricity Corporation (LEC). LEC's deteriorating performance over several years has imposed a heavy financial burden on the GOL and hampered sound business development in Lesotho.

To improve service delivery, the GOL embarked on a Utilities Sector Reform Project (LURP), supported by credits from the International Development Association (IDA – a member of the World Bank group) and the African Development Bank. The LURP was established in support of the privatisation process in order to ensure efficient and reliably functioning utilities. A Key element of the GOL initiative was the appointment of the Interim Management Task Force (IMTF) to prepare LEC for privatisation. The World Bank, under an IDA credit, is providing funding for the IMTF Contract.

Interim Management Task Force

The principle objectives of the IMTF are to reverse the deteriorating performance of LEC in particular with regard to (i) ***limited access to electricity*** (ii) ***financial losses*** (iii) ***operating inefficiency*** (iv) ***non-competitive tariffs*** *and* (v) ***lack of customer data.***

In summary, the objectives of the IMTF assignment are:

A) To manage, with remuneration based on performance, all aspects of the operations, maintenance and expansion of LEC for eighteen (18) months, applying normal electricity utility principles to improve financial, commercial and technical performance;
B) Improve the operational efficiency and overall financial position of LEC;
C) Increase competitiveness of the utility sector and thereby improve the business development environment in the country;
D) To change at least six thousand (6,000) existing credit meters to pre-payment meters, and to connect at least 8,000 new pre-payment customers to LEC's distribution networks;

E) To carry out:
- A detailed customer meter survey to build a geographically referenced (through use of GPS co-ordinates) LEC customer meter database;
- A study on 'Service Territory' to determine LEC's optimal service territory and the service territory to be covered by the future strategic investor after privatisation of LEC; and
- A study on 'Access to Electricity' to identify future potential consumers and growth centres within and outside of the service territory, and also establish a policy for rapidly expanding consumer access to electricity; and

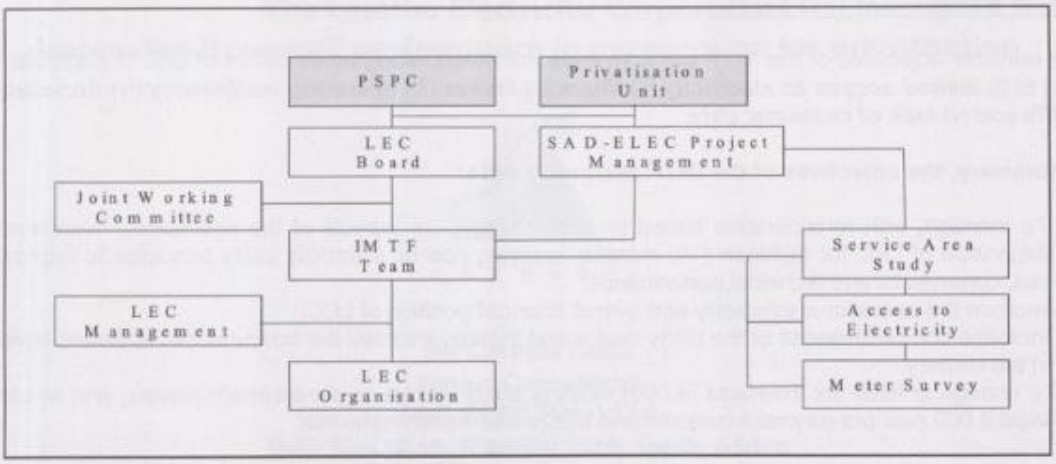
F) To assist the GOL's Divestiture Advisors (hired under a separate contract) with data and information to facilitate the privatisation of LEC.

A SAD-ELEC led consortium was awarded the contract for the IMTF after a competitive tendering process, with the contract being signed on 21 December 2000. The members of the consortium are:

- SAD-ELEC (overall responsibility for the consortium);
- Power Planning Associates (UK);
- DIALOG (South Africa);
- ECON Centre for Economic Analysis (Norway);
- Utility Consulting Southern Africa (Namibia); and
- Sechaba Consultants (Lesotho).

The IMTF commenced its operations on 1 February 2001, with full line responsibility for the management of LEC and is accountable to the LEC Board for the day-to-day operations of the Corporation. The IMTF management team has been integrated in the existing LEC organisation. It consists of a Managing Director (MD) and four (4) Deputy Managing Directors (DMDs) – a solution that avoided the need for structural changes to LEC's organisation and minimised the implications on existing LEC staff at the early stages of the IMTF contract. The team is supported by a number of experts drawn from the consortium to provide specialist services on a 'call' basis.

The LEC Board is responsible to the Ministry of Natural Resources, and the IMTF, in turn, reports to the LEC Board. However, contractually the IMTF is responsible to the GOL represented by the Privatisation Unit (PU). The PU was established under the November 1995 Privatisation Act and has the institutional responsibility for the public utility reform and privatisation process. The Power Sector Policy Committee (PSPC) plays a role as a quasi-regulator of electricity sector matters, including aspects such as connection and tariff policies. The following chart illustrates the working relationship between the Client (represented by the PU), the LEC Board, the PSPC, the TCER, and the SAD-ELEC Project management team, the IMTF management team, the two special studies' teams, and the meter survey.



Overview of key issues at commencement of the IMTF contract

Key issues identified by the IMTF during the Inception Phase (February 2001) centred on:

- Weak top management lacking focus on its core business of supplying electricity on a commercial basis and expanding its customer base;
- Management systems generally lacking;
- Staff numbers (620) too high for the size of the utility's operations;
- Interfaces between divisions, particularly in terms of customer services, not well defined and causing operational inefficiencies;
- Severe skills shortages, particularly in finance and revenue management, planning and project management, marketing, financial planning and tariff analysis;
- Poor commercial performance; billing system collapsed (in 1997); no reliable customer database. High arrears (although the amount of the arrears was unknown);
- Lack of a credit control policy;
- Lack of a tariff policy;
- Shortcomings in the processes for connecting new customers;
- Poor financial management and performance; (no accounts finalised for the past five financial years and financial information generally lacking or non-existent, or otherwise of unsatisfactory quality (thus, the true level of financial losses was unknown);
- Poor control of expenditure;
- Poor maintenance of assets (plant, equipment, buildings, transport fleet, etc); no asset register; poor housekeeping in hydropower plants and breakdowns not addressed promptly resulting in higher bulk procurement costs than otherwise necessary;
- Non-existent safety practices exposing LEC to unnecessary operational and financial risks;
- Weak communications; and
- Generally low staff morale.

Work undertaken by the IMTF to address key issues

Streamlining of the organisation

In consultation with the LEC Board, LEC senior management and the National Union of Retail and Allied Workers (NURAW), a new organisation structure was developed, and an in-depth skills audit was conducted. Surplus functions and skills gaps were identified.

In total 164 staff were retrenched in 2 phases, and the process was completed by 31 December 2001. . Counselling services were extended to all retrenched employees to prepare them psychologically for the transition following a retrenchment decision, and where possible, assistance was also provided in finding new employment.

Basic training was given in business enterprise and entrepreneurship development to train retrenchees in small business development, (this was also linked to initial outsourcing agreements), and specific skills enhancement/development financed under the LURP will be made shortly.

A number of non-core activities have been outsourced, e.g.: security, cleaning services. When investigating the cost-benefit of outsourcing, consideration was given to the introduction of 'empowerment' options, i.e. the establishment of small companies owned and staffed by former LEC personnel.

The new structure was implemented in October 2001, staffed from successful internal applicants and external recruitment of specific professional skills. An Evaluation and Grading Committee has been established to undertake grading of current positions that were expanded beyond their original scope, new positions in the future, as well as address any future disputes. The Committee consists of DMDs, senior managers and NURAW members. The Committee is expected to review the results of the initial job profiling and grading exercise conducted during 2001, and finalise the grading of all positions by the end of March 2002.

To create focus for the newly appointed staff and to improve productivity, proposals have been prepared for a performance management system as well as an incentive scheme that will form part of the performance management system. Regular meetings have been held with staff throughout LEC (head office and all Districts) to provide information on LEC's streamlining, the criteria and process for retrenchments, the performance management and incentive scheme, and progress on the job evaluation and grading scheme. NURAW was represented in all the meetings. In addition, a monthly newsletter is distributed to all staff.

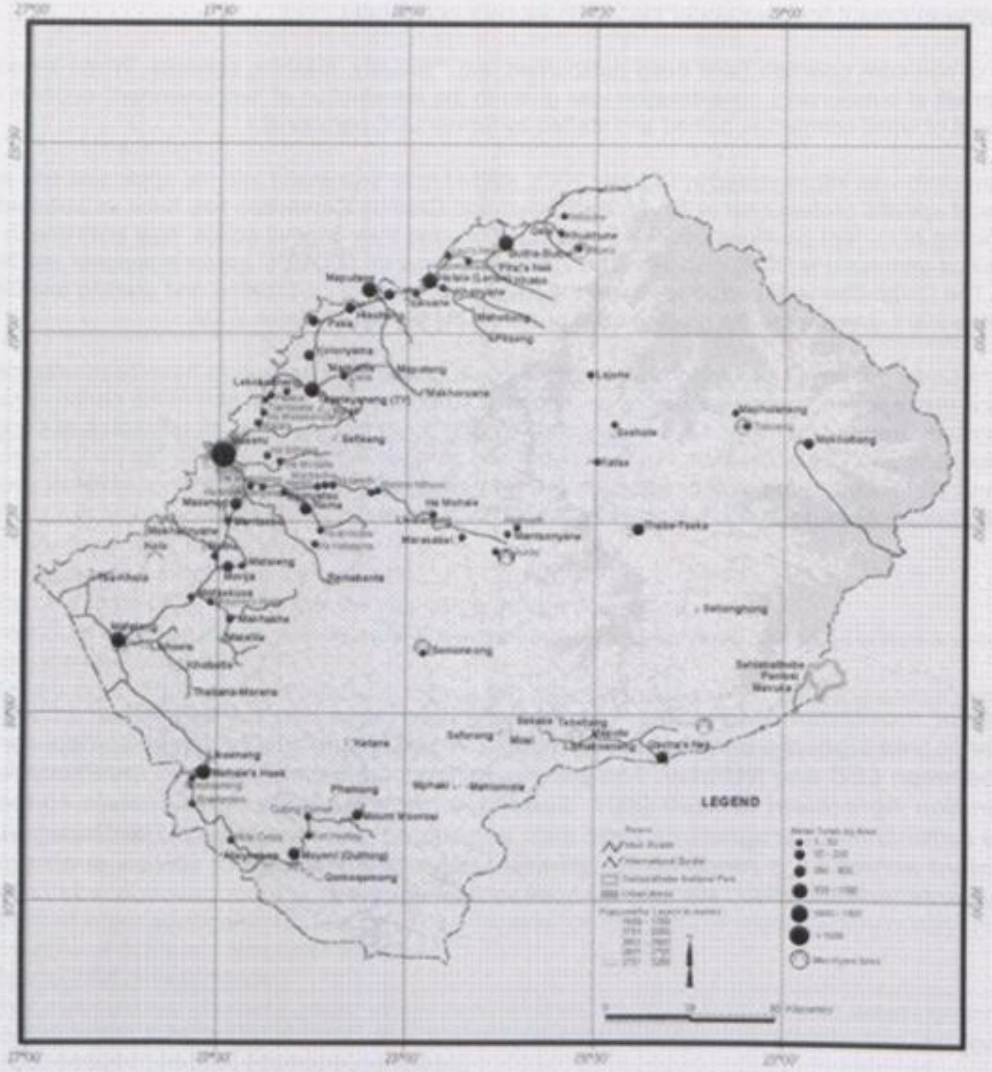
The labour movement in Lesotho is in its fledging stages. More than 50% of LEC's labour force was signed-p members of NURAW. The IMTF negotiated a recognition agreement between LEC and NURAW. The parties concerned formally signed the Procedural Recognition Agreement in April 2001. Subsequently, procedures and criteria concerning the retrenchment programme were also negotiated and formalised. The Recognition Agreement serves as a roadmap for all stakeholders when critical issues such as retrenchments, privatisation, etc. are discussed and decided.

Meter survey, meter exchange and customer database

The meter survey was an essential prerequisite to establishing an accurate understanding of LEC's existing customer base and to reintroduce sound commercial practices. Conradie & Venter (consulting engineers) was sub-contracted by SAD-EELC for the meter survey, and sub-contracted part of the work to Grid Management Solutions (Namibia) and Netlab. Information collected during the survey served to:

- facilitate the geographical positioning of all consumers on aerial photographs;
- identify all faulty and tampered meter installations to be rectified; and
- provide the basis for a new customer database.

The areas surveyed are shown on the map below.



The new customer database established from the meter survey had 21,708 records (as of June 2002), of which 356 were large power users on maximum demand meters, 7,493 single-phase and three-phase credit meters, 2,191 Plessey prepayment meters, and 9,524 EML/CashPower prepayment meters. In addition came 2,134 'not-at-home' connections identified by the meter survey and 10 prepayment connections of unknown origin. The 'not-at-home' connections were subsequently followed up by LEC and reconciled into the database. The largest discrepancies between the information established from the meter survey and the previous LEC customer records (showing in excess of 29,000 customer entries) were in the prepayment meter datasets. Subsequent to the completion of the meter survey, about 3,000 new customers have been connected to the system, implying a total customer number of close to 25,000 customers as at January 2002.

Meter exchange

Prior to the IMTF contract, indications were that substantial revenue losses were due to corruption, tampering and illegal connections because of dysfunctional management systems and a lack of control measures.

LEC had taken the policy decision to phase out credit metering altogether with the exception of large customers on maximum demand tariff. One of the tasks of the IMTF is the replacement of all Domestic and General Purpose customer credit meters with prepayment meters. This amount to about 8,000 credit meters to be replaced (also taking into account credit meters included in the 'not-at-home' customer numbers identified by the meter survey.

The meter exchange programme commenced during the second half of August 2001 and has been completed in most parts of the country. The outstanding exchanges are those that relate to Government buildings where there is need to undertake re-wiring of the premises. These exchanges will only be completed once the necessary wiring has been made. Although a systematic approach by geographic location was preferred for logistical reasons, the meter exchange programme also aimed to improve revenue collection. Therefore, damaged and faulty meters, as well as those that had been tampered with - particularly among commercial customers - received high priority.

Rationalisation and integration of meters and vending systems

Prior to the meter exchange programme, the scope for the rationalisation of prepayment meters was investigated, as was the integration of the different existing meters. Prepayment metering in Lesotho began in 1993 with the installation of about 3,000 Plessey single-phase meters and 3 vending stations in Maseru. Over the period 1994 to 1996 about 10,000 CashPower single and three phase meters and 3 additional vending stations were installed. In addition to the vending machines, two system master stations (one for Plessey and one for CashPower) were installed. However, due to telecommunication problems, transfer of data between the vending stations and the master stations was done via floppy disks about once a week inside Maseru and once a month from outlying areas. Existing vending stations were upgraded to include Standard Transfer System (STS) software and secure modules to ensure that all vending stations can vend to their existing proprietary meter base as well as to any new STS meters. System operators and vendors have been trained to understand the differences between proprietary and STS vending. The new meters procured as part of the IMTF contract follow the STS protocol.

Customer service and marketing

The Maseru Customer Service Centre premises have been renovated and upgraded, and a 'faults desk' has been established to receive all customer fault reports, direct the problem to the correct department/s for resolution, and to be responsible for providing feedback to the customers. Investigations were undertaken in smaller centres to establish the location and priority requirements for additional customer services facilities to receive applications, resolve billing/payment queries, handle general information and enquiries. The investigations included the extension of prepayment vending facilities to presently un-serviced key areas. Three new service centres and a number of new vending points have been established.

As can be seen from these numbers when compared to the result of the meter survey, some of the previously installed prepayment meters were no longer operational at the time of the IMTF taking over responsibility for LEC.

A small specialist department has been created to focus on promotion, education (e.g. customer safety and energy efficiency), customer care, and collection of statistical data for corporate and tariff planning purposes. In co-operation with the Engineering Division, the marketing department is undertaking a concerted marketing drive in the electrification project areas. During December 2001, for example, the team covered 1,307 households in Tsolo and 1,030 households in Tsiu area.

Financial management

The financial management of LEC had been virtually non-existent with a severe lack of normal reconciliation procedures and an inability to provide both internal and external parties with basic information required. LEC had no regular management reporting procedures in place at the time the IMTF took up its position. The latest available management accounts referred to September 2000 and these were subject to major uncertainties as no reconciliations had been undertaken.

The establishment of daily cash flow reporting combined with three-month projections was introduced during the first week of February 2001 and provided basic information regarding revenue collection and cash expenditure as well as control over liquidity.

At the beginning of February 2001 LEC had, for no apparent reason, outstanding suppliers' invoices dating back as far as early 2000. This had not only incurred interest liability, but also communicated to suppliers that they were not important to LEC. Consequently LEC could not expect to get attention or 'best' prices from them. The IMTF entered into dialogue to find appropriate solutions to clear suppliers' debt within a few months and to lay the foundations for a satisfactory future commercial relationship.

Management accounting system and revenue management

At the commencement of the IMTF's contract, none of the financial systems in use had IT support, and both the general ledger and supporting ledgers were kept manually. Although manual systems can be effective if well structured and kept up to date, this was not the case in LEC, as exemplified by the four-year backlog in the preparation and auditing of financial accounts. Hence, the introduction of a modern computerised management accounting system was a high priority. The ACCPAC software was identified as the preferred user-friendly system (and is supported locally in Maseru). With the introduction of a new accounting system, the existing stores system was also overhauled.

As the meter exchange programme is progressing, the existing credit metered Domestic and General Purpose customer accounts in ABAKUS are being reconciled and closed. This process will lead to the identification of a number of 'ghost' accounts that had been included in LEC's revenue reporting since the commencement of the IMTF assignment. It is clear that this has led to an overstatement of LEC's revenue on a monthly basis. Final reconciled revenue figures will be produced on completion of the meter exchange programme and the subsequent 'decommissioning' of ABAKUS as LEC's main billing system. When the restated revenue figures are clear, the IMTF will initiate a process to restate LEC's management accounts and other financial reports influenced by the restated revenue figures. It is hoped that this process can be completed before the end of the financial year 2001/02 (ending 31 March 2002).

A specific requirement under the IMTF's contract concerned the accounts backlog for 1997-2000. The work of preparing these accounts and having them audited by LEC's external auditors was completed in November 2001. The process is now with the LEC Board before final submission to the Auditor General for certification.

Completion of Service Territory study and the Access to Electricity study

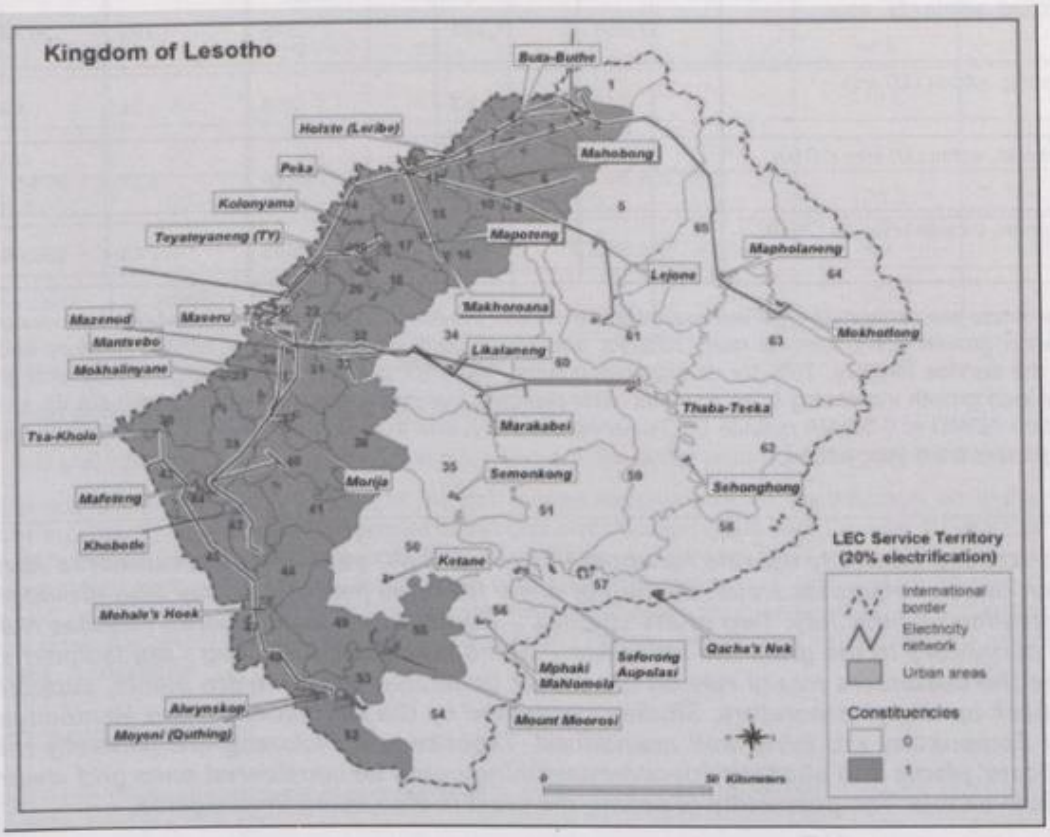
The Service Territory study was sub-contracted to ECON Centre for Economic Analysis. The consultants explored the premise that the principal factor that drives the financial performance of a future LEC is the commitment to electrification, and the financing obligations associated with this. The expansion of the network is limited by the level of debt that LEC's revenue base is able to support.

In the mountainous areas of Lesotho, the costs of extending the network are high, and the low population density together with the limited demand for electricity in these areas mean that revenues will be low. As a result of this, the study recommended that a commercially viable LEC be largely limited to the lowland areas of the country to include the area indicated in the map on the following page.

The study further recommended that within the recommended service territory, ***LEC should have a service obligation***, i.e. an obligation to supply a customer if this customer is willing to pay the costs of providing the service. Associated with this service obligation should be a commitment to invest in network extension, either expressed as a financial sum invested per annum, or as explicit targets in terms of numbers of connections or physical assets installed. While the analysis has indicated an approximate financial level for such a commitment, it will certainly be one of the parameters negotiated (or bid) in any privatisation exercise.

The study demonstrated that LEC should be able to undertake a network extension programme in the first 10 years involving an investment of around M30 – 35 million per annum, including ongoing investment in network replacement and rehabilitation. Forcing an investment programme in excess of this level would drive LEC into a commercially unviable position with debt reaching untenable levels.

In later years, once LEC's revenue base has expanded, it is expected that the investment programme could be extended. Having identified the financial limits of LEC, the decision facing GOL is then whether this investment programme should be more intense in a smaller area, or less intense in a larger area. Choosing a smaller area intensifies the expansion programme, but excludes certain areas from the programme. Choosing a larger area spreads the investment across a larger area and population.



Within the recommended service territory, and within the maximum level of investment considered commercially viable, there will still be many areas that LEC will be unable to electrify in the medium to long-term. In fact, the analysis indicates that the network could reach only 20% of currently un-electrified households in the service territory within 15 years. Consequently, the study recommended that LEC's exclusive rights to supply be restricted within its service territory, for example by limiting any exclusivity to a certain distance from existing infrastructure. This will allow communities and individual customers to seek alternative supply arrangements in cases where supply from the LEC network is too expensive.

It can be mentioned that the recommended service territory does not include any of the areas where LEC's four mini-hydro plants are located. However, this should not be interpreted to mean that a future privatised LEC should not own and/or operate such mini-hydro stations. The recommended service territory is purely related to the areas where a privatised LEC would be undertaking distribution and supply of electricity. Generation by LEC can very well be outside of this service territory area. Decisions about the future of LEC's mini-hydros are presently with the LEC Board, based on recommendations provided by the IMTF.

The Access to Electricity study was sub-contracted to Utility Consulting Southern Africa (UCSA). The work was undertaken in close co-operation with the team engaged on the Service Territory study, and also made extensive use of the output of the Meter Survey.

The number of potential customers was estimated, based on 1996 census household figures, extrapolated to 2010 with an assumed national population growth rate of 2% per annum. (LEC's present customer classification was used).

	Domestic	General Purpose	Commercial	Industrial	TOTAL
Existing, within LEC area	17,659	1,201	1,389	199	20,448
Existing, outside LEC area	548	82	253	21	904
Potential, within LEC area (2010)	354,991	2,469	18,996	117	376,573
Potential, outside LEC area (2010)	131,556	862	6,633	13	139,064

Typical loads per consumer type were used to determine the load. Load growth calculations took account of population growth (2%), take-up rate (30% for households outside LEC's future service territory and 70% within the service territory, 75% for commercial outlets, 100% for general purpose customers), and a linear normal load growth increasing from an initial 'after diversity maximum demand' (ADMD) of 0.43kVA to a final saturation ADMD of 0.59kVA outside LEC's service territory, and from 0.79kVA to 1.22kVA inside the service territory, over a ten year period.

The stations generally operate for about five months per year – from December to April – when there is adequate water. Melting of snow from the mountains may also provide for generation in June/July. Two of the stations – Mantšonyane and Tsoelike (Qachas Nek) - are connected to the grid. The other two – Semonkong and Tlokoeng - are isolated and have the customers totally rely on the power generated by the hydro plants, supported by back-up diesel generators. Studies conducted by the IMTF confirm that Mantšonyane and Semonkong are fairly well maintained. Tsoelike and Tlokoeng are generally more 'delicate' plants and shutting / decommissioning could be considered once grid electricity is available. The possibility of selling the plant is also being investigated.

The existing electricity networks were modeled with network analysis software, from transmission level (132kV) down to distribution level (33kV). Possible future load constraints on distribution station capacity, as a result of electrification, are summarised in the following table:

33kV Distribution Station	Current Capacity (MVA)	Existing load		Inside buffer - Year 5		Outside buffer - Year 5	
		Load (MVA)	% Spare Capacity	Load (MVA)	% Spare Capacity	Load (MVA)	% Spare Capacity
Boesman's Nek	Eskom	N/A	N/A	-	-	9.3	-
Mabote / Highway	80	47	41	65.7	18	94	-
Khukune	40	4.7	88	9.9	75	40.9	-

33kV Distribution Station	Current Capacity (MVA)	Existing load		Inside buffer - Year 5		Outside buffer - Year 5	
		Load (MVA)	% Spare Capacity	Load (MVA)	% Spare Capacity	Load (MVA)	% Spare Capacity
Letseng	20	2.7	86.5	17.6	12	44.8	-
Likhoele	20	9.5	52.5	83.3	-	145.8	-
Maputso	20	5.8	71	-	100	36.5	-
Mazenod	20	11	45	45.8	-	120.3	-
Muela	10	1	90	1.1	89	6.2	38
Quacha's Nek	Eskom	2.7	N/A	-	-	14.8	-

Two grid electrification scenarios were analysed:

- **total grid electrification of the entire country; and**
- grid electrification of all potential customers within a 10km buffer around existing 33kV infrastructure.

The first scenario provides an indication of the total budget requirements for electrification, while the second scenario represents a more realistic estimate of the grid electrification costs over the next 10 years or so. Areas outside the 10km buffer zone are considered off-grid areas (as contemplated in the 1998 policy statement on the electricity sector). An annual electrification budget of M20 million was assumed for areas outside the future LEC service territory, while M32.5 million are available annually for the future LEC service territory. With these budgets the time it will take to achieve the scenario targets, based on a set of standard electrification cost rates, is calculated.

Summary and conclusions

The IMTF has made considerable progress towards improving LEC's operational efficiency and overall financial position, inter alia through:

- streamlining human resources and completing the retrenchment process;
- developing skills enhancement plans and undertaking urgently required formal and on-job training;
- providing mechanisms for performance management;
- completing a meter survey and putting the structures in place for the restoration of the customer database, revenue collection and the reduction of non-technical losses;
- connecting over 5,000 new customers and instituting measures to facilitate the connection of a further 3,000 during the contract period;
- providing strong financial management through the introduction of ACCPAC and the provision of training, recruitment of new professional skills, clearing the accounts backlog, undertaking an asset valuation and rebuilding the asset register;
- completing a study and recommendations for an optimal service territory for the private company that will be formed through the divestiture of LEC; and
- carrying out a study of measures to be used to improve access to electricity in areas both inside and outside the service territory of the private company.

Despite the progress, there are still many problems to tackle, and many of these were outlined in this paper.

Also, the IMTF has also not always covered itself in glory. It is true that the situation 'on the ground' was worse than indicated in pre-bidding documentation and briefings, or had appeared from previous interactions with LEC. While the IMTF had assumed that the rectification of the long-accumulated problems would be a gradual process, more problems kept cropping up, and it became evident that the time frames envisaged in the original work plans had been underestimated. This was compounded by the low level of skills found in LEC – also contrary to the impressions gained and assumptions made prior to the IMTF assignment. Although a great deal was achieved in the first three-four months to provide the foundations for LEC's recovery, the Client was anxious that there was insufficient visible sign of the progress being made. To this extent, certain amendments to the IMTF's contract were made to further strengthen the focus on tangible deliverables.

In this context it should be mentioned that an area that has impacted on the speed of delivery has been the emphasis placed, in terms of the IMTF contract, on recovery of historical information. To this day, considerable management time is required for identifying and explaining events that took place in years past. Clearly, this reduces the time available to deal with present and future issues.

One important area concerns the delegation of authority required to discharge the contractual obligation of full responsibility for LEC's management. Due to LEC's poor past performance, the Board had assumed a more hands-on role than is generally the case. It took some time for the IMTF to find the appropriate modus operandi, a process that has been assisted by the establishment of a number of Board subcommittees.

The arrival in November 2001 of the Sales Advisory team appointed to advice GOL, and prepare the privatisation of LEC, signals a further chapter in LEC's history. The IMTF will make the contributions expected of it. Problems still continue to arise and we will make mistakes. But progress is now visible and is acknowledged. The structures are in place and LEC is well on the way to becoming an entity capable of attracting private investment.

LEC has been cash positive since February 2001.

Cosmas Gutu

Reflections on an Inspection-driven Maintenance Scheme

B A W Finch, Director, Central Distribution Region, Ethekwini Electricity

1. BACKGROUND

In the 1980's Durban City Council held the permit to supply electricity within an area of 1540 square kilometres surrounding Durban.
The electrical system consisted of a small 275kV system and extensive 132, 33 and 11/6,6kV systems and the associated LV networks.
A total of 82 major substations operating at primary voltages of 33kV and above and ± 6700 distribution substations operating at primary voltages of 11kV and below were involved.
6 District Works Sections were established, based at depots situated throughout the supply area. Such Section staff carried out all maintenance , constructions and fault repairs throughout their specific geographical area of responsibility on the 11/6, 6kV systems and associated L.V. networks.

Prior to the introduction of the inspection driven scheme, maintenance was generally carried out in isolation within each Section. Such maintenance consisted of dispatching maintenance crews to particular areas to carry out inspections and maintenance work as they deemed necessary. Thus, on leaving the depot, the maintenance crew had no knowledge of the type or volume of work that would be required during the day. It was therefore almost impossible to be correctly prepared in terms of equipment and material. Due to varying degrees of priority being attached to maintenance by the different section managements, very considerable variations in the progress and level of maintenance carried out existed between sections. There was also the expensive tendency to over-maintain equipment since the work required could easily be "expanded" to fill the time available (i.e. the length of outage which was normally one working day).

Thus some areas were being maintained every 5-6 years while other areas, with similar equipment and environmental conditions, were only being maintained every 10-12 years.
In the early 1980's increasing difficulty was experienced in providing adequate staff to maintain equipment on the above basis and this resulted in the employment of consultants to investigate staffing requirements, methods of operations etc.

The principle of inspection driven maintenance was established from the consultants recommendations. The original innovation thus stems from the consultants rather than from my organisation but I like to think that the implementation of such a principal was not without its' innovative aspects.

2. IMPLEMENTATION OF THE SCHEME

In early 1982 the decision was taken to implement what was, in effect, an on-condition maintenance scheme where, instead of exotic computerised monitoring equipment, our condition monitoring equipment was the eyes and ears of our inspectors supplemented by such mundane instruments as binoculars, hammers and the occasional thermometer. The initial implementation of the scheme involved only our 11/6, 6kV and L.V. systems.

The required inspection staff were recruited, largely by internal transfer, and placed under the direction of a newly formed Work Programming Division. Thus responsibility for the inspection process was entirely divorced from responsibility for carrying out the prescribed maintenance/repair work: the latter continuing to rest with the District Works Sections.

In common with all maintenance schemes the first prerequisite is a complete and up to date inventory of all equipment requiring maintenance.
In our particular case this inventory was computerised and based on a unit of a substation. All items of equipment situated at the substation, together with the associated circuits were shown on the relevant substation inventory together with dates of last inspection etc. where appropriate.

The following two inspection processes were introduced : -

Distribution Inspection

A relatively cursory inspection to identify any hazardous condition and all tree cutting requirements.

Maintenance Inspection

A detailed inspection leading to specification of all necessary maintenance work and the estimated labour and material requirements.

a) Distribution Inspection

A group of 8 Distribution Inspectors were scheduled to carry out largely visual inspections of all equipment on a six monthly cycle and to report any hazardous conditions perceived and any tree cutting requirements. Where feasible, inspectors were expected to remedy minor defects themselves r rather than report same (e.g. replace statutory notices, light bulbs, door locks etc.)

The scheduling of such inspections was carried out on a geographic basis via computer programs based on our equipment inventory, and batches of substations to be inspected were listed on DI inspection forms. Such forms had the dual function of listing the substations to be inspected and acting as a basic inspection report form.

Distribution Inspectors did not attempt to specify the necessary action but only to identify a hazardous condition, thus no time or material estimates were given. However, an indication of the perceived urgency of the job was given.

b) Maintenance Inspection

A group of 6 Maintenance Inspectors carried out detailed inspection on a 4-yearly basis and were required to specify the maintenance work necessary to keep the equipment in satisfactory condition for the next four years (i.e. until the next inspection).

Such inspectors were accompanied by two labourers, at least one of whom was competent to carry out testing of wooden poles according to a standard instruction sheet .This on-condition monitoring involved sounding of wooden poles by hammer, taking of core samples (Using Mattson Borers) and general visual checks, with the aid of binoculars where necessary.
The scheduling of such inspections was carried out via computer programs, which resulted in the printing of the necessary inspection forms.

In the case of certain items of equipment such as switchgear and transformers, an external visual inspection is obviously inadequate to ensure satisfactory condition. In this case a scheduled maintenance function was specified in addition to any items which may stem from the Maintenance Inspector's visual inspection. These scheduled maintenance requirements were indicated on the inspection form prior to the inspector visiting site and were an admission that our on-condition monitoring techniques were not entirely satisfactory in those instances.

The following standard forms were used where appropriate :

1) Hazardous Condition Repair Request (see Figure 1)

Used by both Maintenance and Distribution Inspectors where appropriate, with specified priorities (e.g. immediate, 7 days, 30 days).

2) Tree Cutting Request (See Figure 2)

Used by both Maintenance and Distribution Inspectors where appropriate, with specified priorities of 30 days or 3 months.

Substation Maintenance/Repair Request (See Figure 3)

Used only by Maintenance Inspectors as an inspection report form. Subsequent to completion of the inspection, the form effectively became a job request. A period of four months from date of inspection is allowed for completion of the requested work.

Circuit Maintenance/Repair Request (See Figure 4)

As 3) above

Non-District Works Maintenance/ Repair Request (see Figure 5)

Used largely by Maintenance Inspectors to identify work required to be carried out by groups other than the District Works Section (e.g. repairs to private substation buildings) with specified priorities of 7 days, 30 days or other suitable period.

On completion of the inspection the relevant inspection forms were returned to the Work Programming Division for recording and subsequent issue to Works Sections. At this stage the inspection forms effectively became job requests listing what work needed to be carried out together with the estimated labour and basic material resources required. If, in the process of completing any job request, Works Section staff identified additional necessary work, they were required to carry out same and indicate on the job request accordingly. Thus a partial check on quality of inspection is available in addition to the sample checks carried out by the Inspectors' supervisors.
Monthly reports were issued showing details of work issued, completed, outstanding and overdue in the various categories of work.

Both sets of Inspectors were equipped with radios and, in addition to their routine inspection duties, were involved in the investigation of faults which occur from time to time, even on our system. Also many ad-hoc inspections emanating from reports from the public etc. were carried out.

The major areas of difficulty are listed below : -

1. The ability of the inspectors to adequately inspect overhead line equipment from ground level.

Over many years, it has been found that such ground level inspections are certainly adequate on lines operating at 11kV and below. Very few instances of inadequate inspection have been forthcoming in spite of an initial "keenness" on the part of Works Section personnel to find such inadequacies.

2. Lack of agreement on estimated times.

In the absence of official O & M times, there was initially considerable disagreement on many of the estimated times. However, after much negotiation, I believe that the estimated times used are not in major contention. Such estimates do incorporate Inspectors' discretion and on occasions are inaccurate where, for instance a cable is found to need replacement rather than repair in-situ or vice versa.

3. Scheduling of substation inspections

Scheduling of maintenance was originally carried out on a geographical grid basis. This led to repetitive switching operations where HV circuits run through more than one grid reference.

4. Difficulty in attracting suitable maintenance inspection staff

Such Inspectors need considerable background knowledge together with the "new" ability to use judgement and discretion in specifying the maintenance work required. In addition they must be able to work in isolation and unsupervised for considerable periods. Such staff are in somewhat short supply.

With the introduction of the scheme the following advantages accrued:

1. Works Section maintenance crews received clear job requests prior to leaving their depots and were thus able to carry all necessary equipment and material to site. This largely avoids return trips to the depot to collect necessary items, a situation which often occurred when no prior inspection was carried out.

2. An estimated on-site time for completion of the job was given which :

   a) allowed more efficient scheduling of crews by the respective foreman

   b) indicated to the crews the time period within which the job is expected to be completed. This aspect has been reduced in importance with the introduction of an incentive bonus scheme using agreed O & M standards.

3. A common maintenance level can be established via the Work Programming Divisions Inspectors', irrespective of the Works Section involved.

4. Any changes of maintenance policy can be quickly and easily implemented via the inspectorate staff.

5. A clear indication of progress of both the inspection function and the completion of the resultant works requests is available on an ongoing monthly basis.

3. CHANGES

Since the original introduction of the inspection driven scheme a number of changes have occurred.

1. **Structure Changes**

   In 1992 the structure of the organisation was changed and the original Work Programming Division was disbanded and its functions devolved to the Planning Divisions of newly established Regional Departments. I believe this made it difficult to maintain a consistent maintenance approach throughout the whole Service Unit.

2. **Computerisation**

   Since 1992 further computerisation of the process has taken place which, after considerable teething problems, allows better control. However, the loss of hard copy inspection reports which then became the job request has introduced further possibilities of error in transcription on the computer. The loss of highlighted colours of Hazardous Request Reports is another minor disadvantage.

3. **Changed Inspection Techniques**

   It is important that inspection techniques are continually reviewed, monitored and updated where necessary. An example of such change is the testing of poles (vast majority wood). Such pole testing is now carried out by contractors and includes rather more exotic remedial treatment than the original coat of creosote.
   Fault current monitors are now available on certain switchgear allowing a more realistic assessment of when such equipment requires maintenance.

4. **Increase of Maintenance Inspection Period**

   After several successful maintenance cycles the original four year period was extended to five years (except for certain specific problem switchgear installations). No adverse effects have been identified and it may be that this period can be extended further in certain areas.

The Distribution Inspection cycle remains at 6 months.

5. **Inspection Scheduling**

Inspections are now scheduled in electrical "rings" rather than geographically. This leads to a reduce tion of switching for planned outages and a resultant time/cost saving.
An aspect that needs to be carefully accommodated is the updating of the inventory data base when circuit modifications (such as substation "cut ins") are carried out.
It is obviously essential for all equipment to be identified re last inspection dates and scheduled ac cordingly in rings. This can lead to some premature inspection/maintenance which is kept to a mini mum but which is more acceptable than under inspecting.

4. CONCLUSIONS

Over the approximately 20 years of operation, the inspection driven maintenance scheme has proved to be a very satisfactory process for the specification and control of maintenance of an electrical reticulation system at least cost.
Changes have taken place in the structure of the organisation and some changes of inspection techniques have been introduced.

The attraction and retention of suitably qualified and experienced inspectorate staff (and contractors) remains a problem and requires considerable training resources.
To allow more flexibility across inspection cycles the combining of the Maintenance Inspector and Distribution Inspector posts is being seriously considered.

With continued introduction of the most efficient inspection techniques and critical assessment of required inspection periods, there is every reason to expect that this scheme can be utilised for many years to come.

B A W Finch

Electricity Supply Basics
To meet the challenges of Distribution

Trevor Gaunt
Department of Electrical Engineering, University of Cape Town

1. Introduction

I had a low voltage incident at home earlier this month. The lamps glowed a dull orange and my computer made clucking noises of disapproval. The condition lasted for about eight minutes. Now, without looking any further, I want you to write down in the box below, or on a separate sheet, the first thing you think of when an incident like this is described.
We will return to this matter later, but first we need to consider some broader aspects of electricity distribution in South Africa today.

2. A short history

About a hundred years ago the young electricity departments in some municipalities in South Africa were already providing electricity to their communities, as a service but also to raise revenues to fund other services. They had seen the potential for business in this new technology. At the same time, some private firms were also building their markets, with the mines and industry being key customers.

There were many problems. Much of the electrical equipment had to come from far away and lead times were long. The new technologies of materials, protection and network planning required new skills and there was not a lot of local experience. The country was recovering from internal conflict and its effects on the economy, but the exploitation of natural resources offered promising development. Government was undergoing quite a lot of change, old allegiances were no longer appropriate and further changes were soon to come in the structure of the electricity supply industry.

It is said that history repeats itself. In many ways the situation now is similar to that nearly a hundred years ago. South African utilities now are facing reorganisation, required to make new alliances, coping with advanced technologies with too few skilled people, offering valued services to their customers and still making a business of it.

Others at this meeting will address the aspects of reorganisation and alliances. I would like to turn to the other topics: technologies, skills, services and business.

3. Advanced technologies

Quickly write in the next box the technology issue that is most important for you in your organisation at present.

