# 12e TEGNIESE VERGADERING
# 12th TECHNICAL MEETING

DIE VERENIGING VAN MUNISIPALE
ELEKTRISITEITSONDERNEMINGS VAN SUID-AFRIKA

THE ASSOCIATION OF MUNICIPAL ELECTRICITY
UNDERTAKINGS OF SOUTH AFRICA

5 – 6 September 1988

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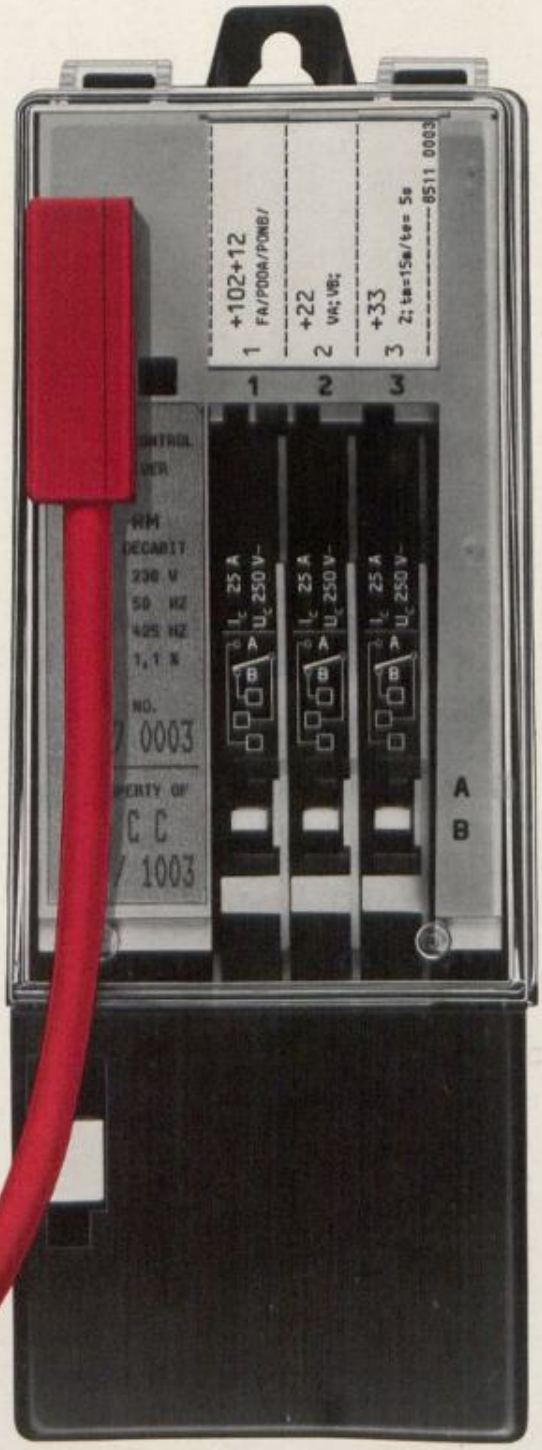


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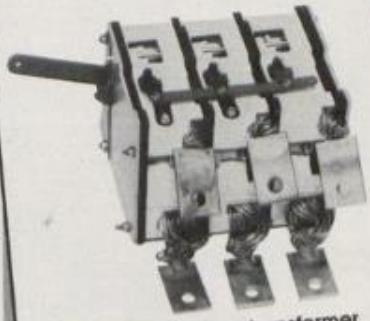

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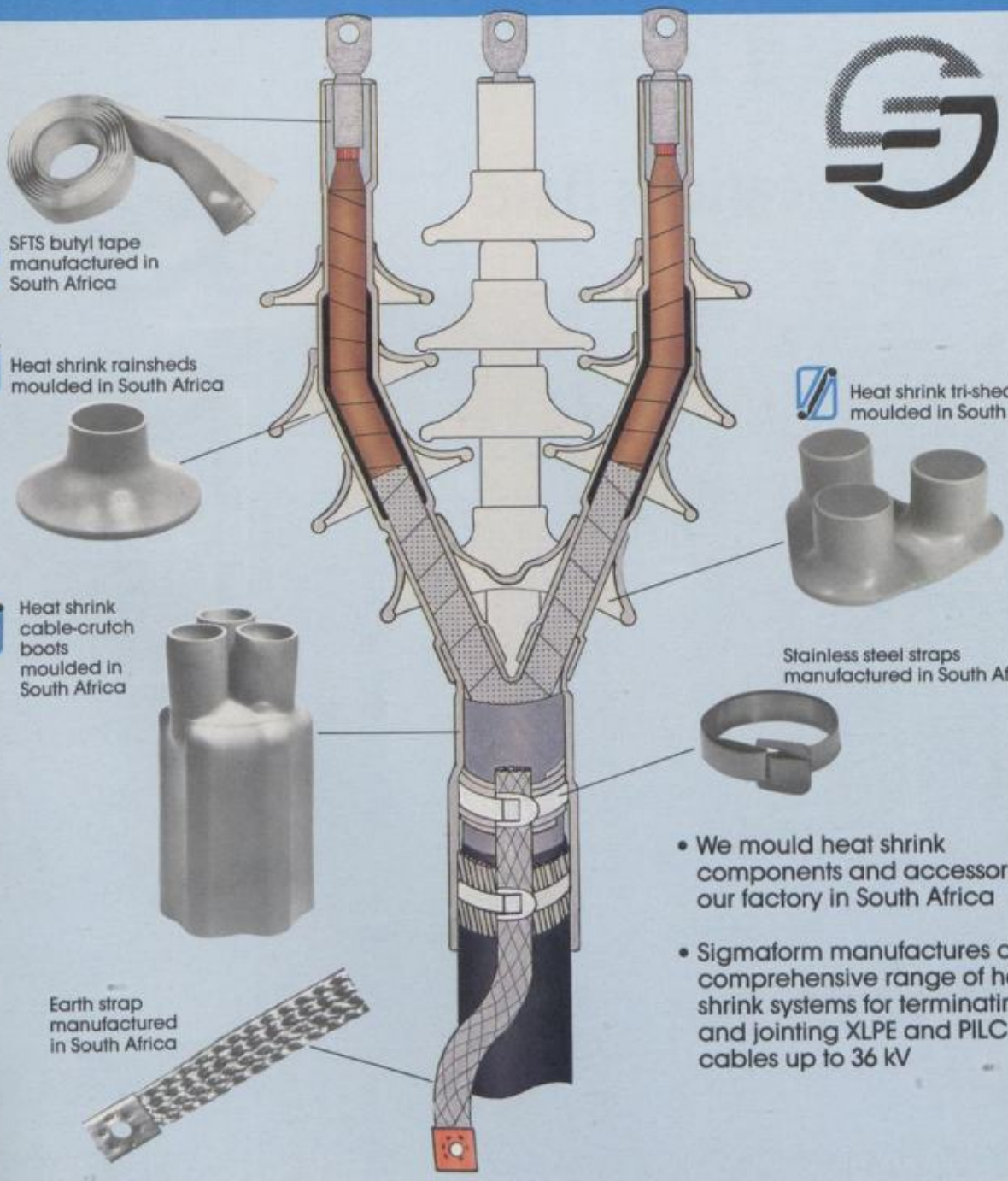

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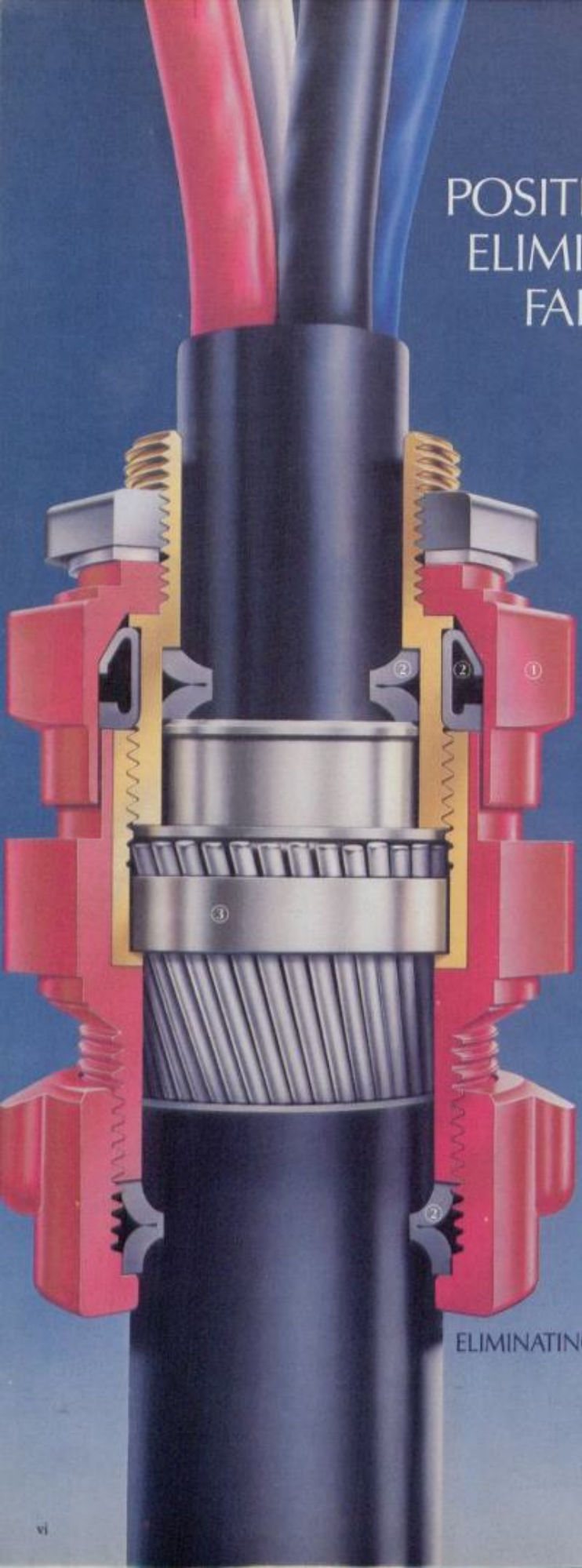


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# THE ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTH AFRICA

# DIE VERENIGING VAN MUNISIPALE ELEKTRISITEITSONDERNEMINGS VAN SUID-AFRIKA

OFFICIAL PROCEEDINGS
12th TECHNICAL MEETING
5-6 SEPTEMBER 1988

AMPTELIKE VERRIGTINGE
12de TEGNIESE VERGADERING
5-6 SEPTEMBER 1988

**Secretary-Sekretaris**
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**The AMEU is the body to bring together municipal councillors, electrical engineers and all persons interested in the advancement and the development of undertakings and to promote wider contact and the exchange of views.**
**Opinions expressed in papers and discussions do not necessarily represent the official views of the AMEU.**

**Die VMEO is die organisasie om munisipale raadslede, elektrotegniese ingenieurs en alle persone met belang in die bevordering en ontwikkeling van ondernemings bymekaar te bring en om wyer kennismaking en wisseling van sienswyse te bevorder. Menings uitgespreek in referate of besprekings verteenwoordig nie noodwendig die amptelike mening van die VMEO nie.**

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# OFFICIAL OPENING /AMPTELIKE OPENING

Ds J van Rensburg het die verrigtinge geopen met skriflesing en gebed.

Mnr A H L Fortmann President
Baie dankie ds van Rensburg. Ons is maar nietige wesens en as kinders van die Here is dit vir ons belangrik om Hom nie uit ons daaglikse take te vergeet nie en waardeer ons dit dus dat u ons Vergadering op hierdie wyse kon open.

# WELCOME AND INTRODUCTION BY PRESIDENT, MR A H L FORTMANN

*Mnr Alwin Fortmann, President van die VMEO aan die woord.*

Mnr die Burgemeester, raadsheer Johan Oosthuizen en mev Oosthuizen, erelede, eregaste, dames en here. Dit is vir my 'n groot eer en besondere voorreg om u almal hartlik welkom te heet by hierdie Twaalfde Tegniese Vergadering van die Vereniging van Munisipale Elektrisiteitsondernemings van Suid-Afrika.

Dit is die 150ste bestaanjaar van Potchefstroom en ag die VMEO dit 'n besondere eer dat u Raad ons, meneer die Burgemeester, uitgenooi het om ons Tegniese Vergadering in Potchefstroom te hou.

Graag wil ek dan ook nou van die geleentheid gebruik maak om u en u Raad, namens die VMEO hartlik geluk te wens met Potchefstroom se 150ste bestaansjaar. Mag Potchefstroom voorspoed geniet en van krag tot krag gaan.

Hierdie is nie die eerste vergadering van die VMEO in Potchefstroom nie, want in 1970 het die Derde Tegniese Vergadering ook hier plaasgevind.

The programme for the next two days promises to be enjoyable and rewarding and I hope that the delegates will be enriched by the contents of the papers and discussions.

There is an exceptionally good turn-out of Ladies and it appears that they are particularly well catered for and I sincerely hope that they will also have an enjoyable two days in Potchefstroom.

Voordat ek Raadsheer die agbare Burgemeester, Johan Oosthuizen aan die woord stel, wil ek graag net kortliks iets oor hom sê.

Raadsheer Johan Oosthuizen is 'n gebore Potchefstromer en is sy hele lewe hier woonagtig.

Hy matrikuleer aan die Hoërskool Gimnasium in 1947. Na een jaar op die Universiteit van Potchefstroom vir Cirstelike Hoër Onderwys, besluit hy om saam met sy vader tot die sakewêreld toe te tree en was vir 22 jaar in die vleisbedryf.

Hy is voorsitter van verskeie direksies met eiendomsbelange en boerderybelange.

Raadsheer Oosthuizen is 'n rustende Ouderling in die NG Gemeente Potchefstroom Die Bult.

Hy is vir die afgelope 26 jaar ononderbroke Stadsraadlid van Potchefstroom. Gedurende dié 26 jaar het hy alle poste bekleë, naamlik:-

5 Jaar raadslid
6 Jaar lid van bestuurskomitee
3 Jaar ondervoorsitter van bestuurskomitee
5 Jaar voorsitter van bestuurskomitee
8 Jaar Burgemeester.

Vanaf 1973 tot 1977 was hy lid van die Kollegeraad van die Onderwyskollege Potchefstroom. Vanaf 1977 tot huidig is hy voorsitter van hierdie Raad.

Hy is ook lid van die Raad van Beskermhere by die Universiteit van Potchefstroom vir Christelike Hoër Onderwys.

Op die 20ste Maart 1985 was hy as Ere-Kolonel van 4 Artillerie Regiment aangestel. Dit was die eerste Ere-Kolonel wat in 'n staandemag artillerie regiment aangestel is.

Op 7 November 1985 ontvang mnr Oosthuizen die Suid-Afrikaanse Polisiester vir Verdienste.

Raadsheer Oosthuizen ontvang vyf oorkondes as blyk van waardering vir diens aan die gemeenskap gelewer.

Hy geniet sy ses kleinkinders.

Dames en here u kan sien dat Raadsheer Oosthuizen voorwaar 'n besondere inwoner en eerste burger van hierdie dorp is.

It now gives me great pleasure to call on his worship the Mayor, Alderman Johan Oosthuizen to officially open this 12th Technical Meeting of the AMEU.

# RAADSHEER JOHAN OOSTHUIZEN: BURGEMEESTER VAN POTCHEFSTROOM

Geagte mnr die President, geagte lede van die Uitvoerende Raad, eregaste, afgevaardigdes, dames en here.

Dankie, mnr die President, vir die vriendelike wyse waarop u my en my eggenote vanoggend verwelkom het as ook vir die wyse waarop u my aan die afgevaardigdes voorgestel het. Wanneer 'n mens na jou eie Cirriculum Vitae luister kom jy weer diep onder die indruk van hoe goed jou Skepper vir jou was en nog steeds is en dat alles onverdiende genade is.

Mnr die President, dit is 'n besondere eer en voorreg om u as afgevaardigdes na die 12de Tegniese vergadering van die Vereniging van Munisipale Elektrisiteitsondernemings van Suid Afrika namens my raad en die inwoners van Potchefstroom van harte welkom te heet, en ek wil die hoop en vertroue uitspreek dat u u besoek aan ons mooi dorp sal geniet.

Ek wil u ook bedank dat u ons uitnodiging aanvaar het om u 12de tegniese vergadering in 1988 gedurende ons feesjaar in Potchefstroom te hou want Potchefstroom het deur die jare 'n besondere bydrae tot die ontwikkeling en uitbouing van u vereniging gelewer.

The late Mr W D Ross, then Electrical Engineer of Potchefstroom was one of the 22 foundation members during 1915. Since then the Town Council of Potchefstroom was regularly represented at the conferences and technical meetings of the Association of Municipal Electricity Undertakings of South Africa, inter alia by the legendary councill Charles de Kock.

I myself was a delegate to the conference held in East-London during 1962, but I very soon decided that it was much easier to be a mayor of Potchefstroom, than to be a delegate to a conference of your Association.

Seventeen years ago, during 1970, it was the privilege of the Town Council of Potchefstroom to be the host when your third technical meeting was held here. As a borne Potchefstromer, I find it hard to believe that you waited 17 years, before meeting again in Potchefstroom.

Mr E de C Pretorius one of our former Town Electrical Engineers was a member of your Executive Council, for a period of 18 years namely from 1967 to 1969 and again form 1971 to 1987, and was the President of the Association of Municipal Electricity Undertakings of SA from 1975 to 1977.

During 1985 lifelong honorary membership was conferred upon him, which is not only a great honour to him personally, but also to Potchefstroom.

For the past few years Councillor Chris Landsberg is a member of your Executive Council. Those of you who know him, will admit that he not only has a formidable figure, but also a sharp and bright personality to match.

Mnr die President uit voorafgaande is dit dus baie duidelik dat Potchefstroom in die verlede diep spore in die bestaan van u vereniging getrap het en in die toekoms ook sy bydrae sal lewer om u vereniging verder uit te bou.

Mnr die President, die voorsiening van elektrisiteit en elektriese dienste is een van die belangrikste funksies wat binne die bevoegdheidsfeer van enige Stadsraad lê. Om hierdie dienste effektief en doeltreffend te lewer lê dit op elke Stadsraad se weg om:

a) 'n Duidelike beleid ten opsigte van die lewering van elektriese dienste te bepaal.

b) Duidelike doelwitte vir elektrisiteits voorsiening daar te stel na aanleiding van geantisipeerde behoeftes in die verband wat uit die beplanningsfeite van so 'n Stadsraad na vore kom.

c) Nooit in 'n krisisbestuurstyl ten opsigte van elektrisiteitsvoorsiening te verval as gevolg van reaktiewe optrede eerder as geantisipeerde behoeftebepaling nie.

d) Die beste gebruik te maak van beskikbare hulpbronne vir die bereiking van gestelde doelwitte.

e) Volgens gesonde finansiële beginsels elektrisiteitsvoorsiening te bestuur.

f) Omrede elektrisiteitsvoorsiening 'n gespesialiseerde diens is, behoorlik gekwalifiseerde mannekrag te bekom en aan te wend om die beleid uit te voer en doelwitte te bereik.

Genoemde 6 faktore wat waarskynlik verder bygevoeg kan word behoort verder binne die totale korporatiewe of strategiese beplanningsraamwerk van 'n Stadsraad gestalte te vind want selfs die elektrisiteitsdepartement kan nie geïsoleerd van die ander Munisipale departement funksioneer nie.

Wanneer verder na aanleiding van genoemde faktore na die profiel van die elektrotegniese stadsingenieur gekyk word, dan is dit duidelik dat hy nie alleen tegnies vervaardig en bekwaam sal wees nie, maar ook sal voldoen aan die vereistes wat aan die moderne bestuurder gestel sal word. Waar hierdie vergaderingf hoofsaaklik aandag sal gee aan die tegniese sy van Munisipale elektrisiteitsondernemings soos beplanning en ontwerp, nuwe ontwikkelings in verspreidingstoerusting, sisteembeskerming ten opsigte van mediumspanningsreekse, probleme rondom landelike oorhoofse lyne en privatisering van munisipale elektrisiteitsondernemings, is dit vir my 'n behoefte om enkele gedagtes met u te wissel slegs ten opsigte van mannekrag voorsienining as 'n dwingende opdrag vir stadsrade en hulle onderskeie elektrisiteitsdepartemente.

Research has shown that the ratio between managers and non-managers in the South African labour market is at present 1 to 52, and that by the year 2000 it can deteriorate to 1/76.

If as I have mentioned earlier, it is taken into consideration that the profile of the Town Electrical Engineer is measured against general management abilities the ratio in the electrical undertaking can be even more negative that 1/76. Add to this the fact that the RSA at present trains approximately only 19% of its actual requirements of qualified technicians a scenario is created of which the results penetrate into the office the department and the personal life of the Town Electrical Engineer.

Navorsing wat deur die Nagraadse Skool vir Bestuurswese aan die PU vir CHO gedoen is, het getoon dat toenemende werkslas van die Suid Afrikaanse bestuurder die simptome van stres, selverwaarlosing, sosiale isolasie, destabilisasie, huweliks- en gesinsprobleme en die erosie van werkbevrediging nie sal ontglip nie. Voeg hierby die sterk kompetisie van die privaatsektor met betrekking tot die bekom van dienste van tegniesgekwalifiseerde mannekrag en die scenario vir die toekoms van elektrisiteitsdepartemente van Stadsrade versleg verder.

Wanneer die verhouding tussen bestuurders en nie-bestuurders in Europa en die VSA van 1 tot 10 en maksimum 1 tot 17 in aanmerking geneem word kan die afleiding gemaak word dat die druk op die Suid Afrikaanse bestuurder en meer spesifiek die Elektrotegniese Stadsingenieur hom nie gespaar sal bly nie.

Na aanleiding van hierdie feite is dit seker dan ook nie onredelik om te verwag dat die VMEO wat die organisatoriese vermoë het en die kundige mannekrag kan aanwend om jaloers te waak oor die welsyn van die Elektrotegniese Stadsingenieur en die toekoms van die bedryf en die beroep nie. Laat dit, afgesien van u tegniese werk ook u opdrag wees in belang van u land en al sy inwoners.

*Raadsheer Johan Oosthuizen in gesellige luim*

Met hierdie enkele gedagte mnr die President, dames en here nogmaal hartlik welkom, geniet asseblief u besoek aan ons mooi dorp en is dit vir my 'n voorreg om die 12de Tegniese Vergadering van die Vereniging van munisipale elektrisiteitsondernemings van Suid-Afrika as amptelik geopen te verklaar.

## PRESIDENT

Mnr die Burgemeester, baie dankie aan u, vir die hartlike en vriendelike wyse waarop u ons in u mooi Potchefstroom verwelkom het – ons voel alreeds sommer tuis.

Mr Mayor, you have had your hands full in this your 150th anniversary year of your town, by virtue of so many other organisations that you have invitied to hold their conventions here and I would like, at this early stage to congratulate your staff, in particular your Town Electrical Engineer, Mr Fanie Steyn and his staff who have been involved in the preparations for this meeting. I would like to express my sincere appreciation to them for making the President's task so easy. Thank you Mr Mayor.

## PRESIDENT-ELECT: APPOINTMENT

At this point, I have an important announcement to make.

I think it is by now common knowledge that Dr Nico Botha was appointed Town Clerk of Bloemfontein and that the AMEU lost a President-Elect in the process.

Ons gelukwense gaan egter aan Dr Botha met sy aanstelling en is ons verheug dat 'n lid van die VMEO en 'n Elektrotegniese Stadsingenieur uit ons geledere, in die hoë amp van Stadsklerk aangestel is.

As gevolg van hierdie verwikkeling was dit toe nodig dat die Uitvoerende Raad 'n nuwe Aangewese President aanwys.

*A view of the delegates in one of the new Andries Hendrik Potgieter Banquet Halls.*

*Two halls were built by the Town Council of Potchefstroom to commemorate the 150th Anniversary of Potchefstroom.*

*The AMEU was the second organisation to make use of these superb meeting facilities.*

Nadat by wyse van 'n posstemming gestem was, het die Uitvoerende Raad mnr Fred Daniel, Elektrotegniese Stadsingenieur van Kaapstad, ooreenkomstig klousule 14.3 van die Grondwet, eenparig as Aangewese President bevestig.

I think you will have a worthy President-Elect in Mr Fred Daniel and it therefore gives me great pleasure to announce the appointment of Mr Fred Daniel, City Electrical Engineer of Cape Town as President-Elect and now ask him to take his place at the main table.

Ladies and Gentlemen, our heartiest congratulations to Mr Fred Daniel. Please give him a big hand.

---

# MNR FRED DANIEL: AANGEWESE PRESIDENT

*Mnr Fred Daniel Elektrotegniese Stadsingenieur van Kaapstad ons aangewese President van die VMEO aan die woord.*

Mnr die President, die agbare Burgemeester van Potchefstroom Raadsheer Oosthuizen, erelede, eregaste, dames en here, dit is vir my 'n groot eer dat die Uitvoerende Raad van die Vereniging my verkies het as die Aangewese President weens die bedanking van dr Nico Both wat nou die Hoof-Uitvoerende Beampte en Stadsklerk van Bloemfontein is. Dit geld nie alleen vir my maar ook vir my vrou en natuurlik ook vir die Stad Kaapstad.

Ons is diep bewus van die hoë eise wat van hierdie pos verwag word. Nietemin vertrou ons dat ons, met al ons tekortkominge, dié diens aan die Vereniging en die Gemeenskap wat van ons verwag word kan lewer.

It was 34 years ago that a City Electrical Engineer of Cape Town was honoured by being elected to this office, when Mr C G Downie accepted nomination in 1954.

Mr President you like all your predecessors have maintained an extremely high standard and it will be no easy task following in your footsteps. It is at a time like this that one is suddenly more aware of one's shortcomings, but I feel confident that with your able guidance and assistance from fellow members the task will not be as formidable as it appears.

I shall therefore Mr President endeavour to fulfil my duties in the best interests of the aims and tradition of the AMEU.

Thank you.

# OBITUARIES / DOODSBERIGTE : MOSIE VAN ROUBEKLAG / MOTION OF CONDOLENCE :

**MR A H L FORTMANN: PRESIDENT**

Sedert die 50ste Konvensie in Kaapstad, het 'n paar van ons lede tot sterwe gekom en is dit met innige leedwese dat ek gewag moet maak van die afsterwe van die volgende voormalige VMEO-lede:

Since the 50th Convention in Cape Town, a few of our members passed away and it is with deep regret that I have to refer to the death of the following past AMEU members:

1) Mr Keith Mc Millan – Formerly Town Electrical Engineer of Umtata.

2) Mnr Sweeney Mostert – Voormalige Elektrotegniese Stadsingenieur van George.

3) Mr Horace Eastman – A Past President during the year 1938 and who reached the ripe age of about 97.

Ons diepe meegevoel word aan hulle naasbestaandes oorgedra. Ek versoek alle aanwesiges om as 'n blyk van eerbied, vir 'n rukkie in stilte te staan.

Our deepest sympathy is extended to their families and I request all present to stand for a while in silence as a mark of respect.

# WELCOME TO HONORARY MEMBERS AND PAST PRESIDENTS

We are honoured to have in our midst the following Honorary Members and Past Presidents:

Dr Ralph Anderson – Honorary Member
Mr William Beesley – Honorary Member
Mr Wessel Barnard – Past President and Honorary Member
Mr John Dawson – Honorary Member
Mr Denis Fraser – Past President and Honorary Member
Mr Terence Marsh – Honorary Member
Mr John Morrison – Honorary Member
Mr Eugene Pretorius – Past President and Honorary Member
Mr José Telles (from Mozambique) – Honorary Member
Mr Gawie Theron – Past President and Honorary Member
Mr Jules von Ahlften – Past President and Honorary Member
Mr Piet Botes – Past President
Mr Jan Loubser – Past President
Clr J H de Lange – Honorary Member

I now ask the Past Presidents and Honorary Members to rise. I would like to extend our special greetings to them and bid them a warm welcome. Give them a big hand Ladies and Gentlemen.

# NUUTAANGESTELDE ELEKTROTEGNIESE STADSINGENIEURS/NEWLY APPOINTED TOWN ELECTRICAL ENGINEERS

Daar is waarskynlik 'n paar nuutaangestelde Elektrotegniese Stadsingenieurs wat 'n nasionale vergadering van die VMEO vir die eerste maal bywoon.

Kan ek hulle versoek om asseblief te staan sodat ons hulle kan sien.

Aan u here, 'n hartlike welkom en mag u verbintenis met die VMEO lank en gelukkig wees.

# VERSKONINGS/APOLOGIES

I have received a few apologies:

Professor Jan Reynders and Dr Naude van Wyk from the CSIR
Mr R M O Simpson – Honorary Member and Past President
Mnr Hennie Dreyer - Elektrotegniese Stadsingenieur van Jeffreysbaai
Mr Ron Leigh – City Electrical Engineer of Johannesburg
Mnr Philip Greyling
Mr and Mrs Sergio de Oliviera
Mr John Grundy
Mnr William Cronjé

Ons is jammer dat hierdie persone nie hier kan wees nie.

# AWARDING CERTIFICATES OF MERIT

**MR A H L FORTMANN: PRESIDENT**

About two years ago, the AMEU Executive Council gave thought to some form of recognition to persons who have rendered valuable service to the AMEU. This culminated in the introduction of certificates of merit to be granted to person whom the AMEU considered have rendered meritorious service to the AMEU and it was resolved that these certificates were to be awarded at AMEU Technical Meetings.

The AMEU has seen fit to award certificates of merit to seven persons and this is the first time that these certificates are to be awarded.

I now call on the following persons to come forward for this occasion.

Mr Jacobus (Bokkie) Boshoff
Mr Gerhard Gerber
Mr Nat Kirschner
Professor Ryno Kriel
Alderman Ben Steyn
Mr Theunis (Stoffie) Stoffberg

*From left to right: Alderman Ben Steyn, Boksburg, Prof. Clr. Ryno Kriel, Bloemfontein, Mr Gehard Gerber, Affiliate, Mr Nat Kirschner, Affiliate, Mr Theunis Stoffberg, Eskom and Mr Jacobus Boshoff, Vanderbijlpark*

Ladies and Gentlemen, Mr Ian Hobbs is not present at this Technical Meeting and I performed the pleasant duty of awarding him his certificate of merit, on behalf of the AMEU, at the time of the Eastern Cape Branch meeting in Grahamstown, in June of this year, but I wish to read his CV a little later.

**Mr J J (Bokkie) Boshoff: Vanderbijlpark**

Mnr Jacobus Johannes Boshoff is op 19 Julie 1929 in Philippolis Oranje Vrystaat gebore. Hy matrikuleer in Philippolis in 1947 en begin as vakleerling-elektrisiën op die destydse Suid Afrikaanse Spoorweë en Hawens in Bloemfontein werk.

Mnr Boshoff voltooi sy vakleerlingskap in Februarie 1953 en werk later as laboratoriumassistent in die S.A.S. se toetslaboratorium in Langlaagte.

In Oktober 1955 aanvaar hy diens as Toetsingenieur by die Dorpsbestuur van Welkom waarna hy na die Munisipaliteit van Ceres in die Kaap as Elektrotegniese Ingenieur in Oktober 1958 verhuis en na die Vanderbijlparkse Munisipaliteit as tweede in bevel van die Departement van die Elektrotegniese Stadsingenieur in September 1961. Bokkie word tot Elektrotegniese Stadsingenieur van Vanderbijlpark in September 1979 bevorder.

Hy verwerf die Nasionale Diploma in Werktuigkunde in 1952 en Staatsbevoegdheidsertifikaat, Elektriese, Bedryf, in 1957 en word geregistreer as Gediplomeerde Ingenieur in November 1987.

Hy is lid van die S A Instituut van Elektriese Ingenieurs asook van die Instituut van Gediplomeerde Wertuigkundige en Elektrotegniese Ingenieurs en het ook vir 10 jaar in die raad van laasgenoemde instituut gedien.

In September 1953 is hy met Lettie Willemse getroud en 3 kinders is uit die huwelik gebore.

Mnr Boshoff is 'n getroue vriend en kollega van die VMEO en het hier reeds diep spore getrap. Hy was voorsitter van die Hoëveldtak en het reuse werk verrig, met onder andere, wysigings van bedradingsregulasies en op SABS komitees, wat te doen gehad het met bedrading, gedien.

Ek vra Mnr Boshoff om nou hierdie sertifikaat in ontvangs te neem. Baie geluk Mnr Boshoff.

**Mr Gerhard Gerber: Affiliate**

Mr Gerhard Gerber was born in Switzerland in 1922, and educated as an electrical engineer in Switzerland. He emigrated in 1947 to South Africa and worked for the first 4 years as Assistant Engineer for Messrs Schindler Lifts. He then had 5 valuable years as Illuminating Engineer and District Manager in S A philips. In 1956 he joined the technical agency firm of A M Burgun (Pty) Ltd and was appointed the independent agent and Resident Engineer for the Zellweger Ripple Control Division of Switzerland.

Since 1956 Gerhard has dedicated his main interest and energy to load management, in which field he is still very actively and happily engaged. To his success, consider that Zellweger ripple control covers Municipal networks of over 4 000 MVA in South Africa, and most of his City and Town Electrical Engineer clients have also become his personal friends, some for over 30 years. Gerhard pays special tribute to this last fact, and warm-heartedly thanks all his friends for this loyal support and friendship.

He regularly attends AMEU Conventions, the first in Cape Town in 1957. He is married to Joan, who is also actively engaged in the business. Their elder son, Peter, joined the family business as a partner over 10 years ago, after extensive education and training abroad. Their younger son, Richard, is a computer programmer gaining further expertise in Switzerland.

Some of Gerhard's hobbies are: Hiking and skiing, and he is also a bit of a herbalist and wine lover.

Ladies and Gentlemen, it now gives me great pleasure to present Gerhard Gerber, a dear friend and colleague of the AMEU, with his certificate of merit.

Congratulations and best of luck Gerhard.

**Mr I L Hobbs: Uitenhage**

Although I have already presented Mr Ian Hobbs with his certificate of merit, I feel that I should tell you something about Ian's background and his meritorious service to the AMEU.

Ian Hobbs was born on a diamond mine near Pretoria – grew up on a gold mine near Benoni – was educated at Benoni High School and the Witwatersrand Technical College in Johannesburg.

He completed his apprenticeship as an electrician during the war years and then worked for Messrs L H Marthinusen.

He completed a learner engineer's course on a gold mine near Johannesburg and then joined Messrs Reunert & Lenz Ltd.

Reunert & Lenz transferred him to the Free State Goldfields in 1951. He married a Swiss girl in the same year and obtained his Government Certificate of Competency (Mines and Works).

His municipal career commenced a year later when he joined the Welkom Municipality under past President Bob Barton. In 1953 he was appointed as Town Electrical Engineer of Virginia and attended his first AMEU Convention in 1955. During this time Ian became a member of the Reef Association of Municipal Electrical Engineers. He was Secretary, Vice Chairman and Chairman, in fact the last Chairman of this Association as it was disbanded in 1962 to form the Highveld Branch of the AMEU. Ian was the first Chairman of the Highveld Branch and as such was a member of the AMEU Executive Committee in that year.

Ian contributed a technical paper to the AMEU Convention in Windhoek in 1964.

He left Virginia in 1970 to join the Uitenhage Municipality as Deputy Electrical Engineer under John Dawson and he holds the post to this day. He is a registered professional engineer, a member of the South African Institute of Electrical Engineers, a member of the Institute of Certificated Engineers and has taken an active part in the proceedings of the Cape Eastern Branch where he has been Secretary for the past seven years.

Ian retires in a year's time.

Our greetings and congratulations to Ian.

**Mr Nat Kirschner: Affiliate**

Nat Kirschner was born in Johannesburg on 30 June 1924.

He matriculated at Parktown Boys High, Johannesburg and served in the Special Signal Services during the 2nd World War.

Nat obtained a B.Sc. degree in Electrical Engineering in 1944 and in Mechanical Engineering in 1946, at Wits University.

In November 1946 he joined Messrs A Reyrolle & Company and after 3 years in the UK returned to SA.

In 1954 he was appointed Reyrolle Resident Engineer – Northern Rhodesia (Zambia) and became Managing Director – Reyrolle for Central and East Africa in 1960 in Salisbury (Harare).

Nat was posted back to Johannesburg as Managing Director – Reyrolle in SA in 1965 and became Managing Director Reyrolle Parsons Group in 1969.