Equipment failure

Is your problem equipment failure? The environment for electrical systems is no less severe today than a hundred years ago. Lightning stresses the insulation of lines and transformers, despite the greater understanding of shielding, earthing and the application of surge arresters. Resource constraints and the pressure to "sweat the assets" require systems to be operated closer to their limits. However, manufacturers have to design and build the equipment to much smaller tolerances than in the past, to be competitive in today's open tenders. Purchasers specifying their minimum requirements cannot expect manufacturers to provide extra capacity at no cost. If equipment is failing too often, the problem may be in the specification or purchasing procedures, not with the manufacturer.

Earthing

Not all the technologies are the responsibility of manufacturers. Earthing is a mature technology, but was the subject of a paper at the AMEU Convention in 1993 [1]. At that stage South Africa was already embarking on the national electrification programme that has so successfully given millions of new customers access to modern energy supply. Utilities faced several pressures - a variety of earthing practices were already in use on existing systems, new approaches in response to cost pressures were changing the details of distribution system design, and new regulations and guidelines were being developed. The problem was to ensure that the correct match was reached between the different components to ensure safe operation of the systems and safety of the public. During the years since that paper, I have been concerned to see that many utilities and staff have still not mastered the basic principles of system earthing:

- Earthing the system neutral provides a reference point for the insulation of the phase conductors.
- Bonding two normally non-current-carrying components reduces the potential between them to safe levels, even when current is flowing through the bond, and reduces the risk to someone touching both components at once.
- System protection should respond to the conditions that indicate there is a fault from phase to earth, disconnecting the supply and removing the possible danger.
- It is not technically possible to prevent every foreseeable dangerous condition by a combination of earthing and protection, but a satisfactory position is reached when the risks to the public and operators are reduced as far as practicable.
- Mixing different earthing and bonding methods together in one system usually produces dangerous conditions.

This last point is particularly relevant with South African utilities adjusting to reorganisation that has brought previously separate networks and staff together in new organisations. Write in the following box whether the condition of the earthing of the systems under your control is acceptable or unacceptable to you.

The earthing of single wire earth return distribution systems is different from protective earthing in that the earth connection is an active part of the SWER circuit under normal conditions. However, the principle of limiting the voltage between two components also applies.

Maintenance

As already mentioned, most utilities (throughout the world) are working their systems harder, to reduce the asset base on which the accountants calculate the financial returns. At the same time the pressure to reduce operating costs leads to a reduction in maintenance. Time based maintenance is giving way to condition based maintenance. But this introduces two new requirements:

- knowing the present condition of the equipment, and
- knowing at what stage the equipment needs attention.

With the age and variety of equipment on the system steadily increasing, and an apparent shortage of suitably skilled maintenance staff, the problems will get worse. Appropriate training and an understanding of the new theories of maintenance management are needed.

Distribution automation

One of the ways to improve the financial return on assets is to increase the flexibility of the distribution systems. Instead of building robust systems, with lots of redundancy and spare capacity, distribution automation techniques are applied to increase the flexibility of operations. Switching can quickly rearrange networks, rebalancing loads, shedding least important loads when required and making the most effective use of the 'heavy' equipment. Distributed automation comprises data acquisition and management, computing and communication. Intelligent metering and protection are opening up new opportunities, but issues in system integration, security, data quality and applications need to be addressed.

These new approaches to maintenance and distribution automation are at least as novel and important as high voltage insulation and machine reliability were a hundred years ago, and the utility engineers still have to master the new technologies.

4 Skills development

Skills shortages, new skills, improved understanding - a consistent theme. A modern utility requires people with a wide range of skills or abilities:

- to lay a cable quickly and without damage, with reliable joints and terminations,
- to identify a wood pole that is so rotten that it must be replaced
- to maintain a modern switch or protection and control panel
- to plan a network so that it meets all the operating demands, but incurs the minimum cost,
- to manage the utility as a business.

In the past, many electricity departments had the facilities and staff needed to provide suitable training in-house. Now there is a wide range of external organisations offering training. At one end, university education provides "training" in problem solving based on knowledge of engineering science. In response to a widespread need for upgrading the knowledge and qualifications of engineers in employment, UCT now offers part-time courses leading to the Masters degree. Manufacturers, suppliers and training companies offer a broad range of courses for improving specific skills for manual workers, artisans and technicians. Even the improvement of the workforce's literacy can improve productivity and reduce losses.

Modern technologies are available to assist the employees in all the tasks identified above, but even then, appropriate training and better understanding can significantly improve the effectiveness of the new technologies.

Employees are valuable assets. But inadequately skilled employees are costly. However, probably for historical reasons, many municipalities are reluctant to utilise the facilities of external training organisations

For what percentage of the employees in your company is provision made for skills improvement?

5. Services

Returning to the low voltage incident described at the start of the paper, we have touched on several of the ideas that may have come to mind as the first thing of which you thought. Was there a fault, had a neutral become disconnected, did the protection operate correctly, did an unsafe condition exist? Or maybe you thought about the expectations of customers, the standards for quality of supply or the liability for damages. All are relevant. Customers and the public during the hundred years of service provided by municipalities have come to expect reliable, safe, efficient, high quality supplies of electricity. Can these standards be maintained in the future?

Quality of supply

An evaluation of the National Electrification Programme, carried out by the University of Cape Town during last year [2], reported the following regarding the quality of supply and service standard:

In most cases, the distributors have not needed to make significant modifications to the projects, indicating that the construction quality was adequate. However, there have been very high failure rates for the prepayment meters. Also, the design standards have been changed substantially or vary widely between the distributors, indicating that the initial designs generally, and designs in some projects, may have been unduly conservative. On the other hand, most staff were unaware of the performance of many of the ... systems designed using very low values of average demand, and so the systems may not be adequate.

and

Some communities resisted the introduction of 20 A capacity limits on the supply. ... However, the suitability of this standard became apparent as the low consumption levels and associated poor financial viability of the electrification programme were confirmed by experience.

Obvious questions arise: Are the design parameters used by your organisation and the quality of supply delivered both consistent with the needs of your customers, without being 'unduly conservative' in the use of expensive resources? Are you sufficiently confident of your response to write it in the next box?

Purpose of electrification

A hundred years ago electricity was supplied for economic reasons. It was less expensive or more efficient and convenient than other forms of energy, so that it contributed directly to the financial productivity of a customer. Later, economists and policy makers realised that here were benefits of electrification for the development of the broader community. The benefits did not accrue directly to the customers or get taken into consideration in electrification planning by the utility. Some benefits were not strictly financial, and techniques were developed to evaluate the economic rate of return of stimulating development. Electrification for the purpose of socio-economic development was implemented widely in the 1970s and 1980s. The National Electrification Plan was conceived in this context during the late 1980s.

However, electrification may also be used to reach another objective: poverty alleviation. Poor people cannot afford much electricity, even if the electrification connection is provided very cheaply or free. And they don't initially have the skills and resources to use the electricity productively.

Therefore the purpose of electrification is neither economic nor socio-economic development. It has been proposed that the poorest households be given a consumption subsidy, to meet objectives of social development.

This conceptual framework is new and outside the policies of international finance institutions, who resist proposals for subsidies because of the distortion of the economic mechanisms.

Basic Electricity Support Tariff

The University of Cape Town was appointed by Eskom and the Department of Minerals and Energy in October 2001 to carry out research into a proposed tariff to subsidise the electricity consumption of poor customers.

Technical, social, financial, economic, environmental, health and institutional factors were researched, and key issues identified.

The research report [3] included the following findings:

- Research into poverty alleviation and tariffs cannot be carried out effectively without a good knowledge of the load parameters. The national load research programme, collecting household load data for about ten years with support from several municipalities, provided a comprehensive model of loads against which to test various tariff alternatives and the impact on feeder overloading and generation capacity.
- Electrification has significant social impact, but the benefits are constrained by lack of access to the network, lack of appropriate appliances for those connected and a poor understanding of tariffs.
- Tariffs for consumption subsidies can be targeted to the poor, or applied as a broad-based (applicable to all connected households), increasing block rate tariff. Targeted tariffs are not as effective in reaching all the households, but have lower leakage of benefits to those outside the target group - the non-poor.
- Most of the poorest people in the country are in rural areas and many are not yet electrified. A broad-based subsidy tariff will require significant financial transfers from utilities with a low proportion of poor households, in a national sense, to the utilities serving the rural customers.
- A targeted tariff should limit the demand of customers to 8 or 10 A and the first block of energy should be supplied at a heavily subsidised rate.

Further energy purchases during the month will be at the same rate as for other households. Most metering and vending systems are capable of implementing such a tariff.

In the next box write down whether the proposed tariff is important to you organisation and, if so, which is the key issue for your organisation?

In my opinion, if it is to be adopted for poverty alleviation, a special tariff will have to be a self-targeted, demand-limiting tariff, with customers electing to have it. For utilities not already offering a range of household or domestic tariffs, the basic electricity support tariff will require a change in the concept of providing services to customers.

6. Business

What business are you in?

Businesses must address several needs at the same time if they are to survive. Some business models show management at the centre of an organisation, directing the financial, technical, human resources, procurement and sales sectors of the business.

Another model has at the core of the business a technology or process that delivers efficiently and effectively something the customers want. A solid understanding is needed of that core business. Surrounding and supporting the core there are units addressing the financial, human resources and regulatory requirements of business. All the activities are co-ordinated by management. The advantage of this model is that without a core, the other units have no function, but the core cannot stand alone. This indicates that there is no room for conflict between management and engineering, nor with any other unit.

Electricity utilities supply a fundamental service to industry and business, as well as to the residents of the service area. South Africa's abundant and relatively cheap supplies of energy give local businesses a competitive advantage. Without this advantage, we would all be worse off. So our core business is electrical technology, but the impact is national economic sustainability.

7. Conclusion

No mention of load flow, insulation co-ordination, voltage drop calculations, probability techniques or distributed generation? Certainly, they are important, but the basics of electricity distribution engineering are technology, skills, services and business. The answers in the boxes indicate the important topics in your situation.

8. Acknowledgements

I appreciate the support of the University of Cape Town in its promotion of knowledge development and dissemination, and of all those organisations that by supplying students, funding and problems support the research and teaching activities in the Department of Electrical Engineering. They all contributed to the formulation of the ideas presented here.

9. References

[1] DJ Irving, CT Gaunt : How safe is South African earthing practice? 53rd Association of Municipality Electricity Undertakings Convention, Durban, September 1993.

[2] M Borchers et al: *National Electrification Programme Evaluation: Summary Report,* University of Cape Town, 2001.

[3] University of Cape Town: *Options for a Basic Electricity Support Tariff.* Research project 400903, February 2002.

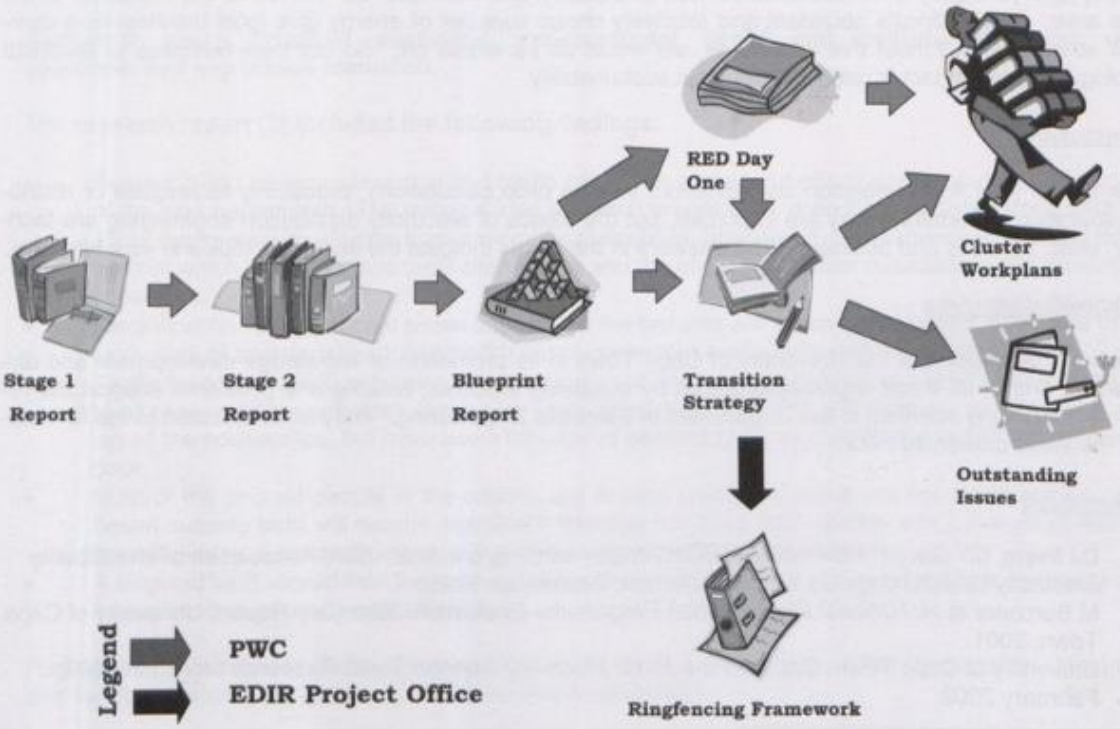
Prof C T Gaunt, Department of Electrical Engineering, University of Cape Town, Private Bag, Rondebosch, 7701 South Africa.
ctg@eng.uct.ac.za

Trevor Gaunt's working experience has included equipment manufacturing, system protection, network analysis and planning, project management, organisation and tariff studies, and now at UCT teaching and research. He leads the UCT team researching the Options for a Basic Electricity Supply Tariff. He presented papers to the AMEU Technical Meeting in 1988 and Conventions in 1991 and 1993.

EDI Restructuring Programme
Integrated Transition Strategy

by
The EDIR Project Office
Gabriel Kgabo & Mandla Letlape

Background

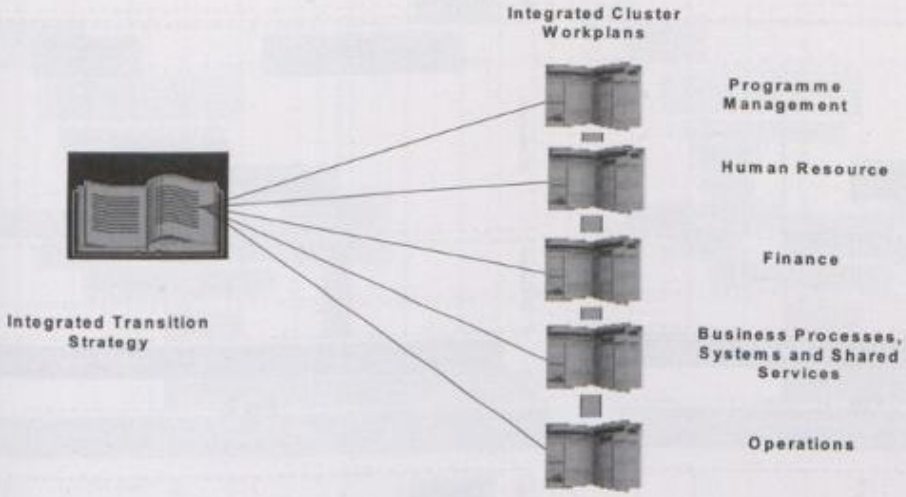


Issues and Conflicts

Please refer to the diagram above.

- EDI Holdings (Pty) Ltd Timeline
- Transition Period
- Restructuring Phases
- Absorption Strategy
- RED Day One
- RED Day One Organisation Structure
- Role of EDI Holdings (Pty) Ltd versus RED's
- Etc ...

The Objective of the Integrated Transition Strategy



Integrated Transition Strategy Document Layout

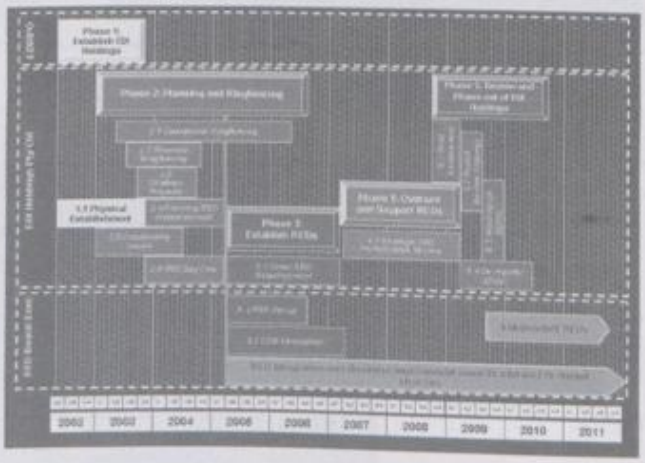
Section 1:	Introduction
Section 2:	Integrated Transition Strategy
Section 3:	Absorption Strategies for EDB's
Section 4:	Strategy for Creating RED's
Section 5:	RED Day One
Section 6:	Ringfencing Framework
Section 7:	Integrated Planning Timeline
Section 8:	Log of Issue, Conflicts and Resolutions

Section 1: Introduction

- Background
- Purpose of this Document
- Document Layout
- Definitions

Section 2: Integrated Transition Strategy

- EDI Restructuring Objectives and Priorities
- Transition Management Principles
- Transition Strategy
- The Integrated Transition Strategy in Detail



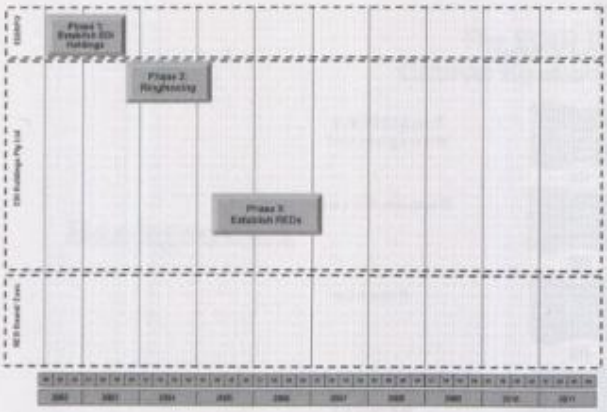


Fig. 1.

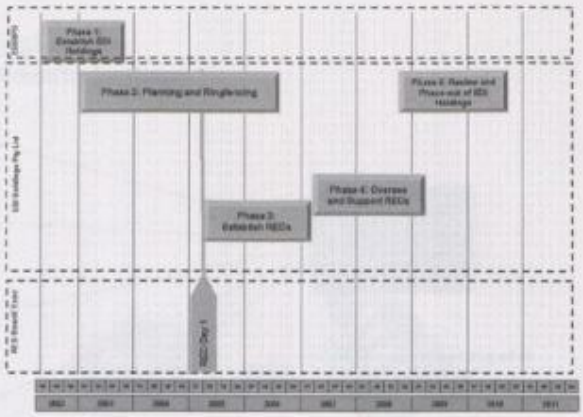


Fig 2.

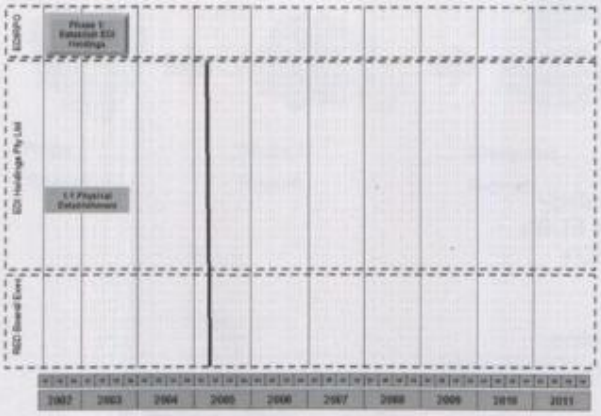


Fig. 3.

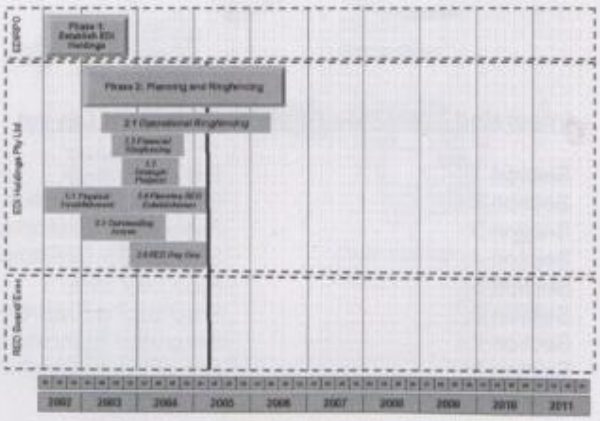
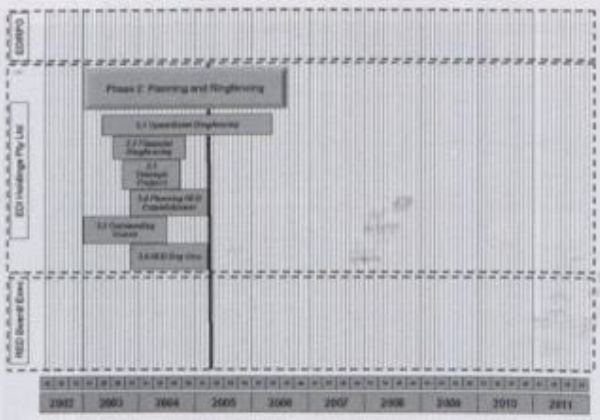


Fig. 4.



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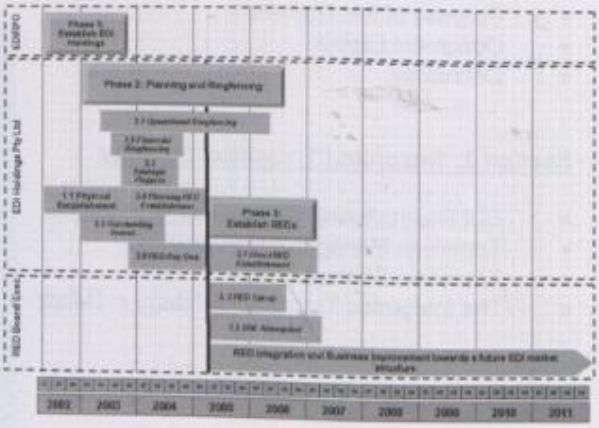
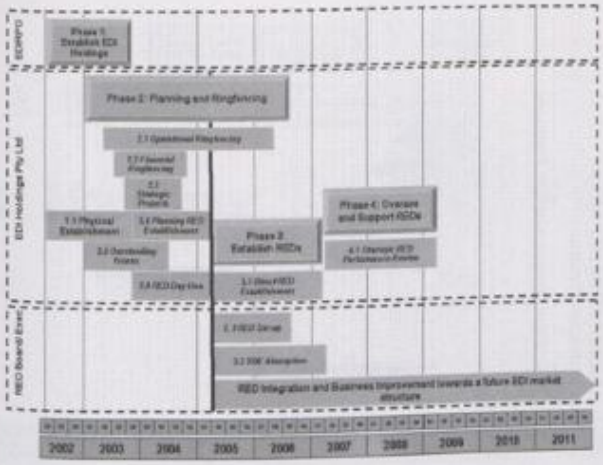


Fig. 6.


EDIHPO
Phase 1: Establish EDI Holdings
Phase 2: Planning and Ringfencing
Phase 3: Establish REDs
Phase 4: Oversee and Support REDs
EDI Holdings Pty Ltd
REC Board/ Exec
REC Integration and Business Improvement towards a future EDI market structure
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2010
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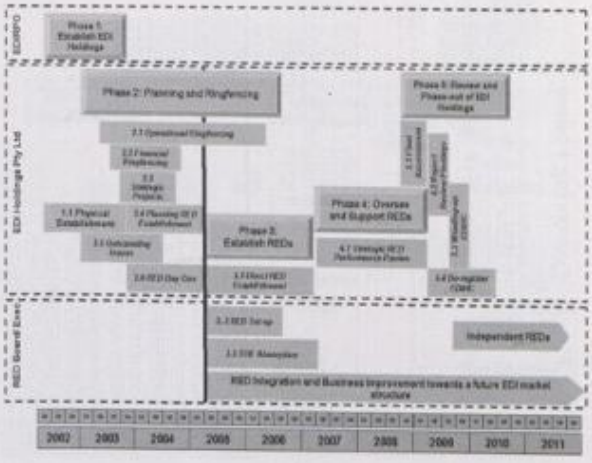
EDIHPO
Phase 1: Establish EDI Holdings
Phase 2: Planning and Ringfencing
Phase 5: Review and Phase-out of EDI Holdings
Phase 3: Establish REDs
Phase 4: Oversee and Support REDs
EDI Holdings Pty Ltd
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Independent REDs
REC Integration and Business Improvement towards a future EDI market structure
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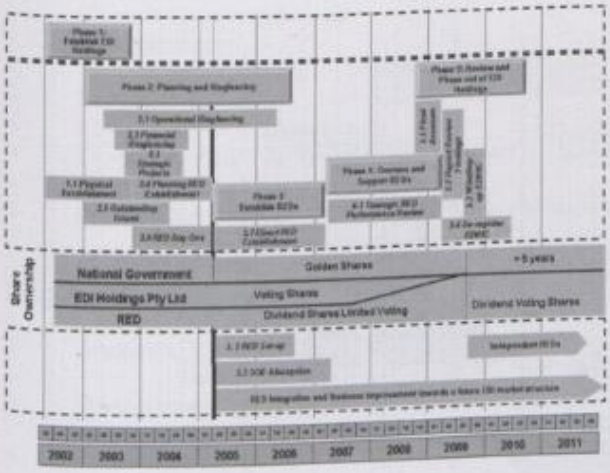
Share Ownership
National Government
Golden Shares
+5 years
EDI Holdings Pty Ltd
Voting Shares
RED
Dividend Shares Limited Voting
Dividend Voting Shares
Independent REDs
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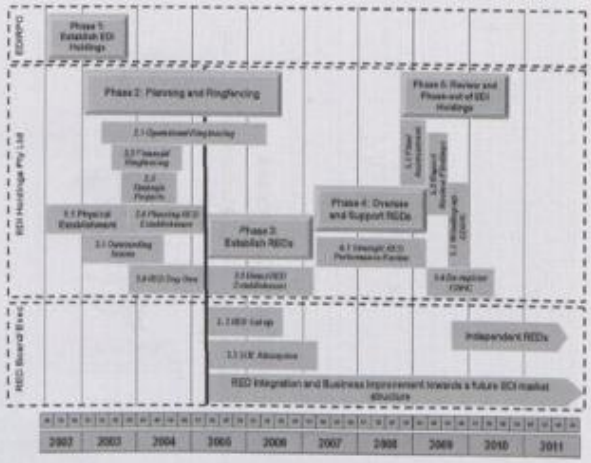
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Independent REDs
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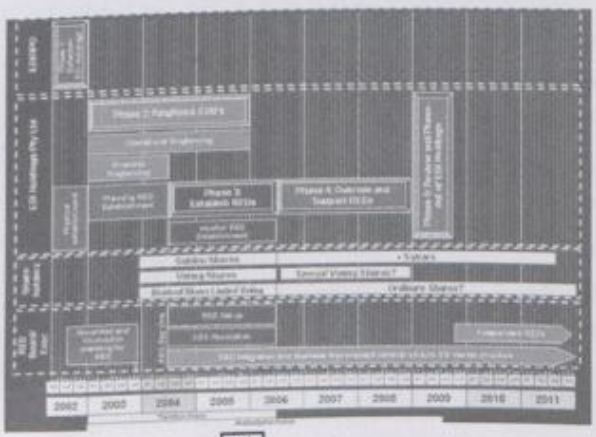
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Fig. 7

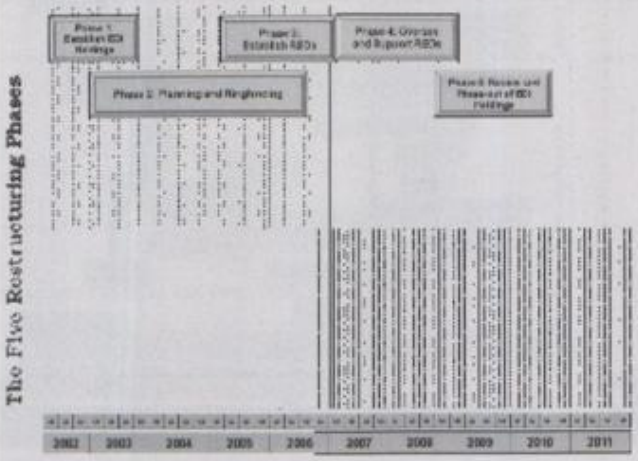


Fig. 11.

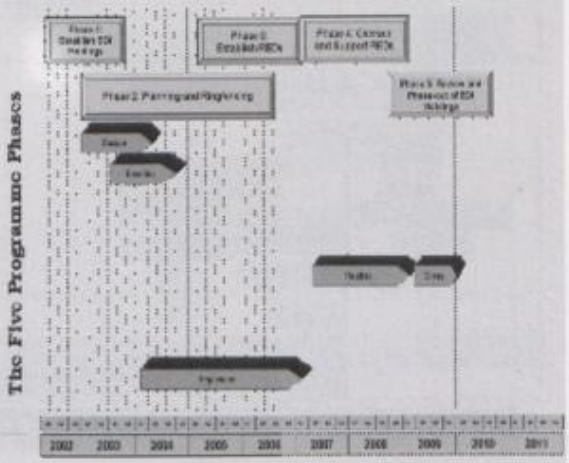


Fig. 12.

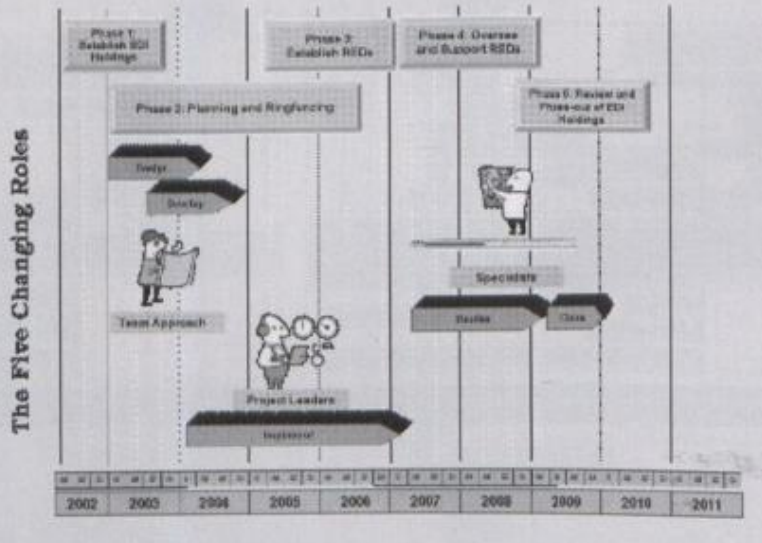
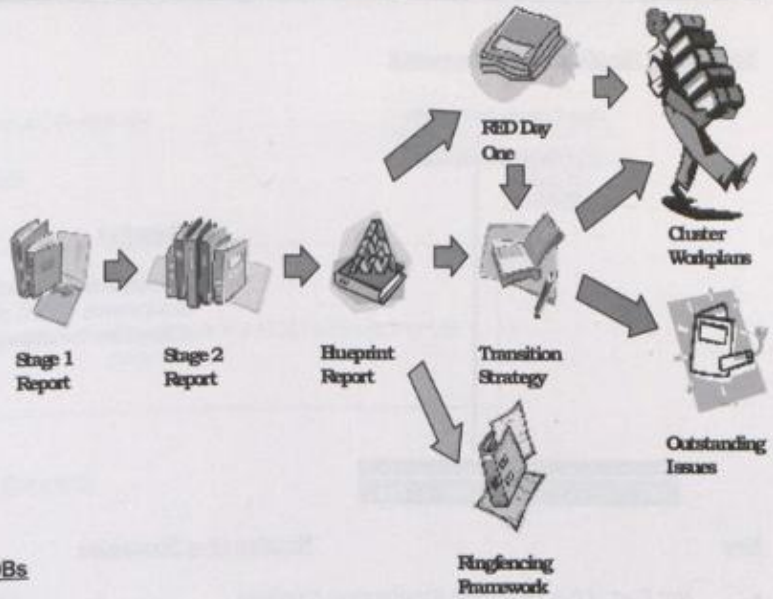


Fig. 13.

Risks

- Timeline
- Outstanding Issues
- Complexity
- Thought Processes, biases, skills and passion

Handover



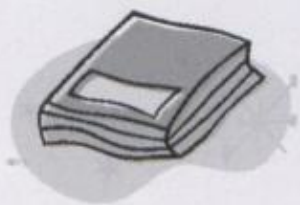
Section 3: Absorption Strategies for EDBs

- Key Issue
  How does a RED absort EDBs?
- Blueprint Recommendations
- Two Approaches
  Phased versus Complete Absorption
- Evaluation Criteria and Scoring
- EDB Absorption Strategies
- Evaluation of the Two Absorption Approaches
- Impact of Phased Absorption Approach
- EDIR Project Office Conclusions and Recommendation
  Phased Absorption Approach

Section 4: Strategy for Creating RED's

- Key Issue
  Do we create all the REDs on the same day or do we phase them?
- Two Approaches
  Phased versus Simultaneous Creation Approach
- Evaluation and Scoring
- Conclusion
  Simultaneous Creation Approach

Section 5: RED Day One

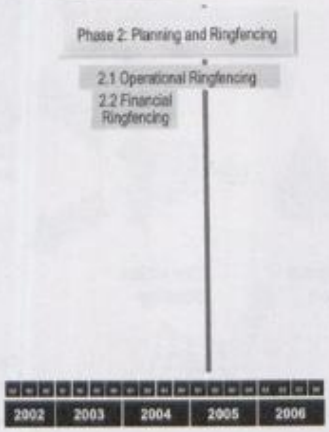


RED Day One

General Clean-up

- **Definition**
- **Philosophy**
- **Organisation Structure**
- **Characteristics**
  - **Authority**
  - **Absorption**
  - **Tariffs**
  - **Customer agreements**
  - **Contestability**

Section 6: Ringfencing Framework



Objective

To prepare the Electricity Distribution Businesses (EDB) of Eskom and the Municipalities for absorption into the RED's.

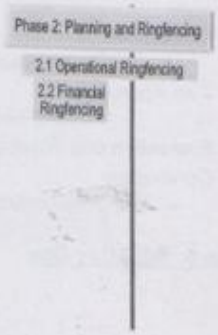
Key

Ringfencing Strategies

- Not Part of the Municipal Ringfencing Exercise
- Lowest cost approach
- Minimum requirements for absorption into RED's
- Standard and uniform approach
- No reconfiguration of legacy systems. Introduce a new basic system layer
- Source for EDI Holdings Pty Ltd, planning information requirements
- Project Managed from EDI Holdings Pty Ltd
- Utilisation of external specialists

Contextual Framework for Ringfencing

- Commonly, ringfencing is pursued through five forms of separation:
  - Operational Separation
  - Financial Separation
  - Legal Separation
  - Ownership Separation
  - Physical Separation
- The framework supports the following two forms of separation:
  - Operational Separation
  - Financial Separation



Ringfencing Framework

- Part 1: Introduction
- Part 2: EDI Restructuring Programme and the Ringfencing Exercise
  - Blueprint
  - Context
  - Operational Ringfencing
  - Financial Ringfencing
  - Accountabilities
  - Deliverables

- Part 3: Operational Ringfencing
- Part 4: Financial Ringfencing
- Part 5: High Level Project Management Guidelines

Section 7: Integrated Planning - Timeline

OBJECTIVE

An integrated Project Master Plan for all the EDI Holdings Pty Ltd projects

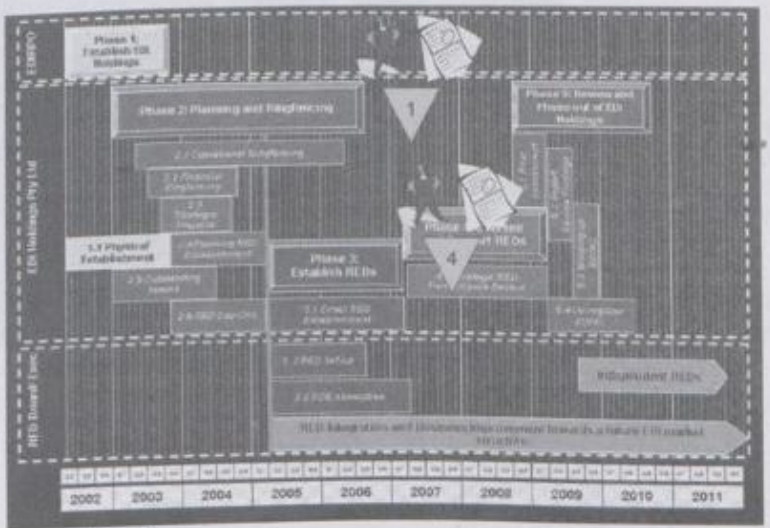
Section 7: Integrated Planning - Show Stoppers

- Outstanding Issues
  - Local Government Issues
  - Ownership of shares - Eskom assets
  - Bulk supply debts
  - Contestable customers
  - Social Plan
  - Operation of the Golden Share
  - RED Boundaries
- Legal Processes
  - EDI Restructuring Bill
  - Amendment to the Municipal Systems Act
  - Amendment to the Municipal Financial Management Bill

Section 7: Integrated planning - Burning Issues

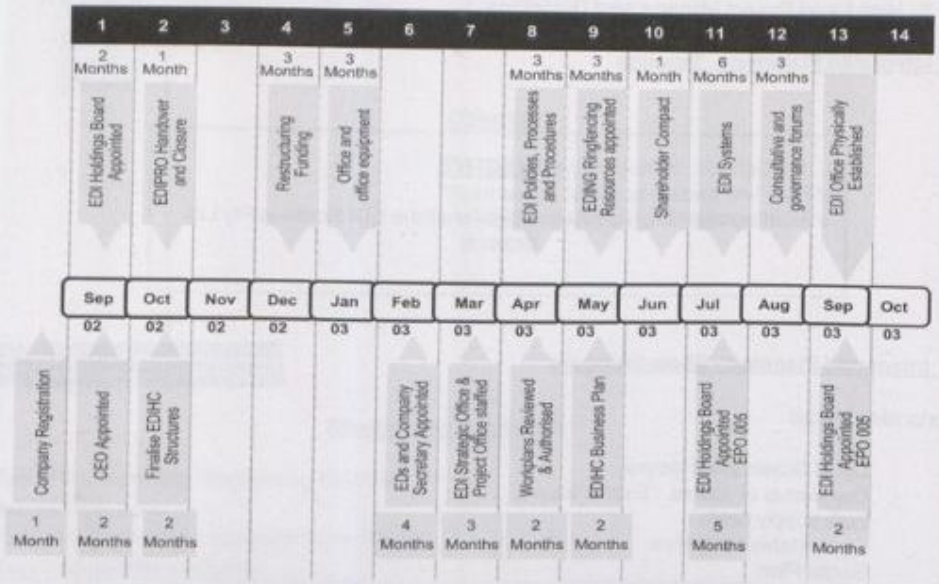
- Establishment of EDI Holdings Pty Ltd
- Future Edi Market Structure

Integrated Planning Timeline



Phase 1: Establish EDI Holdings

1.1 Physical Establishment



Gabriel Kgabo

PREPARING FOR REDS AHEAD

by
CLR TEMBENI LOBE &
AT VAN DER MERWE (Pr Eng)

Synopsis

This paper deals with the required groundwork for preparing for the formation of REDS. It describes the imperatives influencing this decision for municipalities on the way ahead and the necessities why a municipality needs to prepare. Attention is given to the requirements of the Systems Act. In conclusion examples are given for rationale change to MLM.

Background

The restructuring of the Distribution Industry in South Africa is well debated since the process started in 1992, but has yet to deliver definite changes on the ground. The Cabinets approval of the ERIC report in 1992 was preceded by various studies. This was followed by the Energy White Paper approved by Cabinet in December 1998. A clear indication on the stance of government was given with the approval of the six independent regional undertakings in June 1999 paving the way for a R25bn industry overall .

1. Energy White Paper

To understand some of the imperatives on the way forward one have to reflect on some of the pillars on which the restructuring has to be built. Although the Energy White Paper deals with numerous reasons for the envisaged change and merger between Eskom Distribution and Municipalities , the most crucial statements for municipalities about the EDI restructuring are the following:

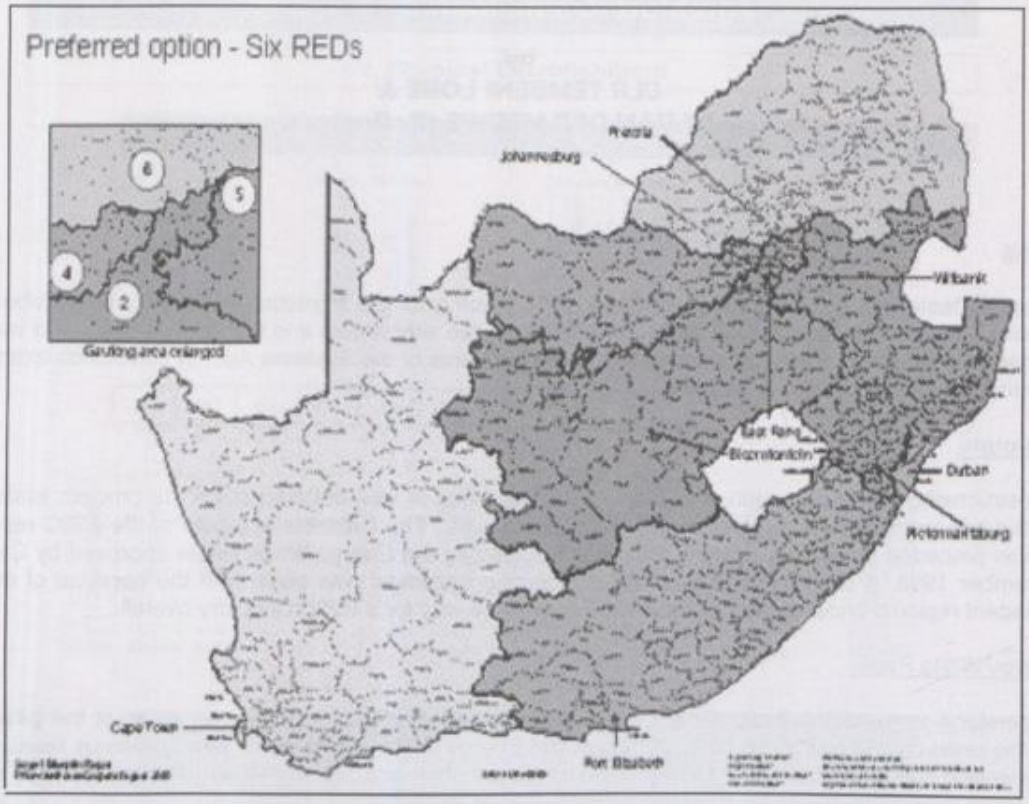
> *Electricity distribution industry will remain under* ***public ownership.***
> *Municipalities will continue .....setting policy, including end-user tariffs,...****supervising the distribution of electricity.***
> *Municipalities will continue* ***to fund other municipality services*** *from the funds generated from electricity.*[1]

It is clear that although the current structure of distribution will change it is envisaging that, public ownership, governance with regard to the distribution activities and an expected revenue stream from electricity will remain unaltered

1.2 Cabinets Recommendations

Without condemning the process that was followed to produce the PWC Blueprint , the vision on the way forward (and eventually supported by Cabinet) a number of critical questions remained unanswered. These issues revolved mainly around the influences the envisaged restructuring will have on municipalities. The proposed six demarcated REDS along municipal boundaries is well known as depicted in the following diagram.[2]

A process of re- modeling to finetune these boundaries are currently underway. The question that remains is what the influence on the municipalty will be and what preparations a munic will have to follow to be ready. The following sections deal with some of the most outstanding imperatives influencing this.