He became Executive Director of NEI Africa on its formation in 1978 and Chairman, Electrical Division NEI Africa, in January 1987.

Nat is a Member of the SAIEE and a Member of the IEE(UK) and Chartered Engineer.

Nat has been attending AMEU main and technical meetings since the late 1950's while he was stationed in Zambia and has been a regular visitor to the Eastern Cape Branch meetings since their beginning almost without fail.

Nat and his wife Freda have three children and four grandchildren.

Nat is a keen golf and tennis player.

It is with pride that Nat gives credit to his wife Freda for her wonderful support of him in their 34 years of married life and feels that this award belongs to her as well.

It is now my privilege and pleasure to call forward Mr Nat Kirschner to present him with this award.

Congratulations and best of luck, Nat.

**Professor Ryno Gerhard Kriel: Bloemfontein**

Prof Rdl Ryno Kriel het sy skoolopleiding by Grey Hoërskool in Port Elizabeth, ontvang.

Sy universiteitsopleiding was by die Potchefstroomse Universiteit vir Christelike Hoër Onderwys en aan die Stellenbosch Universiteit.

Hy behaal onder andere die volgende grade: M.Sc, M.ED., D.Phil.

Hy was onderwyser by die Potchefstroom Boys High en Pietersburgse Hoërskool.

Professor Kriel was Lektor by Stellenbosch Universiteit, daarna Senior Lektor en twee jaar later Professor by die Universiteit van die Oranje Vrystaat.

Tans is hy 'n sakeman.

Ryno Kriel is STadsraadslid van Bloemfontein vanaf 1973 tot hede. Was onder andere gedurende hierdie tydperk lid van die Bestuurskomitee en Burgemeester van Bloemfontein.

Dames en here, Professor Ryno Kriel is 'n jarelange vriend en steunpillaar van die VMEO en was tot onlangs vir 'n hele paar jaar 'n lid van die Uitvoerende Raad van die VMEO.

Dit is dus my eer en voorreg dat ek names die VMEO hierdie verdienstelikheidsertifikaat vir uitstaande diens aan die VMEO gelewer, aan Professor Ryno kan oorhandig.

Baie geluk Professor.

**Raadsheer Ben Steyn: Boksburg**

Raadsheer Ben Steyn ontvang sy skoolopleiding by die Martin School en Boksburg High School en daarna by die Witwatersrand Technical College. Vanaf 1938 tot 1942 was hy as vakleerlingelektrisiën by die ERPM-myn ingeskryf.

Daarna werksaam op die myn as 'n elektrisiën vir enkele jare. In 1946 begin hy sy eie besigheid as 'n elektriese kontrakteur.

Tans is Ben besigheidsman en Direkteur van Maatskappye in Boksburg. Hy dien reeds op die Boksburg Stadsraad vir 231 jaar en was 2 keer Burgemeester van die dorp. Tans is hy weer Burgemeester vir die derde termyn en staan weer as kandidaat in die Munisipale Verkiesing wat in Oktober 1988 plaasvind.

Sy belange is in dorpsontwikkeling en diens aan sy medemens. Hy dien op verskeie komitee's en organisasies in Boksburg.

Onlangs is 'n groot eer aan hom getoon toe die Stadsraad van Boksburg hom as Raadsheer aangewys het.

Ben Steyn dien reeds baie jare op die Uitvoerende Raad van die VMEO, waar hy nie net die VMEO maar ook my persoonlik baie bygestaan en ondersteun het. Voordat hy op die Uitvoerende Raad gekom het, was hy baie jare Boksburg Stadsraad se afgevaardigde om saam met my VMEO-konvensies en vergaderings by te woon.

Raadsheer Ben Steyn is sonder twyfel 'n goieie en getroue vriend van die VMEO en sy uitstaande diens en bydrae word terdeë waardeer.

Dit is dus vir my 'n trotse oomblik dat ek hierdie verdienstelikheidsertifikaat aan Raadsheer Ben Steyn, my eie raadslid, kan oorhandig.

Baie geluk Ben.

**Mnr Theunis Christoffel Stoffberg: Eskom**

Mnr Theunis (Stoffie) Stoffberg is op 25 Oktober 1923 op Krugersdorp gebore. Hy is met Babs Scheepers op 3 Julie 1948 getroud. Tans is mnr Stoffberg 'n wewenaar met twee kinders en vyf kleinkinders.

Theunis Stoffberg matrikuleer aan die Hoërskool Helpmekaar in Johannesburg in 1939.

Hy gradueer as BSc (Ing) (Elektries) aan die Universiteit van die Witwatersrand in 1944.

Verder behaal hy in die sestigerjare ook die MBA-graad aan die Universiteit van Pretoria, en die Governmentsertifikaat van Bevoegdheid as Elektriese Ingenieur.

Stoffie is geregistreer as Professionele Ingenieur en is lid van die Suid-Afrikaanse Instituut van Elektriese Ingenieurs en van die Ingenieursvereniging van Suid-Afrika.

Vanaf Januarie 1948 tot Junie 1968 was hy 'n werknemer van die Munisipale Elektrisiteitsonderneming van Pretoria, aanvanklik as Junior Ingenieur, en later as Toets- en Beplanningsingenieur, Distribusieingenieur, en Adjunk-Stadselektrisiteitsingenieur.

Sedert 1 Julie 1968 tot die huidige is hy 'n personeellid van Eskom in verskillende hoedanighede. Hy was onder andere Eskom se Hoofbeplanningsbeampte en daarna Kragverkopebestuurder. Hy sal op 25 Oktober 1988 op sy 65ste verjaarsdag uit Eskom se diens aftree as Korporaatbemarkingskonsultant.

Sy verbintenis met die Vereniging van Munisipale Elektrisiteitsondernemings van Suid-Afrika tot die middel-vyftigerjare (voor die aanstelling van 'n VMEO Sekretaris) was daar geen amptelike sekretaris van die VMEO nie en het mnr Dirk Hugo, die Stadselektrisiteitsingenieur van Pretoria, gedurende sy Presidentskap vanaf 1955 tot 1956 Theunis Stoffberg gebruik as nie-amptelike komiteeklerk van die Uitvoerende Raad van die VMEO.

Na die kongres in Pretoria in Mei 1956 het hy die merendeel VMEO-kongresse en Tegniese Vergadering bygewoon, en het dikwels bygedra tot die verrigtinge.

As Eskom-verteenwoordiger is hy meermale belas met die moeilike taak om die oënskynlike hoë Eskom-tariefverhogings eerstens by die VMEO-kongresse wêreldkundig te maak en aan hierdie simpatieke gehoor die regverdigheid en onvermydelikheid van hierdie tariefverhogings te verduidelik.

Dames en here, as daar ooit 'n vriendelike persoon was, dan is dit Stoffie Stoffberg. Sy vriendelikheid het by hom uitgeborrel, teen-oor een en almal, ongeag wie of wat jy was. 'n Groot dank daarvoor aan u mnr Stoffberg.

Namens die VMEO gee dit my dus groot genoeë om hierdie verdienstelikheidsertifikaat aan mnr Theunis Christoffel Stoffberg te oorhandig.

Baie geluk Stoffie.

# PAPERS – REFERATE

# MOONTLIKE PRIVATISERING VAN ELEKTRISITEITSONDERNEMINGS IN PLAASLIKE BESTUUR

J.G. MALAN - KEMPTON PARK

# POSSIBLE PRIVATISATION OF ELECTRICITY UNDERTAKINGS IN LOCAL GOVERNMENT


*Mnr J G Malan, Elektrotegniese Stadsingenieur, Kempton Park*

**MNR A H L FORTMANN: PRESIDENT**

Dames en here, ons kom nou by die eerste referaat wat deur mnr Jan Malan gelewer sal word. Hierdie referaat, "Moontlike Privatisering van Elektrisiteitsondernemings in Plaaslike Bestuur" het met die aanloop na hierdie Tegniese Vergadering, reeds wye belangstelling gewek en is ek oortuig daarvan dat u dit besonder insiggewend sal vind.

Jan Gysbert Malan is a Bolander by birth, served his time and received his basic engineering training with the former South African Railways. Thereafter he worked in the private sector, specializing in HV Switchgear and protection for four years with Messrs Johnson & Phillips where he gained valuable experience in the optimum utilization of men, money and machines. In 1968, Mr Malan joined the Kempton Park Town Council as Deputy Town Electrical Engineer where he witnessed a maximum demand growth from 20 to 200 MVA in 20 years.

In 1975 Mr Malan went back to the coast to serve as Town Electrical Engineer of the newly formed Vredenburg/Saldanha Town Council and returned to Kempton Park in 1977 where he now holds the position of Town Electrical Engineer.

He is a Member of the South African Institute of Electrical Engineers and holds the Certificates of Competency for Electrical and Mechanical Engineers.

Stemming from wine farming stock, he has a keen interest in the collection and consumption of good wine!



## 1. INLEIDING

Iemand het gesê dat Privatisering as beginsel baie groter as die mens self is. Dit het soveel intrinsieke krag dat niemand dit kan weerstaan nie en dit beteken dat diegene wat dit probeer weerstaan sal veroorsaak dat verkeerde besluite in die proses geneem sal word wat daardie organisasie op die lange duur sal benadeel. Privatisering is nie 'n modewoord nie - dis nie 'n cliche nie - dit is 'n werkliheid wat elke dag rondom die aardbol gebeur. Ons, die mense wat in die laat 20ste Eeu dinge laat gebeur - ons besef nie hoe bevoorreg ons is om deel van hierdie grootse gebeurtenis te wees nie - 'n gebeurtenis wat hom miskien een keer in menseheugenis voordoen. Hierdie referaat is geskryf enkele dae nadat die Regering aangekondig het dat



## 1. INTRODUCTION

Somebody said that Privatisation as a principle is much greater than mankind. It possesses so much intrinsic power that nobody can resist it which means that those who attempt to resist it will give rise to the wrong decisons being taken which will be injurious to their organisations in the long term. Privatisation is not a word in vogue - it is not a cliche - it is a reality which occurs every day around the globe. We, the people living in the late 20th Century who are responsible for making things happen, we are not aware of how privileged we are to be part of this great occurence which presents itself perhaps once within living memory.

This paper was prepared within days after the Government

Wetswysiging ingedien sal word wat Eskom, die SAVD en die Pos- en Telekommunikasiewese in hul geheel of na verdeling in toepaslike bedryfsinstansies sal omskep in ondernemings wat ten doel het om wins te maak en belasting te betaal.

In sy openingsrede op 5 Februarie vanjaar het die Staatspresident in die parlement gesê dat in die lig van die suksesvolle re-organisasie wat met Eskom bereik is, sal die nodige ondersoeke wat daarop gerig is om beursnotering te verkry in die geval van Eskom eerste gedoen word. Hierdie aankondigings het in Suid-Afrika gekom op omtrent dieselfde tydstip toe Mev Thatcher aangekondig het dat hulle ernstig na die privatisering van die elektrisiteitsvoorsineingsbedryf in Engeland kyk.

Dit is ondenkbaar dat hierdie groot instellings eenvoudig in die ope mark op tender geplaas sou word en dat die mees aanvaarbare aanbod aanvaar sou word. Die private sektor beskik nie oor die finansiële vermoë om hierdie enorme instansies te koop nie. Daarom is beursnotering onvermydelik. Dit impliseer dat die bestuur en werkerskorps in die uitvoering van hulle onderskeie pligte in 'n status quo situasie behou sal bly met die verskil dat aandeelhouers 'n dividend op hulle belegging verwag en derhalwe sal produktiwiteit en effektiwiteit voorrang geniet. Dit het immers met die privatisering van British Telecom en andere gebeur.

Privatisering, om in sy doel te slaag, nl. om 'n bepaalde bedryfsinstansie te omskep in 'n onderneming wat ten doel het om wins te maak en belasting te betaal, moet op die makro-vlak geskied. Daar is weinig sin in dat 'n bedryfsinstansie sekere van sy aktiwiteite uitkontrakteer na 'n private onderneming terwyl hyself beskik oor die infrastruktuur en produksiefaktore nl. kundigheid, mannekrag, masjinerie en materiale om dit self te doen. Dit is nie privatisering nie, dit is duplisering van duur bedryfsmiddele want gewoonlik moet 'n raadgewer aangestel word om na die kontrakteur om te sien en dan het die bedryfsinstansie weer mense nodig om na die raadgewer om te sien. Die landsekonomie kan dit allermins bekostig omdat dit inflasionisties inwerk op die koste van die eindproduk.

Talle Westerse lande het oor die afgelope tien jaar hulle hoë inflasiesyfers aansienlik laat daal deur middel van onder andere privatisering. In Suid-Afrika werk meer as 50% van die ekonomies aktiewe burgers vir die Staat en verwante openbare liggame en die salarispakket is een derde van die jaarlikse Staatsuitgawe. Talle van hierdie openbare liggame maak wins maar betaal nie belasting nie. Elektrisiteitsvoorsiening is 'n goeie voorbeeld hiervan.

In elke dorp of stad is die elektrisiteitsvoorsieningsonderneming een van die grootste besighede in daardie dorp of stad wat 'n wins maak maar nie belasting betaal nie. Sy wins word in die plaaslike belastingfonds gestort meestal ter finansiering van kruissubsidies op openbare dienste wat teen 'n verlies of selfs gratis gelewer word. Voorts word elektrisiteitstariewe dikwels opwaarts aangepas, nie omdat die elektrisiteitsonderneming se inherente kostestruktuur dit regverdig nie, maar om op die plaaslike bestuur se boeke globaal te laat klop. Elektrisiteit is 'n noodsaaklike rou materiaal - dit moet as sulks teen die mees ekonomiese tarief voorsien word.

Om dit ekonomies te kan voorsien moet die onderneming sy besluite onbevange op ekonomiese faktore laat berus. Dit is dus duidelik dat burokratiese regulering en politieke druk faktore is wat belemmerend op hierdie doelwit inwerk.

Plaaslike owerhede is geneig om hul huishoudelike verbruikers (kiesers) se tarief te subsideer ten koste van die kommersiële en nywerheidsverbruikers. Wanneer tariewe in die media vergelyk word dan word slegs die huishoudelike tarief voorgehou. Politieke druk is die hoofoorsaak hiervoor. Indien Eskom se tariewestruktuur vergelyk word dan vind ons dat die huishoudelike tarief relatief hoog is tot die grootmaattarief. Die rede weereens is - daar is geen politieke besluitneming nie tariewe word op 'n

announced that legislative amendments will be tabled with a view to transforming Eskom, the SATS and the Post and Telecommunications in their entirety or after division into appropriate business units, into undertakings with the objects of making profit and paying tax.

In his opening address on the 5th February this year the State President said in parliament that in the light of the successful re-organisation achieved in Eskom the necessary investigations into obtaining stock-exchange quotation in the case of Eskom will be carried out first.

These announcements in South Africa came at the same time when Mrs Thatcher announced that they are seriously considering the privatisation of the electricity supply industry in the United Kingdom.

It is inconceivable that these huge undertakings will merely be put up for sale and that the most favourable tender will be accepted and sold to the private sector. The private sector does not have the financial capability to purchase such enormous organisations and therefor stockmarket quotations seems inevitable. This implies that management and the work force wil remain in a status quo situation in the execution of their respective duties with the diffirence that shareholders expect dividends on investment and therefor productivity and effectiveness will receive high priority. This indeed happened with the privatisation of British Telecom and others. Privatisation, to succeed in it's objective, namely to transform a given business unit into an undertaking with the object of making a profit and of paying tax must be carried out at macro level. There is little sense in contracting out certain of its activities while the undertaking itself has at its disposal the infra structure and yield factors such as expertise, manpower, machinery and material to do it itself.

This is not privatisation, this is duplication of expensive working stock, as normally a consultant is appointed to look after the contractor and the undertaking then requires qualified personnel to look after the consultant. This, the economy can ill afford since it has an inflationary effect on the cost of the end product.

Many Western Countries lowered their high inflation figures dramatically over the past decade as a result of, inter alia, privatisation. In South Africa more than 50% of the economically active citizens work for the State or associated public bodies. The pay bill of the State constitutes 33% of the annual State expenditure. Many of these State owned or public bodies run businesses at a profit but they don't pay tax. The electricity supply industry is one of the best examples.

In every town or city the electricity supply undertaking is one of the largest businesses in such town or city, making a profit but does not pay tax. The profit is deposited in the local rates fund mainly to finance cross subsidies to public services rendered at a loss or even at no charge. Further, electricity tariffs are often jacked up, not as a rsult of any deficienty in the undertaking's cost structure but to balance the books of the local authority at large.

Electricity is a vital raw material and must as such be supplied to the end user at the most economical tariff. In order to supply it economically the undertaking must be able to make impartial decisions based on prevailing economic factors. Clearly, bureaucratic regulation and political pressure are factors posing an obstruction to this objective.

Local authorities are inclined to subsidise their domestic consumers (voters) at the expense of the commercial and industrial consumers. When tariffs are quoted in the media then only the domestic tariff is mentioned. Political pressure is the main reason. If we compare the Eskom tariff structure we find that the domestic tariff is relatively high in relation to the bulk consumer's tariff. The reason again; there is no political decision making and tariffs are derived scientifically, recovering fixed and running costs on a pro-rata basis.

wetenskaplike basis bereken en vaste- en bedryfskostes word in die tariewe pro-rata verhaal.

Die vervaardigingsbedryf moet sy krag teen die laags moontlike tarief ontvang sodat hy kompeterend kan produseer, sy wins kan maksimaliseer en meer belasting betaal! Dit is in lyn met die filosofie oor privatisering.

## 2. DIE WITSKRIF

Die uitskakeling van kruissubsidiëring is 'n voorvereiste vir die inwerkingstelling van die Witskrif oor Privatisering en Deregulering wat in Augustus 1987 deur die regering vrygestel is.

Dit Witskrif het vyf metodes van privatisering geidentifiseer, nl.

- ★ Die verkoop van Staatsondernemings en bates
- ★ Vennootskappe tussen openbare institusies en die private sektor
- ★ Die verhuur van sekere regte aan die private sektor wat vorheen deur die Staat besit is
- ★ Die uitkontrakteer van sekere staatsbedrywighede aan die private sektor
- ★ Wanneer dit noodsaaklik word dat sekere dienste of bedrywighede na die private sektor oorgeplaas word.

Hoewel die Witskrif die regering se houding en breë beleid oor privatisering uitspreek word die implimentering daarvan gekortwiek deur burokrate wat in hulle veilige vestings daardeur bedreig word. Op Kwasi-regeringsvlak kan politici die gevoel kry dat politieke mag hulle ontneem word.

Indien die vyf metodes egter bestudeer word, word dit duidelik dat weinig van hulle in een fase as uiteindelike doelwit deurgevoer kan word, maar indien hulle as stadiums in 'n makro-privatiseringsprogram ingevoeg word, dan kan hulle almal as ontwikkelingsfases dien wat op mekaar volg totdat die hoofdoelwit bereik is.

## 3. VERSPREIDING VAN EKONOMIESE MAG

Privatisering moet nie 'n verdere konsentrasie van ekonomiese mag in die private sektor tot gevolg hê nie. Die bates wat die openbare sektor besit wat deur middel van privatisering in die private sektor se hande geplaas word moet eweredig versprei word. In Brittanje het Mev Thatcher haar sukses met privatisering grootliks te danke daaraan dat aandeelhouding onder die personeel en klein beleggers aangemoedig is.

Die Amerikaanse professor in Ekonomie aan die Southern Methodist University, Ravi Batra, in sy boek "The Great Depression of 1990" sê dat wanneer konsentrasie van rykdom in die hande van 'n beperkte aantal mense geplaas word, dit resessie in katastrofe laat verander.

Hy sê: "When this happens, the losers seek to maintain or improve their living standards by borrowing. Yet they are inherently less creditworthy, being less wealthy. This undermines the soundness of the banks. Secondly, the richer the rich get, the more prone they are to plunge into speculative investments. This stimulates a speculative fever that eventually spreads to the whole population. When recession comes along, it triggers a collapse of the by-now shaky financial system - and that is what turns recession into a once-in-a-lifetime cataclysm".

Minister Barend du Plessis sê die openbare sektor se besigheid is om dienste te lewer en die prys wat hy daarvoor vra is belasting. Dit is 'n duidelike opsomming van die grondslag van dienslewering in die openbare sektor en beteken by implikasie dat dienste wat deur die belastingfonds gefinansier word histories by die openbare sektor tuishoort en dat dienste wat deur middel van tariewe gefinansier word, nl. die handelsondernemings, nie noodwendig by die openbare sektor tuishoort nie. Hierdie uitgangspunt is ook bevorderlik vir die gedagterigting

The manufacturing industry should receive its power at the lowest possible tariff so that it may produce competitively, make a bigger profit and pay more tax!

This is in line with the philosophy on privatisation.

## 2. THE WHITE PAPER

The elimination of cross subsidisation is a prerequisite for the introduction of the White Paper on Privatisation and Deregulation which was released by the government in August 1987.

The White Paper identified five methods of privatisation viz.

- * The sale of public sector enterprises and assets
- * Partnerships
- * Leasing of business rights
- * Contracting out, and
- * Discontinuation of a service or activity which was previously provided by the public sector.

Although the White Paper expresses the government's attitude and broad policy towards privatisation, it's implementation is hampered by bureaucrats who feel threatened in their secure strongholds. At Wuasi government level politicians may get the feeling that they are being deprived of political power. However, if the five methods are examined it becomes clear that few, if any, of them can be introduced in a single phase to reach the ultimate objective, but should they be incorporated as stages into a macro-privatisation program, then all of them may act as development stages following one another until the principle objective has been reached.

## 3. SPREADING OF ECONOMICAL POWER

Privatisation should not have a further concentration of economical power in the private sector. The assets owned by the public sector which by way of privatisation will be put in the hands of the private sector must be spread proportionally. In Britian Mrs Thatcher's success with her privatisation drive is mainly contributed to the fact that shareholding among personnel and small investors was encouraged.

The American professor of Economics at the Southern Methodist University, Ravi Batra, in his book "The Great Depression of 1990" says that when concentration of wealth is put in the hands of a small number of people, recession turns into catastrophe.

He says: "When this happens, the losers seek to maintain or improve their living standards by borrowing. Yet they are inherently less creditworthy, being less wealthy. This undermines the soundness of the banks. Secondly, the richer the rich get, the more prone they are to plunge into speculative investments. This stimulates a speculative fever that eventually spreads to the whole population. When recession comes along, it triggers a collapse of the by-now shaky financial system - and that is what turns recessions into a one-in-a-lifetime cataclysm."

Finance Minister Barend Du Plessis says the public sector's business is to provide a service, the price of which is paid as tax. This is a clear summary of the basic principle behind service rendering in the public sector and by implication it means that services rendered and financed by the rates fund historically vests in the public sector, but those services financed by way of tariffs, such as trading undertakings, do not necessarily belong with the public sector. This outlook would be beneficial to the view that tariffs for and costs of services rendered should increasingly be brought into line with actual costs.

## 4. MONOPOLISTIC NATURE OF ELECTRICITY SUPPLY INDUSTRY

The British Financial Secretary to the treasure, Mr John Moore says: "We always believed that only politicians and government

dat tariewe vir en kostes van dienste wat gelewer word toenemend in verband gebring moet word met werklike kostes.

## 4. MONOPOLISTIESE AARD VAN ELEKTRISITEITSVOORSIENING

Die Britse finansiële sekretaris van die tesourie, mnr John Moore sê: "Daar is altyd geglo dat net politici en staatsamptenare met monopolistiese mag vertrou kan word omdat hulle dit met selfbeheersing, geregtigheid en begrip kan doen. Watter snert was dit nie! Ervaring het ons geleer dat wat die verbruiker betref, die staat net so maklik 'n monopolistiese posisie kan misbruik as 'n private eienaar."

Die Witskrif in hoofstuk 5.2.5. sê die Regering sien weinig langtermynvoordeel daarin om deur die totale vervreemding van bates 'n openbaresektormonopolie deur 'n privaatsektormonopolie te vervang.

Wat hierdie siening nie erken nie is die feit dat enige privaatsektormonopolie spoedig die veld van mededinging sal betree. Die openbaresektormonoppolie daarenteen word dmv regulering daarteen beskerm.

Die monopolistiese aard van 'n tipiese elektrisiteitsonderneming bestaan daarin dat daar op plaaslike vlak nie mededinging in sy hooffunksie (besigheid), naamlik kragaankope en kragverkope, bestaan nie. Dit is onprakties en onekonomies om twee afsonderlike ondernemings in dieselfde straat te hê wat krag te koop aanbied. Sy hoof aktiwiteit egter is onderhewig of kan onderhewig gemaak word aan mededinging. Sy hoof aktiwiteit, nl. om elektrisiteit vir verkope beskikbaar te stel, oorspan 'n breë veld van kundigheid en aktiwiteite en sluit in lynfunksies soos die skepping en bou van nuwe kragstelsels, en die instandhouding van die bestaande stelsels, asook staffunksies soos beplanning, administrasie, bevelvoering, toets en navorsing en beheer. In hierdie operasies is die private sektor uiters aktief en indien die geprivatiseerde onderneming se in-huis prestasies die toets van mededinging kan weerstaan, slegs dan het hy 'n bestaansreg. Indien nie, sal dit vir die onderneming meer ekonomies wees om die verskillende aktiwiteite uit te kontrakteer. Hierin lê die gevaar egter in die gehalte diens wat aan die verbruiker gelewer word.

Indien hierdie lyn- en stafaktiwiteite in simpatie met mekaar is, komplimenteer hulle mekaar en die resultaat vind uiting in 'n harmonieuse en flinke diens aan die eindverbruiker. Indien hulle egter gefragmenteerd is in die vorm van onafhanklike private instansies wat deur die bestuur van die onderneming gekoordineer moet word, sal normale bedryfsprobleme telkens in noodsituasies ontaard en sal die kwaliteit van die diens aan die eindverbruiker daaronder ly.

Die personeel van die plaaslike onderneming is gewoonlik oor baie jare heen geskool in die vaardighede van 'n toegewyde diens aan die publiek en voordat so 'n onderneming geprivatiseer kan word sal dit nodig wees om daardie personeel voor te berei om publieke verantwoordelikheid te aanvaar vir alle fasette van 'n openbare diens waarsonder die hedendaagse gemeenskap nie meer kan bestaan nie. Voorts moet entrepreneurskap uiteraard in die bestuur sterk aanwesig wees en moet hulle inderdaad die siel van die bedryf verstaan. As dit nie so is nie moet dit van buite versterk word.

'n Geprivatiseerde elektrisiteitsonderneming sal vry wees om in die ope mark met die private sektor te kompeteer. Dit is nou deel van die private sektor. Konstruksie- en instandhoudingswerke kan oor die munisipale grense heen uitgevoer word. Agentskappe kan gehou word, selfs in die lugversorgings- of rekenaarbedryf. Hy kan selfs 'n groothandelaar word.

Die Thatcher-regering het in 1984 besef privatisering was so suksesvol dat dit na die statsbeheerde monopolieë uitgebrei kon word. Hulle beweer privatisering het bewys dat dit doeltreffendheid verhoog, of 'n monopolie betrokke is of nie. Hulle meen ook

officials may be entrusted with monopolistic power as they would deal with it with selfcontrol, justice and understanding. What a lot of trash! Experience taught us that as far as the consumer is concerned, a monopolistic situation is abused by the State as easily as it is done by a private proprietor." The White Paper in paragraph 5.2.5. says the government sees little long term advantage through the total alienation of assets in the replacement of a public monopoly by a private monopoly.

This view, however, does not acknowledge the fact that any private monopoly will soon be confronted with competition. The public monopoly, on the contrary, is protected against competition by way of regulation.

The monopolistic nature of a typical electricity undertaking exists in the fact that no competition prevails locally in it's main function (business) namely power purchases and power sales. It is impractical and uneconomical to have two separate undertakings selling power in the same street. However, it's main activity is liable or could be subjected to competition.

It's main activity, i.e. to make electricity available for sale, spans a wide field of expertise and activities and include line functions such as the creation and building of new power systems, and the maintenance of the existing networks, as well as staff functions such as planning, administration, leading, test and research and control. The private sector is most active in all these operations and the in-house achievements of the privatised undertaking will have to withstand the test of competition in order to enjoy justification at all. If not, it will be more economical for the undertaking to put such activities out to contract. However, in this venture the danger lies in the quality of service rendered to the consumer. Should these line and staff activities be in sympathy they complement each other and the end result culminates in a harmonious and swift service to the end user. Should they be fragmented, however, in the form of independent private enterprises which have to be co-ordinated by management, then normal operating problems will forever deteriorate into emergencies, resulting in the quality of the service to the end user to suffer.

The personnel of the local undertaking has usually been trained over many years in the skills of a dedicated service to the public and before such undertaking could be privatised, it would be necessary to prepare the personnel to accept public responsibility for all facets of a public service without which the present day community cannot exist. Furthermore, it is inevitable that entrepreneruship shall strongly exist in management and it is important that they have a thorough understanding of the soul of the business. If this is not the case, it must be reinforced extrinsically.

A privatised electricity undertaking will be free to compete in the open market with the private sector. It is now part of the private sector. Construction and maintenance work can be undertaken across the municipal boundaries. Franchises may be commissioned, even in the air conditioning and computer fields. It may even become a wholesaler.

The Thatcher government realised in 1984 that privatisation was so successful that is could be extended to the state controlled monopolies. They claim that privatisation enhanced efficiency, whether a monopoly is involved or not. They also think that their policy to create a widespread shareholding creates a public that expects an acceptable return on it's investment, as well as fair pricing.

At the end of the day the public judges price and quality of service. Price can be judged by comparing tariffs across municipal boundaries. Quality of service, although more difficult to measure, is subject to creating a perception among the public. Should this perception be or become negative, it usually cannot be rectified by facts. Only a counter perception puts it straight over a long period of time and that counter perception is associ-

dat hulle beleid om 'n wydverspreide aandeelhouding te skep, 'n publiek skep wat 'n aanvaarbare opbrengs op sy belegging verwag, asook regverdige pryse.

Aan die einde van die dag meet die publiek prys en gehalte van diens. Prys van tariewe kan eenvoudig oor munisipale grense heen gemeet word. Gehalte van die diens is, hoewel moeliker meetbaar, onderworpe aan die skepping van 'n persepsie by die publiek. Indien hierdie persepsie negatief word of is, kan dit gewoonlik nie deur feite reggestel word nie. Slegs 'n teenpersepsie stel dit oor 'n lang periode reg en dit gaan gepaard met harde werk en 'n volghoue, toegewyde, hoë gehalte diens.

## 5. DEREGULERING

Privatisering kan nie volkome slaag voordat toepaslike deregulering plaasgevind het nie. Toepaslike deregulering moet dus nie die voorloper wees en die weg baan vir privatisering wat dan logies daarop sal volg in die skepping van 'n vrye mark en 'n meer doeltreffende ekonomie.

Die ironie is dat deregulering deur die burokrasie geinisieer moet word en dit is dieselfde burokrasie wat sy lewensbestaan te danke het aan die toepassing van regulasie in die uitvoering van sy pligte. Daar kan dus verwag word dat deregulering met sleuring sal geskied. Omdat deregulering die uitfasering van beperkende maatreëls op die individue en die bedryf veronderstel, het sy uitwerking wyer implikasies. Diskressie teenoor regulasie is die onderskeid tussen vrye mark teenoor 'n beheerde ekonomie. Die Witskrif sê tereg: "Die benadering tot regulering moet meer op die bevordering van ekonomiese bedrywighede en minder op die beheer daarvan berus".

Tradisioneel is kragverkope die grootste enkele inkomstebron vir Plaaslike Bestuur. Die besoldiging van die personeelkorps is indirek gekoppel aan hierdie inkomstebron omdat inkomste 'n funksie is in die formule vir die bepaling van die Stadsklerk se salaris. Indien die elektrisiteitsonderneming, wat dit betref enige van die handelsondernemings geprivatiseer sou word, sou die inkomstekomponent in daardie formule aansienlik krimp en sou die plaaslike bestuur teoreties in 'n veel laer groep val. Hierdie aspek word as 'n blote tegniese punt beskou en sal die owerhede ongetwyfeld die nodige regstellende stappe neem.

Van belang is egter die feit dat die plaaslike owerheid 'n inkomstebron verloor, nl. winste uit kragverkope. Hy verloor ook weliswaar die personeelkomplement in daardie onderneming maar daardie komplement was in elk geval selfonderhoudend in die sin dat sy besoldiging uit tariefdienste gefinansier word.

Die koopprys van die bate wat geprivatiseer word moet dus sodanig wees dat die renteverdienste op die kapitale belegging die verlies aan winste uitwis. In hierdie verband sou verwag kon word dat uiters kundige beleggingsvaardighede aangewend sou word. Terwyl die inflasiekoers hoër as die bankkoers is, blyk belegging by konvensionele finansiële instellings in elk geval buite die kwessie te wees.

## 6. STYGENDE KAPITAALBEHOEFTES

In 'n ontwikkelende dorp of stad word dit al moeiliker om die jaarlikse kapitaalbegroting te laat klop met dit wat die Staat jaarliks toelaat of wat die gemeenskap kan bekostig. Die Staat het dieselfde probleem op nasionale vlak, so ook het Engeland en Amerika dit gehad voor privatisering.

Dit lei daartoe dat projekte na die volgende jaar uitgeskuif moet word. Die volgende jaar het sy eie behoeftes as gevolg van voortgesette groei en word die uitgestelde projek dus verder uitgestel.

Die jaar daarna word die behoefte so groot dat die projek moontlik uitgevoer moet word teen by nou aansienlike ge-eskaleerde kostes en dit plaas verhoogde druk op die belastingstruktuur.

Die voorspeling kan gemaak word dat die tyd sal kom wanated with hard work and a sustained, dedicated, high quality service.

## 5. DEREGULATION

Privatisation cannot be fully achieved unless appropriate deregulation is instituted. Appropriate deregulation should therefor be the forerunner to pave the way of privitasiation to logically follow in creating a free market and a more efficient economy.

The irony, however, is that deregulation must be initiated by the bureaucracy, and it is this very bureaucracy whose livelihood is attributable to law enforcement in the execution of it's duties. It can therefor be expected that deregulation will prevail with considerable drag. On the assumption that deregulation constitutes the phasing out of restrictive measures on the individual as well as the industry, it's effect has wider implications. Discretion versus regulation is the difference between a free market against a controlled economy. The White Paper justly states: "The approach to regulation must therefore emphasise the promotion of economic activities and be less directed towards their control."

Traditionally, power sales is the largest source of revenue for Local Government. The remuneration of the work force is indirectly coupled to this source of revenue in that revenue is a function in the formula determining the Town Clerk's salary. Should the electricity supply undertaking, for that matter any trading undertaking, be privatised, the revenue component in that formula will be reduced considerably and the local authority will theoretically be demoted to a much lower group. This aspect is considered to be purely technical though, as the powers to be will be undoubtedly attend to the necessary correcting measures.

Of importance is, however, the fact that the local authority does loose an important source of revenue i.e. profits from power sales. It indeed also looses the work force in that undertaking although the work force was self-sufficient in that it's remuneration was financed from tariffs and not from the rates fund.

The purchase price of the assets to be privatised must therefor be such that the interest earned from the capital investment shall off-set the profit loss. In this connection it is to be expected that clever investment skill be appropriated. While the rate of inflation is higher than the bank rate, investment with conventional financial institutions seems to be out of the question any way.

## 6. RISING CAPITAL REQUIREMENT

In any developing town or city it bcomes more and more difficult to balance the annual capital budget against that which the State allows annually or which the local community can afford. The State has the same problem at national level, so did England and America, prior to privatisation.

This leads to capital projects being postponed until the next year. The following year has it's own requirements as a result of continued growth and the postponed project may be further postponed. The next year the need is so great that the project has to be executed, but at by-now-heavily escalated costs. This inevitably pressurises the rates structure.

The prediction can be made that times will change to the effect that most communities will no longer be able to afford their municipalities in their present form as a result of the enormous municipal interest in the local economy.

This aspect can be regarded as one of the most important cornerstones of privatisation for local government.

neer die meeste gemeenskappe nie meer hulle munisipaliteite in huidige gedaante sal kan bekostig nie omdat die belang van die munisipaliteit in die plaaslike ekonomie te groot geword het.