[2]

2. Strategic Objectives to manage the influences affecting municipalities.

A municipality surely has to consider whether it wants to take a pro-active or reactive stance with regard to the envisaged changes. (Salga has also promote these preparatory work in a national workshop in October 2000 and re-emphasised it in a series of provincial workshops around the country.) If the view is that ***if*** something happens ***little*** can be done to influence the process, stocktaking on the impact on the municipality has to be embarked upon to bring the realities of the restructuring on the table! The intention of the authors is not convincing the reader on the impact the envisaged restructuring will have on the electricity business and the remainder of the municipality - that debate has passed - but to evaluate some of the most critical influences having a profound effect on the municipal business since the last phase of the local government democratisation in December 1994. These impacts or uncertainties can be categorised as:

2.1 Impact on Municipal Income

It is envisaged that the future revenue stream will be a combination of a shareholding in the RED and the right to levy a tax on electricity sales. This will replace the current contribution to the relief to the rates fund. However at this stage it is not clear how the shareholding of the future RED is going to be determined and whether this shareholding will yield a dividend especially in the initial years. The scale of the proposed levy is also still an issue of debate and is receiving currently attention from National Treasury.

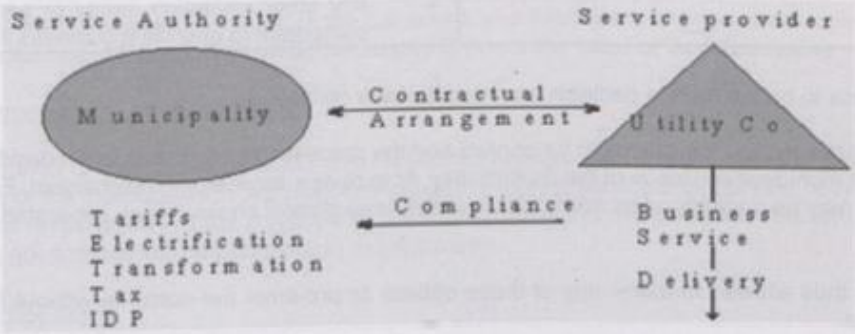
2.2 Impact on remainder of Municipality

Salga warned in their circulars to the effect of the loss of cash flow, credit rating and influences on business systems and processes etc. The exact impact will be different for each municipality and necessitates a process of ringfencing and pro-active strategising to continue to effect efficient delivery.

It is unlikely that the assistance that might be forthcoming from the national restructuring process will develop the necessary wisdom to quantify of the impact within the municipality.

2.3 Ownership and Control (Governance)

It is well known that the Constitution (Schedule 4B) empowers a municipality to the function of reticulation. Both Municipal Structures and Systems Act confirm this with further detail on what reticulation means and how this service has to be rendered. An important concept that came to the fore is the splitting of the roles of the service authority and service provider. [3] The concept is taken up in the PWC Blueprint and accepted by Cabinet. It can be described as below:



[3]

Due to the impact It can be concluded from the above that it will be shortsighted from a municipality not be alerted by these external pressures. Even worse, if a municipality does not strategise in order to be ready. It then follows that a municipality have to have understanding of the future role and the structures it is going to operate in to gain the maximum leavage.

This in practice means that in future a municipality will be able to fulfill its Constitutional obligations and responsibilities by using a service provider to render such functions. Before choosing such a provider, it is necessary to follow a particular process.

4. Municipal Systems Act (MSA) requirements

4.1 Internal vs. External service delivery options

The MSA states at a municipality may render a municipal service in its area, by means of either an *internal* or *external* service delivery option. Some examples of the two options are defined as follows:

Table X Service delivery options defined in the Municipal Systems Act.

Internal options	External options
• a department or other administrative unit within its administration;	• Effected by entering into a service delivery agreement with:
• any business unit devised by the municipality, provided it operates within the municipality's administration and under the control of the council in accordance with operational and performance criteria determined by the council; or	• a municipal entity • another municipality; • an organ of state, including a water committee established in terms of the Water Services Act;
• any other component of its administration.	

Internal options	External options
	• a licensed service provider registered or recognised in terms of national legislation; and a traditional authority; • a community based organisation or other non-governmental organisation legally competent to enter into such an agreement; or • any other institution, entity or person legally competent to operate a business activity.

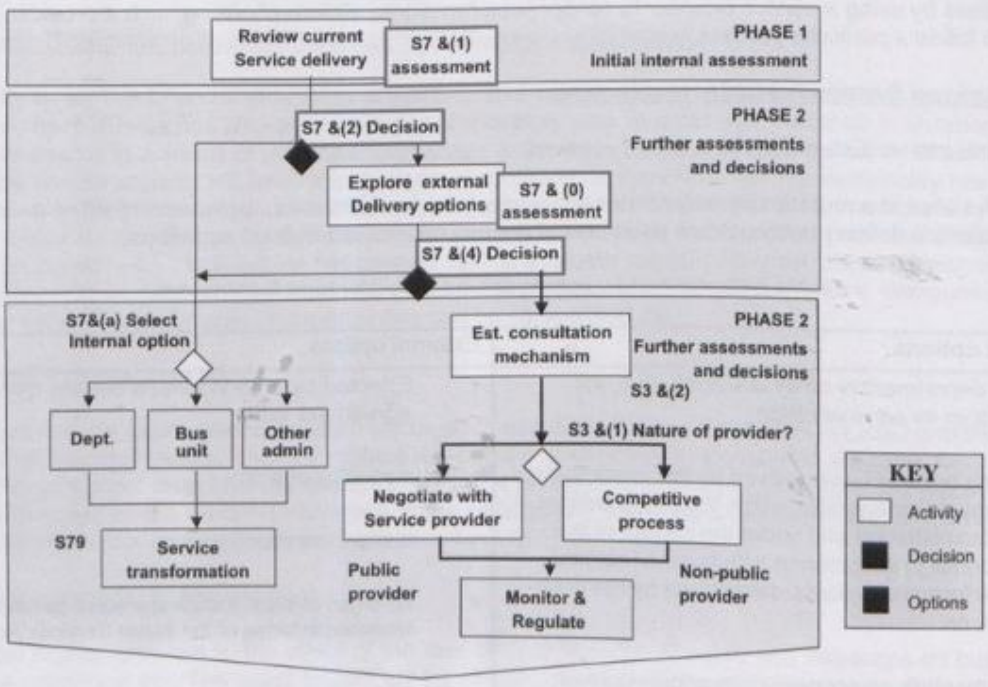
4.2 The process to be followed to decision a service delivery option?

Section 78 of the Act specifies the criteria to be applied and the process to be followed when deciding on a option to provide a municipal service in of the municipality, or to review any existing mechanism. For convenience the process may be understood as taking place within *three distinct phases*, each separated by a Council decision.

No municipality is thus allowed to follow any of these options or pre-empt the outcome without following the prescribed process.

There has been efforts to revoke this section with regard to electricity, but it did not take place as yet. It is thus important for municipalities to follow the route suggested by the MSA in order to prepare for the envisaged changes.

Section 78 - The Process



(4)

5. Preparing for REDS Ahead

5.1 Influences on Mangaung (MLM):

In preparing for the envisaged REDS it is necessary to consider some of the uncertainties for the proposed changes when the municipal electricity service is transferred into the RED. Some of these impacts on Mangaung and other municipalities will be:

5.1.1. Future revenue stream uncertain:

If compared with the current contribution the future revenue stream from the RED is uncertain. It will be in any municipality's advantage to define the true business value of the utility to determine the future shareholding portion in the RED. Ringfenced values of the full assets and liabilities in a discounted cash flow (DCF) or depreciated replacement value(DRV) will be necessary to prove the value of the undertaking

5.1.2. Governance role of MLM in RED:

The incorporation of the municipal entity into REDs, will change the current combined shareholder and governance role of the municipality to the proposed service authority, service provider role. In order to execute the Constitutional responsibility of the municipality it will be essential to mangage this role efficiently. Experience in executing governance will be beneficial to municipalities.

5.1.3 Red's HQ issue:

Economic growth is one of the essential elements of the development of cities. The question on whether people will move away is an issue that needs careful planning and preparation.

5.1.4 Non-core electricity functions:

It is well known that many municipalities operate a variety of other functions for the remainder of the municipality often at a reduced cost to the core administration. It is advisable that municipalities consider these changes in their new macro and micro designs and plan in time to re-allocate costs and functions correctly.

5.1.5 Stranded assets:

Various assets might be stranded in the envisaged merger between Eskom and municipalities. Pre-planning is a prerequisite to enable the remainder of the municipality to ensure cost effective and transparent services to the community.

Following from the IDP process, various workshops and investigations the following rationale for change for MLM were developed.

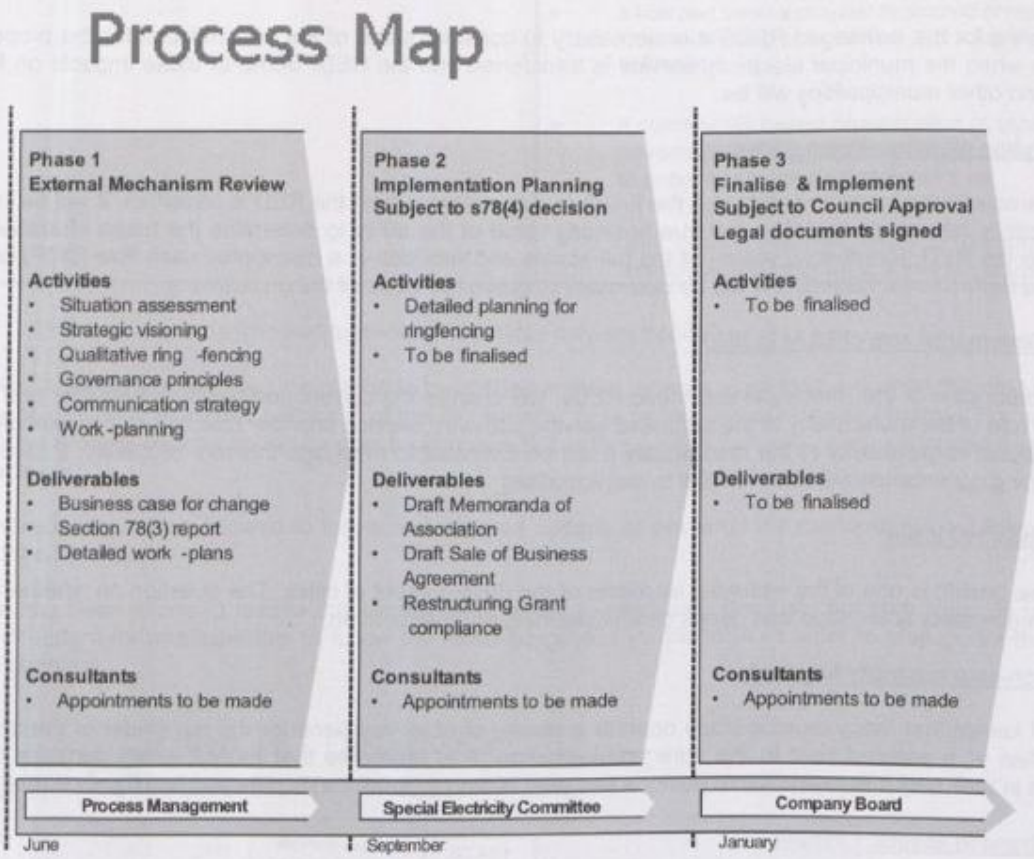
5.2 Rationale for change

- Organise as a business unit for greater efficiency and optimum service delivery to community
- Demonstrate capacity and competency in delivery, to facilitate process in becoming a Metro
- Give leadership in area and province to optimize service delivery
- Ensure definite future revenue stream for Municipality
- Obtain experience in governance and service delivery processes in future RED
- To collude with other municipalities to strengthen municipal definition in RED's to come
- Transform electricity supplies as part of restructuring and transformation in municipality.

5.3 The process

MLM embarked on a process as prescribed by the Systems Act. After the initial 78(1) process a 78(2) decision was taken to explore an external option A definite process was then mapped in three distinct phases as depicted in diagram 4.

It then deals with the external review, planning and implementation phase. The first part namely 78(3) is completed



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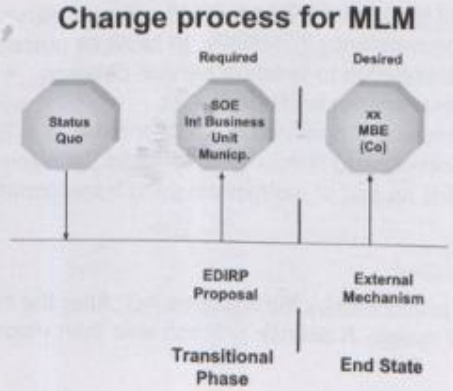
5.4 The SOE vs MBE investigation

The MSA 78(3) process requires from a municipality to follow a methodology that amongst others consider a business case for change and decide in the 78(4) stage on the appropriate internal and external mechanism. The investigation into the change management process for MLM is pictured in the following diagram.



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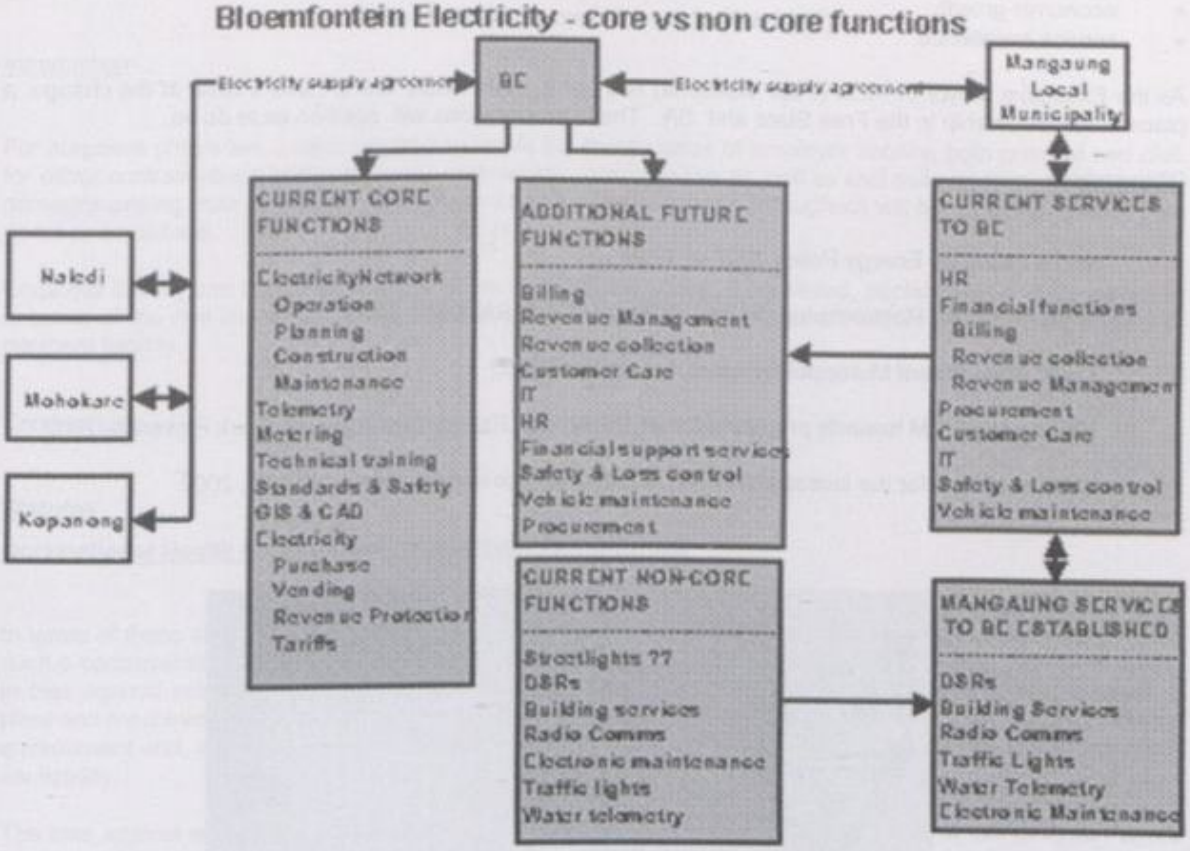
The advantages of a municipality (MBE) vs. the external business unit (SOE) was investigates in order to make recommendations to the MLM Council as to the best service delivery option. Important to understand that a MBE is neither privatization nor commercialization. It is a process of legal separation to enable the utility to achieve strategic financial and operational leverages to achieve the desired readiness in terms of the goals.

5.5. Non-core electricity functions



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As part of the ringfencing process core and noncore electricity functions needs to be identified and be placed appropriately. The following diagram gives an overview of the process currently been followed in MLM. Non-core is replaced in the design of the micro structure and the additional future functions is being evaluated as part of the SOE/MBE investigations. It is foreseen that the majority of these placements will be completed in the current financial year in order to move forward to embrace the changes to come.

5.6 Legal Separation

The process of legal separation from the municipality is the conclusion of the sale of business agreement, the compilation of the memorandum and articles of association and the registration of the entity. According to the investigations legal separation will allow a municipality to ensure commercial viability via a governance process as stated in the Companies Act. . Without legal separation prospects of commercialization and efficiency gain is slim. However a MBE will be 100% owned by the municipality and service delivery will bee managed through a service delivery agreement.

6. Conclusions

In order to be ready for the envisaged restructuring of the EDI MLM embarked on a process to evaluate current service delivery practices as stipulated by legislation. The investigation suggests that there is sufficient institutional and efficiency reasons why these changes should be, for MLM it is clear that these envisaged electricity transformations ties with the IDP visions of:

- Community resilience;
- economic growth;
- service excellence.

As the Executive Mayor of MLM (Papi Mokoena) has put it. "We would like to have a hand in the change, a place in the leadership in the Free State and SA. These preparations will position us to do so.

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Clr T G Lobe

POTENTIAL EMPLOYER LIABILITY FOR OCCUPATIONAL HEALTH AND SAFETY BREACHES IN TERMS OF THE OCCUPATIONAL HEALTH & SAFETY ACT NO. 85 OF 1993, THE MINE HEALTH & SAFETY ACT NO. 29 OF 1996, THE COMMON AND CIVIL LAW, INCLUDING THE ELECTRICITY ACT NO. 41 OF 1987.

Presented by

Advocate Raynard H Looch (BA LLB)

Introduction

For purposes of this talk, I have decided to tackle the thorny issue of employer liability, both criminal and civil, for either contraventions of the statutory criminal law, common law as well as civil suits against employers for damages arising from occupational health and safety. The emphasis throughout will be on ESKOM as an undertaker as defined.

Employer liability can be either in terms of the criminal law where, if convicted, punishment is metered out or in terms of the civil law where compensation is given. Liability, in turn can be divided in corporate liability or personal liability.

Criminal Law

Statutes

Occupational Health & Safety Act / Mine Health & Safety Act

In terms of these statutes, criminal liability is established when one of their provisions is contravened, whether such a contravention results in an incident or not. Nobody is immune to prosecution but both Acts have a built in bias against employers or users of plant and machinery. The rationale being that employers or users of plant and machinery have the necessary resources to furnish their employees with a safe and healthy working environment and, if this is not accomplished, *as far as is reasonably practicable*, they may be may incur criminal liability.

The bias against employers, both corporate bodies and individuals, is particularly true of the OHS Act where criminal liability is potentially artificially imputed onto employers for the wrongdoings of both employees and mandataries (Contractors). This presumption-in-law is contained in section 37 of the OHS Act. Employers, both corporate bodies and individuals, may be held criminally liable since they are *presumed* to have committed the offence of either their employees or outside independent contactors. It is, however, a rebuttable presumption.

/ It reads ...

1. *"Whenever an employee does or omits to do any act which it would be an offence in terms of this Act for the employer of such employee or a user to do or omit to do, then, unless it is proved that –*

   a) *in doing or omitting to do that act the employee was acting without the connivance or permission of the employer or any such user;*
   b) *it was not under any condition or in any circumstances within the scope of the authority of the employee to do or omit to do an act, whether lawful or unlawful, of the character of the act or omission charged; and*
   c) *all reasonable steps were taken by the employer or any such user to prevent any act or omission of the kind in question, the employer or any such user himself shall be presumed to have done or omitted to do that act,*

and shall be liable to be convicted and sentenced in respect thereof; and the fact that he issued instructions forbidding any act or omission of the kind in question shall not, in itself, be accepted as sufficient proof that he took all reasonable steps to prevent the act or omission.

2. *The provisions of subsection (1) shall mutatis mutandis apply in the case of a mandatory of any employer or user, except if the parties have agreed in writing to the arrangements and procedures between them to ensure compliance by the mandatory with the provisions of this Act.*

3. *Whenever any employee or mandatary of any employer or user does or omits to do an act which would be an offence in terms of this Act for the employer or any such user to do or omit to do, he shall be liable to be convicted and sentenced in respect thereof as if he were the employer or user.*

4. *Whenever any employee or mandatary of the State commits or omits to do an act which would be an offence in terms of this Act, had he been the employee or mandatary of an employer other than the State and had such employer committed or omitted to do that act, he shall be liable to be convicted and sentenced in respect thereof as if he were such an employer.*

5. *Any employee or mandatary referred to in subsection (3) may be so convicted and sentenced in addition to the employer of user.*

6. *Whenever the employee or mandatary of an employer is convicted of an offence consisting of a contravention of section 23, the court shall, when making an order under section 38(4), make such an order against the employer and not against such employee or mandatary."*

The Mine Health & Safety Act does not contain this presumption-in-law and, with the envisaged merging of the two Acts, we may see it disappear altogether since the courts are particularly wary of such mechanisms in law.

Corporate liability is established in terms of section 332(1) of the Criminal Procedure Act, essentially it is created through the wrongdoings of its servants or directors while working for the corporate body or furthering its interests. Human employers' liability is normally directed at persons "appointed" in terms of section 16 of the OHS Act (CEO and assignees) for general contraventions of the Act and competent persons for machinery related contraventions. In terms of the Mine Health & Safety Act, potentially also the CEO and his team of managers or appointees. Machinery related contraventions would potentially create liability for the competent persons appointed in terms of the Minerals Act.

A unique crime, namely that of "negligent injury" has been created by both these acts. (It does not exist in our common law). A person has been imprisoned for this offence in the past. *State v Lambert 1996.* This crime is found in section 38(2) of the OHS Act and reads:-

> *"Any employer who does or omits to do an act, thereby causing any person to be injured at a workplace, or, in the case of a person employed by him, to be injured at any place in the course of his employment, or any user of plant or machinery who does or omits to do an act in connection with the use of plant or machinery, thereby causing any person to be injured, shall be guilty of an offence it that employer or user of plant or machinery, as the case may be, would respect of that act or omission have been guilty of the offence of culpable homicide had that act or omission cased the death of the said person, irrespective or whether the injury could have led to the death of such person, and on conviction be liable to a fine not exceeding R100 000 or to imprisonment not exceeding 2 years or to both such fine and such imprisonment."*

and in section of the Mine Health and Safety Act and reads:-

1. *"Any person, who, by a negligent act or by a negligent omission, causes serious injury or serious illness to a person at a mine, commits an offence.*
2. *Any person, other than an employer or employee, who, by a negligent act or by a negligent omission, endangers the health and safety of a person at a mine, commits an offence."*

Common Law

The common law is unwritten law, essentially inherited from Roman Dutch Law. Murder, rape and culpable homicide are examples of common law crimes. In the occupational health and safety arena, culpable homicide will come into play when there is a fatal accident at the workplace. It's a serious crime and can result in imprisonment. It generates a criminal record with all the negative consequences that accompanies such a criminal record.

The principle used by the courts to establish liability for this common law crime is the *"employer's duty of care"*, an objective criteria which is essentially the test for negligence. The court would be guided, in establishing negligence, by contraventions of the statutes which resulted in a fatality and, as far as the OHS Act is concerned, by the guidelines as contained in the definition of *"reasonably practicable"* . (Most duties placed on employers are tempered with "reasonability and "practicability". Reasonably practicable means:-

"Practicable having regard to-

a) the severity and scope of the hazard or risk concerned;

b) the state of knowledge reasonably available concerning that hazard or risk and of any means of removing or mitigating that hazard or risk;

c) the availability and suitability of means to remove or mitigate that hazard or risk; and

d) the cost of removing or mitigating that hazard or risk in relation to the benefits deriving there from.

Civil Law and the Electricity Act

Most case studies in South Africa emanate from civil suits against employers where persons, for example, persons are injured or killed due to the activities of employers. ESKOM, along with other undertakers, has recently being feeling the brunt of these civil suits as more and more legal organisations are prepared to act *pro bono* for plaintiffs. Civil action undertakers is compounded by the Electricity Act which presumes the undertaker to be negligent in any civil suits brought by a plaintiff. (The opposite applies in any other civil matters). Section 26 reads' *In any civil proceeding against an undertaker arising out of damage or injury caused by indiction oe electrolysis or in any other manner by means of electricity generated or transmitted by or leaking from plant or machinery, such damage or injury shall be presumed to have been caused by the negligence of the undertaker, unless the contrary is proved."*

Employees are prohibited from suing their employers (corporate bodies) and certain individuals in terms of section 35 of the Compensation for Occupational Injuries and Diseases Act (COID Act). This prohibition on civil suits by employees against employers was challenged in *Jooste v Score Supermarket Trading (Pty) Ltd* and held to be constitutional. Section 35 of the COID Act reads:-

1. *No action shall lie by an EMPLOYEE or any dependant OF AN EMPLOYEE for the recovery of damages in respect of ANY OCCUPATIONAL INJURY or disease resulting in the DISABLEMENT or death of such employee against such employee's employer, and no liability for compensation on the part of such EMPLOYER shall arise save under the provisions of THIS ACT in respect of such DISABLEMENT or death.*
2. *For the purposes of subsection (1) a person referred to in section 56(1)(b), (c) (d) and (e) shall be deemed to be an employer"*

The following "human" employers also enjoy a civil indemnity vis-à-vis employees:

A) An EMPLOYEE charged by the employer with the management or control of the BUSINESS or of any branch or department thereof;

B) An employee who has the right to engage or discharge employees on behalf of the employer;

C) An engineer appointed to be in general charge of machinery) or of a person appointed to assist such engineer in terms of any REGULATION made under the MINERALS ACT, 1991 (Act 50 of 1991); or

D) A person appointed to be in charge of machinery in terms of any regulation made under the Occupational Health & Safety Act, 1993 (Act 85 of 1993), the employee may, notwithstanding any provision to the contrary contained in THIS ACT, apply to the COMMISSIONER for increased COMPENSATION in addition to the compensation normally payable in terms of this Act.

OHS CASE STUDIES

Shkosana v Eskom 1999
Grootboom v Graaff-Reinet Municipality 2001
Spoornet V Serfontein ans Another 1999

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(Refer to the Klass Looch website: www.klasslooch.com)

Klass Looch Associates offers a variety of innovative and attractive products which include In-House Seminars, Open seminars All-Costs Retainers (Legal Representation & Advice), Guideline to the OHS Act and an On-Line Legal Advice Subscription Service.

ELECTRICITY DISTRIBUTION INDUSTRY RESTRUCTURING: RINGFENCING AND ASSET VALUATION

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1. Introduction

The Electricity Supply Industry (ESI) in South Africa is poised for fundamental change. The impetus for this change stems from a commitment by Government to implement its policy of restructuring the industry, the guiding principles of which are embodied in the White Paper on Energy Policy. A key objective of the restructuring policy is to achieve a combination of increased competitiveness and focused regulation to ensure a self-sustaining industry ultimately serving to benefit the electricity customers.

The restructuring of the electricity distribution sector has been at the forefront of the ESI transformation over the past decade culminating in a comprehensive sector-restructuring plan being developed for implementation. This plan will see the integration of several hundred electricity distributors (including the electricity businesses of municipalities and Eskom Distribution) into six Regional Electricity Distributors (REDs).

The Department of Minerals and Energy in South Africa has formulated the steps and the time frames to be followed for the restructuring of the Electricity Distribution Industry (EDI). Some of the first activities to be undertaken by municipalities and Eskom will involve the *ringfencing* and *asset valuation* of the electricity departments.

This paper has been written to focus on the ringfencing and asset valuation of municipal electricity distributors. Whilst the general principles developed in the paper will be valid for municipalities and Eskom, there will be differences of emphasis that may lead to differences in the detail of the processes adopted by these two groups of distributors.

Ringfencing of electricity business from within integrated structures such as municipalities is not unique. Similar processes have been undertaken in Australia, Canada and parts of Eastern Europe but the scale and context of the South African EDI poses unique challenges.

Asset valuation approaches are relatively well developed and have been successfully used in a variety of countries worldwide. As in the case of ringfencing though, the specific set of key objectives outlined in the White Paper on Energy Policy as well as the unique structure of the South African EDI warrant the development of an asset valuation approach that is suited to the local context.

In this paper we outline the processes of *ringfencing* and *asset valuation* of the electricity distribution assets in preparation for incorporation into the REDs. The paper starts off by defining ringfencing and outlining the key drivers to ringfencing and the various options open to municipalities and Eskom. This is followed by a description of two asset valuation methodologies namely the Depreciated Replacement Cost (DRC) and Discounted Cash Flow (DCF) methodologies.

2. Ringfencing

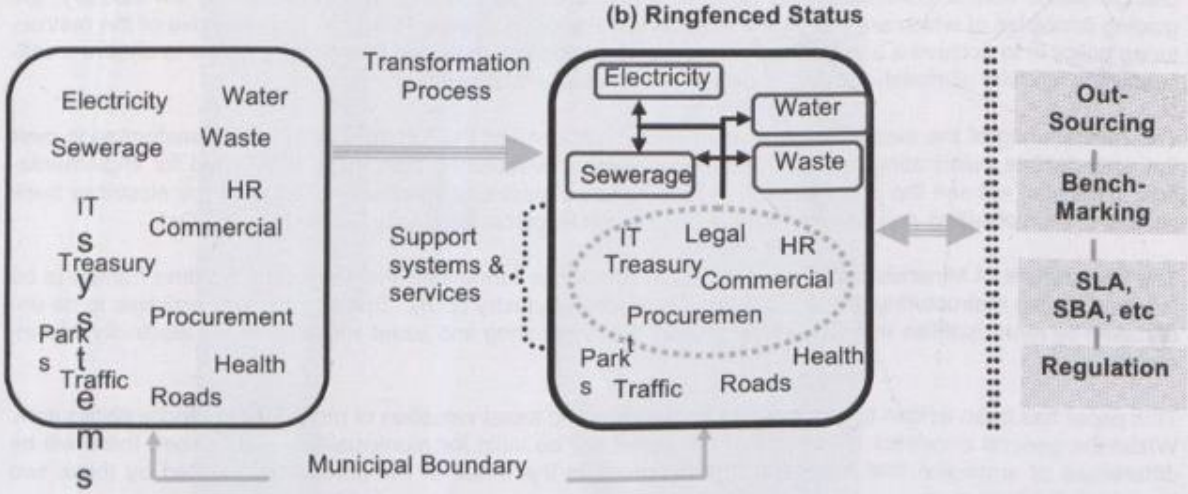
Ringfencing has been defined as *"the identification and isolation of the activities, assets, costs, revenues and community service obligations of services that are provided by an integrated entity, where such services traditionally have been delivered in a limited competitive environment."*[1]

Figure 1 provides an illustration of the concept of ringfencing. In Figure 1(a) a typical municipality providing integrated services within the municipal geographical area is illustrated. In many municipalities, the income from electricity service is used to subsidise the other services within the municipality. . The electricity income is a contribution to the central treasury fund as is the income from other services such as water, waste, etc. In addition, the threat of electricity cut-offs is utilised by the municipality as a leverage to encourage ratepayers to pay the rates, which otherwise would be difficult to enforce effectively.

The municipal accounting system functions on the basis of a *fund accounting system*. In this system, there is no explicit provision for depreciation of assets. The various service departments obtain loans through the treasury in order to execute their approved capital expenditure programmes.

Figure 1(b) provides an illustration of a municipality that has undergone a process of ringfencing of the electricity, water, waste and sewerage services. Here, common support services may be provided centrally on a shared basis and charged to the ringfenced service departments or business units.

Figure 1: Illustration of Ringfencing



Whilst the ringfencing of the electricity distribution industry is a requirement of the restructuring process imposed by the Regulator, municipalities should use the process as an opportunity to maximise the value of their electricity business prior to being incorporated into the REDs. Whilst their interests may become increasingly divergent over time, it is essential that all the role players particular political representatives, council members, labour and the members of the electricity departments work together in formulating the most appropriate strategy for ringfencing.

When embarking on a ringfencing process, the entity should ensure that the following key objectives are achieved:

- Identification of relevant components of business including consideration of shared services, outsourcing of services, etc. with due regard for the possibility of creating stranded assets. A critical consideration is the accountability for billing, collection and other MIS either through separate systems or via shared service agreements
- Preparation for Incorporation into REDs by maximising the value of the electricity business, maximising opportunities for staff redeployment into REDs and maximising the voice of the municipality in the RED
- Enhancement of the ability to measure true financial performance accompanied by the development of commercial benchmarking and efficiency drivers
- Enhancement of cost reflective pricing and the transparency of cross-subsidisation
- Identification of the financial impact of ringfencing and restructuring on the municipality.

The ringfencing of the services can take various forms depending on the size of the municipality and the particular mix of objectives behind the ringfencing process.

Ringfencing can be conducted through four progressive stages:

Stage 1: Financial Ringfencing

This involves the identification of the revenue, costs, assets and liabilities with the result being the creation of separate asset registers, financial statements (compliant with GAMAP), budgets and management reports for the electricity distribution business. This stage will require assets to be revalued on the basis of depreciated replacements costs instead of historical costs and the revalued assets used for balance sheet and depreciation purposes. It is important to introduce at this stage efficiency drivers and performance benchmarks.

Stage 2: Operational Ringfencing

Operational ringfencing involves the separation of the operations of the ringfenced business from the integrated entity with the result that the ringfenced business is accountable for all its operational activities. It is critical that in this stage, the shared services and outsourcing arrangements are identified and costs for these are properly allocated. The operational and financial ringfencing will usually go hand-in-hand

Stage 3: Legal Ringfencing

Legal ringfencing involves the creation of a separate legal entity for the ringfenced service and would typically require corporatisation of the ringfenced activities. In this stage, the ringfencing should include enforceable Service Level Agreements, Sale of Business Agreements, regulatory obligations, etc. Close attention should be paid to the potential tax liabilities. In general, obtaining opening balances will be a difficult problem and will require negotiations between the new ringfenced unit and the municipality. In the case of Stage 3 Ringfencing, the financial statements can be utilised as a measure of the financial position of the new legal entity and could form the basis of obtaining commercial loans for capital expenditure.

Stage 4: Ownership Ringfencing

Ownership ringfencing involves the transfer of ownership to a new owner as will take place when the assets of the ringfenced electricity business is transferred to the RED. The shareholding of the municipality in the RED will be determined by the value of the assets contributed by the municipality to the RED.

In order to be in a position for integration into a RED it is necessary that the municipalities achieve at least Financial and Operational ringfencing of their electricity businesses prior to "Day 1" of REDs.

3. Asset valuation

An important requirement in the ringfencing is the assignment of a monetary value to those assets that form part of the ringfenced entity. There are at least four possible purposes for valuation of assets:

- to determine fair compensation to the current owners upon transfer of its assets into the RED
- for financial reporting, management accounting and internal control
- for regulatory purposes and tariff setting
- for determining tax allowances.

Since these applications have distinct legal, regulatory, industry best-practice and practical requirements, it is necessary that the different valuation approaches be investigated and appropriately applied for each purpose. Currently, most municipalities use historical costs in determining the book value of their assets. These book values are often linked directly to the outstanding loan values associated with the assets and usually bear little relationships to the expected technical life of the asset.

In the next section, we investigate the Depreciated Replacement Cost (DRC) and the Discounted Cash Flow (DCF) valuation methodologies and make recommendations regarding the use of these methods for each of the applications listed above.

3.1 Depreciated Replacement Cost Methodology

The Depreciated Replacement Cost (DRC) methodology is a well-known and widely used approach to the valuation of assets. The methodology focuses on the physical attributes of the assets and provides an estimate of what the assets would cost to replace at today's prices and using today's technology, adjusted for the age and condition of the assets.

To the current owners, the DRC value can provide an estimate of the remaining value of the assets based on its remaining life. To a potential purchaser of the assets, the DRC gives a value of the amount that he/she would need to invest in order to physically reconstruct assets with the same physical attributes.

The following are the steps in the DRC methodology:

Step 1: Calibrate the methodology in terms of purpose, timing and basis of the valuation

Step 2: Obtain an inventory of the assets including an assessment of age, condition, function and technology employed

Step 3: Based on the asset inventory develop representative asset classes, types and expected lifetimes engineering lives of each asset type. The expected lifetimes remaining lives of the assets can be developed on the basis of deterministic lifetimes engineering lives or probabilistic (survivor curve) analysis

Step 4 Conduct technical due diligence involving an investigation into the technical performance of the system, the asset utilisation, loading, load forecast, system development plans and an identification of stranded assets

Step 5: Derive an optimal equivalent system in which a fictitious 'optimised' equivalent asset base is developed to perform the same function but modified for over-design, over-capacity and redundant assets

Step 6: Determine replacement values for each asset type and derive gross replacement values. Care should be taken to consider the total installed costs and inclusion of costs such as Interest During Construction, design and project management costs and corporate overhead costs

Step 7: Apply depreciation to the gross replacement values for each asset type based on straight-line depreciation. Consideration should be given to the residual values of assets

Step 8: Determine the Optimised Depreciated Optimised Replacement Costs valuation (DORC).

In many jurisdictions a further step, which involves the application of an "economic valuation (EV) test", is introduced. n many jurisdictions a further step is introduced and that is to apply the "economic valuation" or EV test. In this step process the value of the network, or portion of the network, is the lower of the DORC and the EV. The EV being the economic value of the asset is the value to the owner should he/she be *deprived* of the assets. and in practice the EV is determined by evaluating alternative methods of providing the same service to the customers. This process is known as Optimised Deprival Replacement Cost valuation (ODRC).

The above methodology is a comprehensive DRC valuation approach that includes optimisation. It can provide a very useful tool for regulators in assessing tariffs. The data requirements are however very high and the development of an 'optimised' equivalent asset base requires highly skilled resources. The optimised DRC approach may be appropriate in a mature industry with well-developed asset registers and well-defined analytical processes for evaluating over-design, capacity and redundant assets. However, in the context of the South African EDI the use of optimisation is at this stage impractical. We would therefore recommend that Steps 4 and 5 be eliminated and a non-optimised DRC approach be utilised.

In this simplified DRC approach, Step 2 is the most intensive process, requiring most resources. We have developed two methodologies to accommodate the fact that some distributors will have more detailed data than others. The first methodology uses detailed data available from those distributors that have such data and applies the data in a spreadsheet model in order to calculate the DRC of the assets. The second methodology has been developed in order to value the assets of those distributors that have minimal data. This "proxy" approach is applied to distributors with limited technical asset data and distributors with no technical data.

3.2 Discounted Cash Flow Methodology

The Discounted Cash Flow (DCF) methodology of asset valuation is based on developing a financial model of the electricity entity over a horizon period (typically 20 years) taking into account the current and future income stream potential of the assets and the associated costs. The value of the assets is determined by calculating the Present Value of the profit stream. In some respects this process can be likened to the EV test described above.

The DCF financial model is based on a specific income statement format compliant with GAAP and GAMAP but adapted for practical use. The components of the model are as follows:

Revenue
The revenue is composed of two main elements namely:

- Electricity revenue from electricity sales, which is a factor of the number of customers and the demand and consumption details.
- Other revenue such as service charges, connection fees, subsidies, grants and capital contributions.

Cost of Sales (COS)

Cost of sales is the purchase price for bulk energy

Revenue – Cost of Sales = Gross Margin

Operating Expenses (Opex)

Operating expenses include labour cost, maintenance and administrative costs and general expenses.

Depreciation
The depreciation is the incremental decrease in book value of the assets based depreciated replacement values.

Gross Margin – Opex – Depreciation = Net Profit before Interest and Tax (NPBIT)

Interest

Interest is calculated on existing loans directly associated with the exisitng assets as well as loans on future assets

Tax

This is the tax that the electricity entity will be subjected to.

NPBIT – Interest – Tax = Net Operating Profit After Tax (NOPAT)

The estimated future stream of *NOPAT* is discounted at a suitable rate and summed to arrive at the present value (PV) of the income stream that is equal to the asset value of the business.

The DCF methodology as described is founded on forecasting of parameters and performance over a long period and is of necessity riddled with uncertainty particularly when forecasting growth, demand patterns, tariffs and performance. This uncertainty can lend itself to abuse and manipulation and can make monitoring, regulation and control very difficult.

These problems make the DCF methodology unsuitable for financial reporting, tax allowances and for tariff determination.

From the foregoing analysis it is tempting to dismiss the DCF approach altogether. However, the DCF methodology can be adapted to provide a simple yet powerful and practical methodology to determine the fair compensation due to the current owners, in the form of shareholdings in the REDs. The shareholding of distributor *i* in a RED will be determined by the following formula:

$$Shareholding_i = \frac{Value\ for\ distributor\ i}{\sum Value\ for\ all\ distributors\ in\ RED} \quad \{1\}$$

Since the shareholding will be determined from the relative values of the assets, any revenue or cost elements common to all distributors within the RED (such as bulk tariff) can be ignored.

In the simplified DCF methodology developed by PB Power, the assets are modelled as they would be in the RED once transfer has been effected. Thus, standardised costs and tariffs per customer category can be applied to the financial model. The tariffs should be based on cost reflective tariffs adjusted for subsidies such as those for rural and electrification customers. In addition, adjustments for effects such as collection rates and non-technical losses can easily be incorporated in the DCF.

We further assume that the relative differences in demand growth over the horizon period are too difficult to model accurately and in most cases will be small enough to ignore.

Based on the above assumptions, the simplified DCF is composed of the following steps:

Step 1: Calibrate the methodology in terms of purpose, timing and basis of the valuation

Step 2: Develop standardised customer categories within the RED C={C1,C2...Cn)

Step 3: Develop standardised cost reflective tariffs witing the RED T={T1,T2...Tn)

Step 4: Adjust tariffs to account for subsidies based within RED T'={T1',T2'...Tn')

Step 5: Adjust to account for collection rates and non-technical losses

Step 6: Develop standardised operating expenditure per customer category K={K1, K2,...Kn)

Step 7: Obtain age and condition profile of current assets

Step 8: Obtain standard lifetimes for assets

Step 9: Develop a specific capital replacement programme for the distributor

Step 10: Calculate the value of the assets where value = PV{PBIT)

Step 11: Calculate the shareholding using equation (1)

This simplified DCF requires the development of standardised customer categories, cost reflective tariffs, operating expenses and standardised lifetimes of assets within the RED. However, in order to complete Step 9, the age and condition of the assets are required as in the case of the simplified DRC. Thus, the simplified DCF requires the asset data from the simplified DRC although in somewhat less detail.

3.3 Comparison of DRC and DCF Methodologies for Shareholding Determination

Table 2 illustrates a comparison between the DRC and DCF methodologies for the determination of the fair compensation to existing owners.

The two methodologies possess different strengths and weaknesses and are in fact complementary. The DRC is focused on providing a snapshot valuation of the 'wires' side while the DCF is focused on providing a valuation of the 'retail' side of the distributor business. Both aspects are important in obtaining an overall value of the business. It is thus suggested that a combination of these two methods be used to obtain an overall valuation for fair compensation.

Table 2: Comparison between DRC and DCF methodologies for shareholding determination

Test Parameter	**Simplified DRC**	**Simplified DCF**
Customer mix	Not considered. Shortcoming	Reflects the income potential per customer category
Tariffs	Not considered. Shortcoming	Utilises cost reflective tariffs
Condition	Reflected in depreciation	Reflected in depreciation and interest on capital replacement costs
Age	Reflected in depreciation	Reflected in depreciation and interest on capital replacement costs
Future Capital Expansion	Capital expansion not modelled. Shortcoming	Capital expansion not modelled. Shortcoming
Future Capital Replacement	Capital replacement requirements are not modelled.	Reflected in depreciation and interest on capital replacement costs
Location (Rural/Urban)	Not considered. Shortcoming	Rural/urban effects (including subsidies) are modelled in tariffs and Opex.
Bulk tariff	Not Considered. Not a shortcoming	Considered
Load growth	Not considered. Shortcoming	Not Considered. Shortcoming
Debts, Grants, Capital Contributions	Can be considered	Can be considered
Utilisation	Full utilisation assumed. Shortcoming	Actual utilisation considered. Reserve capacity ignored.
Losses (tech, non-tech, non-payment)	Not considered Shortcoming	Considers losses
Technical Specifications, Technology and Design employed	Considered	Largely ignored Shortcoming
Opex	Not considered. Shortcoming	Standardised Opex/per customer category

4. Conclusions

In this paper we have described two key processes of EDI restructuring, namely *Ringfencing* and *Asset Valuation* of the electrical distribution entities and assets.

The main drivers behind ringfencing have been discussed and the ringfencing options available have been presented. Two methods of asset valuation have been outlined namely the Depreciated Replacement Cost (DRC) and the Discounted Cash Flow (DCF) Methodologies.

The optimised DRC approach may be appropriate in the future for regulatory and tariff setting purposes but is not suitable for application in the current South African EDI context. The simplified DRC methodology is appropriate for the purposes of financial reporting, tariff determination and determination of tax allowances. The simplified DRC provides a good measure of the value of the 'wires' side of the business but does not reflect the value of the 'retail' side.

The DCF methodology does provide a good measure of the value of the 'retail' side of the business. The DCF methodology has inherent problems that make it unsuitable for use in financial reporting, tariff setting and the determination of tax allowances. The simplified DCF is however a powerful yet practical approach that overcomes some of the inherent weaknesses in the simplified DRC approach for determination of fair compensation. Thus, for the determination of fair compensation to existing owners, we propose that a combination of the simplified DRC and simplified DCF methodologies be used.

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Ron Millard

LIVE WORK MAINTENANCE PRACTICES: A DESCRIPTION OF THE DIFFERENT METHODS THAT ARE USED, THE RISKS INVOLVED AND THE BENEFITS TO BE DERIVED THEREOF

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1. Introduction

Live work involves maintenance, repair, building or construction work carried out on live and operational apparatus using approved techniques and equipment. It is the preferred method of maintenance where system integrity, system reliability, and operating revenues are at a premium and removal of the circuit from service is not acceptable. Live work may also be beneficial in construction and storm damage repair. Furthermore, it is necessary and unavoidable in some cases, such as stringing over or under energized circuits or adjacent to parallel energized circuits.

2. Historical Notes

Live work is sometimes considered a recent development in the electrical power industry. However, forerunners of modern insulating tools made their appearance as far back as 1913. These initial tools were homemade, crude, and bulky; still, they launched the development of the efficient and refined tools that are used by utilities today. These tools were first accepted for work on lines up to 34 kV; however, many linemen were hesitant to perform live work at this voltage. Because of this reluctance, many companies initially restricted live work up to 22 kV. Linemen began to acquire confidence in performing live work when they realized that the tools always kept them at a safe distance from energized parts. Restrictions were gradually relaxed, until by 1930 several utilities were permitting live work operations on 66 kV lines. The permitted voltage limit soon rose to 110 kV, and in the late 1930s the astonishing news was circulated that an American West Coast line of 220 kV had been successfully worked energized. At present live work is performed on voltages up to 765kV transmission lines.

Live work was implemented in South Africa in the early 1970s.

3. Live Working Methods

There are three basic methods that are used in live working namely Gloving, Stick and Barehand Methods.

3.1 Gloving Method

This is the method used in live working whereby live workers use insulating gloves, sleeves as their primary personal protective equipment while working on live equipment. It is applicable to Distribution voltages of up to 33kV.

Insulating blankets, line hose, barriers are used as secondary protection to prevent electrical shock should inadvertent contact with live equipment around the worker occur.

Insulating ladders, platforms pedestal mounted ladders and aerial devices are used for access.

Figure 1. Gloving Method working from an Insulating Platform

Figure 2. Gloving Method working from an Insulating Aerial Device.

3.2 Stick Method

This is the method used in live working whereby live workers at ground potential or floating maintain a specified distance from live parts and carry out their work using tools that are attached to insulating poles or sticks.

The workers relay mainly on the insulating integrity of the poles or sticks for their protection and either work from the structure or use an insulating aerial device for access.

This method is for practical purpose applicable to voltages up to 132kV.

Figure 3. Stick Method working from the structure

3.3 Barehand Method

This is the method used in live working whereby a live worker is in direct contact with energized parts and separated from ground by air and/or insulating equipment. Barehand work can be performed from an insulating ladder, insulating aerial device or helicopter.

In this method conductive clothing is used in the suit, gloves socks and boots.

This method is applicable to voltages from 66kV and more.

Figure 4. Barehand Method working from the insulating ladder

4. Risks involved in Live Working

4.1 Electrocution.

The major risk in performing live work is electrocution. This can be caused by;
a) Using a defective tool or equipment.
b) Deviation from the safe work procedure.
c) Encroaching on the safe working distance.

4.2 Height.

The other risk that live workers are exposed to is falling from heights. This can be caused by using defective access equipment such as:
a) Ladders.
b) Aerial device.
c) Platforms.
d) Fall arrest system.

NOTE: National and International Standards and Specification are available to guide us on ways to reduce these risks.

5. Benefits of Live Work

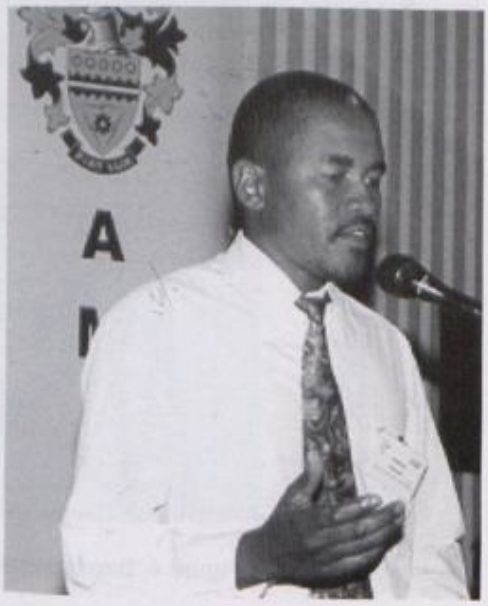
The benefits of live work are:
a) Greater flexibility of Maintenance Management.
b) Enhance the Quality of Power Supply.
c) Increase the Reliability of the System.
d) Increase the Efficiency of the System.
e) Optimize the Generation Facility.
f) Increase Turnover.
g) Reduce Operating and Maintenance Costs.
h) Increase Safety of Operation.
i) Maintain Continuity of Service to Customers.
j) Reduce the planned outage maintenance.

6. Conclusion

Live work has been practised in South Africa for more than 20 years. The standard of work is as anywhere in the World if not better.

The national utility (Eskom) is associated with international institutes such as EPRI (Electric Power Research Institute) for the development.

This also helps the utility easily adopt new technology. Eskom as a National Utility and its customers have benefited a lot from live working so can anyone who implements it.



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Overview of Customer Perception Studies in Eskom

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Abstract

Eskom has been measuring satisfaction regarding issues important to customers since 1994. A range of surveys are conducted, each focussing on specific customer groups or segments and the frequencies of measurement are either monthly, quarterly or annually.

This paper provides an overview of the various measures used in Eskom, namely the design, execution and most importantly – the use of results in the business. Examples of results, as well as action plans implemented to address certain issues, will be shared.

The objective of customer perception measurement in Eskom is to guide the development of appropriate action plans to improve service. In order to remain successful in the electricity distribution industry in future, it is essential to ensure that customers are satisfied with the service received.

1. Background

Since 1994 Eskom has designed and implemented several customer satisfaction measurement tools. The results of these perception studies are reported at all levels within the organisation, from Management Board level through to the Customer Service Areas within the various Regions. High-level results are used as Key Performance Indicators (KPIs) to track and measure performance in monthly reports, together with other factors such as technical, financial and human resources indicators.

2. Content of Paper

The paper starts off with some background regarding customer perception in general. It then provides information regarding the use of the measures within Eskom, together with some reporting examples. Each of the various studies is explained in brief, with some high-level results provided. Lastly examples of action plans implemented to address specific service aspects will be shared for example the "value for money" campaign designed to address negative perceptions about pricing. The paper ends with a summary and conclusion.

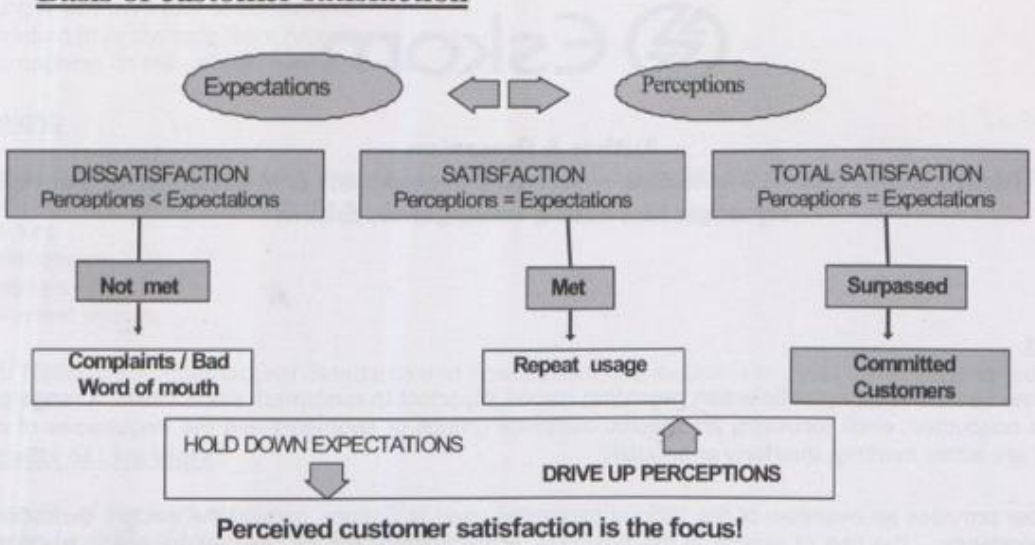
3. Customer Perception

It might be asked why customer perception is important and why this should be measured.

3.1. Basis of customer satisfaction

As indicated in Diagram 1 below, customer satisfaction is based upon customer expectations of what to expect versus customer perceptions regarding the service actually received. As satisfaction sets in when expectations are either met or exceeded, the main focus should be on holding down expectations to realistic levels, thereby driving up perceptions.

Diagram 1



3.2. Factors determining customer perception

It is however important to keep in mind that customer perception is formed over time and is influenced by various different factors. A study conducted by JD Power & Associates, a utility in the US, indicated that customer perception within their residential market is made up as follows:

- Company image 40%
- Price & Value 30%
- Power Quality & Reliability 17%
- Billing & Payment 8%
- Customer Service 5%.

When attempting to address and improve customer perceptions it is therefore important to keep the factors that influence these perceptions in mind. It is interesting that company image, price and power quality made up almost 90% of the overall perception of the above utility.

3.3. Importance of service excellence

The importance of service excellence has been proven in a research study completed early 2002 by the Institute of Customer Service in the UK. This study found that:
Service excellence = Reputation = Increased profits

These findings were based on focus groups and interviews conducted with managers from various organisations in both the public and private sector. Customers were requested to identify companies that had a reputation for excellent or poor service. These organisations were evaluated in terms of relative size, productivity and profitability. It was found that those organisations with a better reputation had a much better profitability (74%).

The importance of delivering excellent service in order to increase profitability is summarised in the key findings below:

- Reputation attracts customers
- Reputation is based on experience rather than image

Customers say that service excellence is about being easy to do business with. This involves delivering promises, providing a personal touch, going the extra mile and resolving problems well.

3.4. Factors influencing customer perception negatively

When analysing customer satisfaction results, it is furthermore important to take note that there are several factors that could lead to a decline. The first cause that comes to mind is worse service delivery, but there are other factors as well, namely:

- Improved service of other companies your customer deals with
- Increased customer expectations in terms of service delivery (today customers expect much more in terms of service delivery than a few years ago)
- Low staff morale and negativity
- Changes in the way that service is delivered (initially this will have a negative impact until staff and customers adapt to the change).

4. Customer Surveys in Eskom

The following surveys have been designed and implemented within Eskom:

- MaxiCare/ PreCare
  - This study tracks the trend of various service aspects on a monthly basis.
- Enhanced MaxiCare/ PreCare
  - This study is more reflective of the absolute level of customer satisfaction, as it measures both importance and performance regarding more detailed service aspects.
- KeyCare
  - This measurement is based on the enhanced methodology and targets Eskom's key customers.
- CallCare and Executive Action Team (EAT)
  - This measurement target customers who phoned the contact centres and highlights the "customer interface" versus the follow-up service.
- NetCare and GenCare
  - These tools measure the service of the Transmission group in Eskom to the Distribution and Generation groups respectively.

4.1. Value of Eskom's measurement tools

The value and benefit of the measurement tools are as follows:

- The tools have been designed specifically for Eskom with the assistance of consultants.
- It provides an independent measurement of customer perceptions.
- It measures those service aspects that are most important to customers.
- The regular measurements allow for the trend to be monitored.
- It provides results by Customer Service Area and customer category (segment) to use as Key Performance Indicator (KPI) at the lowest level, and at Eskom level for the higher level KPIs.
- A specific database and reporting system have been developed that provides invaluable history.
- Analyses of results assist in determining priorities for improving customer service.
- The instruments are adaptable over time to ensure it remains valid.
- It is cost effective; as no royalty fees are payable and contracts are one year contracts with research houses are entered into for fieldwork and capturing.

4.2. How surveys are designed and conducted

The broad process followed for the development of the measurement tools are outlined below:

- Design
  - The tools are designed specifically for Eskom by the Strategic Marketing Intelligence Department, with assistance of consultants.
  - In-depth interviews with customers regarding the needs in terms of service delivery form the basis of the questionnaires.
  - The requirements of the business are also taken into account by means of workshops/ interviews with relevant managers and front-line staff before finalising questionnaires.
  - The initial questionnaire is designed from above mentioned input and an initial survey conducted with a representative sample of customers.
  - Statistical analysis of the data from this initial survey is done in order to finalise the questionnaire that it used for regular measurements.
  - The database, capturing and reporting system is designed and maintained by Eskom's IT capability (Arivia).
- Measurement
  - Fieldwork and capturing is contracted out to a research house in order to maintain independence.
  - Strategic Marketing Intelligence analyses and reports the results to the organisation.
- Update
  - The tools are updated over time to ensure that the tools remain valid in a changing environment.

4.3. Use of the customer satisfaction surveys

Firstly the results of the various customer satisfaction surveys are used as Key Performance Indicator in monthly business meetings at area, regional and national levels. Results are monitored and discussed in order to decide on action plans to correct negative trends, both at regional and national level. Detailed customer comments and customer requests for follow-ups are sent to line managers.

Furthermore results are a component of indexes that form the basis of performance bonus allocations, namely the Eskom Board Sustainability Index and the Distribution Customer Service Index. Within these Indexes each measurement tool has a specific weight and specific targets are set to achieve, based on historic results.

5. MaxiCare and PreCare

The MaxiCare and PreCare tools have been implemented and conducted on a monthly basis since March 1994.

5.1. Segments measured

MaxiCare measures the perception of established direct Eskom customers with various ongoing service issues. The customer categories (segments) measured are Agriculture, Industry (both Technical and Administrative interfaces with each company), Commercial (same interfaces as for Industry) and Residential Prepaid Townships and Residential Directly Billed Townships.

PreCare measures the perception of newly electrified customers or those who have changed their contracts with Eskom and had work done on their premises. These questionnaires focus on the process of getting connected and the work being done, rather than ongoing service aspects. The customer categories measured are Residential (newly electrified townships) and Agriculture/ Industry/ Commercial.

5.2. Measurement methodology

Telephonic interviews are conducted within the Agriculture, Industry and Commercial segments. Customer details are downloaded from the Eskom customer database per Customer Service Area (lowest geographic level reported).

The interviewers select the sample of customers to interview from these lists. Once the customer/ company is phoned, the correct person who has contact with Eskom is identified for interviewing purposes.

Personal interviews are conducted within the Residential Townships, due to the low incidence of telephones. In order to make this practical, each of the Customer Service Areas nominates six townships to be measured. These townships are divided into three groups, each group being interviewed once per quarter. The interviewers travel to the selected townships and once within the town, selects specific households to interview. Care is taken to spread interviews throughout the township. Once a household is selected, the interviewer identifies the head of the household who makes decisions regarding electricity to conduct the interview with.

Normal research back-checking and editing procedures are followed before the data is captured on to Eskom's system that is installed at the research house.

5.3. Sampling strategy

The sampling strategy was designed by a statistician and is based on Control Chart Theory, implying that small samples are used at the lowest level, but that regular measurements need to be conducted and the trend needs to be monitored over time to identify irregularities.

For the telephonic interviews sample sizes at the lowest level are 5 interviews per month per areas, per customer segment. For the Residential segment where personal interviews are conducted, the sample size is ten per township per month. For the MaxiCare and PreCare measures alone Eskom conducts roughly 6 600 telephonic and 6 000 personal interviews per year.

5.4. Questionnaires

Customers rate Eskom on about ten service statements, using a 10-point scale, where 10 is excellent and 1 very poor. Examples of the statements are:

- "Accounts from Eskom are accurate"
- "Eskom electricity has minimal interruptions"

"Eskom informs you in advance of planned supply interruptions".

Thereafter customers are asked "drill down" questions regarding those aspects rated the lowest, in order to get information as to why these aspects were rated low. Furthermore customers are asked an open-ended question as to what Eskom could do to improve its service.

5.5. Reporting

Results are reported to management in spreadsheet and graphic format at various levels of detail. Reports listing the comments made by customers, as well as the details of those customers who need to be contacted, are provided as well.

6. Enhanced MaxiCare and PreCare

As mentioned, the tools are revised every few years to ensure it remains valid. Since the monthly MaxiCare and PreCare study was introduced in 1994, there was an improvement in customer satisfaction models internationally. Furthermore there were changes in the industry in terms of a greater emphasis on a service culture and new and refined customer needs. It was deemed necessary to enhance the existing tools in 1999 to ensure more detailed, actionable results and to keep up with the changes.

6.1 Overview of enhanced measure

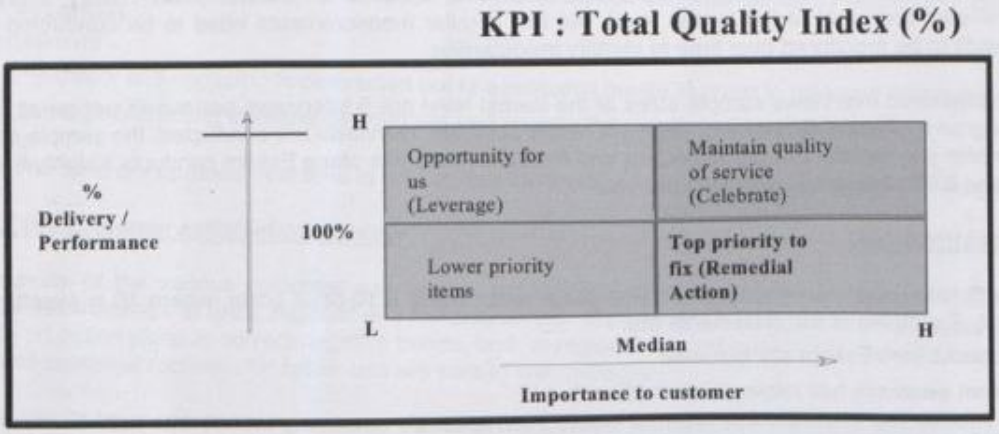
The enhanced measure is a more detailed measure than the original measure and differs in the following ways:

- It uses an emotional scale where customers use words to rate each of the service aspects.
- Customers rate both the importance and the performance of each of the service statements.
- Calculations are done by using statistically determined numeric values that are linked to each of the words in the scale.

- The % delivery on each service aspect is calculated where 100% indicates that customer expectations were exactly met.
- Results are plotted on a service quality action matrix, indicated Diagram 2 below.
- The total quality index (TQI) is calculated, indicated the weighted % delivery overall.
- Since the year 2000 to date measurements have been conducted once per year, with a total of 6 000 interviews per measure.
- The questionnaires consist of about 30 statements that customers have to rate twice (importance and performance)

Diagram 2

Service Quality Action Matrix



7. KeyCare

KeyCare is based on the enhanced MaxiCare methodology and measures the satisfaction of Eskom's key customers, of which there are about 120. The tool was designed and implemented in 1996 and then enhanced and updated in 2000. The survey has been conducted annually up to 2001 and monthly since January 2002. Telephonic interviews are conducted at three interfaces at each plant, namely:

- General Manager
- Engineering
- Accounting.

As these key customers receive personalised service from a specific Eskom Key Customer Executive, results are reported per customer, if permission is granted by the customer.

7.1. Questionnaires

Key Customers rate the importance of various aspects of Eskom's service on about 10 to 14 statements. Customers are requested to elaborate on low ratings given and everyone is asked to recommend what Eskom can do to improve its service.

Examples of statements in these questionnaires are:

- General Manager (strategic interface)
  - How reliable Eskom is as business partner
  - How well Eskom treats your company as long-term partner in its business planning

- Engineering (technical interface)
  - How well Eskom's quality of supply meets the agreed standard
  - How well Eskom understands the effect of unstable supply on your business
- Accounting (accounts interface)
  - The extent to which Eskom ensures that statements are clear and detailed enough to meet our requirements
  - How efficiently Eskom deals with your account queries

8. CallCare and Executive Action Team (EAT)

The CallCare and Executive Action Team (EAT) measurement instruments were designed and implemented in 2001. This tool measures the satisfaction of customers with the service received from the Contact Centres and EAT, as well as the follow-up service to resolve the query. The EAT is a desk at Eskom's head office that deals with all escalated queries and those queries directed at the Executive Director's office.

Quarterly measurements are conducted, although fieldwork is spread evenly throughout the quarter. The list of customers who phoned the contact centres and EAT in the previous week is downloaded and used for sampling purposes every week. A total of 200 interviews for each of Eskom's 7 Contact Centres and 50 interviews for EAT is conducted every quarter. The sample is proportionally spread across the type of interaction logged to ensure that individual Contact Centres receive feedback on all types of queries handled.

Detailed results are reported to each of the Contact Centres to analyse and action upon. It is also important to keep in mind that the follow-up service is also rated and impacts greatly on how the customer experiences the service received via the Contact Centre. It is therefor important to report results to al departments involved in following up requests logged by the Contact Centre.

8.1. Questionnaire

Customers rate various service aspects, using the 10-point scale as in the monthly MaxiCare tool. Customers rate the service received in three separate sections, namely:

- Contact Centre service delivery
- Follow-up service delivery
- Overall service delivery.

As with the other tools customers are asked to comment on low ratings and to recommend what could be done to improve service.

9. Examples of action plans

Results from the customer satisfaction surveys are used by the business to identify which aspects of service need to be improved. It also assists in the prioritisation of actions plans, and once implemented, the success of the intervention can be tracked by means of the trend in satisfaction results regarding that specific service aspect.

It is however important to keep in mind that customer perceptions do not change immediately, and one good experience will not counteract a long period of bad experiences immediately. The successes of interventions are therefore not necessarily immediately noticeable in the results. There might also not be a direct correlation between an intervention and the results, as there are many factors influencing customer perceptions.

9.1. Action plans per main service aspect (Bedrock Factor)

On the following page is a list of improvements in service that Eskom has made to address specific aspects of service.

Service Aspect	Improvement implemented
Quality of Supply	Engineering is becoming involved in analysing results and identifying action plans. Pilot studies of specific "problem" lines are being done to determine the factors that influence performance and how it could be improved.
Outage Management	• An outage management system that allows for outages to be tracked and managed better. Customers can log onto Eskom's CSOnline website and get details of scheduled outages in their area. • Mobile Data Terminals have been installed to assist with feedback from frontline staff back to the Works Management Centre and Contact Centre to indicate progress on faults being fixed.
Accounts	• Payment via 3rd party collectors (EasyPay, Post Office) to facilitate easier, more convenient payment options • New bill format introduced
Communication	Contact Centre CRM improvements made to increase the service levels, as this is the main interface with customers: • Improved answering service to facilitate improved interactions, • Balance enquires via Interactive Voice Response • SMS interaction channels for outage notification and payment reminders, • Workforce management process to schedule resources to meet forecasted workloads on a national basis, • Outbound dialing process introduced where customers are phoned by the system and connected to the agent when they answer.

9.2. Example of a campaign to address perceptions:

"Value for Money Campaign"

The purpose of this section is to give some details of a national action plan that was designed and implemented to address a specific service aspect that customers rated low in the measurement tools described, namely the "Value for Money" campaign.

Analysis of customer satisfaction ratings and comments made by customers, indicated that customers are unhappy with the price of electricity and do not perceive to be receiving value for money.

A campaign was designed to communicate facts regarding electricity pricing to front-line staff and directly billed customers. The campaign provides educational information regarding the following:

- Eskom's price of electricity compared to international electricity prices
- Price of electricity versus those of other energy sources
- Information regarding aspects that can influence quality of supply, such as fires or lighting anywhere along the lines.

Front-line staff received a box containing the facts, as well as vouchers that could be redeemed. The messages to billed customers are being communicated via printed advertisements in specialised publications targeted at specific markets and in the bills.

10. Summary

In summary the following points are made:

- Eskom has many years of experience with customer measurement surveys.
- Perception results are difficult to analyse and report to line management.
- As perceptions are changed over time, little correlation is found between actions and survey results in the short term.
- The major benefit of the measurements is in the trend feedback and the confirming of areas for action.
- It is however important to understand the rating scales, how customers use these and the main messages communicated via these surveys.
- Buy-in from line management is essential, as results form part of Key Performance Indicators and results have to be actioned, else the measurement will be of little or no value.

Lea Theron

ONLINE BULK METERING AND BILLING TO IMPROVE SERVICE DELIVERY AND REVENUE COLLECTION

By Kobus van den Berg
Asst City Electrical Engineer
Mangaung Local Municipality (Bloemfontein, South Africa)

1. Introduction

The larger bulk consumers contribute a major part of the revenue stream of most electricity utilities. These consumers need special attention and service arrangements. In a new electricity distribution dispensation these customers will have to be handled in a more professional way to ensure better service to the customer as well as more effective revenue collection. Value-added products and services need to be incorporated into the service package of these customers. These customers however constitute a variety of customer groups and requirements. A "one service suits all" is not a business approach to suit all customers. The needs and requirements of each of these customers will have to be determined individually and a service compiled to suit particular requirements. One of the areas where service improvement can be accomplished is by upgrading the metering system to provide more information for managerial purposes.

2. Automated Meter Reading (AMR).

AMR is in short an intelligent meter that can be read automatically (remotely) via some communication medium. AMR is not a new concept at all. According to the authoritive Scott report on AMR deployments across the world, 43,8 million meters in 5381 projects are in operation. Radio is the preferred communication medium but power line communication is rapidly gaining ground.

The decision to use AMR by many utilities have been taken for reasons other than return on investment [2]. Most users want an accurate bill, fair price and reliable service[2]. In deploying AMR one thus have to make very sure what the reasons and cost for such a system would be. Value must be added to the service delivery and the customer should realize and use the additional services to be cost effective.

Most utilities realize that especially with more complicated tariff structures, profiling information will be required for larger customers. AMR can be used to provide that information. The main issue however remains namely: "How do we present and manage the data that we collect via AMR systems?" It will have to be converted to useful straightforward information that can be interpreted by the customer. The next few sections will thus cover the management possibilities and some technicalities of AMR.

3. Emerging standards

The bulk metering arena is largely based on proprietary protocol standards between the meter and remote metering equipment. This normally implies that one should implement a reading system that can communicate via different protocols to the different brands of meters installed. A working group (NRS 071) is currently being established to standardize the bulk meter protocol in the RSA. The proposed standard is the emerging DLMS standard developed in Europe. Although not many meters are currently available with this protocol implemented, it should become more readily available in the near future.

4. Data communication systems

Most electronic bulk electricity meters can communicate with computer systems via the optical port for setup and data recovery. Options on most of the meters allow the addition of a standard serial port to be used for external data communication systems. The serial port can be connected to a modem to enable remote computer systems to interrogate the meter via a number of different communication media. The communication system used to interrogate the meter is the main cost factor as far as the equipment is concerned. One can use a variety of systems like the Internet, WANs, LANs, PSTN, cell phone, fibre optics and radio networks to read the meter. These technologies are all available depending on where the meter is located.

The issue to be addressed however is the cost and availability of a particular medium. Because the bulk consumers normally also represent the larger electricity accounts the cost of the communication medium is probably not as critical as in the case of a small consumer.
In the Mangaung example, GSM systems are used due to the fact that it is available throughout the service area (Bloemfontein, Botshabelo and the rest of the Southern Free State) and the cost reasonable. It was thus not necessary to create any infrastructure.

5. Internet services

Once all the data is collected it should be converted to information. The source and format of this information is critical. Most of the electricity customers are not specialists on the intricacies of tariffs. The bottom line for them is the cost of the service. One thus has to ensure that information is made available in a format suitable for a particular customer. Most customers refer the account to the clerk at the commercial division where the main function is hopefully to pay the account.

The Internet provides an ideal vehicle to distribute information to all the relevant consumers by making detail information available under a password protection system to allow a particular customer to view his metering and billing data.

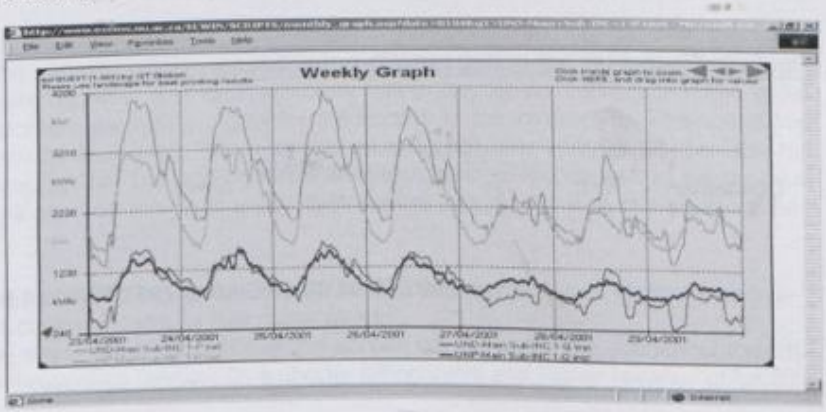
A number of suppliers offer this service. They thus read the meters and provide the infrastructure to display meter and billing data on a website. The customer can decide what information is required and is able to download relevant consumption data for further analysis. If the customer has the necessary knowledgeable people available, the consumption can be managed. Many companies make use of third party or head office based energy managers and the information on the net is an ideal medium to make the information accessible to all interested parties. This function can however also be provided on the utility's own web server as part of an integrated information service to all customers.

6. AMR software available

Web software as well as a suite of accompanying software is available in South Africa to perform the AMR functions. This software can provide the following functions namely:

A) Read meters at pre-determined times
B) Store information on a industry standard database (thus accessible to all standard software packages)
C) Meter database and management
D) Provide tariff comparison functionality
E) Generate various reports
F) Provide profiles, trends and graphs (refer to figure 1)
G) Provide customer access to meter and billing data via the Internet
H) Provide alarm and SMS notification functions
I) Automatically send customer reports via email
J) Provide power quality reports if connected to the relevant monitoring equipment
K) Provide billing information
L) Provide download files to customer

Figure 1: Internet based load curve



7. Classes of Customers

The Mangaung area is not a highly industrialized region. This implies that the bulk consumers are a mixture of various entities, each with it's own requirements namely;

A) Office buildings
B) Educational institutions
C) Government buildings
D) Factories
E) Shopping Malls
F) Holiday resorts
G) Service providers e.g. water supply pumps

The specific need of each one of these groups is currently being analyzed to enable the utility to offer them service package and management information to suit the particular client's need. A more elaborate time of use tariff will also be available to pass the energy management possibilities of the Eskom Megaflex tariff on to the customers. By doing this, the larger customers can contribute towards the utility's demand management efforts.

8. Customer service package

To improve the customer service and add value to the AMR functionality the following service package is proposed :

A) Metering information online;
B) Direct access to a person who will be responsible for that particular account;
C) Frequent visits by the account manager;
D) Tariff consultation and support (access to standard as well as negotiated tariffs);
E) Energy management consultation;
F) E-mail complaints facility
G) Online billing information;
H) Online payment (Internet or bank transfer);
i) % Discount incentive for early payment.

9. Online billing

The Internet based software will generate an accumulating bill ranging from the first billing day up to the current day. The customer will thus be able to monitor the bill as it is being generated every day. At the end of a particular month the bill will be compiled for that month and the customer can either directly download the final bill or it will be e-mailed to him. The customer is expected to pay this bill via the Internet banking services or by direct bank transfer. A paper bill will thus not be sent. To make the project viable the customer is expected to settle his bill before the Eskom account has to be paid by the distributor. Within 10 days after billing has taken place, the distributor thus pays Eskom with the revenue collected from the end users and does not have to carry the burden of interest on money not collected yet.

Figure 2: Typical bill generated on an Internet based system

Customer: XYZ **Account Number:** nnn **Billing Date:** 2001-10-01

From 2001-09-01 00:00:00.0 to 2001-10-01 00:00:00.0

Electricity

Tariff	Description	Reading	Units	Rate[R]	Amount
Basic			1.000month	206.0000	R206.00
MD		1.000pf 14-SEP-2001 10:15	5257.453kVA	43.5500	R228962.11
Consumption	99P00041	13561006.25kWh on 30-SEP-2001	2583259.375kWh	0.1240	R320324.16
				Sub Total:	R549492.27

Total before VAT: R549492.27
VAT(14.0%): R76928.91
Total: R626421.18

In this project Mangaung will ensure that the larger customers receive preferential treatment. By improving the customer service at this level one will be able to respond to the requirements of these customers as well as be in a position to monitor and manage a large percentage of the revenue stream due to electricity sales. Standard municipal procedures do not provide improved service levels for these customers.

10. Financial implications

A) **Interest due to long billing cycle**

The 100 larger customers in the Mangaung area are responsible for at least 30% of the revenue collected for electricity sales each year. Normally these customers are billed and they only need to pay this bill by the 15th of the following month i.e. 6weeks after the billing date. The Eskom bill is normally due within 10 days of the billing date. Municipalities only expect consumers to pay 4 weeks after the Eskom account is due for payment. This arrangement implies that the municipality effectively pays interest on this outstanding amount for 4 weeks at a time or 12 months of the year. At a 10% interest rate this boils down to the fact that a significant amount is wasted in interest each year.

B) **Metering cost**

The cost of the metering system is R7000 per meter equipped with a GSM modem. The capital expenditure for this project will be the establishment of the metering infrastructure, internet link, database and web servers plus the appropriate operating systems and application software. The operational expenses will include Internet as well as GSM airtime costs.

The equivalent AMR services from a third party would cost in the region R200 per meter per month depending on the meter reading requirements. The additional capital expenditure to establish the web and database servers is thus well worth the cost because it also serves the purposed of connecting the utility to the Internet as well as creating management tools to store and report on consumption data. These servers would have been necessary in any case and can thus be seen as a general upgrading of the IT system within the utility.

The questions that need to be answered are, "What financial gain does the utility get from this whole effort and who pays for the service?" There are a number of areas where the system will result in a financial gain. One can firstly assume that each customer has to pay for the service. In some implementations the larger customers are willing to pay for the access to the information. The operational cost for the system can thus be recovered. The customer receives valuable information to enable him to manage his energy consumption. The utility gains from the interest saved as well as revenue collection efficiency. If the total process results in a saving in energy supply cost then this effort will be a win-win situation.

As far as the capital cost is concerned one would in any case have to install a bulk meter at the customer's premises and the customer pays for this meter as well.
In the Mangaung business model the introduction of this service will not be for the account of the customer but be funded from the savings realized by a shorter billing cycle and higher revenue collection level.

11. Improved customer service

The advantage of the improved customer service cab be seen as:

A) Customer knows what is happening with his bill and consumption.
B) Can check tariff information.
C) Can take steps to manage his electricity costs.
D) Has direct access to support personnel within distributor.
E) Can expect preferential customer service.

12. Improved service management

A) Sales and metering data available online to all service departments i.e. systems operation, planning, revenue collection, revenue protection as well as the metering sections.
B) Meter is monitored on a daily basis. Frequent inspections are thus not required at these locations. Software alarms can be used to alert supplier if any un-acceptable readings are encountered.
C) Different tariffs can be modeled very easily to verify customer tariff efficiency.
D) The electricity distributor will have direct access to the consumption and billing information of an important group of customers who are contributing a large % of the annual revenue of the utility.

13. Conclusion

Following from the investigation and process so far the following conclusions can be made:

A) Larger customers contribute a significant % of sales revenue;
B) Service to these customers needs improvement.
C) Online information on metering and billing data can improve customer's capability to manage his consumption.
D) The infrastructure to enable information management can be outsourced or created internally depending on the business plan.
E) A shorter billing cycle can save a large amount of interest to the distributor and can partially be used to finance a better service to the customers.
F) Online meter reading and monitoring can simplify revenue protection procedures significantly.

14. References

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[2] Can an investment in AMR be justified?, RD Kennedy, Director, Metering and information services, Florida Power Corporation
[3] Itemized utility bill available on the net, South Staffordshire Water Authority
[4] Entering the information age with AMR, Howard Scott, Cognyst Consulting
[5] Improving your revenue, Kevin Holland, Advanced Technology (UK)
[6] Total Metering website, www.metering.co.nz
[7] IST Otokon brochures

Kobus van den Berg

CONNECTING PERFORMANCE SPECIFICATIONS AND POWER DISTRIBUTION CODES OF PRACTICE

Jaco van Heerden Pr. Eng. – Distribution Technology: NETFA

Introduction:

With the advent of the 2001 Edition of the Code of Practice SABS 0142-1, a new dispensation was established for Component Suppliers and for Manufacturers of Motor Control Centres. In a similar way, prominence is given to surge protection in low voltage applications. The introduction of systems earthing into the Code, which traditionally has concentrated on the LV fixed electrical installation serves as an indicator to what extent power reticulation and fixed installations and control systems are interlinked.

The draft Code of Practice for Power Installations to be referred to as SABS 0142-2, was a natural extension to connect the power distribution codes of practice and the respective components together. Specifiers, manufacturers, suppliers, installers and users are increasingly offered the opportunity to get a grasp of the integrated nature of the distribution, reticulation, fixed installations and control systems.

An orderly approach toward performance improvement of MCC's

The decision to manufacture a distribution board or a motor control centre will soon require dedicated skills and knowledge of the applicable safety and performance specifications in use in South Africa. The decision further needs to be backed up by detailed development and type-testing programs to bring about an power circuit system which can perform to designed short-circuit, temperature-rise, surge protection and environmental conditions.