Hierdie aspek word as een van die belangrikste hoekstene van privatisering vir plaaslike bestuur gesien.

## 7. DIE ELEKTRISITEITSWET (WET 41 VAN 1987)

Elektrisiteitsvoorsiening in Suid-Afrika word deur die Elektrisiteitswet gereguleer.

Die Ordonnansie op Plaaslike Bestuur (Transvaal) bevat geen bepalings wat vir die doel van hierdie bespreking nadelige effek het nie.

Dit is egter interessant om daarop te let dat die Elektrisiteitswet verskeie bepalings bevat wat daarop dui dat voorsiening gemaak is vir die bedryf van 'n onderneming deur 'n maatskappy.

Enkele tersaaklike bepalings is soos volg: -

**Woordbepalings**

"Lisensie" 'n lisensie deur die Elektrisiteitsbeheerraad kragtens hierdie Wet toegestaan vir die ontwikkeling en voorsiening van elektrisiteit.

"Onderneming" 'n onderneming vir die voorsiening van elektrisiteit binne 'n bepaalde gebied, met al die daarby behorende bates en laste, hetsy dit uit hoofde van 'n lisensie of andersins en hetsy dit onder die beheer van Eskom, die Regering (met inbegrip van die S.A.V.D.), 'n plaaslike owerheid, 'n maatskappy of ander vereniging van persone of 'n natuurlike persoon gedryf word.

"Ondernemer" iemand wat kragtens hierdie Wet of enige ander wet gemagtig word om 'n onderneming te dryf wat minstens een gigawatt-uur elektrisiteit per jaar verkoop.

Artikel 3:
Die oogmerke van die Elektrisiteitsbeheerraad is om, behoudens die bepalings van hierdie Wet, beheer uit te oefen oor die elektrisiteitsvoorsieningsbedryf ten einde orde in die ontwikkeling en doeltreffende voorsiening van elektrisiteit te verseker, en om die ander werksaamhede te verrig wat by of kragtens hierdie Wet aan hom opgedra word.

Artikel 4:

(1) (b): Die raad kan die pryse waarteen en die voorwaardes waarop elektrisiteit deur 'n lisensiehouer voorsien kan word, bepaal.

Artikel 6:

(1): Behoudens die bepalings van subartikel (2) mag niemand behalwe uit hoofde van 'n lisensie 'n onderneming vir die ontwikkeling van elektrisiteit of die voorsiening daarvan dryf of op enige wyse daarby betrokke wees nie: met dien verstande dat geen lisensie vereis word nie deur -

- (a) 'n Staatsdepartement;
- (b) die regering van 'n selfregerende gebied;
- (c) 'n plaaslike owerheid binne sy regsgebied;
- (d) 'n streeksdiensteraad;
- (e) Eskom; of
- (f) iemand wat elektrisiteit ook vir eie gebruik laat ontwikkel en nie meer as een gigawatt-uur elektrisiteit per jaar verkoop nie.

Artikel 8(4):
'n Lisensiehouer mag sy lisensie nie sonder die raad se toestemming aan iemand anders oordra of sedeer nie.

Artikel 12(1):
Indien 'n lisensiehouer versuim om sy verpligtinge ingevolge die voorwaardes van sy lisensie of die bepalings van hierdie Wet na te kom, kan die raad skriftelike kennis per pos aan hom bestel om daardie verpligtinge binne 30 dae of die langer tydperk wat

## 7. THE ELECTRICITY ACT (ACT 41 OF 1987)

Supply of electricity in South Africa is being regulated by the Electricity Act.

The Local Government Ordinance (Transvaal) contains no stipulation which, for the purpose of this discussion, has detrimental effect.

It is, however, interesting to note that the Electricity Act contains various stipulations which point to the fact that provision has been made for the running of an undertaking by a company.

A few appropriate stipulations are as follows:

**Definitions**

"Licence" a licence granted by the board under this Act for the generation and supply of electricity.

"Undertaking" an undertaking for the supply of electricity within a defined area, with all the assets and liabilities appertaining thereto, whether carried on under the authority of a licence or otherwise and whether under the control of Eskom, the Government, (including the S.A.T.S.), a local authority, a company or other association of persons or a natural person.

"Unvertaker" any person authorized under this Act or any other law to carry on an undertaking which sells at leaast one gigawatt hour of electricity per annum.

Section 3:
The objects of the board are, subject to the provisions of this Act, to exercise control over the electricity supply industry so as to ensure order in the generation and efficient supply of electricity, and to perform such other functions as may be assigned to it by or under this Act.

Section 4:

(1) (b): The board may determine the prices at and conditions on which electricity may be supplied by a license.

Section 6:

(1): Subject to the provisions of subsection (2), no person shall carry on or engage in any manner in any undertaking for the generation of electricity or for the supply thereof except under the authority of a licence: Provided that no licence shall be required by:

- (a) A State Department
- (b) the government of a self-governing territory;
- (c) any local authority within its area of jurisdiction;
- (d) any regional services council;
- (e) Eskom; or
- (f) any person who also causes electricity to be generated for his own use and does not sell more than one gigawatt hour of electricity per annum.

Section 8:

(4): A licensee shall not cede or transfer his licence to any other person without the consent of the board.

Section 12:

(1): A lisensee fails to meet his obligations in terms of the conditions of his licence or the provisions of this Act, the board may serve upon hum by post a notice in writing to meet obligations within 30 days or such longer period as the board may determine, and if the licensee fails to comply with the requirements of the notice -

(b) the board may recommend to the Minister to authorize Eskom in writing to enter upon and take possession of the undertaking of the licensee, and Eskom shall in that event operate the undertaking for and on account of the licensee and at the risk and expense of

die raad bepaal, na te kom, en indien die lisensiehouer versuim om aan die vereistes van die kennisgewing te voldoen –

(b) kan die raad by die Minister aanbeveel dat hy Eskom skriftelik magtig om die lisensiehouer se onderneming te betree en daarvan besit te neem en moet Eskom die onderneming in daardie geval vir en op die rekening van die lisensiehouer en op die lisensiehouer se risiko en koste bestuur en die saldo, as daar is, van die netto inkomste van die onderneming aan die lisensiehouer betaal.

Artikel 13:

(1): Behoudens die bepalings van subartikel (2) mag geen ondernemer sy onderneming of 'n deel daarvan of sy reg op voorsiening aan 'n ander ondernemer of voornemende ondernemer sonder die goedkeuring van die raad oordra nie.

13(8): Geen bepaling van hierdie Wet verhinder 'n ondernemer om 'n ooreenkoms met iemand anders aan te gaan waarvolgens daardie persoon die onderneming of 'n gedeelte van die onderneming namens die ondernemer oprig, bestuur of dryf nie: met dien verstande dat die ondernemer nie van sy bevoegdhede en verpligtinge kragtens hierdie Wet onthef word nie.

Artikel 14:

(1): By die inbesitneming van 'n onderneming ingevolge artikel 12 of die oorname van bates ingevolge artikel 13 moet Eskom of die oordragnemer, na gelang van die geval, die gewese ondernemer vergoed vir die waarde van die bates wat behoort aan of gebruik word in verband met die dryf van die onderneming.

(2): Bedoelde waarde is die billike waarde ten tyde van die oorname, met behoorlike inagneming van die aard en toestand van die bates, en hulle geskiktheid vir die doel van die onderneming en vir onmiddellike gebruik.

(3) (a): By die vasstelling van bedoelde waarde word die volgende nie in aanmerking geneem nie:

(i) Dat dit 'n verpligte oorname is;
(ii) die klandisiewaarde van die onderneming;
(iii) die te wagte winste van die onderneming;
(iv) enige soortgelyke omstandighede of oorwegings.

(b): Waar die koste van die bates reeds gedeeltelik of in die geheel deur middel van die tariefinkomste gedelg is, moet hierdie feit in ag geneem word by die vasstelling van die waarde van die bates ten einde te verseker dat die betrokke verbruikers na oorname van die bates slegs aanspreeklik sal wees vir die delging, by wyse van die tariewe wat gehef staan te word, van die gedeeltes van die bates wat nie reeds uit die tariefinkomste gedelg is nie.

Artikel 15

(1): Behoudens die bepalings van subartikel 2 is die verkoop en voorsineing van elektrisiteit binne die regsgebied van 'n plaaslike owerheid onder die beheer van daardie owerheid, behalwe vir sover 'n ondernemer wettig die reg op voorsiening verkry het binne daardie gebied of 'n deel daarvan, hetsy ingevolge 'n lisensie of deur ooreenkoms met die plaaslike owerheid of andersins.

Die Wet maak dus weldeeglik voorsiening vir die bedryf van 'n onderneming deur 'n maatskappy. Oordrag van verantwoordelikhede aan sodanige maatskapy mag egter slegs geskied met toestemming van die Elektrisiteitsbeheerraad, welke raad voorwaardes kan stel soos hy gerade ag.

the licensee, remitting the balance, if any, of the net income derived from the undertaking to the licensee.

Section 13:

(1) Subject to the provisions of subsection (2), no undertaker shall transfer his undertaking or any part thereof or this right of supply to any other undertaker or prospective undertaker without the approval of the board.

(13)(8): No provision of this Act shall prohibit an undertaker to enter into an agreement with any other person in terms of which such person shall erect, manage or carry on such undertaking or any part of the undertaking on behalf of the undertaker: Provided that the undertaker shall not be absolved from his powers and obligations under this Act.

Section 14:

(1): At the taking into possession of an undertaking in terms of section 12 or the take-over of assets in terms of section 13, Eskom or the transferee, as the case may be, shall compensate the former undertaker for the value of the assets belonging to or used in connection with the carrying on of the undertaking.

(2): Such value shall be the fair value at the time of take-over, due regard being had to the nature and condition of the assets, and their suitability for the purpose of the undertaking and for immediate use.

(3) (a): In determining the value in question the following shall not be taken into account:

(i) that it is a compulsory take-over
(ii) the goodwill of the undertaking;
(iii) the prospective profits of the undertaking;
(iv) any similar circumstances or considerations.

(b): Where the costs of the assets have already been redeemed in part of or in full by means of the tariff income, this fact shall be taken into account in determining the value of the assets in order to ensure that the consumers concerned, if any, will, after the assets have been taken over, only be liable for the redemption, by way of tariffs to be charged, for those portions of the assets which have not yet been redeemed out of the tariff income.

Section 15:

(1): Subject to the provisions of subsection (2), the sale and supply of electricity within the area of jurisdiction of a local authority shall be under the control of that authority, except in so far as any undertaker has lawfully acquired the right of supply within that area or any portion thereof, whether under a licence or by agreement with the local authority or otherwise.

The act therefor most certainly makes provision for the running of an undertaking by a company. Transfer of responsibilities to such company shall, however, only occur with the consent of the Electricity Control Board, which Board may impose conditions as it may deem fit.

It is clear that the electricity supply industry, as a result of it's economic sensitivity and the total spectrum it serves, cannot be delivered into incompetent hands. The fact that clause 12 stipulates that Eskom shall temporarily take charge of the undertaking in case of the licence holder failing to fulfil it's obligations proves the acknowledgement of an immediate need which must be satisfied when the undertaking is subjected to mismanagement. It would therefor be risky for any local authority to transfer it's undertaking in a privatisation deal into the hands of an ousider without transferring the available in-house detail knowledge and expertise.

Dit is egter duidelik dat die elektrisiteitsvoorsineingsbedryf, weens sy ekonomiese sensitiwiteit en die totale spektrum wat hy bedien, nie in onbevoegde hande gelaat kan word nie. Die feit dat artikel 12 bepaal dat Eskom tydelik moet oorneem indien 'n lisensiehouer versuim om sy verpligtinge na te kom, bewys die erkenning van 'n oombliklike behoefte wat bevredig moet word wanneer die onderneming aan wanbestuur onderwerp word.

Dit sou dus vir enige plaaslike owerheid uiters riskant wees om sy onderneming in 'n privatiseringsaksie aan 'n buite instansie oor te dra sonder oordrag van die detail kennis en kundigheid wat in-huis beskikbaar is.

## 8. DIE MAATSKAPPYWET (WET 61 VAN 1973)

Die maatskappywet (Wet nr 61 van 1973) reël die wetgewing met betrekking tot 'n maatskappy en die Akte van Oprigting en Statute van die maatskappy reël sy interne sake byvoorbeeld aandelekapitaal, doelstellings en huishoudelike reëls. Die maatskappywet lê verder minimum vereistes neer waarvolgens maatskappy finansiële state opgestel moet word en vereis by implikasie dat voldoen moet word aan die standpunte oor algemeen aanvaarde rekeningkundige praktyk soos uitgereik deur Die Suid Afrikaanse Instituut van Geoktrooieerde Rekenmeesters.

### Waardevermindering (Depresiasie) en bepaling van wins (Netto Inkomste)

Waardevermindering moet op alle roerende en depresieerbare goedere voorsien en jaarliks teen inkomste afgeskryf word. 'n Maatskappybeleid moet deur die direkteure neergelê word wat die volgende bepaal:

- afskrywingskoerse op elke soort bate (byvoorbeeld kantoormeubels, masjinerie, kapitaaltoerusting.
- afskrywingsmetode (reguitlyn, verminderde saldo).

Die nuttige lewensduur van 'n bate en sy beraamde residu-waarde na 'n tydperk van gebruik moet dus vooraf beraam word.

Netto inkomste, na belasting, van 'n onderneming beskikbaar vir dividende asook vir die bepaling van opbrengs op aandeelhouersfondse word deurgaans bereken na aftrekking van depresiasie vir die jaar.

Die koste van kapitaaluitgawes, byvoorbeeld aankoop van toerusting (roerende bates) en terugbetaling/delging van verpligtinge word nooit deur 'n maatskappy teen inkomste afgetrek in die bepaling van netto inkomste nie.

Oorplasings na reserwes en fondsrekeninge vind plaas nadat die netto inkomste, soos hierbo aangedui, bereken is.

Die koste van geboue en struktuurverbeteringe (aanbouings) word noit direk teen netto inkomste afgeskryf nie maar gekapitaliseer na die balansstaat, item vaste eiendomme.

Depresiasie word normaalweg nie voorsien op grond en geboue nie.

Onderhoud, herstel en vervanging van kapitale bates word normaalweg nie as kapitaalbate beskou nie en direk, in die jaar waarin aangegaan, teen netto inkomste afgskryf.

### Klandisiewaarde

Klandisiewaarde is 'n fiktiewe, nie-tasbare bate en word slegs in die boeke van 'n maatskappy getoon indien daarvoor in kontant betaal is. As gevolg van die aard van hierdie bate verkies maatskappye om hierdie koste oor 'n periode, so gou moontlik, teen netto inkomste af te skryf. Sodanige afskrywing is nie vir inkomstebelastingdoeleindes aftrekbaar nie.

Klandisiewaarde kan kortliks gedefinieer word as die waarde van oorwinste wat 'n onderneming verwag in die mediumtermym (drie tot vyf jaar). Oorwinste is daardie surpluswinste nadat voorsineing gemaak is vir 'n redelike opbrengs op aandeelhouersfondse. In die bepaling van 'n verwagte redelike opbrengskoers word die volgende in ag geneem:

## 8. THE COMPANY ACT (ACT 61 OF 1973)

The Company Act (Act 61 of 1973) rules the legislation with respect to the company whilst the Memorandum of Association and Statutes of the company dictates it's internal business such as share capital, objectives and domestic rules. The company act further lays down minimum requirements whereby company financial statements are to be drawn up and demands by implication that standpoints with regard to generally accepted accountancy practices shall be complied with, as isued by the South African Institute of Chartered Accountants.

### Depreciation and Determination of Profit (Net income)

Depreciation shall be allowed on all movable and depreciable property and written off annually against revenue. A company policy must be laid down by the directors to determine -

- writing-off rates on every type of asset, such as office furniture, machinery, capital equipment etc
- writing-off method, whether straight line, reduced balance etc.

The useful life duration of the assets and their estimated residual value after a period in use must therefor be estimated in advance.

Net income, after tax, of an undertaking available for dividends and for the determination of yield on shareholder funds is calculated throughout, after deduction of annual depreciation.

The cost of capital expenditure, for example movable assets such as equipment, and the refund/redemption of liabilities is never deducted from revenue by a company in determinging it's net income. Transfers to reserves and fund accounts take place subsequent to determining net income.

The cost of buildings and structure improvements (extensions) is never written off directly against net income. It is capitalised to the balance sheet, as fixed property.

Depreciation is not normally provided for in the case of land and buildings.

Maintenance, repair and replacement of capital assets are not normally considered as capital assets and are directly deducted from net income in the year incurred.

### Goodwill

Goodwill is an imaginary, non-tangible asset and is only shown in the books of a company if paid for in cash. Due to the nature of this asset, companies prefer to write-off this cost against net income over a period as short as possible. Such write-off is non-deductable for income tax purposes.

In short, goodwill may be defined as the value of excess profits expected by the undertaking in the medium term (three to five years). Excess profits are those surplus profits available subsequent to provision being made for a fair yield on shareholder funds. In determining an expected fair yield rate the following are taken into consideration:

- how constant flow of revenue and profit expectations will be
- competition, present and future
- risk of investment
- type of undertaking and products/services from which revenue is generated.

Various theoretical methods exist, which can be rather technical, to determine goodwill. In practice, goodwill essentially occurs with the following two methods in determining purchase price:

- hoe konstant inkomstevloei en winsverwagtinge sal wees
- mededinging (huidiglik en toekomstig)
- risiko van belegging
- tipe onderneming en produkte/dienste waaruit inkomste verkry kan word.

Verskeie teoretiese metodes (wat redelik tegnies van aard is) bestaan ten einde klandisiewaarde te bepaal.
Klandisiewaarde kom hoofsaaklik in die praktyk voor met die volgende twee metodes van bepaling van koopprys:

Alternatief i)
Die waarde van die onderneming word bepaal as volg:
- netto bates dit wil sê bates teen ooreengekome waardes MIN verpligtinge
- PLUS klandisiewaarde bereken teen ooreengekome formules gebaseer op ooreengekome winsverwagtinge.

Bogemelde gee dus die totale koopsom.

Alternatief ii)
Die waarde van die onderneming word bepaal deur huidige en toekomstige winste te verdiskonteer teen 'n ooreengekome opbrengskoers. Die koopsom so bepaal word toegedeel eerstens na:
- netto bates, soos hierbo verduidelik en die balans
- verteenwoordig dus die waarde van klandisiewaarde.

Bogemelde gee dus die totale koopsom.

Klandisiewaarde, soos omskryf in alternatief i), kan moontlik as volg bereken word:

Klandisiewaarde = $\frac{(A \times 100)}{(B)} - C$

Waar A = *huidige waarde* van netto inkomste na belasting vir die volgende vyf jaar
B = verwagte opbrengskoers
C = netto bates (soos uiteengesit in alternatief i) hierbo.

Aangesien klandisiewaarde vir 'n koper geen belastingvoordeel inhou en aangesien dit 'n onaantasbare bate is sal 'n voornemende koper sover moontlik die volle koopprys toedeel aan netto bates (dit wil sê 'n hoër premie aan sekere bates heg, vir sover moontlik dit regverdigbaar is), om sodoende 'n kleiner of geen klandisiewaarde syfer op sy balansstaat te toon.

**Rekeningkundige Aanpassing**
Om bogemelde van toepassing te maak op 'n geprivatseerde Elektrisiteitsonderneming word die volgende stappe uiteengesit:

i) Herstrukturering en bepaling van begrote winste om aan algemeen aanvaarde rekeningkundige vereistes te voldoen. In kort kom dit neer dat begrote winste verhoog moet word met delging van lenings, voorsienings vir reserwes en fondse en bydraes tot kapitaaluitgawes en verminder moet word met waardevermindering en enige bedrae op kapitaal wat onderhoud, herstel of vervanging verteenwoordig.

ii) Begrote winste, na normale belasting, behoort vir 'n tydperk van vyf jaar, op 'n konserwatiewe basis, bereken te word aan die hand van die bogemelde.

iii) Die huidige waarde van begrote winste na normale belasting moet bereken en verdiskonteer word teen 'n redelike, ooreengekome opbrengskoers.

iv) Alle vaste bates, dws vaste eiendomme en roerende eiendomme, moet herwaardeer word. Hierby moet getel word bedryfsbates soos debiteure, kontant, voorraad ens., en afgetrek word, verpligtinge oorgeneem.

v) Die laagste van die twee waardes bepaal in iii) en iv) hierbo of 'n bedrag daartussen na gelang van 'n paar faktore (byvoorbeeld afbetaling van koopprys ens) behoort as riglyn te dien vir bepaling van 'n prys.

Alternative i)
The value of the undertaking is determined as follows:
- net assets, i.e. assets at agreed values, MINUS liabilities
- PLUS goodwill, calculated at agreed formula, based on agreed profit expectations.

The foregoing thus gives the total purchase price.

Alternative ii)
The value of the undertaking is determined as follows:
- net assets, as explained above and the balance
- represents goodwill value.

The foregoing thus gives the total purchase price.

Goodwill, as defined in alternative i), may be calculated as follows:

Goodwill = $\frac{(A \times 100)}{(B)} - C$

Where A = *present value* of net income after tax for the following five years
B = expected yield rate
C = net assets, as explained in alternative i) above.

Since goodwill does not constitute any tax advantage and since it is a non-tangible asset, an intending puchaser will, as far as possible, tend to apportion the total purchase price to net assets (i.e. a higher premium attached to certian assets, as far as is justifiable), in order to show a smaller or no goodwill figure in his balance sheet.

**Adapting Accountancy**
To apply the above to a privatised electricity undertaking, the following steps should be taken:

i) Restructuring and determining budgeted profits to comply with generally accepted accounting requirements. In hosrt is means that budgeted profits are to be increased by redemption of loans, provisions for reserves and funds and contributions to capital expenditure, and reduced by depreciation and an amounts representing maintenance, repair or replacement.

ii) Budgeted profits, after tax, should be determined conservatively for a period of five years.

iii) The present value of budgeted profits, after tax, must be calculated and discounted at a reasonable, agreed yield rate.

iv) All fixed assets, i.e. fixed property and movable property, must be revalued. Added to this is working assets such as debtors, cash, stores etc., and subtracted from it is liabilities taken over.

v) The lowest value as determined in iii) and iv) above, or a value in between according to certain factors e.g. payment of purchase price by instalment etc. should be used as a directive in determining the price.

vi) Finally it should be determined whether goodwill is calculated or not as well as the method to be used.

## 9. METHOD OF PRIVATISATION

Although there would certainly be many ways and means by which a traditional municipal service could be privatised, the options for the electricity supply industry are limited due to it's specialised nature.

The method described hereunder is based on the principle that the people in the organisation presently rendering the service are capable of taking over the service systematically. This implies inevitably that management has at it's disposal the necessary entrepreneurship and is interested in taking it over. As the traditional electricity supply undertaking does not have

vi) Ten slotte moet bepaal word of klandisiewaarde bereken word al dan nie asook die metode.

## 9. METODE VAN PRIVATISERING

Hoewel daar sekerlik 'n menigte metodes en tegnieke mag bestaan waarvolgens 'n tradisionele munisipale diens geprivatiseer kan word, is die opsies vir elektrisiteitsvoorsineing weens sy aard en gespesialiseerdheid beperk.

Die metode wat nou verder beskryf word, is gegrond op die beginsel dat die mense in die organisasiestruktuur wat die diens tans lewer, bevoegd is om die diens geleidelik oor te neem.

Dit impliseer uiteraard dat die bestuur oor die nodige entrepreneurskap beskik en daarin belangstel om dit oor te neem. Omdat die elektrisiteitsonderneming tradisioneel nie oor finansiële personeel beskik nie sal hierdie dissipline in die onderneming opgeneem moet word, tot die mate wat hedendaagse rekenaarstelsels dit nie kan behartig nie. Die moderne tegnologie is so ver ontwikel dat bv. meterlesings vandag direk by die meter in 'n draagbaar rekenaar ingepons word en dit is die enigste plek waar die mens 'n handeling uitvoer. Daarna word die data in die verskillende lêers deur die rekenaar geprosesseer totdat die rekening uiteindelik in die koevert op 'n vervoerband in die posbus beland vir die poswese om te hanteer. Dit gebeur alles binne enkele dae nadat die meterlesingsdata uit die veld ontvang is.

Die proses van geleidelike oorname is 'n proses van uitfasering vir die plaaslike owerheid en 'n gelyktydige proses van infasering vir die maatskappy. Op hierdie manier kan die emosionele betrokkenheid van alle partye d.i. die plaaslike owerheid, die maatskappy, die verbruiker en die moontlike aandeelhouer sinvol hanteer word.

Hierdie proses kan in vier ases ingedeel word nl.

- ★ Uitkontraktering
- ★ Verhuring
- ★ Koop/Huur (Gedeeltelike Afstanddoening)
- ★ Uitkoop (Volle Afstanddoening)

### 9.1 FASE EEN : UITKONTRAKTERING

**Wetlike Implikasies**

Voor die aanvang van Fase Een word 'n maatskappy gestig waarvan die akte van oprigting al die fasette van elektrisiteitsvoorsiening bevat plus fasette wat gesonde mededinging toelaat soos bv. die aanhou van agentskappe in die elektriese en elektroniese bedryf, asook groothandelsaktiwiteite.

Daarna doen die plaaslike owerheid aansoek by die Elektrisiteitsbeheerraad om ingevolge Artikel 8(4), Artikel 13(1) en Artikel 15(1) van die Wet sy lisensie aan die maatskappy te sedeer. Indien goedgekeur, word die maatskappy, as lisensiehouer, die voorsieningsowerheid en moet hy as sulks die tersaaklike wette, regulasies en bywette administreer. In terme van die Wet aanvaar die maatskappy publieke aanspreeklikheid ten opsigte van die lewering van elektrisiteit aan die gemeenskap.

**Oordrag van Personeel**

Volgens ooreenkoms met die plaaslike owerheid bedank die personeel van die onderneming op 'n gegewe dag by die plaaslike owerheid en sluit onmiddellik by die maatskappy aan. Hierdie handeling moet uiteraard veel aandag geniet. Aspekte soos pensioen, mediese voordele, verlof, versekering ens. sal in die kort termyn deurlopend moet wees totdat die maatskappy tot minstens fase twee gevorder het waarna die maatskappy sy eie voordelepakket aanbied.

Die uniekheid van hierdie situasie bestaan daarin dat hoewel die personeel vir die maatskappy werk, die werksaamhede van die maatskappy so nou verbonde is aan die plaaslike owerheid weens sy dienslewering aan die gemeenskap wat die plaaslike owerheid dien, dat onmiddellike en finale verbreking van alle any financial staff, this discipline would have to be incorporated into the undertaking to the extent to which modern computerised systems cannot cope. Modern technology is so far advanced that, for example, meter reading today is keyed directly into a hand held computer and this is the only place where man carries out an operation. Thereafter the data is off loaded into the main frame which processes it into the various files until the account becomes available in the envelope on a conveyer belt into the post bin for the postal service to handel further. This all happens within days after the meter reading data was received.

The process of gradual take-over is a phasing out process for the local authority and a simultaneous phasing in process for the company. In this way the emotional involvement of all parties concerned i.e. the local authority, the company, the consumer and the future shareholder may be meaningful.

This process may be divided into four phases viz.

- ★ Contracting Out
- ★ Leasing
- ★ Purchase/Lease (Partial Relinquishment)
- ★ Outright purchase (Full Relinquishment)

### 9.1 PHASE ONE: CONTRACTING OUT

**Legal Implications**

Prior to the commencement of Phase One a company is incorporated of which the memorandum of association contains all facets of the electricity supply industry including those allowing competition such as agencies in the electrical and electronical fields, as well as wholesaler's activities.

The local authority then applies to the Electricity Control Board, in accordance with Section 8(4), Section 13(1) and Section 15(1), of the Act, to cede it's licence to the company. If granted, the company as licence holder now becomes the supply authority and the company shall as such administer the appropriate laws, regulations and by-laws, The company, in terms of the Act, accepts public accountability for the supply of electricity to the community.

**Transfer of Personnel**

In accordance with the agreement with the local authority, the personnel resigns from the local authority on a given day and immediately joins the company.

This operation must of necessity receive much attention. Aspects such as pension, medical aid, leave, insurance etc. must be uninterrupted in the short term until the company has progressed to at least phase two, after which the company offers it's own benefits and remuneration.

The uniqueness of this situation is in the fact that although the personnel works for the company, it's activities being so closely related to the local authority as a result of it's service rendering to the same community, it becomes impractical to loosen the ties at once. Further, the local authority should have the right to resile from the agreement should the privatisation project, in it's opinion, be unsuccessful and under such circumstances the personnel would be reinstated with the local authority without loss and service and associated benefits.

This conditions should not be considered negatively, but rather as an encouragement to the company to perform maximally in order to ensure the obtainment of autonomy as early as possible.

Pension and leave monies should not be paid out during Phase One. The company should be allowed to take over the local authority's obligations in respect of it's pension contributions, leaving the personnel as members of the municipal pension fund.

bande prakties nie moontlik is nie. Voorts behoort die plaaslike owerheid die reg te behou om indien die privatiseringsprojek na sy oordeel nie suksesvol is nie, terug te tree uit die ooreenkoms en in sodanige geval sou die personeel weer in diens van die plaaslike owerheid tree sonder verlies van kontinuiteit van diensjare en wat daarmee saamgaan.

Hierdie bepaling moet nie in 'n negatiewe lig gesien word nie, maar eerder as 'n aansporing vir die maatskappy om maksimaal te presteer sodat hy sal verseker dat outonomiteit so spoedig doenlik verkry word.

Uitbetaling van pensioen- en verlofgelde moet nie gedurende Fase Een geskied nie. Die maatskappy moet toegelaat word om die plaaslike owerheid se verpligtinge t.o.v. pensioenbydraes oor te neem en die personeel bly dus lede van die pensioenfonds.

**Finansiële Aspekte**

Die plaaslike owerheid betaal aan die maatskappy 'n dienslewerings-fooi wat gelykstaande is aan die jaarlikse departementele begroting minus die Eskom-rekening en as teenprestasie lewer die maatskappy die totale elektrisiteitsvoorsieningsdiens. Die plaaslike owerheid behou die bates en hoofinkomstebron nl. kragverkope terwyl die maatskappy toegelaat word om al die bestaande produksiemiddele te gebruik om ook vir konstruksiewerke en instandhoudingswerke vir private eienaars in die ope mark te beding. Die inkomste wat hieruit gegenereer word is vir die maatskappy se eie rekening.

Die wins vir die plaaslike owerheid bestaan in die verskil tussen kragverkope en kragaankope minus bedryfskapitaal, terwyl die wins of verlies vir die maatskappy bestaan in sy woekering in die ope mark t.o.v. konstruksie- en instandhoudingswerke wat hy mag aanpak. Dit sou oor munisipale grense heen kon geskied.

**Evaluering**

Fase Een kan een of twee finansiële jare duur in welke tydperk die plaaslike owerheid die prestasie van die onderneming in sy nuwe formaat evalueer en die maatskappy tyd kry om te konsolideer en homself te bewys. Fase Een is die transisiefase waartydens die plaaslike owerheid homself vergewis van die geldigheid van sy besluit om te privatiseer. Die plaaslike owerheid pas voortdurende evaluering toe en billikheidshalwe sal hy terugvoering aan die maatskappy gee. Daar vind dus steeds 'n noue wisselwerking tussen die plaaslike owerheid en die maatskappy plaas. Onderlinge hulpverlening in 'n vertrouensverhouding is belangrik en behoort die wagwoord te wees.

In die ooreenkoms word die tydsduur vir Fase Een vasgestel en aan die einde van sodanige tydperk word 'n oorsig van die deurlopende evaluering opgestel wat die plaaslike owerheid instaat stel om 'n besluit te neem oor die moontlike vordering van die maatskappy na Fase Twee, al dan nie. Vordering na Fase Twee impliseer dat die plaaslike owerheid ten volle tevrede gestel is oor die vermoë van die maatskappy om onafhanklik te funksioneer. Dit bevestig die plaaslike owerheid se bereidwilligheid om groter publieke verantwoordelikheid na die maatskappy te delegeer.

## 9.2 FASE TWEE: VERHURING

Die ommeswaai vanaf uitkontraktering na verhuring versinnebeeld die maatskappy se strewe na onafhanklikheid. Hy het reeds bewys dat hy die oordrag van publieke verantwoordelikheid vanaf die plaaslike owerheid met sukses kan hanteer. Hy bou dus voort in die verwesenliking van die gemeenskaplike doelwit nl. om 'n tradisionele openbare diens vir sy volle wese suksesvol te privatiseer, beide vir die plaaslike owerheid en vir die maatskappy.

In Fase Twee staak die plaaslike owerheid die betaling van dienslweringsfooi aan die maatskappy, behalwe in die geval van

**Financial Aspects**

The local authority pays to the company a service rendering fee equal to the annual departmental budget less the Eskom bill and in return the company renders the total electricity supply service to the community. The local authority retains the assets and the main source of revenue i.e. power sales, while the company is permitted to utilize all the relevant production resources to compete in the open market for construction projects and maintenance work. The revenue generated thus is for the company's own account.

The profit realised by the local authority is the difference between power sales and power purchases, minus working capital, while the profit or loss to the company exists in it's proliferation in the open market in execting construction projects and maintenance works. This would occur across municipal boundaries.

**Evaluating**

Phase One may take one or two financial years during which period the local authority would evaluate the performance of the company in it's new format, and the company be given the opportunity to consolidate and to prove itself. Phase One can be termed the transition phase during which the local authority ascertains the validity of it's resolution to privatise. The local authority continually evaluates the performance of the company and in all fairness it would provide feed-back to the company. A close interaction between the local authority and the company must therefor persist. Mutual support in a relationship of trustworthiness is important and should be pursued at all times.

The duration of Phase One is scheduled in the agreement and at the end of such period a summary of the continual evaluation is compiled which enables the local authority to resolve whether the company should progress to Phase Two or not.

Progress to Phase Two implies that the local authority has been fully satisfied with the ability of the company to operate independently. It confirms the readiness of the local authority to delegate more public responsibilities to the company.

## 9.2 PHASE TWO: LEASING

The reversal from contracting out to leasing symbolises the company's pursuit of independence. It has clearly demonstrated it's ability to handel the successful transfer of public responsibility from the local authority. It therefor proceeds in the realisation of the common objective i.e. to successfully privatise a conventional public service in it's entirety, both for the local authority and for the company.

In Phase Two the local authority suspends the payment of a service rendering fee to the company, except in the case of streetlight and traffic signal maintenance. The company now pays to the local authority a leasing fee for the use of assets, takes over the large consumer power bill and reimburses the local authority accordingly. The local authority still pays the Eskom bill. Debt comparison is exercised when the two parties agree upon the leasing fee payable by the company in exchange for the use of the infra structure and certain production resources. In this process a monetary value is attached to the burden component which is taken oever by the company.

Streetlight and traffic signal maintenance costs are normally funded by the rates fund. Because it is not a revenue generating source, the expenditure is carried by the local authority in the form of a service rendering fee to the company. The local authority transfers all large consumer deposits to the company. No fixed assets are taken over by the company. The company accepts responsibility for maintaining the infra structure and the extension thereof in accordance with conventional practice. The local authority undertakes to maintain existing insurance cover on it's assets.

**MNR FRED DANIEL, KAAPSTAD**

Vergun my om mnr Malan namens u met sy baie interessante en prikkelende referaat geluk te wens. Ek is seker dat mnr Malan sal saamstem dat sy referaat vir hom, trouens vir almal van ons wat vandag hier aanwesig is, aan die begin geplaas het van die leerkurwe in die studie oor die Privatisering van die munisipale Elektrisiteitsvoorsieningsbedryf in Suid-Afrika.

Die proses van privatisering van staat- en parastatale organisasies is al vir baie jare in die VSA en Brittanje aan die gang en 'n magdom kennis en deskundigheid kan verwerf word deur die metodes wat hierdie lande gevolg het en die resultate wat hulle behaal het, te bestudeer. In albei lande is privatisering heel eerste geïmplementeer in daardie dienste/gebiede wat die grootste invloed op die publiek uitgeoefen het. Deur middel van hierdie benadering kon die voordele wat privatisering inhou die beste gedemonstreer word en kon geloofwaardigheid aan die konsep verleen word. Dit is interessant om te sien dat die groot monopolistiese dienste soos elektrisiteitsvoorsiening heelwat later in die privatiseringsprogram verskyn het. In die Republiek blyk dit dat ons hierdie proses wil omkeer en die eledtrisiteit hoog op die prioriteitslys plaas.