The new requirements of SABS 0142-1 make it no more possible for anyone to simply judge an ASSEMBLY on its physical appearance alone. Internationally it is accepted that temperature-rise limits and short-circuit withstand strength can only be confirmed by subjecting an ASSEMBLY to type-tests as prescribed by SABS IEC 60439-1 'LV Switchgear and Controlgear ASSEMBLIES'

Over the past more than two decades, scores of ASSEMBLIES have been tested in one form or another. Manufacturers were often more interested in certain aspects of a test programme and less or none in others. It was decided by the SABS 1473-1 Working Group that a uniform test program as prescribed by SABS IEC 60439-1 should be performed on all ASSEMBLIES of 10 kA and higher, short-circuit rating. This would ultimately be the only way to compare performance of different models when a decision needs to be made on a set of intricate service and client requirements.

As from 1 January 2002, ASSEMBLIES tested to some selected type-tests, will be referred to as 'Specially tested ASSEMBLIES'. Such test reports will enable Manufacturers to comply with the minimum requirements for distribution boards in accordance with SABS 0142-1. Specific rules have been compiled against which derivations (of the specially tested sample) can be constructed. Persons will be trained to apply the rules and declare that the derivation will perform in accordance with the outcome of the short-circuit tests performed on the sample.

It is envisaged that the trained person for assessment of ASSEMBLIES of 10 kA and above will be called ASSEMBLY Assessors. For distribution boards below 10 kA, trained persons will be called Distribution board evaluators. The trained persons will submit a clearance report to the Accredited Person who ultimately will be responsible to issue a Certificate of Compliance for the ASSEMBLY.

Specifiers, Manufacturers and users are urged to carefully study the implications of SABS 0142-1:2001. Amendment 1 will provide specific information in this regard. Decisive action needs to be taken how the changes should best be managed and implemented.

A Code for power installations above 1 kV from the point of supply

The mosaic of power distribution codes of practice supported by performance specifications is taking form with development of a code of practice for power installations above 1 kV from the point of supply. This segment in the mosaic has up to now been left wide open for any party to design, construct and commission. Users were left on their own to judge whether the standard of design and workmanship is safe and whether the installation will perform.

The proposed Code is not aimed for use by licensees of the NER but mainly for use by their Customers who receives a supply of more than 1 kV at their point of control. It is equally applicable to step-up / step-down installations often found on farms. The attached sketch provides insight in the area of application for the proposed Code of Practice.

Safety of the installation is first and foremost. Contractors and their employed designers need to rethink in future whether they are competent to undertake work of this nature. A Certificate of Compliance must be signed by the Contractor and his ECSA Registered Competent Person. This code of practice main purpose will be to re-establish the importance of applying expert knowledge in the field of medium and high voltage distribution systems.

Portable earthing gear performance established and qualified

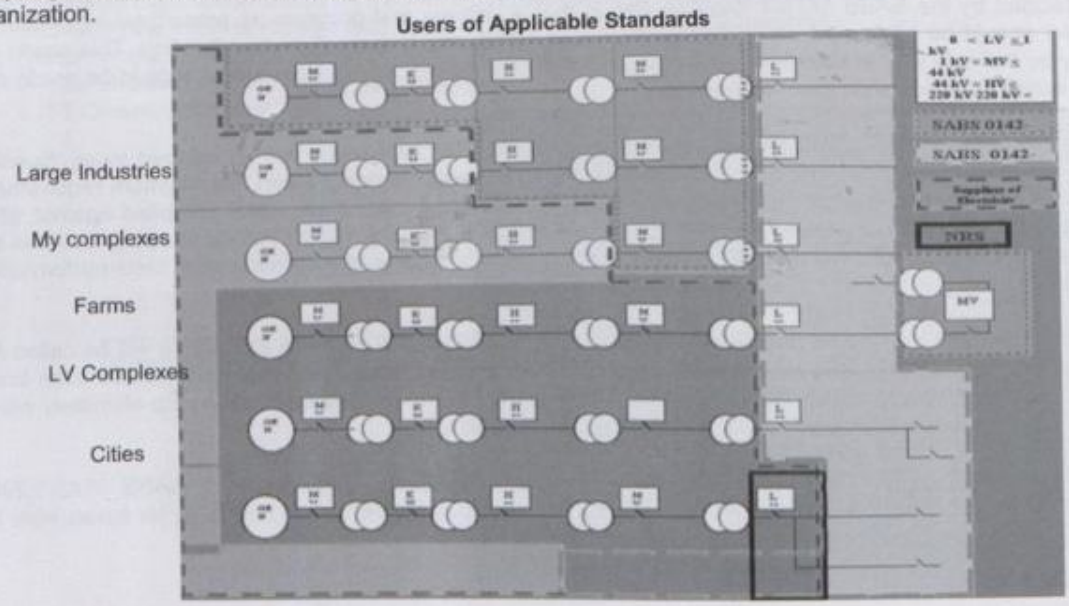
Portable earthing gear has long been a box full of brightly coloured sleeved conductors and funny attachments. Performance of the arrangement was never challenged. Few persons has seen the devastating effects of such a system when called upon to protect workmen on a busbar system.

It is now possible to insist on 'approved performance' of the system by testing the portable earthing gear to SABS 1934. The test methods are based on the SABS IEC 61230 specification with an extra restriction that the calculated end temperature of the cables shall not exceed 250 °C after 1 second of a short-circuit condition.

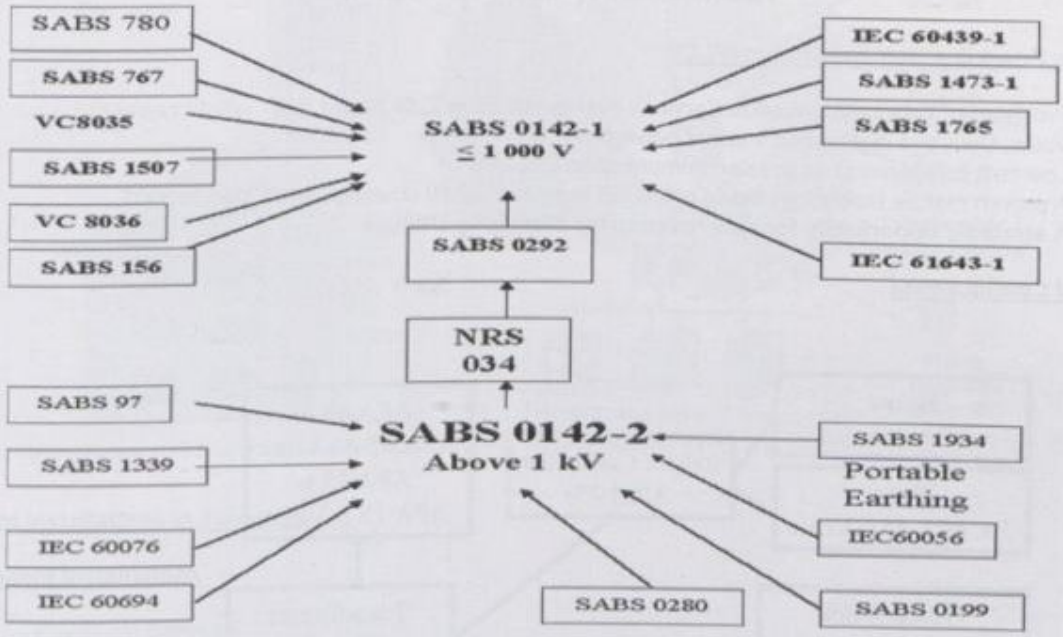
Future adoption of NRS 034 and NRS 048 as SABS Codes of Practice

The mosaic will be further developed with proposed adoption of the NRS 034 and NRS 048 specifications as SABS Codes of Practice. Development work in the respective fields of Power distribution and supply of electrical energy is gradually bringing about a better understanding amongst the specifiers, manufacturers, installers and users how the respective parts of the power distribution system interlink with each other. The process of compiling standards and more important of using those standards, must be filtered down to all levels of each organization.

Users of Applicable Standards



Distribution, Reticulation and Installation Interface (a few specifications)



Jaco van Heerden

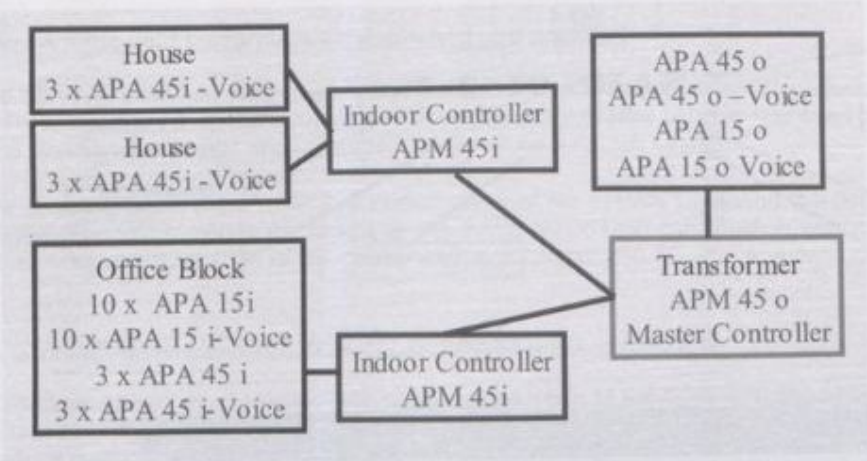
Powerline Communications

By
Charles Kuun BSc MBA
Head: Electronic Services
Tshwane Metropolitan Municipality

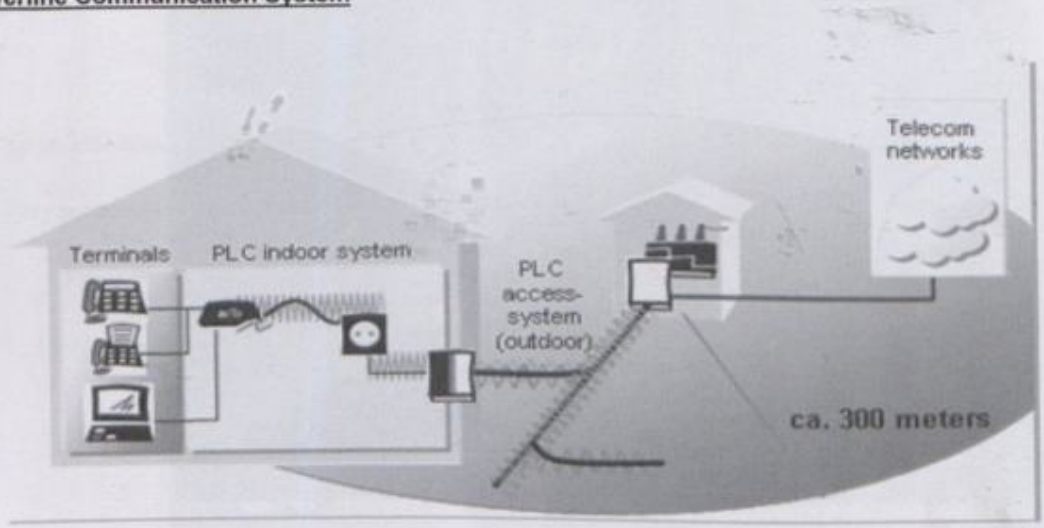
What is Powerline Communication (PLC)

- Provision of Telecommunication Services over the existing 220v power grid
- Voice, Data and high speed Internet network
- Low cost compared to other telecommunication systems
- A proven mature technology being rolled out in more than 60 countries since start in 2001.
- **A strategic opportunity for new revenue for Electricity Utilities**

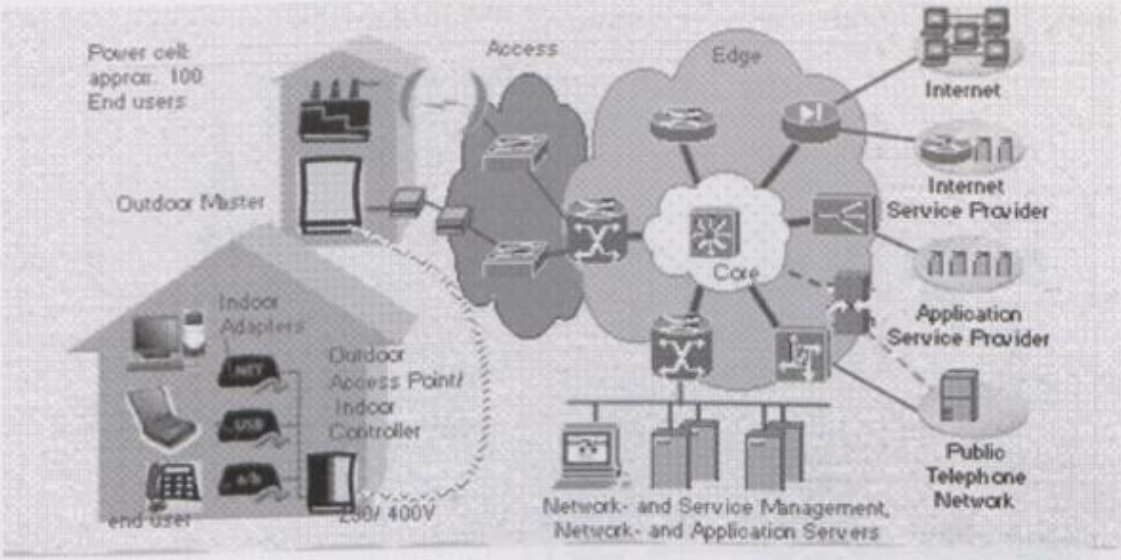
Typical Configuration



Powerline Communication System



Typical Powerline System



Pilot Installations in Tshwane

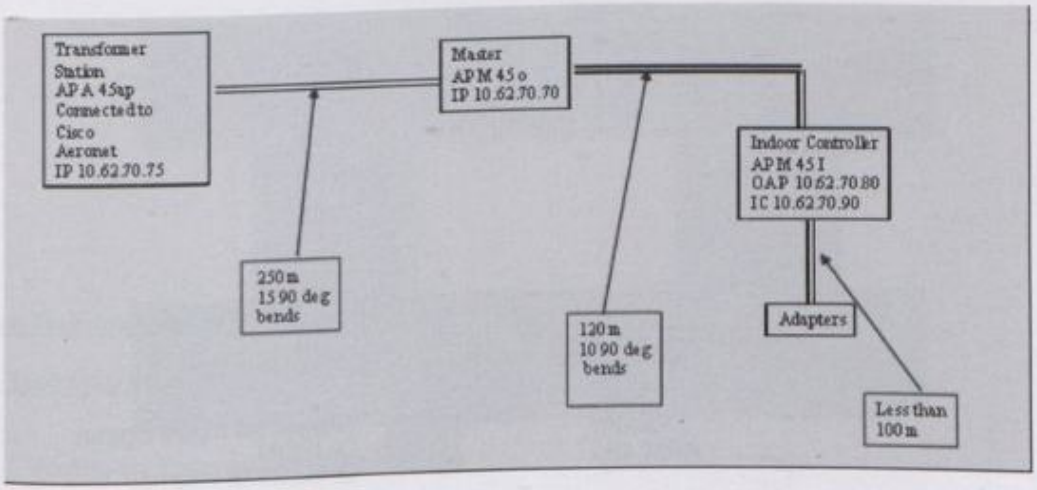
Present Installations

- Electronic Services
- Riviera Primary School

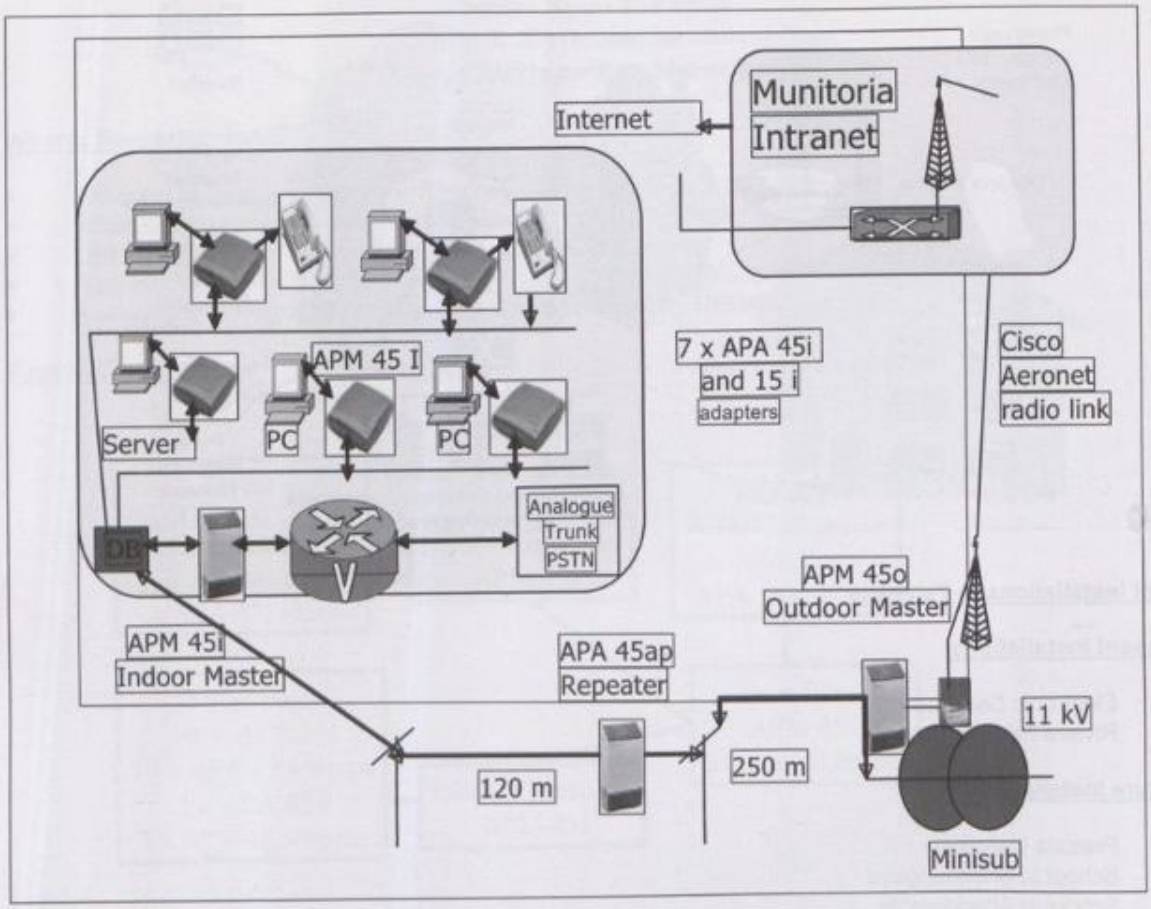
Future Installations

- Pretoria University
- School in Shoshanguve
- School in Atteridgeville

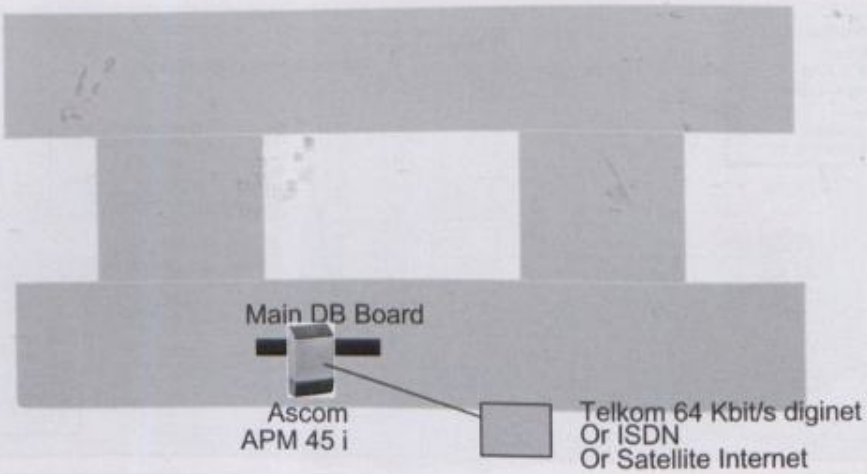
Figre of Tshwane PLC



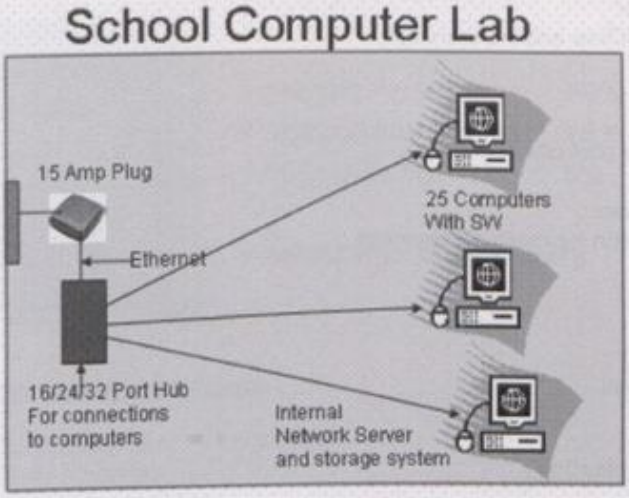
Figre of Tshwane Electronic Services Powerline System



Figre of "School Design"

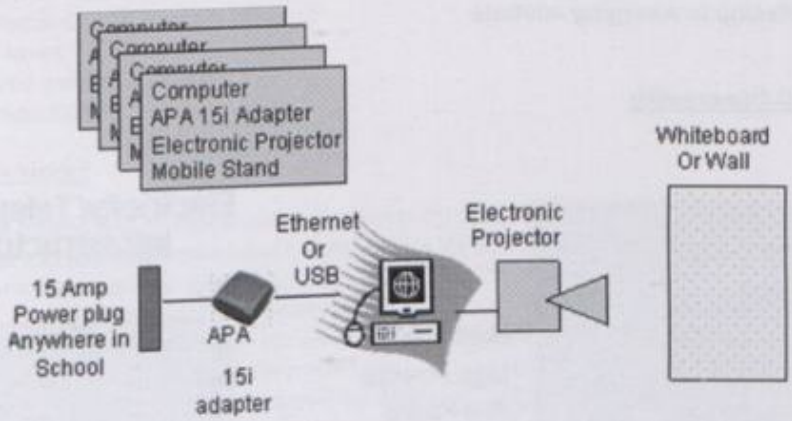


Figre of a School Computer Lab



Mobile Systems

Systems can be deployed anywhere in School and will automatically be linked to school network or internet through power grid. Teachers or students can use when required.



From Technology to Mass Deployment

A). Technical Development

- Testing the Technology at Customer Lab
- Few Lines

B). Field Trial/Market Test.

- Testing PLC at customers power grid
- Few Lines
- Know How Transfer
- Develop Business Case and Partnerships

C). Pilot

- Deploying PLC in a pilot city
- Few 1000 lines
- Verify Business Case
- Establish organisation for mass deployment

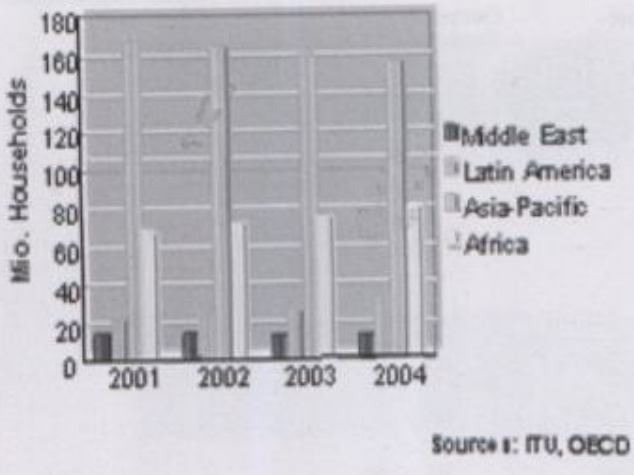
D). Mass Deployment

- Mass Deployment
- Up to millions of lines

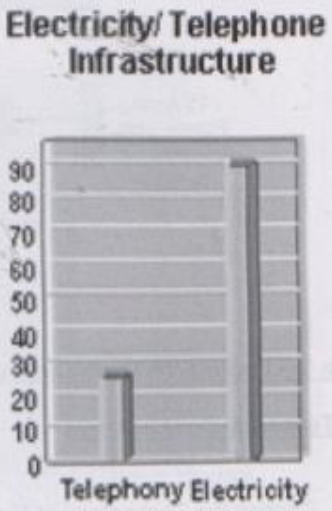
Why Powerline Communication?

- Most households are electrically Connected
- Every wall socket acts as an interface
- Indoor networking is unique
- An intelligent home brings a new quality of life
- Low initial investment
- Broadband internet boom now
- Deregulation Energy/Telecommunication market
- Need for networked home
- ***Infrastructure missing in emerging markets***

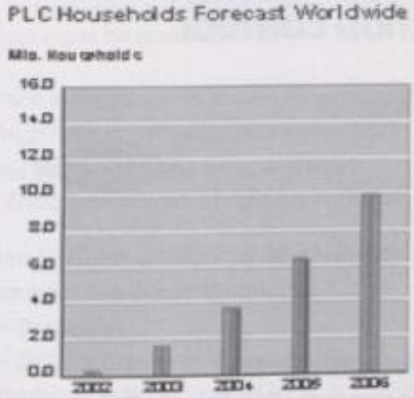
Emerging Markets PLC Opportunity



Source: ITU, OECD



Broadband PLC Opportunity



	Today	2004
• Internet Penetration:	50%-70%	70%-90%
• Highspeedof Internet:	15%	35%-45%
• PLC ofHighspeed	0%	2%-15%

→ **A Huge Opportunity**

Opportunity for Local Government involvement

- Local Government ("LG") owns local Electricity Grid
- LG has paying electricity customers
- Provide local loop connectivity to NNO
- New Powerline Communications Technology makes communications over power lines a reality and best option
- Become leader in service management

Benefits to Local Authorities

- Economic Development for poorer sections of constituency
- Telecom access to poorer sections of community and increased sustainability
- One electricity and telecom account
- Lower taxes
- Improved service delivery
- Debt reduction

Why will this work?

- LG has paying and qualified customers while the NNO does not
- 9 Large Municipalities estimated to incorporate 70% of national telecom customers
- LG owns the local loop electricity grid
  - Can enable most affordable services
  - Can enable service in the shortest time frame
- Revenue get shared by both NNO and LG
- LG can provide NNO political support for choice of correct partnership and customers

Recommended Action Plan

- Form joint political action group and Telco plan
- Identify New Network Operator (NNO) participants before Invitation To Apply close and offer PLC Services
- Engage NNO to create a local loop supply agreement under their licence
- Lobby Central Government on LG Telco plan
- Create joint business structure strategy and action plan
- Explore funding options
- Develop Telco Infrastructure design

Charles Kunn

THE ELECTRICAL POWER SUPPLY INDUSTRY: YOUR SOLUTION TO VEGETATION CONTROL

VEGETATION MANAGEMENT

Author & Presenter: Dr E van Rensburg PhD –
Chief Consultant Weed Science: Vegetation Management, TSI, Eskom Enterprises

1. Summary

Vegetation Management (VM), a Department of Technology Services International (TSI) part of Eskom Enterprises, which is a holding company of Eskom, the fifth biggest power utility in the World. As part of Eskom's drive to commercialize, all vegetation management had been contracted to VM as a partner to fulfill Eskom's quality of supply with special reference to Eskom ROW's (Right Of Way).

Many different Acts' govern South Africa. The Act's, which impact onto the Electrical Supply Industry mostly, refer to Environmental clauses. The OSHA Act, Act 85 of 1993 refers to safety, health and environment with specific references to safety clearances between vegetation communities and powerlines. Further, Act's refer to issues when working in the Environment such as the pesticide Act, Act 36 of 1947 as well as Provincial Legislation concerning the control and or eradication of vegetation such as trees, etc. on ROW's and electrical properties.

Vegetation Managements head office is at Megawatt Park, Sandton with Regional offices in Mphumalanga, KZN, Northern Province, Western Cape, Northern Cape, Freestate and Gauteng. We are also ISO 9001 and 14000 accredited. We have team capacity up to 150, specializing in the following services:

- Bush and tree encroachment on powerline servitudes (NEC contract and project management).
- Plant invader control on powerline servitudes and other properties.
- Reed and bulrush control on powerline servitudes.
- Grass cutting/chemical mowing/species switch on powerline servitudes.
- Grass/ tree control around wooden pole powerlines.
- Substation HV yard weed control.
- Security fences weed control, grass maintenance including chemical mowing and species switch.
- Creating fire breaks using herbicides.
- Herbicide recommendations on any property.
- Herbicide maintenance plans for all properties (powerline servitudes, HV yards, security fences, etc.).
- Management/supervision of herbicide contracts.
- Negotiating herbicide contracts for all properties (powerline servitudes, HV yards, security fences, etc.).
- Herbicide analysis in any matrix.
- Herbicide research.
- General advice and consultation on herbicides and pesticides.
- Horticultural landscape maintenance and office gardens.
- Gate and fencing installation and maintenance at substations, access roads and other secure areas.
- Powerline audits and maintenance.

2. Introduction

When maintaining vegetation, what impacts onto the quality of electrical supply? Therefore, the following questions must be answered:

- Which environmental issues are at stake?
- Which Acts control weed science work?
- Who implements the work and why?
- What type of work should be implemented?

Question 1: Which environmental issues are at stake?

- There are two areas of concern:
- 1 = Properties
- 2 = ROW's (Rights of Way = wayleaves and servitudes)
- Why do we maintain our ROW's. Is it to provide quality of supply to our customers or to adhere to the safety regulations in the OSHA Act?

Question 2: Electrical Supply Industry: Which Acts impact onto this Industry?

- Pesticide Act 36 of 1947
- Health and Safety Act: OSHA Act 85 of 1993
- Host of other Acts which impact on Environmental issues such as Provincial Legislation.

Question 3: Weed Science Areas, which impact onto Quality of Supply

- Powerline way leave/ servitude maintenance
- Substation maintenance
- Fire Management
- Wetland or March (reed and bulrush) management
- Grass maintenance
- Other weeded areas

3. Quality of Supply Impacts

To maintain quality of supply to customers many different vegetated areas cause impacts. To minimize or reduce these impacts, the different areas must be identified and accordingly maintained. The impact areas are as follows:

Impact 1: Bush/ Tree control or maintenance

- Directs impact on powerline maintenance of vegetation
- Densifier/ encroachment control
- Invader control

Impact 2: Substation Maintenance

- HV-yard weed maintenance
- Security fence vegetation maintenance
- Fire break introduction and maintenance
- Other grassed or weeded areas vegetation maintenance

Impact 3: Fire Management

- Introduction of fire breaks and maintenance of exciting fire breaks
- Wooden pole fire protection (maintaining vegetation around wooden pole power lines to stop fire impacts onto the pole)

Impact 4: Grass Management
Grass can be maintained using 3 different technologies, such as:

- Mechanical mowing
- Chemical mowing
- Species switch or vegetation composition change

Impact 5: Wetland (march) Management

- Wetland management is done by controlling the two climax species, common reed and bulrush

Impact 6: Other weeded areas

Other weeded areas, which need vegetation management, consist of:

- Cable and drum stations
- Road shoulders/verges
- Waterways
- Crash barriers
- Pole yards
- Around structures
- Any other area which need vegetation management
- Horticultural Services (Gardens, etc)

4. Conclusion

Vegetation on property owned by or under the control of electrical utilities must be managed in an environmentally responsible and cost effective manner. Various methods can be employed to achieve this, ranging from the use of registered herbicides to mechanical means. As some of these herbicides and their application hold inherent liabilities and risks, electrical utilities must commit themselves to the Pesticide Act, Act 36 of 1947.

Different electrical utilities inside AMEU will therefore be using many different industrial registered herbicides to control vegetation communities inside ROW's, between security fences and in HV yards. Vegetation is managed to discourage tall and invasive species dominance, as well as densifier plants from establishing along ROW's. The correct use of herbicides in these areas reduces fire hazards and eliminates flashovers due to tree interference on the powerlines. Herbicide application has proven to be more cost effective and less time consuming than conventional options such as vegetation removal by heavy machinery.

Dr Eugene van Rensburg

Innovative Solutions for High Voltage Substations

Presented by
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ABB South Africa (Pty) Ltd

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E-mail: john.van_veenhuyzen@za.abb.com

1. Summary.

ABB has numerous innovative solutions for high voltage substations up to and including 765kV for both outdoor and indoor applications.

These innovative solutions include re-engineering of traditional substation equipment so that circuit breakers, current transformers, disconnectors and earth switches are combined into a single switchgear module, using the best technology readily available, based on field proven components.
Benefits from using these switchgear modules include reduced yard space, minimized civil works and shorter installation time, less commissioning and maintenance requirements, higher availability and reliability of the substation.

This paper deals with the basic concepts and success stories of these 132kV switchgear modules for outdoor applications in South Africa therefore complimenting the meeting theme: "back to basics; successful electricity distribution practices".

2. Introduction

The restructure of the electricity industry will bring significant changes and pressures on utilities. The new environment will demand a more competitive and efficient approach.
These changes will demand that the substations be designed, built and maintained to achieve lower operating and maintenance cost and higher plant availability.

The utility industry is by nature very conservative. The high capital cost, long service life and the demand for high plant availability does not encourage risk taking on new major projects. Introduction of new technology has typically been progressively.

New technology is usually introduced by installing the new type of plant or system in a single bay, in less important part of the transmission or distribution system or where redundancy exist, evaluate it for a couple of years proceeding on major projects, or alternatively observe the performance of new technology installed by someone else and when proven use it on own new installations.

The problem with this approach is that major new green field installations only get built with mature or superseded technology. Yet it is exactly on the new green field sites, the substations of the future, that we get the maximum benefits of using new leading edge technology.
However, being prepared to accept a reasonable risk, which is unavoidable if introducing leading edge technology, brings many opportunities for review and improvement upon present designs and operating practices.

3. The Basic Concepts

Consider an auto-puffer circuit breaker (Fig 1) and an electromagnetic wound current transformer (Fig 2) integrated into one unit (Fig 3).

SF6 Circuit Breaker
(Fig 1)

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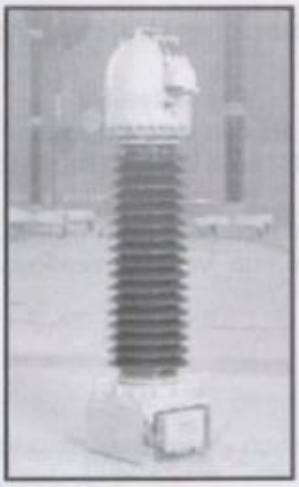

SF6 Current Transformer
(Fig 2)

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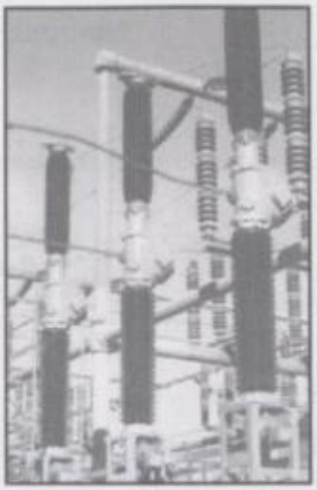


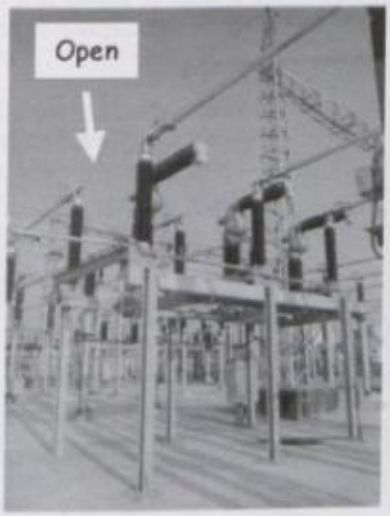
Integrated SF6 Unit
(Fig 3)

By displacing the circuit breaker (Fig 3) 90° to the current transformer the basis of the switchgear model is formed (Fig 4), to which other bay functions are added.

Integrated SF6 Unit
CB 90° to CT
(Fig 4)

Add disconnecting contacts to the integrated SF6 unit (Fig 4) and install the assembly on a motor driven moving frame fixed to a support structure. The assembly can now either be isolated (Fig 5) or inserted (Fig 6) from the main circuit.

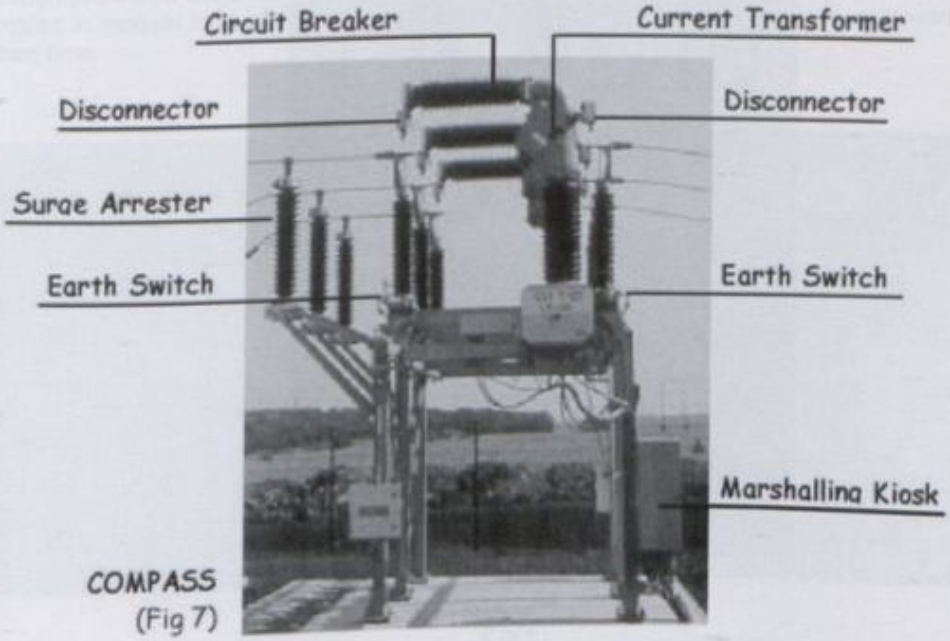
Earth switches (motorized or manual) are installed on one or both sides of the supporting frame, to which surge arresters are also mounted (Fig 7).



Isolated
Fig 5.

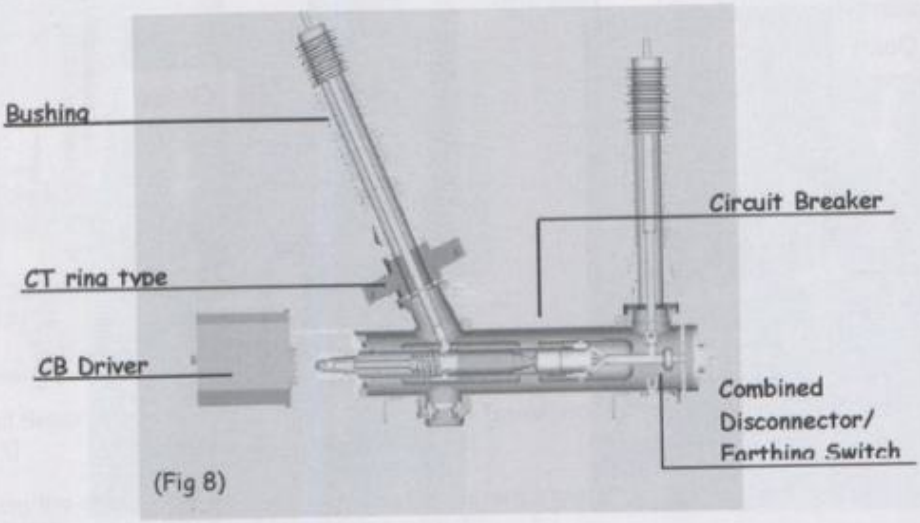
Inserted
Fig 6.

The combination of a circuit breaker, current transformers, disconnectors, earch switches and surge arresters represent all bay functions in a single switchgear module, known as the "**COMPASS**" (Fig 7).



COMPASS
(Fig 7)

Similarly, consider a conventional auto-puffer circuit breaker and GIS disconnecting and earthing contacts integrated into a single switchgear module with ring type current transformers fitted to the bushings (Fig 8).



(Fig 8)

The combination of a circuit breaker, current transformers, disconnectors and earthing switches represent all bay functions in a single switchgear module, known as the "**PASS MO**" (Fig 9).

PASS MO
Fig 9.

SUCCESS STORIES

4.1 Compass (Utilities Application)

The plan was simply to build a 132kV 8-bay switchyard utilizing conventional switchgear. The existing overhead lines converged at one central point, which dictated the site location, unfortunately against the side of a hill.

The challenge for Durban Metro Electricity Engineers was to fit the 132kV 8-bay switchyard into the given area. The layout (Fig 10) indicated below shows that the land area required was **6056m²**, and included **5 terraces** on which the switchyard was to be built.

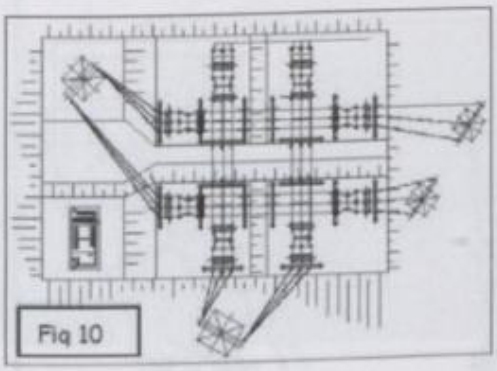


Fig 10

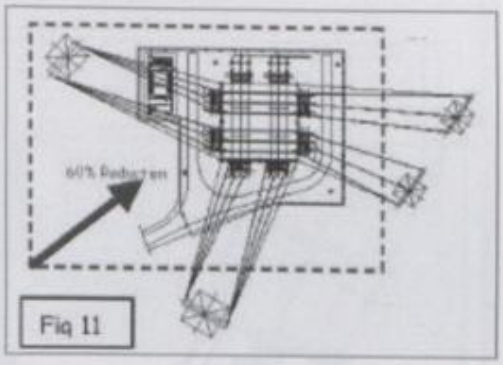
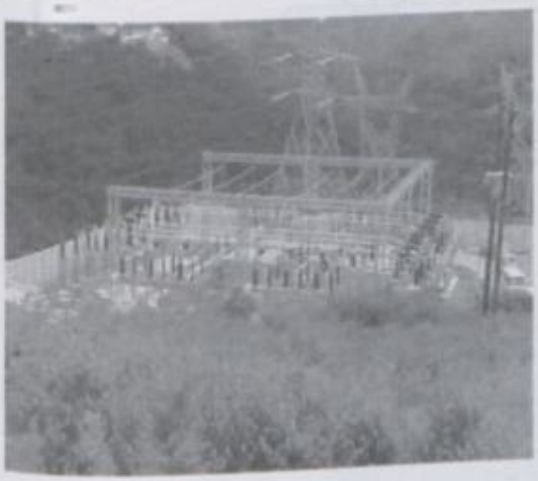


Fig 11

The COMPASS switchgear modules installed reduced the switchyard size to only **2440m²**, as shown in (Fig 11) and only **1 terrace** was required.

The Switchyard area required was substantially reduced, i.e. by **60%**, and so was the corresponding savings in civil works, foundations, steelwork, clamps, installation time,etc...

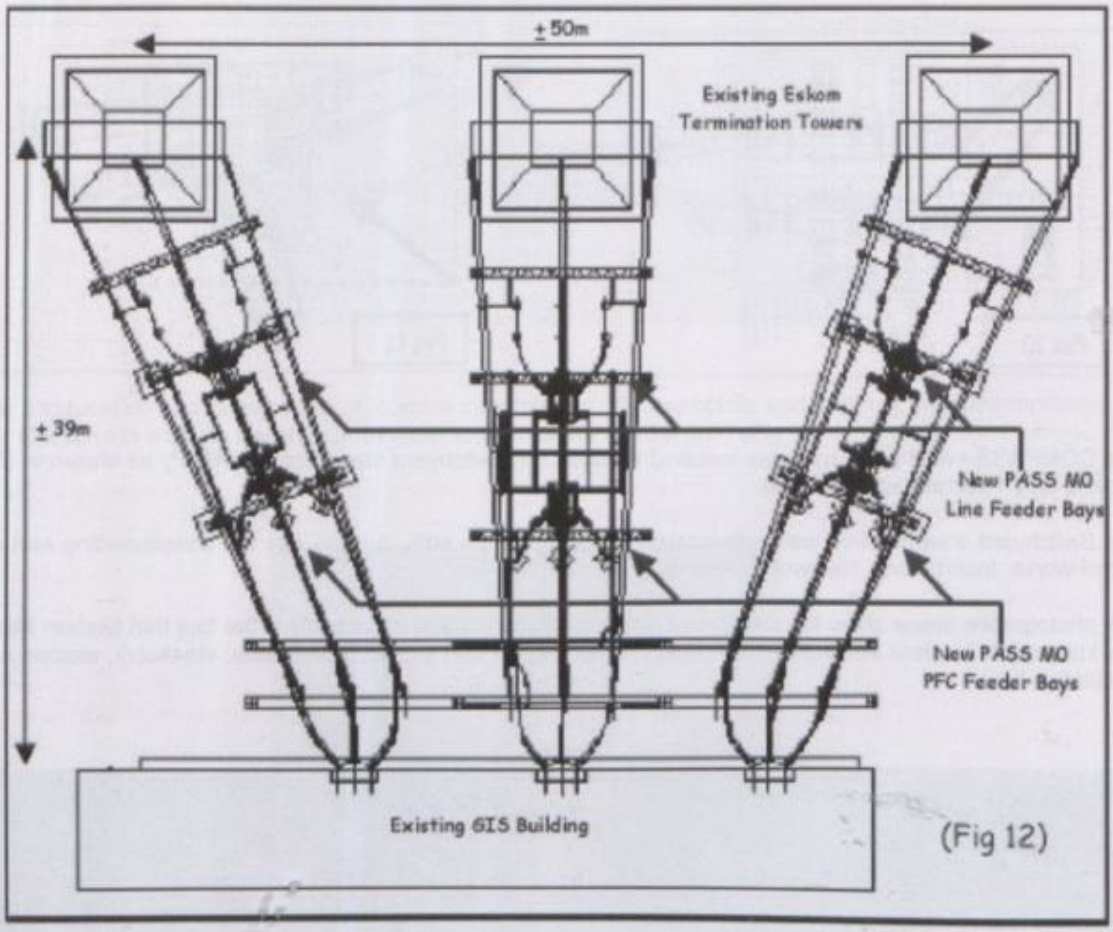
The photographs below show the switchyard near completion. Most importantly is the fact that Durban Metro has invested in modern innovative technology rather than in civil works, foundations, steelwork, clamps and installation time.



4.2. PASS MO (Industrial Application)

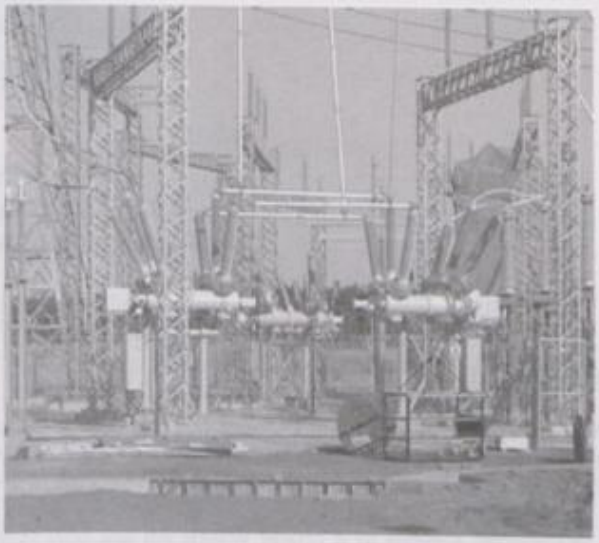
ABB has recently commissioned a **6-bay outdoor 132kV switchyard** using the **PASS MO** switchgear modules for Hillside Aluminium in Richards Bay.

The project required the introduction of 3 x 132kV incoming line bays and 3 X 132kV 110var PFC feeder bays installed outdoors between the existing Eskom termination towers and the existing 132kV GIS incoming line bay as indicated below (Fig 12).



(Fig 12)

The photographs below show the switchyard near completion. Notably, Hillside Aluminium has invested in modern innovative technology with the highest possible availability and reliability available today for this difficult outdoor application.



5.5. Conclusion

The major impacts of the new technology have been significant changes to design practices. Bays are pre-fabricated, pre-wired and pre-tested in the factory before shipment to site

A reduction in the number of drawings required, new and more cost effective site layouts, radical changes to bay layouts, new busbar arrangements, less cabling, abandonment of old requirements which were no longer seen as essentials.

A different approach to switching, isolation and access should be accepted as well as radical changes to maintenance and practices as maintenance are based on the concept of remove for repair and insert replacement components.

Therefore in conclusion, a break with the past provides a powerful base for thinking of solutions for the future.

John van Venhuyzen

Service Excellence-The Bottom Line

Author & Presenter:
Danie van Wyk (Pr Eng, B Eng (Electrical), Hons B Com (Business Economics)
City Electrical Engineer of uMhlathuze

INTRODUCTION

Why do we say it is difficult to meet our customer's requirements? Surely by saying this, we already place a burden on ourselves not only to meet the requirements, but also to give better than expected services – to go the extra mile!

I believe we are still in a phase where we are only doing "fire fighting" and are barely meeting our commitments. What we need is a paradigm shift to meet our commitments with 90 % of our efforts and still have 10 % reserved to enhance our services. This will be the drive to grow and keep up with the trend of a dynamic and challenged technological, information and political environment.

CUSTOMISED INFORMATION

The drives to grow that we take on in our businesses are part of strategic planning of the future and ensure sustainability of our business.

We need to ensure that these drives are:

- In line with our organization's mission and vision statements
- Realistic and achievable
- Add value to our services
- Increase the scope of existing services and gain new ground

What are we doing to go the extra mile to make our customers say : "WOW!" ? This makes the difference between service and excellence!

It is extremely important to share information with our customers that will benefit both. With this, we will empower them to understand and make informative decisions but this certainly requires from us a thorough understanding of our customers' needs and employ state of the art technology already available in the market.

The rapid developments in IT environment has made life extremely easy and given us the ideal tools to do smarter business with less effort.

Why not start with your "cream of the crop" – i.e. those top five or ten customers in terms of their contribution to your turnover.

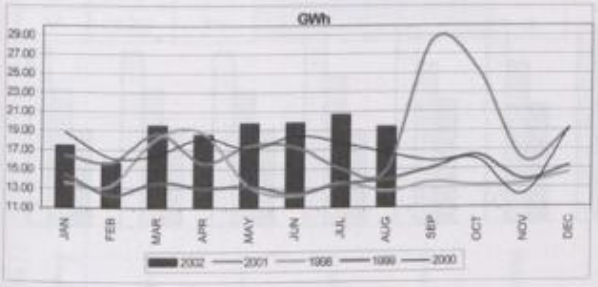
Consumption information and performance trends

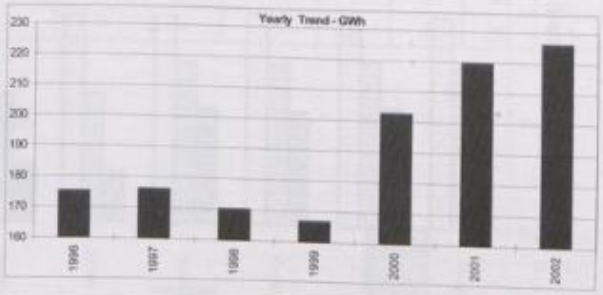
Together with the monthly account, what additional information are we providing? The minimum service is to ensure that the accounts sent to customers monthly are correct and have at least gone through one check. Even this is not done in many municipalities what I am aware of.

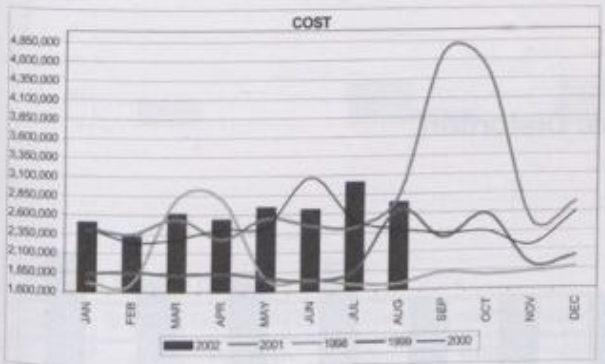
How often do we interact with our customers on their accounts and their performance on effective utilization of our product? We merely leave this over for them to try with the limited information, (mostly insufficient), to establish their own performance, or even, not at all.

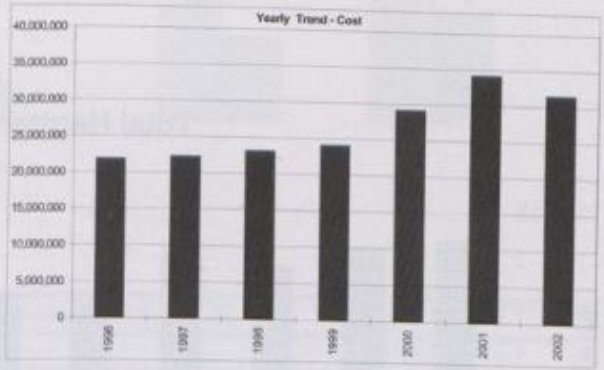
The following graphs (all available and printed on an A4 sheet) will be an extremely valuable management tool to any customer when receiving it with the monthly account:

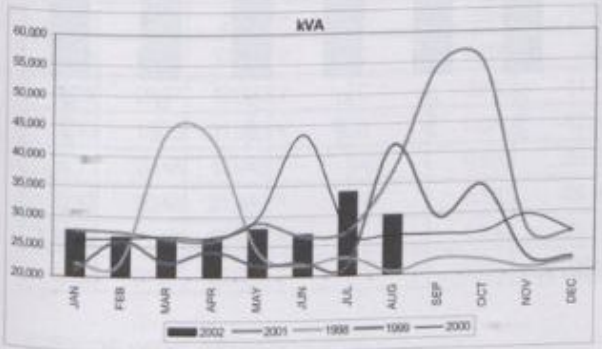
Customer name and Account No.

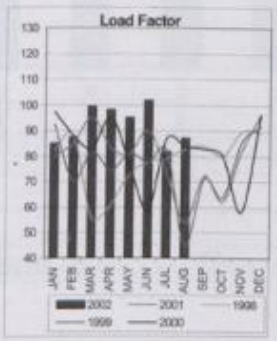


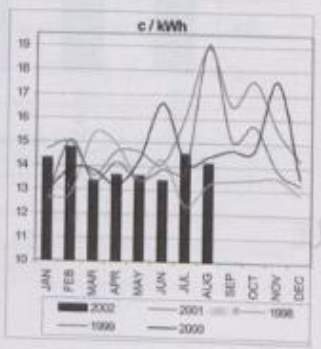










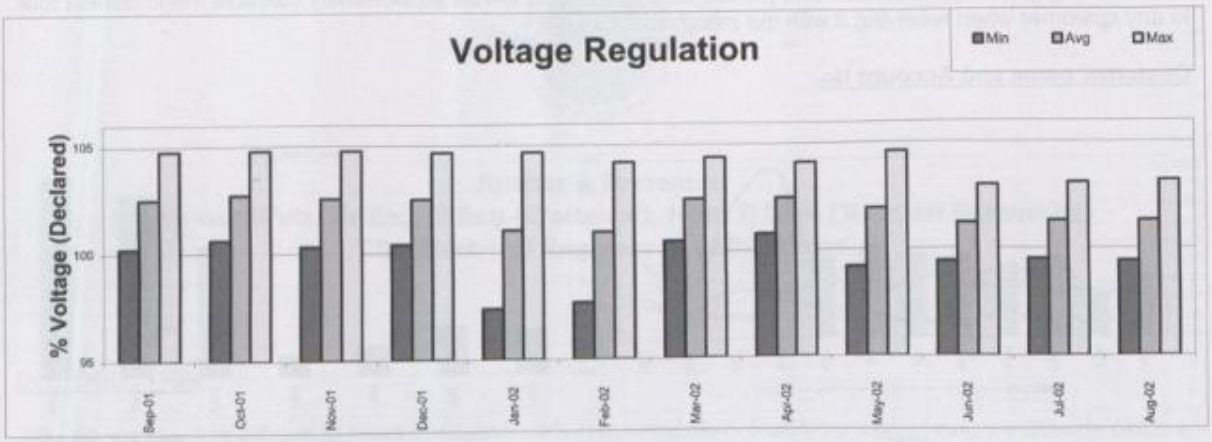


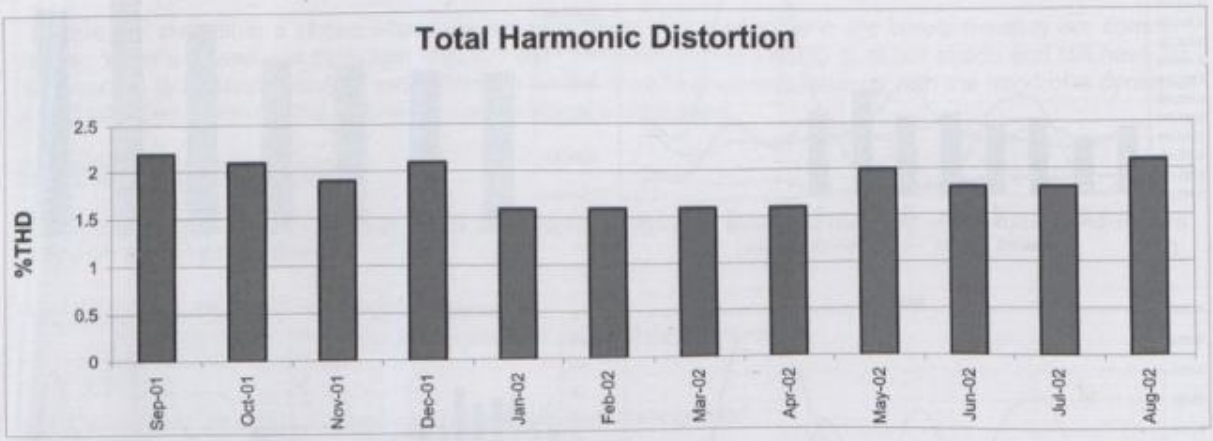
The customer is immediately empowered to observe the graphical explanation of its account, see the trends of consumption and account costs and develop an understanding for its monthly load factor and effective cost of electricity. From these graphs, strategic management decisions and budgets can be done. The latter information when updated, is an excellent opportunity for the distributor the verify and check the correctness of the account prior to dispatch.

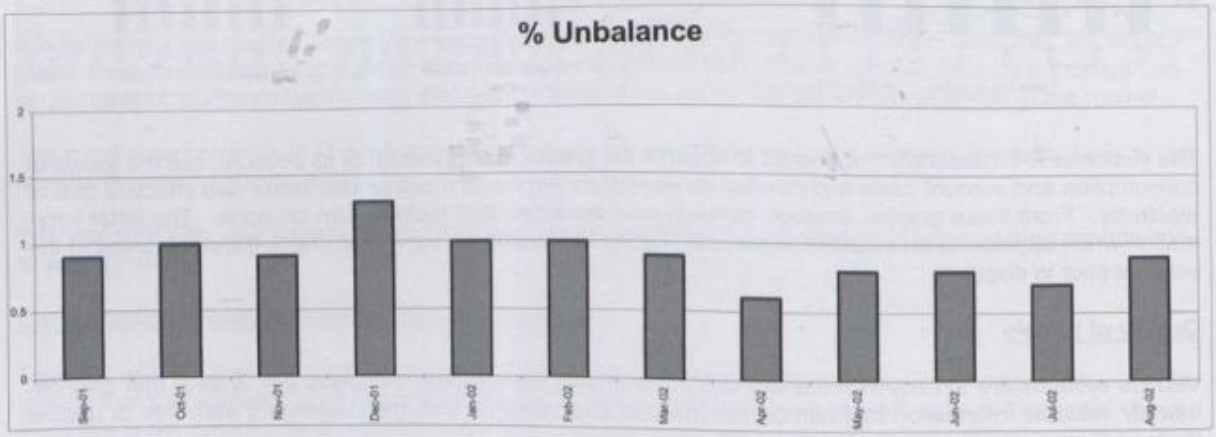
Quality of Supply

Various systems are already in place like QOS instruments (as required by SABS 047 & 048) that give extremely valuable information that can be summarized and provided with the customer's accounts to update them on their and your recently updated QOS.

Each dip or outage is summarized to explain the source of the dips. For practical reasons, this is normally done for all dips except Class X and Y dips.

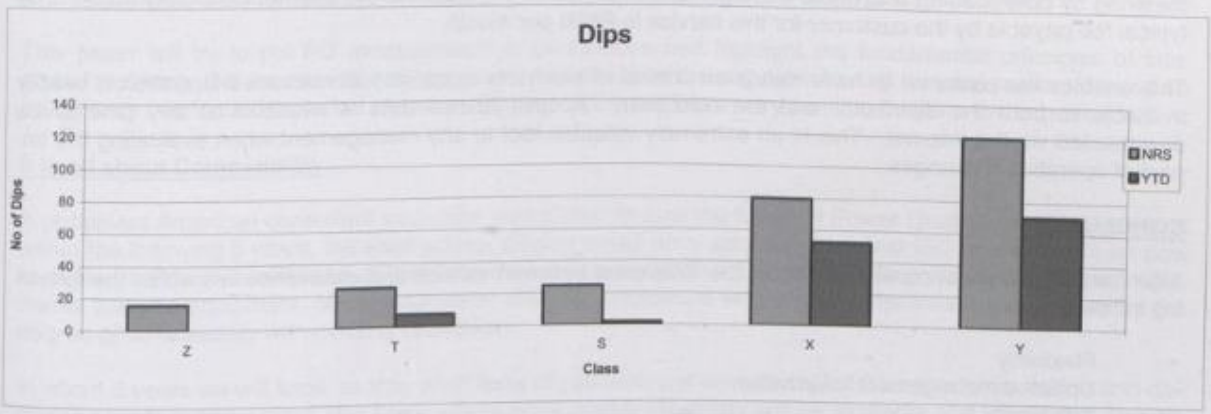






Year to Date Dips

Class	NRS	YTD	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02
Z	16	0												
T	25	8		5							1			2
S	25	2	1											1
X	80	53	12	3	6	3	3	3	2		1	4	14	2
Y	120	71	11	6	3	4	3	5	4	2	5	4	20	4



Events for the month

Date	Time/hr	Time/s	NRS	Phase	Duration	Deviation	Remarks on events (Z, T, S)
8/12	06:52	15.640	X	BC	0.070	-22.4	
8/22	12:37	22.97	Y	B	0.050	-12.4	
8/23	07:44	37.140	Y	C	0.060	-17	
8/26	09:37	12.690	Y	C	0.040	-11.1	
8/30	15:55	21.630	Y	B	0.070	-12.6	
8/30	20:48	18.940	T	AC	0.120	-84.5	132kV fault on Capella line1 (Flash-over during strong winds)
8/30	20:48	21.490	T	AB	0.120	-84.9	
8/30	21:57	36.420	X	A	0.150	-28.1	
8/30	21:57	39.620	S	AC	0.250	-28.2	Eskom - Athene: 132kV B/Zone operation.

CITY OF uMHLATHUZE CASE

uMhlathuze Electricity negotiated customized agreements with its five largest customers and has provided the above information with enhanced service for the past 3 years and achieved great success and benefits to both parties. Customer care is addressed at top management level. Accounts are being paid within 15 days from the meter reading date, which also coincides with the ESKOM account payment. These few customers represent 40 % of the total sale of electricity and has reduced the debtors turn-over rate for electricity to 1/3 (from 15 to 5). The effective saving achieved from this is in the order of R740,000 p.a. for the past financial year, based on a 10% interest rate.

Initially the accounts were hand delivered to the customers. Recently the accounts, together with all related documentation is e-mailed with a personal covering letter to our customers – and even better – to the "hot contact" who pays the account with copies to all the relevant and interested parties e.g. management, finance, engineering, production, etc.

This has the advantage of all parties acknowledging that:

a. The account has been received and checked
b. Exceptions have been highlighted and explained
c. Personal interaction and interest is shown
d. Immediate options to act/react and address/rectify
e. Ensure payment on time

STATE OF THE ART TECHNOLOGY

On-line metering is a new trend and technology is available whereby a service provider contracts to do the metering by downloading and make management information available via the internet on a daily basis. The typical fee payable by the customer for this service is R600 per month.

This enables the customer to have hands-on control of electricity costs and all relevant information is readily available to both the distributor and the customer. Access to raw data is available at any time to be downloaded via the internet. This is an extremely valuable tool to any management when evaluating the impact of operational changes.

CONCLUSION

After carefully considering all the above, the difference between service and excellence lies within the following indicators:

- Flexibility
- Updated management information
- Efficiency
- Reduced outstanding debts
- Personal interaction,
  and most important
- Going that extra mile!

Danie van Wyk

Integrated Power Quality Metering

by
Willie van Wyk (CT Lab)

Introduction

It is now almost 10 years since Power Quality (PQ) measurement was introduced in South Africa. The market has been dominated by the NRS048 requirements. Many municipalities have bought equipment that complies with the very minimum NRS048 requirements. There was, and still is, no long-term plan in place. A few municipalities, however, have seen this requirement from the NER (National Energy Regulator) as an opportunity to learn more about their networks and to provide a better service to their customers.

This paper will try to put PQ measurement in perspective and highlight the fundamental principles of integrated metering. If done correctly, the negative experience of the regulator forcing an unnecessary burden on the already overloaded technical personnel can be converted into a very positive preventative experience.

It is all about Compatibility

A prominent American consultant was once asked how he saw the future of Power Quality. His reply was that within the following 5 years, the international market would have adopted the latest IEC requirements on how to measure Power Quality and all instruments would comply. The focus would then move away from instruments towards equipment. Manufacturers of different equipment would then differentiate themselves by the degree of compatibility with existing networks.

In about 5 years we will know exactly what level of performance we can expect from the transmission and distribution system and we will also know where good quality electricity will be available and where not. The client can then use this information together with a good electrical specification to buy equipment that will be 100% compatible with the network.

Good quality statistics and a good supply policy can be a valuable asset to attract large industry to certain areas. This in return will guarantee more units sold and the growth of the area. If equipment end users put pressure on equipment suppliers to be fully compatible with the supply network, they can reduce their downtime considerably. It also leaves possibilities for the municipality to supply its key customers with a better than average quality electricity at an additional premium. Both the customer and the utility will benefit from this policy, as there will be less customer induced problems.

Permanent PQ monitoring will still be required, because the network and environment changes constantly. Today the 5th harmonic may not be a problem, but it might grow at a constant rate to become a major problem within a few years. The trends of all PQ parameters are therefore very important.

Be customer orientated

If a customer complains about the quality of their electricity supply, the right thing to do is to check it out. Roaming PQ monitoring instruments with standard site assessment reports are needed for this. The technician installs an instrument at the point of common coupling and a week or two later removes it. A report on the findings is now automatically created for the customer, already classified according to NRS048 requirements. Both parties can now come to the table with facts and start negotiation on solutions. A very important aspect of this approach is that the instruments used must fully comply with the requirements set out by NRS048.

Any large customer (larger than 1.5MVA) should be permanently monitored for power quality. The load impedance of this size of customer is normally significant in the contents of the network. Any fault generated in such a plant might have a large impact on the network. If a significant event or a series of events caused large losses to the customer or disturbances to the network, you would need detailed diagnostic data to prove that the network has responded to the events as expected. If not, you have detailed information about how the network has responded that can be used by experts for analysis. Such events normally happen far apart in time and if you do not have the information, you will always have an unhappy customer.

An added advantage of permanent monitoring at key customers is that the customer will learn more about his plant and consumption profile. An informed customer is a better customer.

If an event like a dip happened high up on the transmission system, the municipality can call the customer within 5 minutes after the event has occurred informing him that the event was upstream. The customer can then go through a normal restart procedure to restart his plant.

Link PQ events with fault data

An American customer told me about a utility that entered a supply contract with his firm that excluded any lightning events. One night a bad storm hit town and the customer experienced severe damage as a result of dips. The next day the customer retrieved all lightning strike data from the Internet and matched the dips caused by lightning with the dips that he measured at his supply point. To his surprise only 10% of the dips matched. It was later found that the utility had tried to save costs by not cutting trees and that the wind had blown the trees onto the network causing numerous dips. The trees were cut and the amount of dips during storms was reduced by more than 90%. The customer claimed damage from the utility and the utility paid for their duplicity.

This story just illustrates how important it is to know the origin of each event. If you do not investigate each event, you will not be able to identify patterns and simple solutions.

If you know what has caused dips, you can use the information as proof to justify capital expense, or you can advise sound solutions.

If you do not have the in-house experience to analyse PQ statistics, you can enter into partnership with instrument suppliers or consulting engineers to analyse the data monthly and to report back to management.

Planning

Network planners very seldom install large quantities of instruments on the network. The models they use are dominantly developed for 50Hz applications. Modern plants are changing from directly connected rotational plants to variable speed drives. This kind of load is normally highly distorted and the dynamic response differs considerably from directly connected rotational plants. Network stability and harmonics (and flicker) become ever more important.

If the municipality has profiled information available that includes phase response information, then planners can build much better models and prevent problems from happening.

One of the biggest problems that planners face is that the captured data they receive is sometimes not time synchronised, or is calculated using different accuracies. They then have to work with large tolerances to cater for the inaccuracies. If data can be properly time synchronised and flagged if a dip has occurred etc, then planning departments can design better cost effective networks.

Integrate the data in reports

Many different departments in an organisation can use power Quality data:

- Management needs performance indexes
- Reporting to the NER
- Network planners need field data
- Key customers need profile + event statistics
- Maintenance people need feedback
- Treasury need power consumption profiles and they need to monitor supply contracts
- GIS systems want to archive data for future use

Once the data is captured, it needs to be categorised and stored in a central database. From this database the different role players must collect the information that they require.

If each department or user can define a daily, weekly or monthly report, then the system can automatically generate the report in a PDF or HTML format and mail it to a mailing list or to a web server. The user is then triggered when he receives the report in his Inbox. Reports generated can also include data obtained from other third-party information sources like GIS systems, billing databases, maintenance databases, lightning event databases etc.

This way the complete system can run autonomously and will only call for assistance when needed. The cost of ownership is dramatically reduced this way.

It sounds Expensive!

Power Quality monitoring, unlike revenue metering, is normally done on a statistical basis or it is implemented with key customers where the customer pays for the instrument. Each instrument normally requires remote communications links (modem, cell modem, etc) as well as installation hardware (weatherproof enclosure, CT's etc). This kind of instrumentation is intended to be operational for at least 10 years. The instruments must therefore be designed to work unattended for at least 5 years, but preferably for 10 years.

A typical large South African utility would require about 50 instruments. At a budget price of R 75,000.00 per installation (labour + hardware + SW included), this will cost the utility about R3,75M. If you pay back the investment over a period of 10 years at interest of 10% per annum, it would cost about **R 1,000.00 per instrument per month**.

Conclusion

Power Quality is a new name for old well known network parameters, but it put the focus on the right place namely: **Compatibility**. If you do not know the performance of your network or the character of the load drawn by the customer, you would not be able to implement the right solutions to constantly improve or maintain your network.

There is valuable information embedded in raw meter readings. It takes a lot of time and effort to collect it, make sure that it is cleaned up properly and stored in a well-organised way. Spend the time and money to automate as far as possible and to compile reports that can be used throughout the company. Knowledge is power.

Draw up a long term plan or start talking to your instrument supplier. You do not want instruments; you want reports that contain practical information. Suppliers do not just want to sell instruments; they want a long-term relationship with a happy customer.

Try to explain all system events and identify those that can be eliminated today. If you can identify and remove one small repetitive problem, the sustainability index for that year gets a considerable boost.

Start measuring today – you will need the information tomorrow!

Willie van Wyk

Power Transformers, Cellulose Paper Insulation.

by

H.C. VISSER

Plant Engineering

1. Abstract

Power Transformers are employed in all Sub-Transmission Networks. The maintenance of these units has been erratic and still causes disputes today.

Individual components are usually considered in isolation, without considering the effects that the chosen maintenance will have on the other components of the transformer, especially the Cellulose Paper.

This paper will focus on the aspects affecting Cellulose Paper. A misconception is that external appearance determines the total condition and therefore the expected life of the total transformer.

2. Kraft Paper

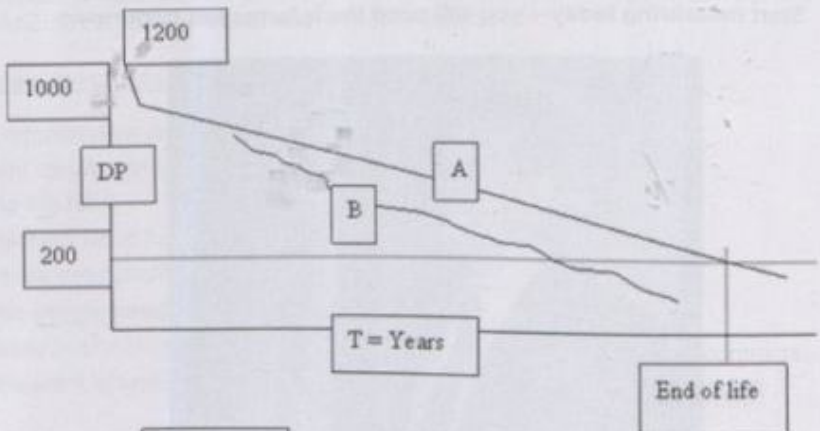
Oil Impregnated Cellulose Paper is still the preferred choice in transformer construction. Two types of paper treatments are used namely:

- Kraft paper Ambient + 55°C
- Thermally enhanced paper Ambient + 65°C

Paper is wound onto the copper before the coils are formed. It is therefore deep into the transformer and can't be economically replaced at regular intervals. Cellulose is responsible for mechanical spacing and clamping pressure in the coil. Elasticity in paper is reasonable when new, but becomes brittle when the paper has been subjected to multiple temperature cycles.

Paper performs a mechanical function and it is now known that once the paper fails the transformer fails. Paper is not visible to maintenance personnel and is generally not considered to have a need for maintenance.

Paper Life = Transformer Life



Graph 1

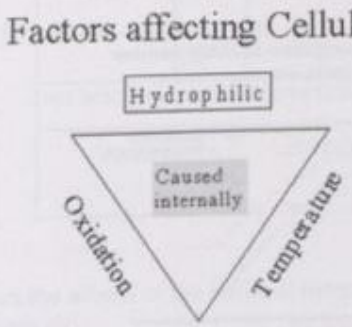
In graph A, we note a constant degradation of the condition of the Cellulose Paper. In theory this will be a straight line. The less the slope of the line, the longer the theoretical service life that can be expected.

In practice it may not be possible to achieve such a straight-line condition. Graph B show that neglect, incorrect maintenance and operational abuse of the transformer can damage the condition of Cellulose Paper .

3. Factors effecting cellulose paper

The condition of the paper can be altered by events internal to the main tank, as well as events external to the unit.

3.1. Internal factors



3.1.1 Moisture

Both paper and oil are Hydrophilic, they have the tendency to absorb water. Water reduces the insulating properties of both oil and Cellulose Paper, but more importantly it reduces the tensile strength of Cellulose Paper. Moisture enters the main tank through the open breather system as well as through leaking gaskets. Water is a by-product from the natural ageing process of Cellulose Paper. So even if all the external moisture is perfectly managed then moisture will still be formed inside the unit. (Dalton, 2002:59)

The absolute rule must be to keep the moisture level in the oil and paper as low as possible from the manufacturing process onward. Remember that paper can never be 100% dry. We have to maintain a suitable level in terms of % moisture in the paper according to the dry weight of paper. New transformers are usually specified at between 0.5% and 1%.

From graph B, we note that any damage to the paper is permanent. Once the DP (Degree of Polymerisation) is reduced by an event, the DP can't be lifted to graph A again. This loss can also be described as a reduction in life expectancy for the transformer.

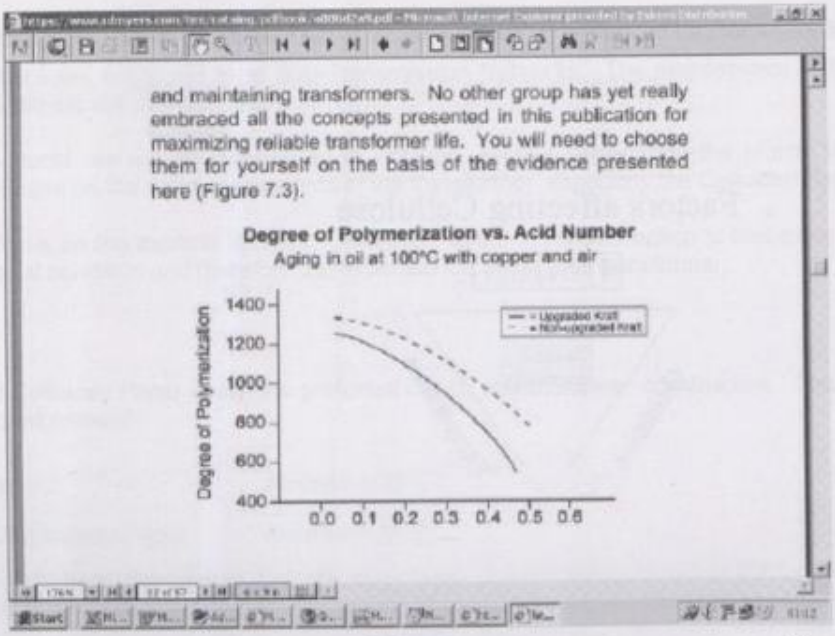
Note that water in the transformer can be in any of the following three states:

- Dissolved water — In Solution
- Water in suspension — In Emulsion
- Free water

When deciding on the maintenance action to be taken, care must be taken to know what maintenance will be

3.1.2 Oxidation

When oxygen is present in the insulating oil then acid will be formed. Oxygen enters the oil through the open breather system and faulty seals. Acid aggressively attacks the paper and break-up the fibre strings, causing the DP to reduce. The tensile strength and hence the mechanical ability of the paper is therefore reduced. The graph below shows the relationship between Acid and Cellulose Paper damage. (Horning, Kelly and Myers, 2001:192)



3.1.3 Temperature

Temperature is probably the one aspect in the transformer that has the most profound effect on the processes inside the unit. You might say that temperature is the catalyst in starting the damaging processes.

To understand the temperature effects, we divide temperature into the following two categories:

- Continuously high temperature
- Number of temperature fluctuations

3.1.3.1 Continuously high temperature

The Cellulose Paper life is considered to halve for every 6°C rise above 98°C and double for every 6°C fall. (See graph 2). Transformers are subjected to day / night temperature variations as well as seasonal variations. Most transformers also experience cyclic loadings.

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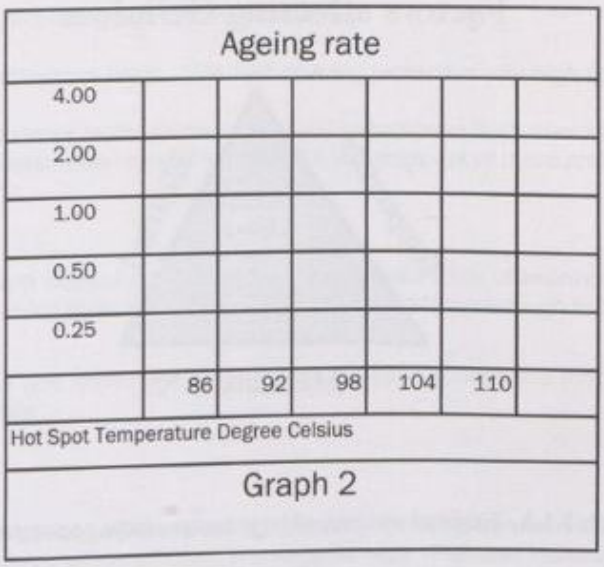


Graph 2

The following table shows the affects of the hot spot temperature, (Elder, 2002:21). Estimated insulation life for Cellulose Paper is given as:

Years	@	Continuous temperature level in °C
7.5		110
15		104
30		98
60		92
120		86
240		80

Overloading mostly causes high hot spot temperatures.

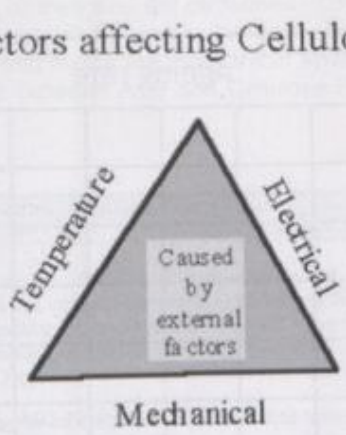
3.1.3.2 Number of temperature fluctuations

The number of fluctuations, as well as the rate of change in temperature has a severe effect on Cellulose Paper life. According to the PIPER chart, water migrates back and forth between the oil and paper. Water molecules are forced into the paper fibres and out everytime there is a temperature variation. This causes mechanical damage to the Cellulose Paper.

Manage and maintain the following heat sources:

- Operational loading, especially overloading and hot spot temperatures
- Iron and copper heat losses
- Number of temperature fluctuations
- Hot connections (electrical)
- Core short circuits

3.2. External Factors



3.2.1 Temperature

Following on from paragraph 3.1.3. External sources of heat can promote paper damage.

These are for example:

- High ambient temperatures
- External heat sources like, boilers, furnaces, etc. in close proximity
- The transformer is placed next to an obstruction like a building or firewall. This prohibits effective cooling by obstructing the airflow to the cooling fins.
- Oil and fan start settings should be checked for effective cooling. Where the fans can be selected in groups, it is more effective to switch the fan sets on in smaller groups, but starting at lower temperatures.
- Cooling fins must be clear of objects restricting airflow. Remove bird nests, plastic and other debris from the fins.
- Unobstructed oil flow through the cooling fins is vital. Check that all valves are fully open. When high acid levels are present in the oil, then there may be a build-up of sludge in the bottom of the cooling system and may reduce the flow of oil through the cooling system.

3.2.2 Electrical

The electrical factors are elements that must be controlled from the outside of the transformer. Most of these are applicable from the design application and commissioning stage.

Voltage surges are critical and many times overlooked. Design factors to be taken into account:

- Correct station earth mat
- Overhead lightning shield / spikes

- Correct neutral earthing ratio plus resistor. The voltage surge needs to be limited to a value not exceeding 250%
- Surge arrestors, correct rating and correct positioning
- Switching surges and system faults. Use fast clearing protection with high-speed circuit breakers
- Through faults and furnace loads cause violent and unbalanced fluctuations in the electrical current. The enormous magnetic fields caused will shift the windings out of place and damage the paper.

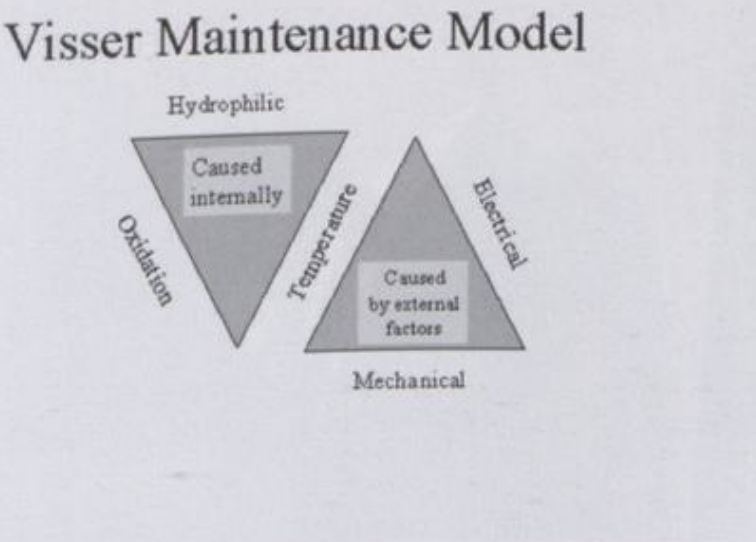
3.2.3 Mechanical

The motor / machine action is caused by rapid changing magnetic fields of enormous magnitude. Distortion of the windings takes place, which tears the paper. The forces are strong enough to bend the big steel bulkhead and clamping devices.

During transportation of the unit, care must be taken not to create shocks and mechanical disturbances to the delicate paper inside the coils.

4. Model

The model below has been developed to show the integral relationship between the two triangles. When any side is distorted then the others will be affected in a negative way. Planned Maintenance activities on power transformers need to be carefully planned and the results monitored to verify the affects on the other components as work progress.



5. Balancing Act of Maintenance

Most utilities test oil samples in order to determine the condition of the oil. This is the representative test to also determine the condition of the Cellulose Paper.