Mr Malan has ably illustrated that the beginning of the process is the re-framing of legislation to enable the privatisation concept becoming a reality. There are many interested parties and parties with vested interest in this process and it can therefore be expected that the road to successful privatisation will not be without some corrugations.

Fortunately, the local authorities are not alone in this arena as a great deal of general legislation will of necessity have to be re-framed to enable Eskom to privatise. This process I understand has already gained a great deal of impetus and would therefore assist significantly in streamlining the movement of Municipal Electricity Undertakings into the privatisation field.

It would appear from the experience of the CEGB in the UK that legislation is the single most important time constraint in the ultimate privatisation goal.

If therefore we as the AMEU are to pursue the privatisation of the Municipal Electricity Undertakings positive steps will have to be taken to ensure that the legislative aspects of the privatisation are actively pursued if the privatisation goal is to be reached within a reasonable time span, bearing in mind that many Municipal Electricity Undertakings are potential organisations for privatisation and all will have to be consulted via the appropriate organisational channels if a unified policy is to be formulated for the privatisation process.

Electricity Undertakings are unlike other business organisations, firstly they are monopolistic and the return or profit on assets is very poor unlike all its private sector counterparts who strive for the very best return on assets. How the private market will react to investing in organisations where the earnings on investments might not be as profitable as others in the private sector will only be determined in time.

In America the Public Utilities attract their fair share of market support and judging by those criteria it would seem reasonable to assume that a similar position should prevail here in South Africa.

Mr Malan has sketched some of the scenarios which could result from privatisation, and it is apparent that the privatised electricitry undertaking could be considerably different from its present Municipal Electricity Undertaking form.

The implications of privatisation are so far reaching that to do any justice to the Municipal Electricity Supply Undertaking sphere far more time will have to be devoted thereto and might I be so bold as to suggest that the AMEU arrange a special seminar at which greater debate and specific guidelines can be formulated to assist in the implementation of privatisation. This could serve to allay the fears which might arise with staff and consumers.

I think it would be appropriate to draw attention to the Government's appointment of the Committee for the Co-Ordination of Privatisation in Local Authorities under the Chairmanship of Dr S Evans, Town Clerk of Cape Town. The inaugural meeting of the Committee was held on 1988-08-29 and no doubt it will be necessary in the future, to channel all Privatisation activities through this Committee.

Mnr Malan bepleit die geleidelike oorgang van die Munisipale sektor na die Privaat sektor en, alhoewel dit moontlik is, beskou ek die proses as te lank en loop dit die risiko om die konsepte van privatisering se geloofwaardigheid aan te tas. Ek glo dat groter geloofwaardigheid bereik kan word indien algehele privatisering van die begin af geïmplementeer word. Die voordele vir die verbruikers, en die selfvertroue van die verbruiker, wat sodoende verkry word, kan volgens my 'n beslissende faktor in die aanvaarbaarheid van die konsep in die algemeen wees.

Indien privatisering aan die doelwitte, soos uiteengesit in die Goewermentswitskrif, beantwoord, moet ons nie die debattering van die aangeleentheid uitstel nie, maar spesifieke tydsbeperkings daarstel waarbinne die aanvanklike doelwitte bereik moet word.

Die ekonomiese vooruitgang van die Republiek is in 'n hoë mate afhanklik van die beskikbaarheid van bekostigbare elektriese energie aan verbruikers en indien privatisering die kostevoordele waarna ons streef teweeg bring, dan moet ons nou in die vinnige baan van hierdie pad begin beweeg, hoe gouer hoe beter vir die bevolking van die Republiek.

Dankie meneer die President

**MNR GAWIE NORTJE, GERMISTON**

Meneer die President, die van ons wat mnr Malan ken, weet dat die onderwerp van sy referaat nie vir hom iets vreemds is nie. Hy is 'n entoesiastiese voorstaander van privatisering, en hy het oor 'n tydperk van jare reeds die onderwerp deeglik ondersoek, soos baie duidelik blyk uit sy referaat.

Elektrisiteitsondernemings, en veral die groter ondernemings, word bedryf binne die raamwerk van bestaande wette, en gedelegeerde bevoegdhede. Hulle funsioneer, vir soverre so iets moontlik is binne die munisipale opset, as outonome ondernemings. Na goedkeuring deur die Raad van die departementele begroting is daar inderdaad weinig verdere verslagdoening of eksterne beheer.

Elektrisiteitsverspreiding is ook een van die weinige winsgewende bedrywighede van 'n plaaslike owerheid.

Die kombinasie van hierdie twee faktore bring mee dat elektrisiteitsondernemings betreklik maklik geprivatiseer, en deur die bestaande personeel bedryf kan word. Al wat basies nodig is, is die byvoeging van finansiële kundigheid en ander bronne van finansiering.

Waarskynlik ten minste deels te wyte aan die sukses van die beleid van die Thatcher regering, het privatisering ietwat van 'n slagspreuk geword. Ek glo egter dat, wanneer dit kom by privatisering, onderskeid getref moet word tussen 'n owerheidsinstelling wat 'n meulsteen om die nek van die belastingbetaler is, en een wat 'n aanwins is. Ek is sekerlik bevooroordeeld, maar die meeste van die lede van die VMEO sal seker saamstem dat ons ondernemings in die algemeen goed bestuur is, en 'n groot en kommervrye aanwins is vir die onderskeie plaaslike owerhede, en dus ook die plaaslike gemeenskap.

Die baie belangrike vraag wat dus opduik is: Waarom privatiseer?

Telkens wanneer ek besef dat ek besig is om die papieroorlog te verloor, ure by vergaderings moet deurbring waarby die Elektrisieteitsdepartement weinig of geen belang het nie, of my vasloop teen burokratiese reëls, veral ten opsigte van personeelaangeleenthede, is ek 'n sterk voorstaander van privatisering.

Vir die plaaslike owerheid (en daarby is sy inwoners ingesluit) hou so 'n stap egter finansiële implikasies in. Dit is dan ook net logies dat die privatisering van die elektrisiteitsonderneming alleenlik gunstig deur die plaaslike owerheid oorweeg behoort te word, indien daar sekerheid is dat so 'n stap in die beste algehele belang van die gemeenskap sal wees, of allermins nie tot hulle nadeel sal strek nie.

Indien die plaaslike owerheid sy huidige wins uit die elektrisiteitsonderneming moet verbeur, skyn dit onvermydelik te wees dat eiendomsbelasting, en/of ander diensteheffings, verhoog sal moet word, om hiervoor te vergoed. Indien die privaat elektrisiteitsonderneming se tariewe soveel laer gaan wees, dat die verbruiker se besparing op die aankoopprys van elektrisiteit vergoed vir die verhoging in heffings, word die gemeenskap nie benadeel nie.

Daar bestaan by my ernstige twyfel of dit wel moontlik sal wees.

Daar moet ook gelet word op die bepalings van artikels 14(3)(a) en (b) van die Elektrisiteitswet, soos in mnr Malan se referaat aangehaal. Die enigste vergoeding wat aan die plaaslike owerheid betaalbaar is by die verkoop van die onderneming, is die balans van uitstaande lenings. Die plaaslike owerheid mag dus nie 'n verkoopprys vir die onderneming bepaal, wat aan hom surplus fondse beskikbaar stel vir belegging, en waaruit hy dan 'n inkomste kan verkry om tot 'n mate te vergoed vir die verlies aan wins, nie.

Dit is wel so dat wette gewysig kan word. Die Elektrisiteitswet kan sekerlik ook gewysig word om voorsiening te maak vir die verkoop van 'n elektrisiteitsonderneming, teen 'n hoër prys as die uitstaande leningskuld. Die implikasie is egter dat, hoe hoër die aankoopprys, en dus die nuwe onderneming se leningskuld, hoe hoër die tariewe wat hy sal moet hef.

Dit wil gevolglik vir my voorkom asof daar met vrug gekyk kan word na 'n privatiseringsmodel wat die plaaslike owerheid in staat sal stel om die wins uit die onderneming te behou.

Artikel 13(8) van die Elektrisiteitswet maak daarvoor voorsiening dat 'n ondernemer die onderneming deur "iemand anders" kan laat bestuur en bedryf. Die "iemand anders" kan vermoedelik 'n privaat maatskappy wees. Die Raad sal steeds die bates besit, en die wins behou, behalwe 'n persentasie wat aan die maatskappy afgestaan sal word, as 'n aansporingsmaatreël. Hierdie benadering sou naastenby ooreenstem met Fase 1 van mnr Malan se model, behalwe dat die maatskappy nie die lisensiehouer word nie.

Die grootste stuikelblok is egter om te bepaal op welke basis die maatskappy vergoed moet word vir sy dienste aan die plaaslike owerheid.

I believe that we are now at the point where, if the matter is to be further pursued, an in-depth financial viability study is required. It is suggested that such a study be financed by the AMEU, and that the services of a Chartered Accountant be obtained for this. As Mr Malan is already so deeply involved, such a study could, subject to the consent of the Kempton Park Town Council, be carried out with specific reference to that undertaking. Such a study should include a cost analysis of the proposed private company, predictions of likely tariffs, and the financial implications for the Council. Possibly Mr Malan could comment on this aspect.

Mr President, Mr Malan's paper, dealing with a topic which is now receiving publicity on a national scale, is timely indeed. It is going to be hotly debated by both believers and nonbelievers. I thank him for this most valuable contribution to our proceedings, and for his presentation here today.

Thank you Mr President

# MNR VAN DER SCHYFF VAN DIE MINISTERIE VIR ADMINISTRASIE EN PRIVATISERING, VOORHEEN SEKRETARIS VAN DIE ELEKTRISITEITSBEHEERRAAD

Mnr President, in die posisie wat ek nou beklee by die ministerie vir administrasie en privatisering is dit my opdrag by uitstek om privatisering te bevorder in Suid-Afrika. Ons is dan ook dankbaar vir die aanvoorwerk wat by hierdie vergadering gedoen is in hierdie verband oor die moontlike privatisering van munisipale elektrisiteitsondernemings. Ek is ook genoeg van 'n realis, veral vanweë my betrokkenheid by die elektrisieteitsbeheerraad om te besef dat daar baie probleme in die pad lê van die uiteindelike privatisering van munisipale elektrisiteitsstelsels.

Die saadjie is nietemin gesaai en hoewel dit nou nog 'n saadjie is, dink ek sal daar nog iets groots hiervan kom in die nasionale konteks. Ons probleem in die verlede was dat ons nou nie genoeg aandag gegee het aan privatisering nie. Dat ons nooit eintlik daaraan gedink het nie, maar gelukkig het die posisie nou verander.

Mnr die President, in die verlede as daar 'n kind gebore is dan vra die ouers waarvoor moet ons hom laat leet, vir wie gaan hy eendag werk? Terwyl in Europa is die kultuur totaal anders. As 'n king gebore word dan vra huylle vir hom watter besigheid gaan hy eendag doen. Dit is miskien nou tyd dat ons oorskakel na hierdie kultuur. Dat ons nie meer vra vir wie gaan ons werk nie, maar dat ons vra watter besigheid gaan ons doen. Die eintlik een van die take wat ons het by die Ministerie vir Privatisering en Deregulering.

Mr President I must immediately say that the Electricity Controlboard has not yet given indepth thought to the privatisation of municipal undertakings and the application that it may have. It would in any event probably be wise to await the outcome of the Eskom privatisation excercise which in some ways would serve as a model for municipal undertakings.

An important question in this regard would be whether there will be control over tariffs and other activities of private electricity supply undertakings. This is a matter that still requires much thought.

Mnr die President dit was in die referaat gesê dat 'n privaat ondernemer 'n lisensie moet bekom.

Soos u weet, is munisipaliteite tans egter baas op hulle eie plaas. Hulle het nie nodig om lisensies te bekom nie en as hulle aan iemand anders binne hulle munisipalegebied elektrisiteit voorsien, het hul ook nie nodig om 'n lisensie te bekom nie. Dit nou maar net so terloops.

Die vraag ontstaan of daar in die nasionale belang nie dalk probeer beheertariewe ingestel moet word nie. U weet munisipaliteite is op die oomblik vrygestel van beheer, behalwe vir die mate van beheer wat hulle het van die Provinsiale Administrasies nie. As ons nou vir Eskom gaan privatiseer, en u weet Eskom is op die oomblik nie onder beheer soos hy vroeër was toe hy 'n lisensiehouer was nie, het die vraag nou ontstaan of daar nie dalk weer 'n mate van beheer ingestel moet word nie. Dit is egter 'n saak wat nog by die elektrisiteitsbeheerraad uitgemaak moet word en waaraan hy op die oomblik nog aandag gee.

'n Ander punt wat mnr Nortjé so sydelings aangeraak het is die kwessie van die vergoeding van bates. U weet dat die elektrisiteitswet bepaal op die oomblik dat sekere formules wat neergelê word vir die bepaling van vergoeding uitgewerk moet word vir wat betaal moet word vir die bates wat oorgeneem moet word. Nou die belangrike ding daar is dat hulle die verbruikers beskerm, maar as ons nou by 'n privatiseringsaksie kom, dan sal dit dalk nie vir munisipaliteite so aanloklik wees om van hulle bates ontslae te raak voordat ons nie dalk hierdie formules verander het nie. Daar is ook nog heelwat ander bepalings in die Elektrisiteitswet wat ons na sal moet kyk wat op die oomblik struikelblokke lê in die wet van privatisering.

Dankie

## MR DENNIS KNEALE, AFFILIATE

I would like to express my appreciation to Mr Jan Malan for a most interesting and informative paper. I agree with him that many ways and means by which facets of traditional municipal services could be privatised. But as stated in his paper and I quote: "The options for the privatisation of the electricity supply industry are limited to a certain extent due to its specialized nature," however the inspection of electrical installations as required in terms of the Machinery Occupational Safety Act need not necessarily remain vested with the supply authorities whether the undertaking is privatised or otherwise.

Mr Jules von Ahlften has conservatively estimated that the 207 members of the AMEU employ approximately 500 installation inspectors at a total cost of ± R25m per annum and this is largely for the account of the rate payers. The idea of the establishment of a National Inspection Council is not a new concept and was first mooted in the report of the 5 man delegation representing the AMEU/ECA and the Department of Manpower who went on a study tour of Europe and the U.K. during July 1978.

**The RSA Electrical Installation Inspection Council**
(Or whatever name is decided on) would have the following aims and objectives.

1. To ensure the safety of electrical installation work,
2. To ensure that only good quality materials and workmanship are used in the electrical installations,
3. To foster the interests of both the electrical contractor and the consumer of electricity,
4. To monitor the registration of potential and existing electrical contractors,
5. To ensure code of ethics is maintained.

While items 4 & 5 above are the long term objectives, it is proposed that this council be formed primarily to monitor the testing of electrical installations and the issuing of wiring certificates.

It is the E.C.A.s objective to administer our own industry, which is in line with the Government's policy of privatisation. A major step has already been made in this direction with inaugural meeting of the Industry Training Board for Electrical Contracting which took place on the 24th June 1988. This makes the E.C.A. (SA) the responsible body for all training in the Electrical Contracting Industry.

1. Several representatives of the E.C.A. and the electricity supply industry, who would be registered installation electricians will serve as members and inspectors of the council,
2. Association of Estate Agents, Building Societies and other financial institutions. (One representative each)
3. Consumer bodies, e.g. The South African Co-Ordinating Consumer Council. (One representative)
4. Organisations not mentioned above and should be representative.
5. E.C.A. who will act as secretary and be responsible for all administration duties.

Any electrical contractor may register with the inspection council on a voluntary basis and will be required to pay an annual registration fee to cover the running costs of the which will be a non profit making organisation.

In order to qualify for registration the contractor must be a registered installation electrician or must have one in his employ. This installation electrician will then be regarded as the responsible person in the contractors organisation to whom all correspondence, etc. emanating from the council will be directed.

The council will then appoint the electrical contractor as an approved electrical contractor which will enable him to test electrical installations and issue wiring certificates.

The electrical contractor will be able to use the fact that he is registered with the council in his advertisements and negotiations, etc. He will also be allowed to use the council's crest on his letterheads, etc.

This would man that whilst not precluding electrical contractors who have not registered with this council from carrying out the above tests, the Inspection Council would not be prepared to act as arbitrators in any disputes arising between a customer and a non member electrical contractor.

Estate Agents, Building Societies, Financial Institutions and the consumer would only employ electrical contractors who are registered with the council to ensure that they have the aforementioned protection. In the event of a contractor consistently doing shoddy or unsafe work or behaving unethically, his registration with the council would be cancelled.

**Advantages for the consumer can be best summed up as follows:**

As the testing of installations at present by the Supply Authorities is confined to safety aspects only, the quality of workmanship and materials is not the criteria in passing the installation, under the proposed system the consumer, being the end user of the installation will benefit from quality control as well as a safe installation.

In conclusion the time has now come for the electrical contractor to be more professional and to deliver a quality and safe installation.

## CLR FRANK VAN DER VELDE, PR ENG: CITY OF CAPE TOWN

In commenting on this paper I must congratulate Jan Malan not only on his presentation and obvious in depth research that has gone into the preparation thereof but in particular for his initiative in raising the subject and the courage of a Eldorados in taking a subject so frought with misconceptions, inbuilt prejudices and vested interests.

I talk about misconceptions and prejudices because no sooner had Cape Town adopted a tentative policy and a stand on privatisation when SAAME and the other Unions started calling emergency meetings and installing in their members a premature fear and I believe a misconceved fear for their own future security.

Anyone with any knowledge of the availability of staff, in particular in a field as specialised as that undertaken by its members of his Associations, will know that any change of ownership of our undertakings will necessitate the take over of that skill, expertese and experience. Can we in fact afford to pay the remuneration required by these experts?

It is absolutely essential therefore that any moves to privatise our undertakings addresses this perception – this fear of redundency.

The strongest vested interest that needs to be overcome relates to the Remuneration of Town Clerks Act which advocates that a salary or status of a Town Clerk is measured by the size of the empire he controls. Diminish that empire and he drops a grade or two and with him by a domino effect the rest of the municipal staff – another problem that needs to be addressed.