The oil contains and keeps a history of the transformer condition. However, when the oil is re-generated with "fullers earth" or replaced with new oil, then this history is discarded. Moisture in a transformer can be reduced on site. The method and rate of drying must be considered carefully.

Permanent damage can be caused to the paper by applying incorrect methods of dry-out.

Operate and Maintain The Transformer With the Health of Paper in Mind

6. References

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Dalton, T.H. (2002) Insulating Oil Management Training, Unpublished notes, p.59.

Elder L. (2002) Economically Optimal Transformer Rating, Proceedings of TechCon 2002 Asia-Pacific, p.17.

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Sensor Technology – Applications for Medium Voltage

Author & Presenter: Bo Westerholm B.Sc. . Product development engineer, ABB Oy, Medium Voltage Technology

1. Introduction

Sensors are a new solution for measuring currents and voltages needed for protection and monitoring in medium voltage power systems.

Certain strong trends have been present during the whole period of electrical equipment manufacturing: a continuous reduction of equipment *size*, a continuous improvement of equipment *performance* and a continuously grooving need for *standardization*

However, in some types of equipment the visible effect of those trends has, during long periods of time, been relatively small. A typical example is the transformer, including instrument transformers. The natural properties of the soft iron core, as maximal flux density and lack of linearity in the excitation curve, have set limits for the possibilities to reduce the transformer size and to use the transformer in a wider range of applications. As a consequence, most instrument transformer units have been electrically tailor-made for one certain application and a far-reaching standardization has never been realized.

This inconvenience can be defeated with the introduction of sensors based on alternative principles like the Rogowski coil and resistive or capacitive dividers for current and voltage sensing respectively.

These *principles* are far from new, they are generally as old as the principles of conventional inductive instrument transformers. However, the *utilization* of the principles has not been possible to carry out - except in special applications - due to the lack of accurate and inexpensive electronic devices required. Not until now, with the introduction of versatile electronic relays, has it been possible to make use of the advantageous properties of sensors.

This paper presents practical sensor technology solutions as it has been introduced in medium voltage applications. Characteristics and behaviour of sensors in various service conditions are explained by comparing with traditional instrument transformers.

2. The principles of sensors

2.1 Various principles

Sensors for current and voltage measurement can be based on various principles. For medium voltage applications simple, compact and cost-effective solutions are needed. In the practice there are a few in commercial use:

- Current sensors:
  - Rogowski coil
  - Low Power Current Transformer
  - Hall sensor
- Voltage sensors
  - Resistive divider
  - Capacitive divider
  - RC-divider

Rogowski coil sensors and resistive/capacitive voltage divider sensors are described below.

2.2 Current sensors

The measurement of currents is based on the Rogowski coil principle. A Rogowski coil is a so-called air-core coil, a toroidal coil without an iron core placed around the primary conductor in the same way as the secondary winding in a current transformer.

However, the output signal from a Rogowski coil is different:

- The output from a current transformer with its *iron core and nearly short-circuited secondary winding is a current.* This so-called secondary current is *proportional to the primary current.*
- The output signal from a sensor with *its air-core and open Rogowski coil is a voltage.* This so-called transmitted signal is proportional to *the derivative of the primary current.*

Thanks to the absence of iron in a Rogowski coil sensor, no saturation occurs. The output is therefore linear over the whole current range up to the highest currents.

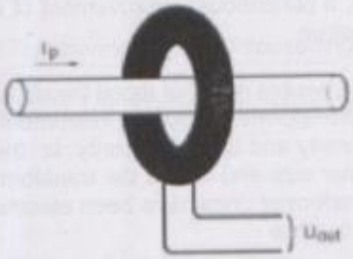

Fig. 1 Rogowski Coil

Transmitted signal from a Rogowski coil

- The transmitted signal is a voltage:

$$u_{out} = M \frac{di_p}{dt}$$

- *For a sinusoidal current* under steady state conditions the voltage is:

$$\underline{U}_{out} = M \cdot j \cdot (i) \cdot \underline{I}_p$$

The signal is a sinusoidal voltage, proportional to the current, with 90° phase shift (lead).

- *In all cases*, even if the primary current is non-sinusoidal, a signal reproducing the actual primary current waveform is obtained by integrating the transmitted signal.

2.3 Voltage sensors

The measurement of voltages is based on the use of voltage dividers, resistive or capacitive.

The output is linear over the whole range. Resistive dividers are more accurate, but capacitive ones are smaller in size

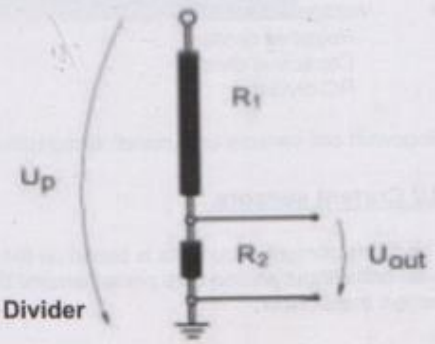

Fig. 2 Resistive voltage Divider

Transmitted signal from a voltage divider

- The transmitted signal is a voltage:

  from a resistive divider: $u_{out} = \frac{R_2}{R_1 + R_2} u_p$

  from a capacitive divider: $u_{out} = \frac{C_1}{C_1 + C_2} u_p$

- In all cases, the transmitted signal reproduces the actual primary voltage waveform.

2.4 Protection and control IEDs (Intelligent Electronic Devices)

In comparison with instrument transformers the transmitted signal from a sensor is a more exact reproduction of the primary current or voltage, inclusively harmonics and high-frequency disturbances, up to the highest values such as short-circuit currents. The price one has to pay for it is a low signal level and a high output impedance. Consequently a sensor can not be connected to a traditional relay. In addition the output signal from a Rogowski coil sensor must be integrated to obtain a exact reproduction of the primary current. Even if the sensor principles has been known for a century the lack of suitable relays has until now limited the use of sensors to certain special applications.

But modern electronics has changed the situation. Relays, suitable also for sensor use are now available on the market. Thanks to them the utilization of the sensor principles is possible to carry out, even as a standard solution for medium voltage switchgear. In addition modern relays have an improved ability to perform complex calculations when accurate input data is available. Consequently more information about the operation conditions is available from the new relays, also called Protection and Control IEDs.

3. Standards

3.1 IEC standards

The following IEC-standards are published. The requirements on the primary side of the sensor is based on traditional thinking and are the same as for traditional instrument transformer. The requirements on the secondary side of the sensor are based on traditional thinking but adapted for the new technology.

- IEC 60044-7 (1999-12)

  Instrument transformers .
  Part 7: Electronic voltage transformers

- IEC 60044-8 (2002-07)

  Instrument transformers .
  Part 8: Electronic current transformers

For combined sensors there are no standard yet. The corresponding standard for instrument transformers can be used but one have to remember that the standard is old and based on old standards IEC 185 and IEC 186.

- IEC 60044-3 (1980-01)

  Instrument transformers .
  Part 3: Combined transformers

3.2 Diagrams

Below is shown a general block diagram for an electronic voltage transformer as given in IEC 600044-7. As pointed out in the standard the applied technology decides which parts are necessary for the realization.

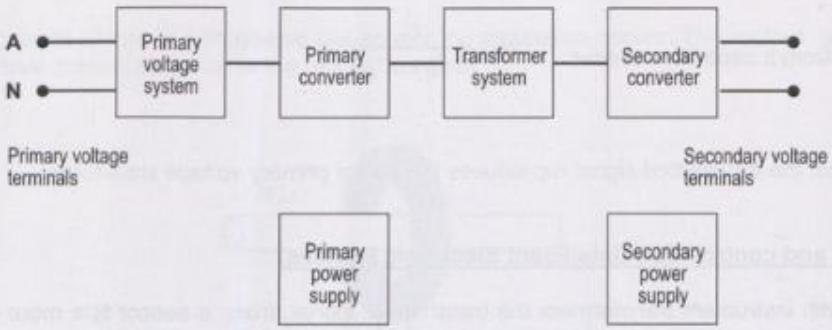

Fig 3. General Block Diagram according to IEC

A sensor application for medium voltage is built up of a minimal numbers of components. Below is shown a diagram for a typical installation in the practice. No active primary converter is used, and the secondary converter, if needed, is integrated in the protection and control IED.

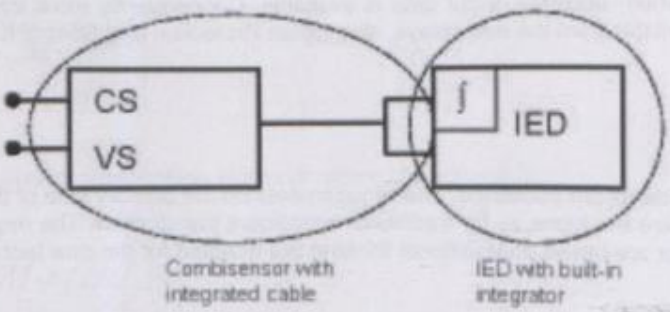

Fig 4. Medium voltage sensor application built up of only two components. CS=Current sensor, VS=Voltage sensor

4. Sensors v. ITs (Instrument Transformers)

4.1 Absence of iron

The characteristics of traditional instrument transformer are mostly determined by the properties of the core materials used. Because the iron core is linear only within a limited range, most instrument transformers are tailor-made to fit a certain application and can typically not be used for other applications.

Contrary, a sensor according to item 2 is built up of linear components only. The function of sensor is linear over a very vide range of currents and voltages, the limitations are often caused by other circumstances than the sensor itself.

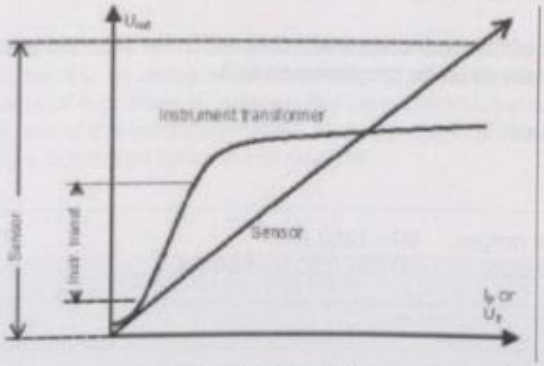

Fig 5. Linear range for instrument transformer and sensor

4.2 A New approach to rated currents and voltages

The perhaps most important consequence of the sensor's linearity is the possible to extend the operation range far outside the limits given by the standard for a certain rated current or voltage.

In Fig. 6 is as an example shown the standard class limits for a current transformer or sensor with rated current 80 A. Typical accuracy curves for an CT and a Rogowsky coil sensor are also shown.

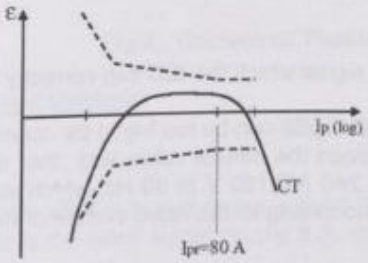

Fig 6. Rated current, accuracy limits and accuracy curves for a current transformer (CT).

Because a current sensors is highly linear within a very wide range of currents, one and the same sensor can be used for various *switchgear* rated currents. Instead of *one sensor rated current*, a *sensor current rated current range* can be defined. For every switchgear rated current within the sensor rated current range, the sensor fulfills the accuracy specification given by the standard for this particular rated current.

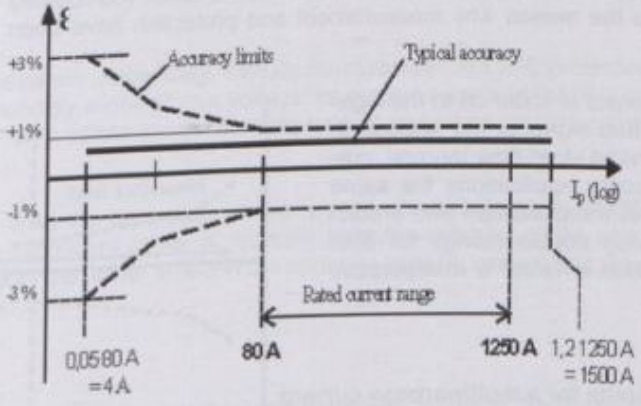

Fig 7. Rated Primary current range, accuracy limits and accuracy curves for a current sensor

The same is also valid for the rated voltage of voltage sensors.

To achieve a correct function of the protection and control IED the selected rated current as well as the rated transformation ratio of the sensor must be programmed to it

Examples of typical rated values:

Current sensor:

Rated primary current range: 80 - 1250 A
Rated transformation ratio: 80 A/0, 150 V at 50 Hz

Voltage sensor:

Rated primary voltage range: 6: $\sqrt{3}$—22:$\sqrt{3}$ kV
Rated transformation ratio: 10 000:1

The rated current or voltage range is limited by:

Upper Limit:

- Highest voltage for equipment (voltage sensors)
- Rated continuous thermal current (current sensors)
- The highest voltage of transmitted signal which the IED can correctly process

Lower Limit

- The lowest value of the transmitted signal which the IED can correctly read

At higher primary currents the transmitted signal can be too big to be connected directly to the IED. In such cases a adapter shall be connected between the sensor cable and the IED. The adapter will reduce the transformation ratio to a lower value e.g. 240 A/0,150 V at 50 Hz, which value then shall be programmed to the IED. The adapter is chosen not only according to the rated current of the switchgear but also according to the specification for the IED.

4.3 Multipurpose sensors

As shown in fig. 6 the accuracy curve for an measuring current transformer is highly unlinear. Especially the fact that the (amplitude) error is big and negative at overcurrent, has been used to protect instruments from high secondary currents and voltages under fault conditions.

On the other hand a protective current transformer must have a small (composite) error particularly in the overcurrent range. That is the reason why measurement and protection have been carried out by different cores.

A Rogowski coil current sensor is linear up to the highest currents. The transmitted signal is low enough to be harmless even at the rated short-time thermal current. Consequently, in sensor applications the same core can be used for both measurement and protection. Such a sensor having double ratings for both measurement and protection is called a multipurpose sensor.

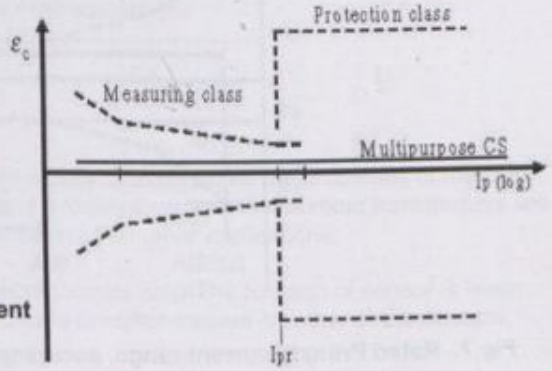

Fig 8. Accuracy limits for a multipurpose current sensor and a typical accuracy curve

4.4 Correction factor

The amplitude error of a current sensor is in the practice constant and independent of the primary current. Hence it can be corrected in the IED by using a correction factor, measured separately for every sensor. A sensor fulfilling the requirements of e.g. class 3 *without* the correction factor can be corrected to fulfil the requirements of class 1*with* the use of the correction factor. Voltage sensors can easily be corrected before encapsulating and subsequently a correction factor is not needed.

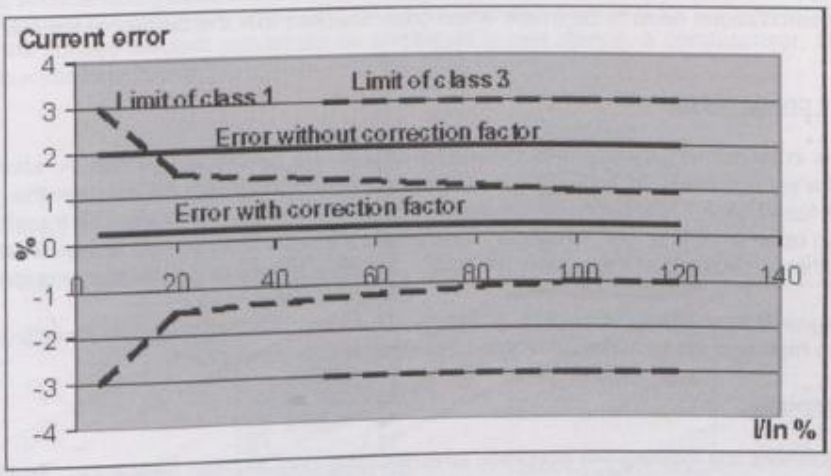

Fig 9. Correction Factor

4.5 Secondary signals, wiring and burdens

Secondary signal level

The secondary signal rated level for voltage transformers is appr. 60 V, during fault conditions it can be appr. the twice. For current transformer is the rated signal mostly 5 A, during fault conditions it can be hundreds of amperes.

For sensors the rated secondary voltage is below 1V. During fault condition the output voltage of a voltage sensor is appr. the twice. The direct output from a current sensor is even at full short-circuit current small. An extreme example: if the transformation ratio is 80 A/0,150 V the voltage of the transmitted signal will be only 75 V at 40 kA. Because the internal impedance is very high, such a signal is still harmless for people and equipment.

Secondary wiring

As mentioned above separate secondary circuits for measurement and protection are not needed in sensor applications. The secondary wiring from a voltage or current sensor to the IED can then be made with a single cable. In the case of a combi-sensor the voltage and current secondary cables can even be combined in one.

Due to the low signal level the secondary wiring is prone to disturbances and therefore must the cable be properly shielded. The secondary cable is typically a double-shielded cable, one of the shields is earthed in one end of the cable and the other shield in the opposite end. By using cable connectors the correct connection will easily be made.

Burdens

The losses in the cable are negligible but the cable capacitance affects the phase displacement. Accuracy tests of the sensor are therefore made with the cable connected. A cable of suitable length must be ordered and the maximal length of the cable is limited.

To ensure that the shieldings are correctly connected and the accuracy requirements are fulfilled the secondary cable must not be:

- shortened
- lengthened
- Branched

On the other hand, if the sensor is ordered with a suitable cable, the secondary connections are very easily made. No burden calculations need to be made when once checked that the burden of the IED is suitable for the sensor.

Faulty secondary connections

Faulty connections in instrument transformer secondary circuits are always dangerous. A short-circuit in the secondary side of a voltage transformer will cause a short-circuit which always will damage the transformer if the circuit is not fused. A full short-circuit on the secondary terminals will make the transformer explode within a minute. An open circuit in the secondary side of a current transformer can easily cause overvoltages higher than the withstand voltage of secondary terminals, terminal blocks and secondary equipment.

The transmitted signal from a sensor is always a voltage. The internal impedance of both voltage dividers and Rogowski coils are high enough to make both type of sensors short-circuit proof.

4.6 Frequency response

Instrument transformers are fulfilling the accuracy specifications only at rated frequency. At higher frequencies the accuracy is decreased, at 1000 Hz the additional error is appr, 2 %. At lower frequencies the additional error increases fast, at 25 Hz it is appr. 5 %. The rated voltage factor and accuracy limit factor are strongly dependent on frequency.

All sensors described in this paper are linear without any additional error between 10 and 1000 Hz. The behavior at lower and higher frequencies is mainly depending on the capacitances in the secondary cable.

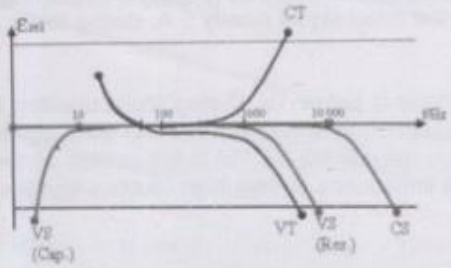

Fig 10. Frequency response for current transformer (CT), voltage transformers (VT), current sensor (CT) and voltage sensor (VS)

4.7 Extreme voltages and currents

Voltage transformers are factory tested at increased frequency, 250 - 400 Hz, to avoid saturation. If such a test voltage is not available when the switchgear is tested, the voltage transformers must be disconnected during testing.

All sensors can be retested with rated frequency without extra arrangements.

Current transformers can suffer from remanence e.g. after a fast current switch-off. Because the sensors do not make use of ferromagnetic components no remanence occur, and there is no risk for the sensor to be outside the accuracy specifications.

4.8 Direct voltages

Voltage transformers are very sensitive for direct voltages and must subsequently be disconnected during dc-testing of cables. Resistive voltage dividers can withstand a dc voltage high enough for most cable testing. (24 kV sensor 70 kV dc). In most cases the sensors need not be disconnected for the dc test.

4.9 The impact on equipment size

As sensing elements are noticeably small and the same elements are used for both measurement and protection, current and voltage sensors can easily be combined in one device, a combisensor, still smaller than a conventional current transformer.

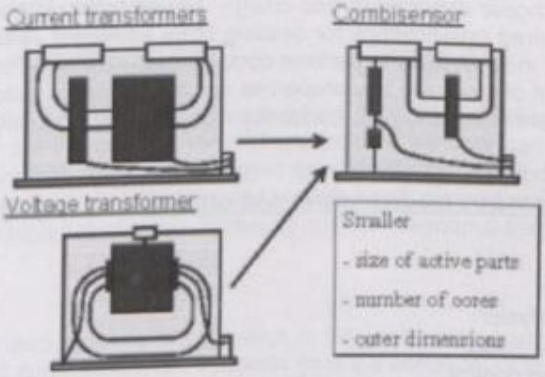

Fig 11. Size of instrument transformers and sensors

The small dimensions of sensing element make it possible to integrate them in other components as bushings, insulators, housings and circuit breakers.

4.10 Ferroresonance

Voltage transformers are one of the most sensitive components used in the medium voltage network, the failure rate is appr. ten times so high as for current transformers. The reason is the primary winding build up of thousands of turns of a very thin wire. This winding plays a double role in the development of voltage transformer failures:

- In some networks the unlinear inductances of the primary windings form a resonance circuit together with the earth capacitances of the network. Under unfavorable circumstances a so called ferroresonance can occur in this circuit causing high overvoltages, saturation of the core and high primary overcurrents. The resonance frequency is often below the nominal frequency of the network.

- On the other hand the primary winding is very sensitive to all kind of overvoltages and overcurrents, especially subharmonics and dc-components.

The risk for ferroresonance can be reduced, but not completely eliminated, with a damping resistor.

Voltage sensors are resistive or capacitive, and they are linear. They do not cause ferroresonance and they are not sensitive to overvoltages or -currents caused by other components. There is no need of damping resistors.

4.11 Varieties and delivery time

Instrument transformers are linear only within a very limited range of current or voltage. As a consequence, most instrument transformer units have been electrically tailor-made for one certain rated current or voltage, for a certain secondary burden and moreover, different secondary windings have been needed for measurement and protection.

Thousands of different types have been needed to cover even the most common applications and a far-reaching standardization has never been realized.

One single sensor can be rated for several switchgear rated currents or voltages, both for measurement and protection. The number of varieties needed to cover the most common applications are so small that the sensors can be delivered from stock, which will strongly affect the delivery time.

Easy engineering and uncomplicated mounting are other factors shortening the manufacturing time for the swichgear.

4.12 The impact of new relay technology

Besides the impact on switchgear dimensions and design, sensor technology supporting modern protection and control IEDs, gives required qualifications for building more intelligent switchgear. The main reason for this is the improved ability of modern IEDs to perform complex calculations when accurate input data is available. From the sensor point of view, the key properties are their ability to exact reproduce primary currents and voltages, inclusively harmonics and high-frequency disturbances, up to highest values, e.g. short-circuit currents.

Switchgear features enhanced by modern relays and sensors

- Better selectivity
- Improved fault location
- Better disturbance analyses
- Power quality measurements
- Remote monitoring and control
- Easy maintenance
- Optimized maintenance program
- Simplified IED testing

4.13 Shortcomings. The actual situation and further development

Instrument transformer technology is a ripe technology and proven solutions for most measurement and protection application already exist. Sensors for medium voltage applications are under development and there are still some advantageous application lacking.

Revenue metering

- Class 0,2 sensors can be manufactured , but a inexpensive and reliable solution is still missing.
- Meters are still missing
- External accredited/certified laboratories for routine testing are not accessible

Differential protection

- In most cases are cables with a length >10 m needed. Because so long cables will seriously affect the phase displacement of the sensor an uncomplicated solution is not yet available.

Io-measurement

- "Cable current sensors" are not manufactured. Io is easily calculated by the IED from the three phase currents, but the sensitivity is in most cases not good enough for protection.

The behavior of instrument transformers is well known. The unlinearity leads to complicated applications, but there is a lot of experiences and the limits for the applications are well known.

Sensors, on the other hand are linear which in most cases leads to simple applications. Their behavior as successors to instrument transformers is skillful in most applications. Experiences of some exacting applications with great demands, complicated but realizable with instrument transformers, are still missing.

But usually linear components facilitate more un- complicated solutions than un-linear ones. The exact limits for additional future applications are unknown and partly depending on the future development of the IED technology.

5. Experiences

Medium voltage sensors (ABB sensors) are until now been installed at 261 customers in 56 countries.

6. Conclusions

Some instrument transformer disadvantages can be defeated with the introduction of sensors based on alternative principles like the Rogowski coil and resistive or capacitive dividers. New types of relays are needed, but a number of advantages can be achieved:

Size

The active parts are smaller than in a conventional instrument transformer. Different secondary windings for measurement and protection are not needed. Current and voltage sensors can easily be combined in one single combisensor, still smaller than a traditional current transformer, or be integrated in other components as insulators, bushings, housings and circuit breakers. The small dimensions have an positive impact on cubicle dimensions, the use of high-valuable raw materials and environmental friendliness.

Performance

Because of the good linearity and absence of saturation is the information transmitted from the sensors to the IED, especially during fault conditions, more accurate than the corresponding secondary information from an instrument transformer. Improved ability of new relays to perform complex calculations gives the qualifications for versatile relay functions and more intelligent switchgear.

Standardization

The good linearity make it possible to cover several rated currents and voltages as well as measurement and protection applications with one single sensor. The standardized secondary connection with one cable to one single secondary equipment makes it possible to have only one secondary rating. As a consequence a minimum of versions are needed and they can be standardized for delivery from stock. This will give simple order-specific engineering, short delivery times, easy and fast installation as well as uncomplicated and compact cubicle design.

Bo Westerholm

Members Forum
Chaired by Peter Fowles and Deon Louw

The development of a national online vending specification

By

Kobus van den Berg, Chairman STS User Group

1. Introduction

Current pre-payment vending technology has been specified in 1993 in the NRS 009 process as well as in Eskom's common vending specifications in the mid 90's. The idea was to create a common vending system to ensure that all vending systems conform to the same basic requirements to vend to especially STS compatible meters. Many proprietary metering systems where however already in use. This fact resulted in the use of proprietary vending systems with STS capabilities. Although the interfacing equipment Standard Token Translator (STT) has been specified in the NRS 009 documentation, very few manufacturers developed a system. A new generation of vending systems are currently being developed by various manufacturers but no standards exist. Thus the need for a specification to ensure that the new generation of vending systems are compatible.

2. Reasons for development of the specification

Some of the main reasons for developing these specifications are as follows

A) The existing systems and specifications are outdated;
B) New amalgamated municipalities need integrated vending systems to serve a variety of meters and communities;
C) Available systems are not compatible and do not include facilities to vend to older meter technologies from other manufacturers;
D) Not all manufacturers are willing to share their older encryption technologies;
E) The vending industry itself does not come forward with suitable standards and no international standard exists for vending systems. The IEC is working on a concept of universal requirements for payment systems but a specification is far from completed. The end users thus had to step forward to facilitate the process.
F) REDs will require large integrated and inter-compatible systems in the near future;
G) Higher security and data processing capabilities are required;
H) Newer payment mechanisms need to be accommodated to facilitate better customer services.

3. Current process

An initiative from the STS Users Group as well as the fact that some larger municipalities need to update their systems resulted in the establishment of a working group to compile such a specification. The events leading up to the project as well as the current working group activities are as follows;

A) Presentations at AMEU (2000) technical meeting as well as Vending options(2001) did not effecttively convey the message to the industry that standards need to be introduced in new vending systems;
B) At a meeting of the STS Users Group (Eskom and Municipalities) in January 2001 manufacturers were briefed about this requirement.
C) The support of the ESLC was obtained for this project;
D) Eskom provided the funds to appoint a person from TSI to perform this task
E) Nothing significant happened in the industry and the STS user group took a decision at a meeting in March 2002 to convene a meeting with manufacturers on 2002-4-8 to get their co-operation on compiling a specification. Some larger Municipalities at that stage already had tenders out for the replacement of existing systems.

F) The TSI person visited all vending manufac- turers (April 2002) as well as a number of municipalities to get their input. This process however did not result in a significant contribution by any manufacturer in terms of a ready made specification;

G) At a meeting of the working group on 2002-8-12 it was decided to proceed without these inputs and this resulted in the draft scan report (RES/SC/02/17493) on the basic requirements. Manufacturers and STS User group members form part of the extended working group and will be involved in the specification process which should result in a new updated NRS 009 specification for online vending systems.

H) The draft scan report [1] has been circulated to all manufacturers and STS User Group members for comments (August 2002).

4. Online vs off line vending

Once the fact that a new specification is required has been established one has to elaborate on the options and possibilities that exist. What is really required by the industry and what will this contribute to the service delivery? One of the fundamental changes to new vending systems will be whether an offline or an online system is required. The exact definition can be debated but for the purpose of this paper the following definition will be applicable.

Off line systems can conclude transactions at a point of sale without direct communications with a management system at a higher level but data must be synchronized (uploaded) at specific intervals to ensure that transactions are recorded in the main database.

Online systems need a direct real time communications link between the point of sale and a centralized database to conclude any transaction. All authentication, authorization, encryption and recording is performed by the centralized management system.

5. Advantages vs disadvantages of an online system

Advantages

i. Higher security due to the fact that all encryption and data are centralized an managed from one point;
ii. Transaction, EBSST and revenue information updated in real time;
iii Better customer service through the new payment systems and vending channels e.g. internet, credit card, cell phone etc
iv Encryption for proprietary and STS systems can be centralized;
v Multiple vending contractors can be appointed as long as they all have access to the same central ized database;
vi Much simpler POS terminals
vii Arrears collection much simpler because customer data is centralized.

Disadvantages

i Currently more expensive due to required communication systems;
ii Vending not possible when communication line not operational;
iii Communication not available in rural areas
iv Current systems will lock customers into one supplier because no industry standards exist;
v Requires a very secure communication and authentication system.

6. Requirements for online systems

These perspectives have been compiled after the visit of the project leader to all manufacturers and a number of utilities.

User perspectives

- User should not be locked into a specific manufacturer
- EBSST functionality
- Debt recovery functionality

- Possibly include payment of other municipal services
- Both STS and proprietary systems shall be supported
- Secure central database and encryption
- Off line vending support where online systems cannot be used or when communication breaks down
- Multiple vending channels eg internet, IVR, SMS, WANS, LANs, radios, X25;
- Compatible with various clients or token requestors eg CDU,POS,Cell Phone, 3rd party transaction switch, ATM etc
- Extensive vending management tools.
- Open IT platforms.
- Compatibility with other financial systems.

Supplier perspectives

- Integrate current vending systems in new systems
- Network and database redundancy catered for;
- Online systems should include offline support
- Specify system performance
- Lack of standard banking interfaces should be addressed
- Effect of Electronic communications and transaction bill should be addressed
- Should be an interface specification
- Specify processes and not protocols
- Various payment methods catered for
- Conformance testing must be specified and managed by a third party;

7. Encoding mechanisms : STS vs proprietary systems

The first pre-payment metering systems were installed in the early 90s. Each supplier designed a transfer protocol to ensure that information contained on the pre-payment credit token could not be copied or fraudulently generated. The only problem with this approach is the fact that non of the meters were compatible and an encoding card or a complete vending system required to vend to these meters. The result is that many utilities are still locked into the systems of specific meter suppliers

The solution to this situation was the development of the Standard Transfer Specification (STS) by Eskom in 1993. This forced all manufacturers to use the same transfer mechanism and meters were thus compatible in the sense that one STS vending system could be used to vend to all the different meters from different manufacturers. Meter manufacturers did not necessarily view this to be in their interest at the time but today every body experiences the advantages of standardization. In the RSA most conventional pre-payment meters sold today makes use of STS.

Large installed bases of proprietary meters however are still in use. This implies that to a certain extent, users are still locked into using specific vending systems for these meters . This is a serious disadvantage that needs to be addressed. The STS Users Group requested the different manufacturers to come to some sort of an agreement to make legacy technology available to all vending manufacturers to enable utilities to acquire new vending systems that can vend to STS as well as older meter technologies. This is especially important with the amalgamation of different municipalities into metros where a number of different older meters are still in use. Most manufacturers responded very positively to this request but there are still those manufacturers who think that their older technology will ensure their survival in the pre-payment market. This attitude is to the detriment of utilities and the whole industry and should thus be eradicated. Utilities should insist on standardized systems and refuse to buy from manufacturers who try to lock them into specific technologies. This situation illustrates the importance of standards in the pre-payment vending industry.

8. What needs to be specified?

It is quite important to decide what should be specified. Many standards and procedures already exist and it will be foolhardy to re-invent the wheel in many cases. One should define the essence of what ensures compatibility as well as allow manufacturers to use techniques to differentiate their product from others in the field. As far as pre-payment meters are concerned the token encryption technology was specified and this was enough to ensure interoperability.

The Scan report [1] covers the field of standardization but at this stage not all stakeholders agree. One will thus have to give everybody an opportunity to make comments and make a final decision based upon the best interest of the industry.

At this stage it seems necessary to ensure that the exchange of data between the point of sale and the main database should be specified as well as interface mechanisms to allow banking, cell phone and third party vending suppliers the opportunity to link into the vending customer database. It will also be necessary to ensure that all encryption technologies can be linked to the main encryption server to allow vending to STS as well as all the different proprietary systems.

9. Proposed framework

The figure (1) gives a basic layout of the proposed system. One can add a number of subsystems in terms of the various servers required but his figure shows the minimum system.

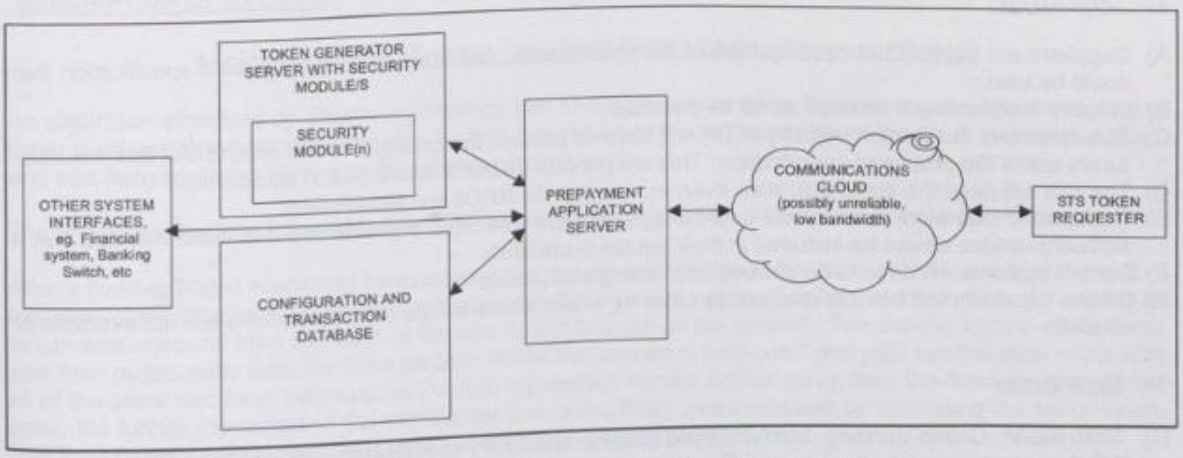

Figure 1 Proposed online vending system

The specification will have to cover the transaction messages between the token requester and the vending server. A common set of messages will have to be defined as well as the security and authentication mechanisms employed to ensure confidentiality and integrity of data exchanged. The specification will ensure that various manufacturers can supply tokens requesters (POS, CDU, Cell phone, as well as internet based systems) and that these devices will be compatible.

The system will be independent of the communication method used. One will thus be able to use the most appropriate and cost effective system in a particular situation.

10. Time line for developments

A) The scan report [1] will be finalized during August 2002
B) First draft of the proposed specification will be available for comment by end October 2002
C) Final version will probably not be available before the first quarter of 2003.

11. Vending in the Regional Electricity Distributors (REDs)

Vending systems will constitute a vital business machine in the REDs. A large number of consumers have already been connected to the grid by using pre-payment systems. The current vending systems need upgrading to ensure inter-operability once the industry is formed within the next few years. The business of selling electricity and provide good customer services will depend on how well the industry can upgrade it's business data systems. Some of the bigger metro's have already embarked on implementing systems by themselves. Successful integration depends without doubt on industry standards being implemented. Situations where one RED will vend on behalf of neighboring RED cannot be avoided due to the demarcation of distributions areas. This is especially true in the Gauteng region.

Interfacing with other business machines like financial, GIS, customer data bases, banking systems, third party s transaction switches ,call centers and maintenance systems is vital to ensure seamless integration of RED management information systems.

To ensure that REDs function effectively one will have to concentrate on the integration and standardization of information sub-systems.

12. Way ahead?

A) It is absolutely essential that the EDI as a unified front go ahead with the development of this specification
B) One should also cater for other services like water and arrears recovery .
C) The EDI has to take responsibility for this development and ensure that it is used for all vending systems to purchased in future;

13. Conclusion

A) Suppliers will support the development of the specification, but none want to propose a specification that could be used;
B) Industry standards will be used as far as possible
C) The electricity distribution industry (EDI) will have to provide the driving force to ensure that the manufacturers adopt the proposed specification. This will prevent possible future lock in situations;
D) The EDI will need the standardization even more once the REDs are established.
E) If a specific distributor cannot wait until the specification has been implemented it is recommended that a software update clause be included in their tender documents;
F) Current systems will have to be phased into new specifications
G) Off line capability will have to retained to cater for areas where online communications are not available or reliable.

14. References

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[2] AMEU technical meeting 2000, Mosselbay, STS and Beyond
[3] Vending Options 2001, Standardisation and functionality of vending systems for the distribution industry
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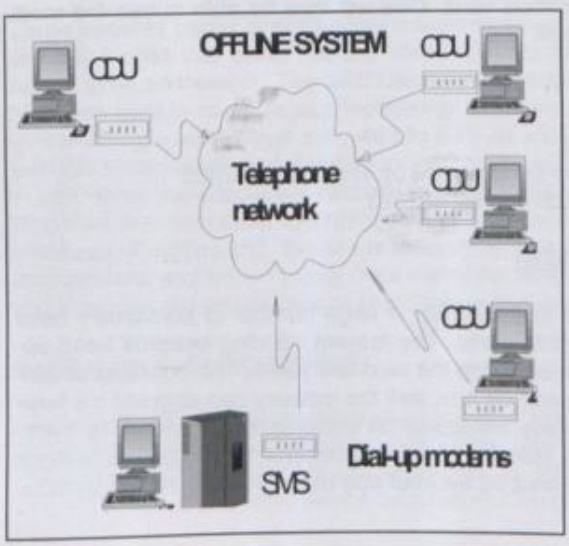

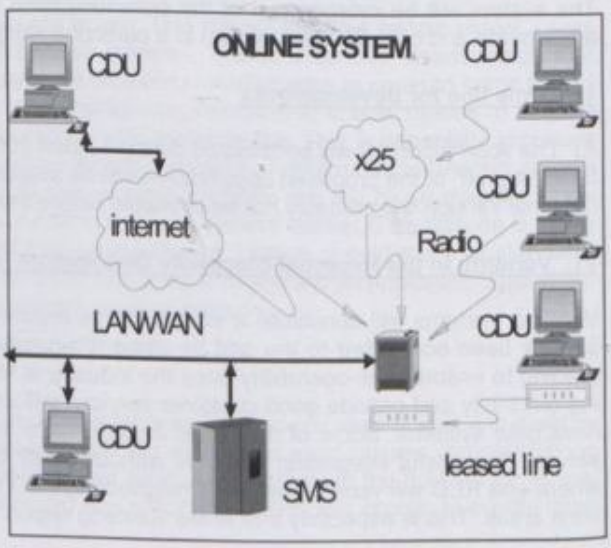

Accident Reports and Lessons Learned

ACCIDENTS/INCIDENTS/ IN THE ELECTRICITY DISTRIBUTION INDUSTRY AND PREVENTIVE MEASURES AND MAINTENANCE/RISK MANAGEMENT.

Following is a reported incident/accident and measures taken to prevent such an accident recurring.

ACCIDENT/INCIDENT: Ekurhuleni Metropolitan Municipality. Accident Occurred During November 2001.

DESCRIPTION OF EVENTS.

Accident Involving Scissor Type High Mast Lighting Column: Alberton.

An electrician employed by Ekurhuleni Metropolitan Municipality was badly injured, when, while attempting to lower a scissor type high mast column, he was caught up in a steel cable, when the mast suddenly pivoted, and was flung against a brick wall, thereby injuring his back.

The procedure that was followed to lower the mast on the day that the accident occurred was as follows:

After a hand-operated winch had been attached to the mounting plate at the base of the mast, and the end of the steel cable attached to the moving section of the mast, a length of cable, approximately 10 metres in length was unwound from the drum of the winch, and laid out on the ground. The moving section of the mast was then pulled away from the fixed section, whilst the operators held onto, and paid out the steel cable until all of the slack had been taken up as the moving section moved further away from the fixed section. At this point, the further movement of the moving section of the mast was controlled by unwinding the winch drum, until the luminaire cluster, mounted on top of the mast, reached the ground.

On the day of the accident, the mast had pivoted with great speed such that the electrician and his co-workers were unable to control the initial movement, and the electrician, who had apparently coiled the cable around his wrist for a better grip, was caught up in the slack cable and flung against a nearby brick wall where he sustained injury.

CONCLUSIONS AND SOLUTIONS TO PREVENT A RECURRENCE.

- The accident occurred as a result of an unsafe practice, which was followed during the lowering of the mast.
- There was no formal safe working procedure in place at the time, and the procedure, which was used, had evolved over a period of time. The fact that not all scissor type masts were identical, or properly counter balanced was a contributory factor, as was the effect of the alleged strong wind on the day.
- The electrician did not appreciate the dangers inherent in the unsafe practice, which he followed.
- Safe working procedures for the lowering and raising of all types of high mast columns are now being developed and implemented.
- Specialized training in the safe operation of high mast lighting masts is to be provided to all maintenance personnel involved in the servicing of these masts.

Following is a reported incident/accident and measures taken to prevent such an accident recurring.

ACCIDENT/INCIDENT: Graaff-Reinet Municipality. Accident occurred during May 1997.

DESCRIPTION OF EVENTS

The Municipality had a pole mounted 11 000/400 Volt transformer on a typical H - structure supplying 3 phase electricity to a nearby sewerage pump station. This structure was installed in about 1976 to 1978.

An old LV 4 - core lead sleeve cable and a newly installed SWA PVC 4 - core LV cable were installed on a pole next to each other, fastened with stainless steel bandit strapping around the pole. An angle iron was placed over the SWA PVC cable to protect it against vandalism.

The MV supply was via 3 bare overhead aluminium conductors connected down to a set of cut-out fuses and from the fuses to the transformer bushings. The transformer was mounted on two horizontal I - beams between the H - poles.

A young schoolboy climbed up the H - poles on to the transformer platform to have a better view of goats he was in charge of. He apparently lost his balance and slipped - his normal reaction to avoid falling was to grab something. Unfortunately he grabbed hold of the MV aluminium conductor connected to the MV bushing of the transformer and was severely injured, resulting in the loss of both arms.

The position of the transformer was about 600 metres from the nearest developed township next to a cemetery and on open ground adjoining a vlei area. There is a footpath to the installation being used by the residents. The height from ground level to the MV bushings connector of the transformer is approximate 150 mm below the required height for a transformer outside a township.

However, during the trial the plaintiff's advocate reasoned as follows:
- that the installation is within a township and therefore the height above ground level should have been in accordance with Act 85 of 1993;
- that the bandit strapping made it easier for somebody to climb the pole; and
- that there were no barbed wire or danger signs installed.

The ruling of the Judge was that the Municipality was negligent.

STEPS TAKEN TO PREVENT SUCH AN ACCIDENT RECURRING.

Subsequently the Municipality has had barbed wire installed and danger signs on all poles carrying electrical machinery and equipment. This is an ongoing process, which must be inspected on a regular basis as vandals frequently remove the danger signs as well as the barbed wire.

The following crucial factors came to light from this incident and which further contribute to preventing the recurrence of such an accident:

1. All electricity distributors must ensure that barbed wire or some deterrent and danger signs on poles carrying electrical machinery & equipment be installed.

2. The OHS Act, Act 85 of 1993 is not very clear on some technical issues.

3. Detailed records must be kept of routine inspections performed to check whether barbed wire and danger signs are still intact.

4. Employees should ensure that they fully understand the OHS Act 85 of 1993.

The Municipal Manager is of the opinion that all electrical incidents should also be reported to the AMEU in future and should be discussed at all AMEU Branch meetings and to receive inputs from members and make recommendations on how to improve on safety, etc.

Electrical Accident In Glencoe.

ACCIDENT/INCIDENT: Borough of Glencoe.

DESCRIPTION OF EVENTS

An employee of Glencoe Municipality was seriously injured due to electric shock when he came into contact with a 6600Volt cable at Substation No. 2.
Mr. Leon van der Merwe, Acting Manager Technical Services of the Borough of Dundee was appointed by the then CEO to conduct an preliminary investigation into the accident and was further co-opted by the Department of Labour to assist with the investigation.

The person in charge and apparently responsible for the accident was found guilty by the court, but was acquitted after he appealed, as the sentence imposed was not congruent with that prescribed in the OHS Act.

The probable cause of this unfortunate accident can be attributed to the following reasons:-

- Persons appointed to positions of responsibility beyond their capabilities.
- No proper switching and earthing procedures were followed.
- No schematic diagrams available of the network.
- Assumption made that all was safe.
- Switching on supply while staff was still working on equipment (no permit system).

Description of Event in Greater Detail.

From statements obtained from witnesses and persons in charge and an on-site investigation, it was found that no logs were kept of switching operations, therefore the procedure followed was given by the person in charge at the time.

On 30 October 1996 he isolated Substation No. 2 by opening all OCBs and racking them out. He then isolated the GPO, Biggar and Blue Ribbon feeders at the 'Magnafix' switchgear and placing the links he had removed in the switchgear cubicle and locking the cubicle. He then proceeded to open the feed from the 'Sanlam' Sub. At the 'Magnafix' switchgear and applied the earthing.

The supply from the SAR Hostel Sub. Was isolated by means of withdrawing the fuse links into an 'open' position without removing them.

The supply from 'Van Riebeeck' Sub. Was still open from a previous fault on the circuit. The medium voltage link in Substation 2 was opened.

The person in charge stated that he tested the installation on the morning of 31 October 1996, before work was commenced on the equipment and that a Mr. Purchase worked on the busbar end current transformers, at which place the accident occurred.

Ignoring the fact that no proper isolation procedures were followed, the investigating team tried to determine the possible source of the "temporary" supply of electricity that caused injury to Mr. S Mchunu.

The first possible cause mooted by the person in charge, was that a flash-over occurred at the SAR Hostel Sub. at the fuse-links, was investigated by the investigating team and found to have been impossible due to a number of factors, as follows:-

The distance between the 'live' points would not allow for a flash-over and the circuit breakers at Sub. No. 2 were still in the 'open' position.

On further investigation it became evident that the electrocution of Mr. S Mchunu actually occurred on the busbar side of the SAR Hostel oil circuit breaker in Sub. No. 2.

A further fact which emerged was that the earth-fault protection on the 'South' ring oil circuit breaker feeding 'Blue Ribbon' and the 'GPO' feeders tripped during the accident, confirming that the possible source of supply did not emanate from the from the other three feeders.

The possibility of back-feed through the local transformer through the MV links is also ruled out due to the fact that the 'South' ring oil circuit breaker had tripped on earth-fault.

In the opinion of Mr. Leon van der Merwe, the investigating officer, the source of supply could only have been from the 'South' ring supply, which had tripped on earth-fault during the accident. This leaves the only logical conclusion, namely that the path for the electricity supply must have been through the 'GPO' or 'Blue Ribbon' 'Magnafix' switchgear and the medium voltage links in Sub. No. 2.

STEPS PLANNED TO AVOID THE RECURRENCE OF A SIMILAR ACCIDENT.

The Borough of Glencoe with the assistance of the Acting Manager Technical Services of the Borough of Dundee, Mr Leon van der Merwe, designed the following measures in an attempt to avoid a similar accident occurring in future:-

- A log-book and permit system was implemented.
- Schematic diagrams of the MV system were compiled.
- Arrangements were made for all staff involved with MV switching, to attend the MV Switching and Regulations course at Durban Electricity.
- Sufficient earthing and test equipment was provided for the staff.
- As an interim measure, the Glencoe staff was trained in the correct switching and test procedures by the Dundee Electrical Department.
- As a further control measure, the log-books and permits were audited on a regular basis to ensure compliance.

Best Paper Award

Trevor Gaunt

Membership Roll
Past Presidents

1915 -1917	*	JH	Dobson	Johannesburg
1917-1917	*	J	Roberts	Durban
1919-1920	*	B	Sankey	Port Elizabeth
1920-1922	*	TWC	Dodda	Pretoria
1922-1924	*	GH	Swinger	Cape Town
1924-1926	*		Roberts	Durban
1926-1927	*	B	Sankey	Johannesburg
1927-1929	*	JM	Lambe	East London
1929-1931	*	R	MacCauley	Bloemfontein
1931-1933	*	LL	Horrel	Pretoria
1933-1934	*	LF	Bickell	Port Elizabeth
1935-1936	*	GG	Ewer	Pietermaritzburg
1936-1937	*	A	Rodwell	Johannesburg
1937-1938	*	JH	Gyles	Durban
1938-1939	*	HA	Eastman	Cape Town
1940-1944	*	IJ	Nicholas	Umtata
1944-1945	*	A	Rodwell	Durban
1945-1946	*	JS	Clinton	Zimbabwe (Harare)
	*	JW	Phillips	Zimbabwe (Harare)
1946-1947	*	GJ	Muller	Bloemfontein
1947-1948	*	C	Kinsman	Durban
1948-1949	*	A	Foden	East London
1949-1950	*	DA	Bradley	Port Elizabeth
1950-1951	*	CR	Hallé	Pietermaritzburg
1951-1952	*	CJ	Downey	Springs
1952-1953	*	AR	Sibson	Zimbabwe (Bulawayo)
1953-1954	*	JC	Fraser	Johannesburg
1954-1955	*	GJ	Muller	Bloemfontein
1955-1956	*	DJ	Hugo	Pretoria
1956-1957	*	JE	Mitchell	Zimbabwe (Bulawayo)
1957-1958	*	A	van der Walt	Krugersdorp
1958-1959	*	CG	Downie	Cape Town
1959-1960	*	RW	Kane	Johannesburg
1960-1961	*	RMO	Simpson	Durban
1961-1962	*	C	Lombard	Germiston
1962-1963	*	PA	Giles	East London
1963-1964		JC	Downey	Springs
1964-1965		RW	Barton	Welkom
1965-1967	*	D	Murray-Nobbs	Port Elizabeth
1967-1969		GC	Theron	Vanderbijl Park
1969-1971	*	HT	Turner	Umtata
1971-1973		JK	Von Ahlften	Springs
1973-1975		JC	Waddy	Pietermaritzburg
1975-1977		E	de C Pretorius	Potchefstroom
1977-1979		KG	Robson	East London
1979-1981		PJ	Botes	Roodepoort
1981-1983		DH	Fraser	Durban
1983-1985		W	Barnard	Johannesburg
1985-1987	*	JA	Loubster	Benoni
1987-1989		AHL	Fortmann	Boksburg
1989-1991		FLU	Daniel	Cape Town
1991-1993		CE	Adams	Port Elizabeth
1994-1995		HR	Whitehead	Durban
1995-1997		JG	Malan	Kempton Park
1997-1999		HD	Beck	East London
1999-2001		AJ	van der Merwe	Bloemfontein

*** Deceased/Oorlede**

Membership Roll
Honorary Members

1915 -1936	*	Dr HJ	van der Bijl	ESC
	*	J	Roberts	Durban
	*	E	Poole	Past Secretary
1938	*	LL	Horrell	Pretoria
1944	*	GH	Swingler	Cape Town
	*	AT	Rodwell	Johannesburg
1950	*	Dr JH	Dobson	Johannesburg
1951	*	HA	Eastman	Cape Town
1955	*	W	Bellad-Ellis	East London
	*	JC	Fraser	Johannesburg
	*	C	Kinsman	Durban
1956	*	WH	Miltone	ESC
	*	A	Morton Jaffray	Salisbury
	*	Major SG	Redman	Merz & Mellan, JHB
	*	Clr CEK	Young	Pietermaritzburg
1957	*	DA	Bradley	Port Elizabeth
1958	*	Col EG	Ewer	Pietermaritzburg
	*	A	Foden	East London
	*	Clr	Halley	Pietermaritzburg
1960	*	Clr FJ	Castelyn	Bloemfontein
	*	Clr LP	Davies	Springs
1962	*	AR	Sibson	Bulawayo
1963	*	CG	Downie	Cape Town
	*	JC	Downie	Springs
	*	RW	Kane	Johannesburg
1965	*	GJ	Muller	Bloemfontein
1967	*	Clr JD	Marais	Johannesburg
		JR	Telles	Maputo
1969		W	Beesley	Estcourt
	*	PA	Giles	East London
	*	D	Murray-Nobbs	Port Elizabeth
	*	EL	Smith	Boksburg
1971	*	D	Hugo	Pretoria
	*	ACT	Frantz	Cape Town
	*	HT	Turner	Kloof
		R	Leishman	Johannesburg
	*	RMO	Simpson	Durban
		W	Rossler	Pretoria
	*	F	Stephens	Durban
	*	JF	Lategan	Stellenbosch
1973		RG	Ewing	Past Secretary
1975	*	Clr HG	Kipling	Germiston
		C	Lombard	Germiston
		DC	Plowden	Johannesburg
	*	JG	Wannenburg	Cl of Factories
1977	*	Dr RL	Straszacker	ESC
		AA	Middlecote	Fish Hoek

Membership Roll
Honorary Members

	*	GC	Theron	Vanderbijlpark
		JC	Waddy	Pietermaritzburg
1979		RW	Barton	Welkom
	*	Clr HJ	Hugo	Roodepoort
1981		JDN	van Wyk	CSIR, Meyerspark
		Dr RB	Anderson	CSIR, Lynwood
		J	Morrison	Plettenberg Bay
1983		TC	Marsh	Northmead
1983+1998		JK	von Ahlften	Springs
1985	*	AA	Weich	CI Occupational
		KG	Robson	East London
	*	Clr RL	de Lange	East London
		E	de C Pretorius	Potchefstroom
		W	Barnard	Johannesburg
1987		AP	Burger	Pretoria
		JC	Dawson	Uitenhage
		DH	Fraser	Durban
		PC	Palser	Cape Town
1989		PJ	Botes	Roodepoort
1989+1998		MPP	Clarke	Randburg
		EG	Davies	Pietermaritzburg
	*	JA	Loubser	Benoni
1991+1998		AHL	Fortmann	Boksburg
1993		FLU	Daniel	Cape Town
		JE	Heyderych	Middelburg TVL
		B	van der Walt	General Secretary
1995		CE	Adams	Port Elizabeth
		B	Madeley	Iso-Tech Systems
1997		JD	Algera	Rustenburg
		HR	Whitehead	Durban
		F	van der Velde	NER
1999		JG	Malan	Kempton Park
2001		HD	Beck	Buffalo City
		C E	Burchell	ABB Powertech

* Deceased/Oorlede

+ Citation

Membership Roll
Past Recipients of AMEU Certificates of Merit

12th Technical Meeting – September 1998				
	Mr	Bokkie	Boshoff	Vanderbijlpark
*	Mr	Gerhard	Gerber	Affiliate: Zwellweger
	Mr	Ian L	Hobbs	Uitenhage
	Mr	NAT	Kirschner	Affiliate: Reyrolle
	Prof	Ryno G	Kriel	Bloemfontein
	Ald	Ben	Steyn	Boksburg
*	Mr	Theunis C	Stoffberg	Eskom
13th Technical Meeting – September 1990				
*	Mr	ACT	Frantz	Cape Town
	Mr	JAD	Foubister	SABS
	Mr	F	Prins	Public Work
*	Mr	WP	Rattey	Strand
	Prof	K	Van Alphen	SABS, Pretoria University
	Mr	Jan A	Venter	Cape Town
14th Technical Meeting – August 1992				
	Mr	William	Lashley	Affiliate: GEC
	Mr	Emil E	de Villiers	Rustenburg
15th Technical Meeting – August 1994				
*	Ald	Frikkie	Kotze	Port Elizabeth
	Mr	J	van Soelen Lochner	Pietersburg
	Mr	William	Tindle	Affiliate: Reyrolle
16th Technical Meeting – October 1996				
	Mr	KJ	Murphy	Somerset West
	Mr	PJ	Muller	Affiliate: African Cables
	Mr	AJ	van den Berg	Krugersdorp
17th Technical Meeting – September 1998				
	Mr	Clive	Burchell	Affiliate: ABB Powertech

* Deceased/Oorlede

UNDERTAKING MEMBERS

Company	Name	Address	Phone	Fax
//Khara Hais	Mr HA Auret	P B X6003 UPINGTON 8800	(054) 332 5911	(054) 331 2909
Abaqulusi Local Council	Mr Ken Tupper	P O Box 57 VRYHEID 3100	(034) 982 2947	(034) 980 8822
Ba-Phalaborwa LC	Mr JI Ten Cate	P O Box 67 PHALABORWA 1390	(015) 780 6305	(015) 781 0726
Beaufort Wes LC	Mnr Roelof van Staden	P B 482 BEAUFORT WES 6970	(023) 415 2121	(023) 415 2811
Bela Bela LC	Mr VJ de Souza	P B X1609 WARMBAD 480	(014) 736 8007	(014) 736 3288
Bergrivier LC	Mr JJ Erasmus	P O Box 50 PORTERVILLE 6810	(022) 931 2100/2101	(022) 931 3047
Bergrivier Municipality	Mr Nelius Rossouw	P O Box 60 PIKETBERG 7320	(022) 913 1126	(022) 913 1380
Blue Crane Route LC	Mr DW Jordaan	P O Box 21 SOMERSET EAST 5850	(042) 243 1333	(042) 243 1548
Botswana Power Corporation	Mr S Hlambelo	P O Box 48 GABARONE	(09267) 360 3214	(09267) 360 864
Breede Valley LC	The Town Electrical Engineer	P B X3046 WORCESTER 6850	(023) 348 2647	(023) 347 2599
Breederivier/Winelands LC	Mr Johan Rossouw	P B X2 ASHTON 6715	(023) 626 3112	(023) 626 2426
Buffalo City	Mr HD Beck	P O Box 2001 BEACON BAY 5205	(043) 705 9601	(043) 748 3748
Camdeboo LC	Mr MP Minnie	P O Box 71 GRAAF REINET 6280	(049) 892 2121	(049) 892 4319
Cape Agulhas LC	Mr Francis Bussell	P O Box 51 BREDASDORP 7280	(028) 425 1919	(028) 425 1019
Central Elect Board	Mr PJS van Niekerk	P O Box 40 ROYAL ROAD, CUREPIPE	(09230) 675 7960	(09230) 675 7958/9
City of Cape Town	Mr NF Croucher	P O Box 82 CAPE TOWN 8000	(021) 400 2500	(021) 421 5088
City of Cape Town - Blaauwberg Admin	Mnr JJ Hattingh	P O Box 35 MILNERTON 7435	(021) 400 3864	(021) 425 2293
City of Cape Town - Oostenberg Admin	Mr Hugo Daniel Mostert	P B X16 KUILSRIVIER 7579	(021) 900 1569	(021) 900 1559
City of Cape Town - Tygerberg Admin	Mr JG Louw	P O Box 82 CAPE TOWN 8000	(021) 400 2610	(021) 400 5913
City Power	Mr MK Mohlala	P O Box 38766 BOOYSENS 2016	(011) 490 7307	(011) 490 7696
City Power	Mr MK Mohlala	P O Box 38766 BOOYSENS 2016	(011) 490 7307	(011) 490 7377
City Power	Mr Patric O'Halloran	P O Box 38766 BOOYSENS 2016	(011) 490 7679	)011) 490-7679
Dan-Lime LC	Mr JH van Wyk	P O Box 43 DANIELSKUIL 8405	(053) 384 0013	(053) 384 0326
Delmas Local Council	Mr Leslie Niewenhuizen	P O Box 6 DELMAS 2210	(013) 665 6000	(013) 665 2913
Department of Housing N Cape	Mr CH Schoeman	P B X5005 KIMBERLEY 8300	(053) 830 9522	(053) 831 8016
Dihlabeng LC	Mnr P Potgieter	P O Box 551 BETHLEHEM 9700	(058) 303 5732	(058) 303 8451
Ditsobotla Mun	Mr C Geldenhuys	P O Box 7 LICHTENBURG 2740		(018) 632 5247
Drakenstein LC	Mr JE Coetzee	P O Box 12 PAARL 7620	(021) 871 1911	(021) 872 4074
Drakenstein LC	Mr JA Venter	P O Box 12 WELLINGTON 7655	(021) 873 1121	(021) 873 2524
Eastern Cape Prov Administration	Mr A Didloff	P B X6005 PORT ELIZABETH 6000	(041) 390 4167	(041) 3904177
Ekurhuleni MC	Mr MJ Wilson	P O Box 215 BOKSBURG 1460	(011) 899 4020	(011) 917 6112
Ekurhuleni N Admin	Mr JD de Villiers	P O Box 215 BOKSBURG 1460	(011) 899 4023	(011) 917 6112

UNDERTAKING MEMBERS

Company	Name	Address	Phone	Fax
Ekurhuleni Southern Admin	Mr Mark Wilson	P O Box 215 BOKSBURG 1450	(011) 899 4029	(011) 892 4806
Emalahleni LC (Kriel)	Mr Braam Botha	P B X5014 KRIEL 2271	(017) 648 2241	(017) 648 4764
Emfuleni Municipality	Mr M Tshabalala	P O Box 3 VANDERBIJLPARK 1900	(016) 950 5361	(016) 950 5024
Emnambithi Mun	Mr W Albertyn	P O Box 56 LADYSMITH 3370	(036) 637 6905	(036) 637 2592
Emthamjeni Municipality	Mr FD Taljaard	P O Box 42 DE AAR 7000	(053) 631 0927	(053) 631 1518
Endumeni Municipality	Mr Leon van der Merwe	P B X2024 DUNDEE 3000	(034) 212 2121	(034) 212 3856
Eskom Distribution	Mr Willie de Beer	P B X1 BEACON BAY 5201	(043) 703 2369	(043) 703 2412
eThekwini Municipality	Mr HR Whitehead	P O Box 147 DURBAN 4000	(031) 300 1000	(031) 306 3196
Freestate Prov Gvmnt	Mr HP Pretorius	P O Box 211 BLOEMFONTEIN 9300	(051) 405 4730	(051) 405 5008
Gariep LC	Mr F Joubert	P B X4 STEYNSBURG 5920	(048) 884 0034	(048) 884 0386
Gariep LC	Mr JW Visser	P B X2 VENTERSTAD 9798	(051) 654 0224	(051) 654 0374
George LC	Mr Kevin Grunewald	P O Box 19 GEORGE 6530	(044) 874 3917	(044) 874 3936
Gobabis Municipality	The Electrical Engineer	P O Box 33 GOBABIS	(09264) 681 2551	(09264) 681 3012
Govan Mbeki Municipality	Mr CD Dirks	P B X1(017) SECUNDA 2302	(017) 620 6062	(017) 620 6164
Great Kei LC	The Chief Electrical Engineer	P O Box 21 KOMGA 4950	(043) 831 1028	(043) 831 1306
Greater Giyani Munic	Clr CD Ndleve	P O Box 2944 GIYANI 826	(015) 812 3707	(018) 812 2068
Greater Kokstad Municipality	Mr Denis Barker	P O Box 8 KOKSTAD 4700	(039) 727 2625/2298	(039) 727 4321
Greater Marble Hall LC	Mr JL Durie	P O Box 111 MARBLE HALL 450	(013) 261 1151	(013) 261 2985
Greater Tzaneen Municipality	Mr Andy Loubscher	P O Box 24 TZANEEN 850	(015) 307 8167	(015) 307 8049
Greater Tzaneen Municipality	Mr Pierre van den Heever	P O Box 24 TZANEEN 850	(015) 307 8160	(015) 307 8049
Hibiscus Coast Municipality	The Chief Electrical Engineer	P O Box 5 PORT SHEPSTONE 4240	(039) 688 2000	(039) 682 1131
Honorary Member	MR Max Clarke	Cresta Palms 8, Bernhard Str. RANDBURG 2194	(011) 476 5925	(011) 476 5939
Honorary Member	Mnr FLU DANIEL	P O Box 4542 TYGERBERGVALLEY 7536	(021) 976 1677	(021) 976 1677
Inxuba Yethemba LC	Mr MJC Roodt	P O Box 24 CRADOCK 5880	(048) 881 1515	(048) 881 1421
Kai !Garib LC	Mr MW Clarke	P O Box 174 KAKAMAS 8870	(054) 431 6300	(054) 431 6301
Kannaland LC	Mr WK Hartzenberg	P O Box 30 LADISMITH 6655	(028) 5511023	(028) 550 1766
Khai-Ma Municipality	Mr Petrus Boltman	P O Box 108 POFADDER 8890	(054) 933 0066	(054) 933 0252
Kimberley DC	Mr K Bogacwi	P B X5030 KIMBERLEY 8300	(053) 830 6400	(053) 832 5367
King Sabata Dalindyebo LC	Mr Engineer The Electrical	P O Box 57 UMTATA 5100	(047) 501 4304/5	(047) 531 2704
Klerksdorp LC	Mr Cornelius Johannes Coertze	P O Box 20 STILFONTEIN 2550		(018) 484 2833
Klerksdorp LC	Mr LH Strydom	P B X8 ORKNEY 2620	(018) 473 1451	(018) 473 3364
Klerksdorp LC	Mr Wynand Viljoen	Priv Bag X99 KLERKSDORP 2570	(018) 462 9851	(018) 464 1221

UNDERTAKING MEMBERS

Company	Name	Address	Phone	Fax
Knysna Municipality	Mr L Richardson	P O Box 21 KNYSNA 6570	(044) 382 5066	(044) 382 5551
Kopanong LC	Mr Blen Buitenbach	P O Box 23 TROMPSBURG 9913	(051) 743 1658	Ask for Fax
Kouga LC	Mr AH du Plessis	P O Box 21 JEFFREYSBAAI 6330	(0422) 931111	(0422) 934488
Kouga LC	Mr Desmond Walter Pennels	P O Box 137 ST FRANCIS BAY 6312	(042) 294 0309	(042) 294 0312
Kungwini LC	Mnr DJ Botha	P O Box 40 BRONKHORSTSPRUIT 1020	(013) 932 0061	(013) 935 1311
Kuruman-Mothibastad LC	Mr Theo Pretorius	P O Box 4 KURUMAN 8460	(053) 712 1095	(053) 712 3581
Kwadukuza LC	Mr J Hall	P O Box 5 BALLITO 4420	(032) 946 8005	(032) 946 1918
Kwadukuza LC	Mr LF Klopper	P O Box 72 STANGER 4450	(032) 551 3091	(032) 551 5500
Langeberg LC	Mr G Mans	P O Box 29 RIVERSDALE 6670	(028) 713 2418	(028) 713 3146
Lekwa LC	Mr Dawid Lottering	P O Box 66 STANDERTON 2430	(017) 714 6683	(017) 712 6808
Lephalele LC	Mr Aardt Both	P B X136 ELLISRAS 555	(014) 763 2193	(014) 763 5662
Lesedi LC	Mr HB Coetsee	P O Box 201 HEIDELBERG 2400	(016) 341 3111	(016) 341 6458
Letsemeng LC	The Electrical Engineer - Letsemeng	P O Box 7 KOFFIEFONTEIN 9986	(053) 205 0007	(053) 205 0128
Lichtenberg LC	Mr D Lowe	P O Box 31 COLIGNY 2725	(018) 673 1007	(018) 673 1674
Lukanji LC	Mr P Bezuidenhout	P B X7111 QUEENSTOWN 5320	(045) 838 2684	(045) 839 7545
Madibeng LC	Mnr JL Mynhardt	P O Box 106 BRITS 250	(012) 3189383	(012) 318 9354
Mafube LC	Mr AP Linde	P O Box 2 FRANKFORT 3830	(0588) 31051	(0588) 33072
Magalakwena LC	Mr JN Fourie	P O Box 34 POTGIETERSRUS 600	(015) 491 9601	(015) 491 9755
Magalakwena LC	Mr EJ van der Horst	P O Box 34 POTGIETERSRUS 600	(0154) 491 2244	(0154) 491 5142
Makana LC	Mr WR Bufe	P O Box 176 GRAHAMSTOWN 6140	(046) 603 6050	(046) 622 5264
Makhado Municipality	Mr E Joubert	P O Box 96 LOUIS TRICHARDT 920	(015) 516 0212	(015) 513 2339
Maletswai LC	Hoof Elektriese Ingenieur	P B X1011 ALIWAL NOORD 9750	(051) 633 2406	(051) 633 2401
Mangaung LM	Mnr AJ van der Merwe	P O Box 3704 BLOEMFONTEIN 9300	(051) 409 2210/1	(051) 409 2366
Mantsopa LC	The Chief Electrical Engineer	P O Box 64 LADYBRAND 9745	(051) 924 0654	(051) 924 5144
Mantsopa LC	Mr HD Potgieter	P O Box64 LADYBRAND 9745	(051) 924 0654	(051) 924 5144
Masilonya LC	Mr FC Meyer	P O Box 26 WINBURG 9420	(051) 881 0003	(051) 881 0003
Matatiele Electricity	The Chief Electrical Engineer	P O Box 35 MATATIELE 4730	(039) 737 3135	
Matjhabeng LC	Mr LC Herbst	P O Box 29 HENNENMAN 9445	(057) 573 2055	(057) 753 2058
Matjhabeng LC	Mr GJ Meyer	P O Box 708 WELKOM 9460	(057) 391 3116	(057) 391 3450
Matzikama LC	Mr JH Viljoen	P O Box 98 VREDENDAL 8160	(027) 213 1045	(027) 213 3238
Mbombela LC	Mr Pieter Fourie	P O Box 2 WHITERIVER 1240	(013) 751 1184	(013) 751 2667

UNDERTAKING MEMBERS

Company	Name	Address	Phone	Fax
Mbombela LC	Mr Ephriam Thabethe	P O Box 45 NELSPRUIT 1200	(013) 759 2230	(013) 752 7168
Merafong City Council	Mr Chris Spies	P O Box 708 WELKOM 9460	(057) 391 3160	(057) 391 3112
Messina LC	Mr JAP du Toit	P B X611 MESSINA 900	(015) 534 0211	(015) 534 2513
Metsimaholo LC	Mr HJ van Wyk	P O Box 60 SASOLBURG 9570	(016) 976 0029 X 145	(016) 976 0029 X 183
Middelburg LC	Mr JA Kok	P O Box 55 MIDDELBURG 5900	(049) 842 1122	(049) 842 2252
Middelburg LC (Mpumalanga)	Mr Raymond Grunig	P O Box 14 MIDDELBURG 1050	(013) 249 7220	(013) 243 2550
Mkhondo LC	Mr H G Botha	P O Box 13 PIET RETIEF 2380	(017) 8262211	(017) 8260330
Mngeni Municipality	The Electrical Engineer	P O Box 5 HOWICK 3290	(033) 330 6124	(033) 330 4183
Modimolle LC	Mr JJ Kasselman	P B X1008 NYLSTROOM 510	(014) 717 5211	(014) 717 4077
Mogale City LC	Mr F Erasmus	P O Box 94 KRUGERSDORP 1740	(011) 951 2254	(011) 665 2666
Mookgophong Munic	Mr CP Cloete	P B X340 NABOOMSPRUIT 560	(014) 743 1111	(014) 743 2434
Moqhaka LC	Mr Hannes (MJ) Brewis	P O Box 302 KROONSTAD 9500	(056) 216 9283	(056) 216 9284
Mossel Bay LC	Mr Ockert Bothma	P O Box 25 MOSSELBAAI 6500	(044) 691 2215	(044) 691 1903
Mossel Bay LC	Mr G Willemse	P B X29 MOSSELBAY 6500	(044) 620 2100	(044) 620 2853
Mpofana LC	Mr Godfrey Smith	P O Box 47 MOOI RIVER 3300	(033) 263 1221	(033) 263 1127
Msukaligwa LC	Mr TJ Bezuidenthout	P O Box 3 BETHAL 2110	(017) 624 3000	(017) 624 5232
Mthonjaneni LC	Mr P Hamalainen	P O Box 11 MELMOTH 3835	(035) 450 2082	(035) 450 3224
Municipality of Walvis Bay.	Mr Gerhard Coeln	P B X5017 WALVIS BAY	(09264) 64 217600	(09264) 64 204574
Nala LC	Mr JJ Heimans	P B X15 BOTHAVILLE 9660	(5651) 49200	(5651) 53922
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Nelson Mandela MC	Mr Willem Meyer	P O Box 42 DESPATCH 6220	(041) 933 1111	(041) 933 2721
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Republic Power & Comm	Mr Pieter Minnaar	P O BOX 3257 HALFWAY HOUSE 1685	(011) 315-0334	(011) 805-1018
Rescap cc	Mr. Herbert Teubner	P O BOX 785064 SANDTON 2146	(011) 886-7874	(011) 787-0178
Revenue Investigations	Mr Rens Bindeman	P O BOX 1131 BRACKENFELL 7561	(021) 9595352	(021) 9514220
Reyrolle WBT	Mr Brian Jones	PO BOX 526 MODDERFONTEIN 1645	011 606 2777	(011) 606 8075
Reyrolle WBT	Mr BV Magee	61-10TH STREET ORANGE GROVE 2192	(011) 640-4477	(011) 485-4587
Robmet Meters cc	Mr. Ian Robinson	P O BOX 4036 RIVONIA 2128	(011) 469-3807	(011) 469-0461
ROCLA	Mr Anthony Offenberg	P O BOX 1480 ROODEPOORT 1725	116707600	(011)4722141
Roshcon (Pty) Ltd	Mr Johan Greyling	P O BOX 40879 CLEVELAND 2022	(011) 626-2576	(011) 626-1089
Rotek Engineering	Mr Mike Cary	P O BOX 40099 CLEVELAND 2022	(011) 6294455	(011) 6261159
RSA Electrical Cable	Mr Kenny Strydom	P O BOX 10496 STRUBENVALE 1570	(011) 316-1453	(011) 316-3590
Rural Maintenance	Mr. Emile Lambrechts	P O BOX 545 STELLENBOSCH 7599	(021) 883-8252	(021) 8838938
SABS	Mr Adolf Claasen	PB X191 PRETORIA 0001	(012) 428-6613	(012) 428-6246
SAD-ELEC	Mr. Arnot Hepburn	P O BOX 1049 RIVONIA 2128	(011) 803-1314	(011) 803-7019
Schneider Electric S.A.	Mr Gerald Brown	PB X139 HALFWAY HOUSE 1685	(011) 254-6446	(011) 254-6529
Sentech Ltd	Mr JD Martin	PB X06 HONEYDEW 2040	(011) 475-4540	(011) 679-5232
Sicame SA	Mr Jean-Luc Lagarde	P O BOX 58 GOODWOOD 7569	(021) 535-0655	(021) 535-0613
Siemens Ltd	Mr Brendon Young		(011) 652-2849	(011) 652-2263
Sinesonics	Mr Dick Jelley	P O BOX 605 EDENVALE 1610	(011) 456-8200	(011) 452-4841
Specialist Syst Engin	Mr G Bezuidenhout	P O BOX 7170 CENTURION 46	(012) 663-4331	(012) 663-4335
Spectrum Communic	Mr. Kevin Clack	P O BOX 36900 CHEMPET 7442	(021) 551-5800	(021) 551-5809
Sperosens	Mr Johan Lombard	PB X115 CENTURION 46	(012) 665-0317	(012) 665-0337
Spintelligent	Mr Rudi Leitner	P O BOX 321 STEENBERG, CT 1947	(021) 700-3560	(021) 701-9841
Spoornet	Mr A Versteeg	P O BOX 1276 JOUBERT PARK 2044	(011) 773-5165	(011) 773-4556
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Strike Technologies	Mr Gerhard Grobler	P O BOX 1810 HALFWAY HOUSE 1685	(011) 315-0815	(011) 315-2559
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Superule SA	Mr. Combe	P O BOX 76128 WENDYWOOD 2144	(011) 444-3087	(011) 444-3496

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Company	Name	Address	Phone	Fax
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Surge Technology	Mr J Slagter	P O BOX 3109 RANDBURG 2125	(011) 792-1303	(011) 936928
Switchboard Manufacturers	Mr Josè Almeida	P O BOX 40086 REDHILL 4071	(031) 508-1520	(031) 507-7318
Taihan Electric Wire Co	Mr. HC Lee	P O BOX 10037 VERWOERDPARK 1453	(011) 805-6139	(011) 800-6139
Tank Industries	Mr Aad van Oosten	P O BOX 9 STEENBERG 7947	(021) 7011153	(021) 7010128
Technikon PTA	Dr SD Roos	PB X680 PRETORIA 0001	(012) 318-5999	(012) 318-5963
Technology Consultancy	Mr. CH Smit	P O BOX 4105 HALFWAY HOUSE 1685	(011) 315-0857	(011) 805-4246
Tellumat (Pty) Limited	MR Julia Williamson	P O BOX 30451 TOKAI 9766	(021) 710-2044	(021) 710-2851
Terrain Software Systems	Mr. T Rajakanthan	P O BOX 542 WITS 2050	(011) 728-9019	(011) 728-6360
Tridonic	Mr John Pritchett	P O BOX 123 GATESVILLE 7766	(021) 637-8000	(021) 637-4501
Tshepego Projects	Mr Tony Moodley	P O BOX 8179 CENTURION 0046	(012) 666-9040	(012) 666-8617
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Company/Organisation	Name	Address	Phone	Fax
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City Power	Mr P O Halloran	P O BOX 38766 BOOYSENS 2016	(011) 490-7679	(011) 490 7346
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Ekhuruleni MC	Mr A Richardson	PB X014 BENONI 1500	(011) 741-6368	(011) 741-6372
Ekhuruleni MC	Mnr J Roos	P O BOX 215 BOKSBURG 1460	(011) 899 4027	(011) 917 6112
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Eskom	Mr C Visagie	P O BOX 36099 MENLOPARK 0102	(012) 421-4770	(012) 421-4778
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Eskom North East	Mr J Engelbrecht	P O BOX 36099 MENLO PARK 0102	(012) 421-3342	
Eskom Pietersburg	Mr T Moller	PB 9477 PIETERSBURG 700	(015) 299-0111	
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Company/Organisation	Name	Address	Phone	Fax
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eThekwini Municipality	Mr AJ Dold	P O BOX 147 DURBAN 4000	(031) 300-1002	(031) 300-1010
eThekwini Municipality	Mr B Finch	P O BOX 147 DURBAN 4000	(031) 300-1008	(031) 300-1010
eThekwini Municipality	Mr A Gower	P O BOX 147 DURBAN 4000	(031) 300-1006	(031) 300-1010
eThekwini Municipality	Mr S Harilal	P O BOX 147 DURBAN 4000	(031) 300-1122	(031) 300-1010
eThekwini Municipality	Mr K Moulder	P O BOX 147 DURBAN 4000	(031) 300-1013	(031) 300-1010
eThekwini Municipality	Mr R Sharp	P O BOX 147 DURBAN 4000	(031) 300-1301	(031) 300-1010
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George Municipality	Mr J Moller	P O BOX 19 GEORGE 6530	(044) 874-3917	(044) 874-3936
George Municipality	Clr J Rogers	P O BOX 10001 GEORGE 6530	(044) 873-3924	(044) 873-3924
George Municipality	Mr J van der Westhuizen	P O BOX 19 GEORGE 6530	(044) 874-3917	(044) 874-3936
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Stellenbosch LC	Mnr WFJ van der Walt	P O BOX 17 STELLENBOSCH 7599	(021) 808-8405	(021) 808-8409
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uMhlathuze LC	Mr AL Gullan	PB X1004 RICHARDS BAY 3900	(035) 901-5370	(035) 901-5444
uMhlathuze LC	Mr GJ van den Berg	PB X1004 RICHARDS BAY 3900	(035) 901-5353	(035) 901-5444
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Mnr IF Boyack	44-15th Street MENLO PARK 81
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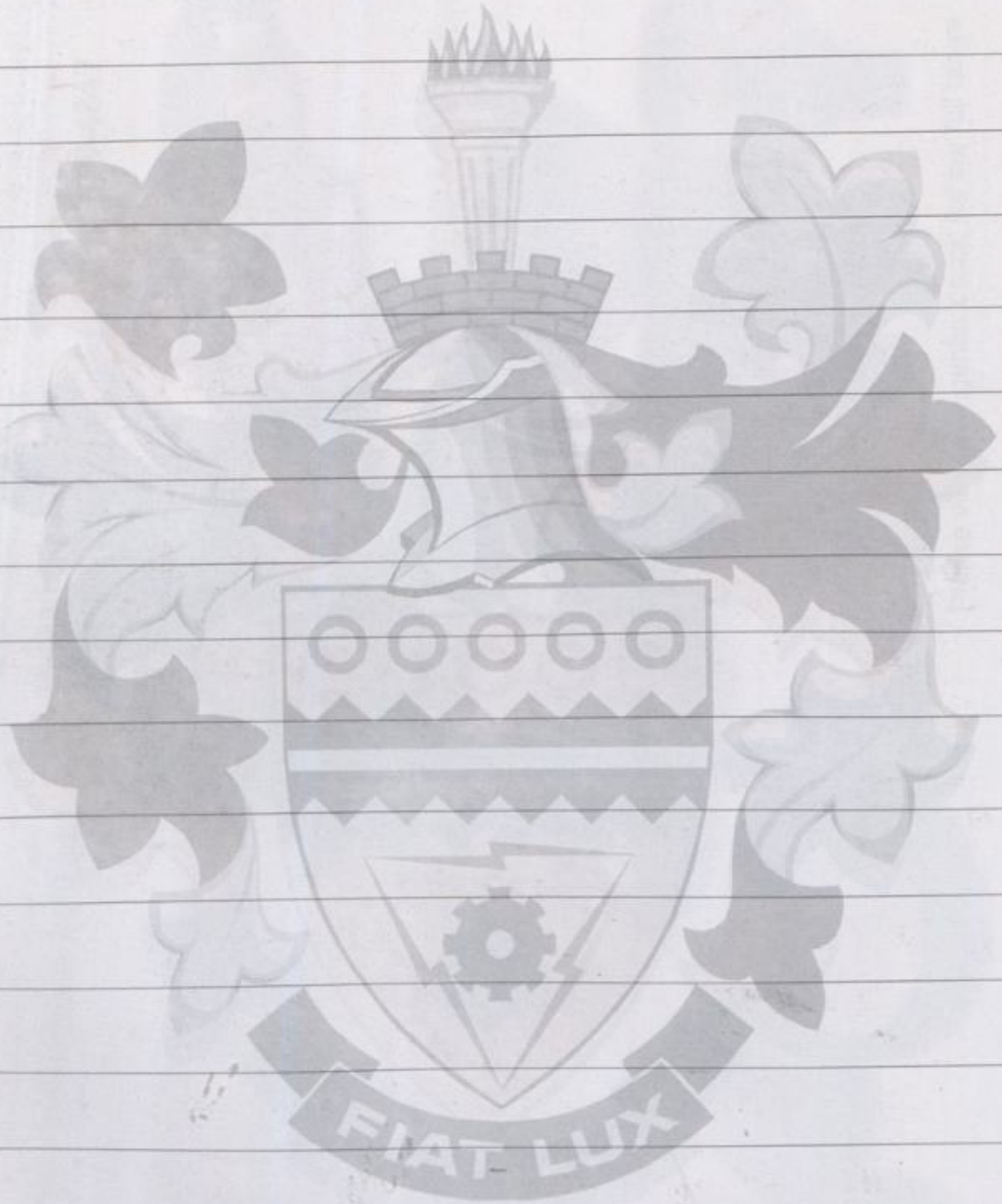

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