But first and foremost we need to ask the question: "Is the Journey really necessary" – why do we have to privatise? Do we really have to react to this cliché this buzz word which is being thrown around government circles and which has to date only meant the hiving off of certain departments which have either been politically embarrasing to the government or have been a financial loss!

Why should we therefore privatise a department that makes our local authorities money that runs at a profit?

Our first and predominant criteria must therefore be that privatisation MUST BE TO THE BENEFIT OF THE CONSUMER – both economically and efficiently.

I truely believe that this criteria can be met by combining the skill and expertese of the current staff and its resources and diversity of a private sector company. A private company is able to make managerial decisions quickly and reallocate resources without the cumbersome processes required by public sector regulation – Tender Board requirements etc.

The final question to be asked is what hold need the local authority have over the now privatised undertaking – Should the local authority be able to fire that company for not performing – How does the ratepayer or consumer protect himself from monopolistic tarriff increases or against inefficiency of supply. These questions need to be answered Mr President before we hand over a public sector monopoly to a private sector monopoly.

Finally may I say that I am excited by the prospect and I firmly believe that the lateral thinking that only Engineers and hardly ever polititions can apply will find a formula that can work to the best benefit of the consumers and its members of this Association.

## MR G R MARSHALL: AFFILIATE

In the paper Mr Malan has made a detailed analysis of privatisation applied to local authorities and is in support of it.

He compares the objective of a municipal undertaking with a hypothetical private company and makes reference to the privatisation which is underway in Britain. It is interesting to look at that government's objectives in the UK privatisation.

1. That the supply industry should be consumer driven rather than technology driven.
2. That government control should be replaced by market forces and competition.

The South African White Papers stresses the same points, and emphasises the importance of reduction in the States' share of total capital investment. Compared with Britain the large number of supply undertakings in South Africa could be perceived as achieving satisfactory identity with the needs of specific consumer groups and locations. But there might be too many for privat operation to be efficient and attentive to

the needs of rural areas. It might be asked if the industry as it exists in South Africa forms a suitable base for privatisation.

To achieve a significant reduction in State held investments it would be necessary to privatise the whole industry and the method adopted could well affect any privatisation of local government undertakings. The control of production assets will be important in determining the interest shown in privatisation. Mr Malan's thoughts that this should be my way of a transfer of equity through leasing is an interesting idea in that it would spread the drain on scarce development capital. But it would have the undesirable effect of depriving the private concern of an asset base during its formative years.

At this stage it is difficult to foresee the objectives which government will place before the industry but in making an educated guess Mr Malan has given us an interesting scenario to contemplate.

### MR R DEETLEFS: DEPUTY TOWN TREASURER – BOKSBURG

**1. Privatisation**

Privatisation shoul not only produce a new goose to lay a golden egg for taxation, but it must be a company supplying electricity at a cheaper rate to the consumer, and make bigger profits.

**2. Take over**

This memorandum is about the take-over by the current employees, whilst there is no saving mentioned in costs except for the principle that loan redemption is not taken as a cost. Depreciation replaces this cost except for building depreciation which is relatively insignificant as to the total value of assets.

**3. Profit margins**

At present, most local authorities make a net profit of 10% which is utilised in relief of rates.

If the private sector had to indulge in such a project, the net profit after tax should be in the vicinity of at least 20% as to pay a reasonable dividend, otherwise, the capital utilised could be invested at 15% p.a. without any risk.

**4. Conclusion**

That electricity undertakings not be transferred to employees as nothing but a new owner will be achieved, unless the employees admit that they are not at present giving their best under the local authority.

If the electricity department is not sold to a privat company which is in a better organising capacity, nothing will be achieved except more taxation in the state coffers from the same ratepayer via a company. The incidence of this tax is still related to the same people which can be achieved in a cheaper way by increased taxation.

### DR R B ANDERSON: HONORARY MEMBER

**A Private Opinion**

PRIVATISATION: This is a new business-word. It is based on the assumption, true or false, that state or peristatal organisations are inefficient and because of their monopoly, do not conduct their affairs at the lowest cost to or into/ of the consumer, or customer.

However I think that we tend to forget why such undertakings as electricity were changed from private hands to public bodies. There were obviously factors in that previous privatisation that were not satisfactory and if we go that route again we should be sure that these factors are taken care of for example the electrification of rural areas which are not profitable.

An alternative is perhaps to first look inside our own organisation to see if in fact our efforts can be improved, streamlined or in any other way can become more cost effective. Perhaps having done this present organisations are better equipped to meet the threat of privatisation.

### MNR M L LOEST: GEAFFILIEERDE LID

As die munisipaliteite hulself beperk tot die lewering van net die volgende:

(a) finansiële administrasie, en

(b) oorhoofse koördinering en meesterbeplanning,

en alle veldwerk en installasiewerk aan private konsultante en kontrakteurs oorlaat, dan sal die verbruiker se belange in hoë mate beskerm word.

Dienste soos inspeksiewerk, meterlees, onderhoud en installering kan alles per private kontrak gedoen word.

Is die hele kwessie van privatisering nie die resultaat daarvan dat die munisipaliteite tot nou toe in 'n te hoë mate gepoog het om alle dienste self te wil lewer en in die proses vergeet het dat hul funksie slegs dié van plaaslike regering is. Dit is nie hul funksie om met private ondernemers mee te ding nie.

### MNR HENK TURKSTRA: GEAFFILIEERDE LID

1. **Probleem:**

U as elektriese ingenieurs werk as gevolg van die stelsel van kruissubsidering nie net vir u eie departement nie, maar ook vir ander departemente wat deur wins op die elektrisiteitsrekening gesubsideer word. Dit is beslis nie 'n bevredigende situasie nie.

2. **Elektrisiteitsgebruiker se siening:**

Waarom moet ek as gebruiker van elektisiteit meer betaal (hoër tariewe) sodat ander dienste daardeur gesubsideer kan word. Dit veroorsaak dat 'n gebruiker *minder* elektisiteit gebruik as wat hy in werklikheid wou gebruik. Die gesegde is "Jy betaal vir wat jy kry." Onder die huidige stelsel is dit nie so nie. Hy betaal gedeeltelik ook vir 'n ander diens.

3. **Voorstel**

3.1 As stap nommer 1 na privatisering, (wat heelwat later kan volg) moet elektriese ingenieurs agiteer dat die elektisiteitsrekening as 'n geslote rekening bedryf moet word, dit wil sê winste deur die elektisiteitsdepartement gegenereer moet in die departement bly. Die elektisiteitsdepartement moet dus as 'n volwaardige besigheid wat finansieël op eie voete moet staan, bedryf word.

3.2 Lone en Salarisse behoort departementeel bepaal te word, moontlik in samewerking met die VMEO wat as raadgewende liggaam kan optree.

4. **Voordele:**

4.1 Beter motivering vir alle personeel in die elektisiteitsdepartement omdat die departement vir homself werk.

4.2 Gepaardgaande hoër produktiwiteit as gevolg van beter motivering.

4.3 Die gebruiker van elektisiteit betaal die werklike koste van sy diens.

4.4 U as munisipale elektriese ingenieurs sal beter beheer oor die departement se sake kan verkry om dit in belang van die gebruiker en die departement te bestuur.

### MNR D C U DU TOIT: GEAFFILIEERDE LID

Ek bespeur in mnr Malan se voorstel vir die implementering van privatisering 'n ingeboude sekuriteit vir die huidige amptenary.

Vergelyk hiermee dat in die geval van die oorname van een private maatskappy deur 'n ander daar geen waarborge aan enige van die bestuur of werknemers verskaf word.

Ons moet waak daarteen dat hierdie waarborge (of vrese i.s. sekuriteit) nie die privatiseringsproses 'n vroeë dood laat sterf nie of dat die proses 'n kameel baar nie.

Vir die gemoedsrus van die elektisiteitsverbruikers en om inspraak namens hulle te maak, is dit aan te bevele dat die plaaslike owerheid 'n inspraak of aandeelhouding in so 'n geprivatiseerde elektisiteitsonderneming behou.

Mnr Malan stel dit in die vooruitsig dat so 'n geprivatiseerde elektisiteitsonderneming die vrye mark kan betree om dan ook as groothandelaar, elektriese kontrakteur, ens. mee te ding.

Omgekeerd glo ek dat gevestigde groothandelaars, kontrakteurs, ens. dan ook toegelaat moet word om vryelik en op gelyke voet te kan meeding en hulle toegelaat moet word om sulke elektisiteitsondernemings te koop.

Dalk kan nóg groter effektiwiteit en besparings langs die weg bereik word.

Privatisering van elektisiteitsondernemings moet gedryf word deur ekonomiese oorwegings en nie deur geografiese, historiese en/of politiese oorwegings alleen nie. Sodoende moet bestaande ondernemings toegelaat word om oor huidige grense saam te smelt vir groter ekonomie van skaal wat behoort te lei tot beter diens teen 'n laer koste.

As moontlike voorbeeld vir so 'n rasionalisering is die huidige oorname van elektisiteitsverspreiding vanaf ESKOM deur Kaapstad se noordelike bure, Bellville, Brackenfell, Durbanville, Goodwood, Parow, ens. waar elkeen sy "eie ding doen."

Mr Malan proposes that e.g. streetlighting and traffic signalling be maintained by such a privatised undertaking by say cost plus a percentage mark-up. I am very wary of this "cost" as it can vary widely from organisation to organisation, is open to interpretation and provides no incentive for efficiency of effectiveness.

This is an activity that could be put out to tender and even currently existing companies could tender.

'n Potensiële probleemarea wat aandag sal moet geniet, is die moontlike konflik tussen die belange van verbruikers en die van die aandeelhouers, aangesien dit twee verskillende groepe kan wees met verskillende belange.

Neem as voorbeeld hiervan die sogenaamde huidige lae opbrengs op kapitaal soos uitgewys deur mnr Daniel en ook dat elektisiteit 'n prys-onelastiese kommoditeit is en verbruikers nie maklik na alternatiewe kan oorslaan nie.

'n Verdere aangeleentheid wat aandag sal moet geniet is die koste van eksterne toevoere na nuwe ontwikkelings. Die koste hiervan wissel reeds drasties, sonder dat die huidige elektisiteitsonderneming 'n verklaarde winsoogmerk het, van owerheid tot owerheid en selfs van geval tot geval in dieselfde area.

Wat sal ontwikkelaars kan verwag in die geval van 'n geprivatiseerde elektisiteitsonderneming met 'n winsoogmerk, watter alternatief het hulle anders as om te betaal of elders te ontwikkel, en hoe kan die plaaslike owerheid dit teenwerk om ontwikkeling nie af te skrik nie.

Ek glo dat terwyl dié privatisering nog bestudeer word, kan verbruikers alreeds groot baat vind as die elektisiteitsdepartement op 'n geslote rekening bedryf sou word en nie gebruik word vir kruissubsidiëring nie.

I support Mr Daniel that this privatisation will have to be debated further in depth, but also that the sooner this privatisation is implemented, the better.

Behoede ons asseblief van die moontlike beheer van tariewe voorsien deur mnr Van der Schyff. Deregulering, privatisering en vrye mededinging is die antwoord en nie verdere regulering nie.

## ATTIE VAN DEN BERG: KRUGERSDORP

Die volgende stellings verg kommentaar:

**Elektisiteitstariewe word aangepas om die boeke van die Stadsraad te laat klop. Die beginsel van kruissubsidiëring. Die Stadsraad maak 'n wins en betaal nie belasting daarop nie.**

Die voordele word deurentyd voorgehou asof daar geen nadele sou wees nie. As dit so sou wees, waarom dan op so 'n laat stadium daaraan dink?

Die gevare word onder punt 3 baie duidelik gestel as die ekonomiese mag gekonsentreer in die hande van 'n paar enkelinge. Daar moet dus beperkings wees op die persentasie aandeelhouding van bv finansiële reuse in die ekonomie. Daar moet gekonsentreer word op die indiwidue.

**Punt 4:** Monopolistiese stelsel in die hand van die Staat of owerheidsliggaam howel dit as snert beskryf word, het nogtans die voordeel dat die verbruiker sy misnoë by die stembus te kenne kan gee waar dit andersins nie die geval is nie.

**Punt 5:** Verlies aan winste. Kapitaalbates behoort nie verkoop te word om die bedryf of diens (van die Raad of die Staat) voort te sit nie. Dit is net so goed as om jou huis te verkoop om kruideniersware te koop.

Indien wins op elektisiteitsondernemings in privaat besit belasbaar is, moet die belasting aan die stadsrade toegewys word want dit is immers die stadsrade wat die winste afgee want Staats- geprivatiseerde ondernemings betaal dan belasting aan die Staat, d w s hulle inkomstebasis verbreed daardeur terwyl hul uitgawes afstaan.

Stadsraad is "diens-gemotiveerd" terwyl 'n privaat onderneming "wins-gemotiveerd" is.

Daar moet gewaak word teen "roofbou" (hoë winste) op die kort termyn ten koste van 'n langtermyndoelwit van voortgesette kragvoorsiening.

Kruissubsidiëring vind nog daagliks plaas by die heffing van belastings, hetsy op inkomste of eiendomswaarde, want almal maak nie van die dienst (bv Polisiebeskerming by die Staat of straatligte by die stadsrade) in direkte verhouding tot die belasting wat hulle betaal, gebruik nie.

Ek is persoonlik nie teen privatisering nie – maar net versigtig.

Dankie mnr die President

## RDL WILLEM SPIES: KEMPTON PARK

Mnr die President, baie dankie vir die geleentheid om iets te mag sê oor privatisering. Laat my egter eers vir u as President gelukwens met u Voorsitterskap en ek dink dit is puik, veral tydens die sitting toe die luidsprekerstelsel probleme gegee het. U het al die tyd soos 'n waardige President gehandel en het nooit senuagtig begin rondhardloop nie.

Mnr die President, dit is met 'n benoude oog dat heelparty munisipale personeel op die oomblik na privatisering kyk. Na jare van beroepsekuriteit beleef hulle nou beroepsvrese. Iets wat baie van hulle nooit geken het nie.

Dit is nou byna 10 jaar dat privatisering 'n huishoudelike woord in Suid-Afrika geword het, maar mnr die President, soos met potjiekos as jy die potjie wegneem, het jy groot probleme. So is dit met privatisering as jy deregulering wegneem, het jy ook groot probleme. Hoe gouer deregulering dus gedoen word, hoe gouer sal gevorder word met privatisering. Privatisering kan nie 'n proses sonder politieke gevolge wees nie, en een van die gevolge wat juis nie onderskat moet word

nie, is die munisipale werknemer se beroepsvrese. Daar is duidelik onsekerheid onder personeel oor die implikasies vir hulle persoonlik – 'n doodnatuurlike menslike reaksie. Eensydig sal die besluitneming oor privatisering nie kan wees nie. Daar is reeds aanduidings gegee dat die Kommissie vir Administrasie die riglyne in samewerking met die verskillende personeelverenigings opgestel het. In Brittanje is privatisering uit die staanspoor deur die breë publiek en op alle vlakke deur personeel geesdriftig verwelkom. Dit word as een van die belangrikste redes vir die Britse sukses vertolk, maar die omstandighede in Brittanje verskil hemelbreed van die groot mate van werkvrede wat ons in Suid-Afrika op munisipale vlak beleef. Om dieselfde soort positiewe ontvangs hier te kry, sal die personeel se vrese besweer moet word.

Kontrakte sal opgestel moet word waarin die grondreëls vir die hantering van personeel ingeskryf is. Die personeelverenigings sal hierin 'n rol moet speel en enige werknemers wat oorgeplaas word sal waarskynlik 'n skriftelike aanbod ontvang wat die voordele uitspel.

Die sleutel van sukses is egter vrye keuse. Mededinging is gesond en met beswering van vrese kan die personeel vind dat daar groter geleenthede vir hulle wag.

Mnr die President, een van die sprekers (ek meen dit was mnr Nortje) het 'n voorstel gemaak dat die VMEO 'n finansiële konsultant aanstel om na die hele kwessie van die finansiële implikasies van privatisering van 'n Munisipale Elektisiteitsonderneming ondersoek in te stel en hy het genoem dat moontlik kan Kempton Park as proefkonyn gebruik word. U sal verstaan dat ek nie my Raad of Bestuurskomitee kan kompromiteer nie, maar ek wil sy voorstel sekondeer en voorstel dat die VMEO met 'n formele aanbieding na die Stadsraad van Kemption Park kom, aangesien dit ook ons volgende stap sou wees as ons wou kyk na die privatisering soos voorgestel deur ons Elektrotegniese Ingenieur, mnr Jan Malan.

As Voorsitter van die Komitee vir privatisering van my Raad sal ek u in alle opsigte steun want ons het reeds met verskeie konsultante gesels onder andere met prof Brummer van die Universiteit van Pretoria en een van sy voorstelle vir 'n moontlike wyse van optrede vir privatisering is om eerstens na die finansiële implikasies te kyk.

Ek dank u.

**MNR PIET BOTES: ROODEPOORT**

Eskom is nou besig om die wetgewings na te gaan om privatisering van Eskom moontlik te maak. Dit is 'n enorme taak en gewag is gemaak dat dit 2 jaar sal neem om dit aan te spreek en u sal verbaas wees oor die aantal wetgewings wat bygewerk sal moet word. Daar is ook gewag gemaak dat hierdie veranderings moet voorsiening maak vir ander privatiseerde elektriese verspredingsnetwerke. Die VMEO sal hier meedoen. Daar is ook korter paaie wat ondersoek word op die huidige. Ek wil dit duidelik stel egter, dat Eskom op hierdie stadium die moontlikhede ondersoek hoe te werk gegaan moet word indien Eskom moet privatiseer. Dit is myns insiens verkeerd om te sê dat Eskom alreeds ver gevorder is op die pad van privatisering. Mnr Malan moet geluk gewens word met 'n prikkelende referaat. 'n Begroting, vergelyking, voor en na privatisering behoort die volgende fase te wees waaroor ons moontlik aan kan kou. Daar is nog baie vrae naamlik die depresiasie van bates aangekoop voor oorname en na oorname en die siening van de Ontvanger van Inkomste. Oor hierdie aangeleenthede moet nog besin word. Ek hoop dus dat hierdie referaat verder gevoer sal word by moontlik die konvensie in Kaapstad oor die feitlike koste-aspekte waaroor meeste persone bekommernis het. Sover ek kan agterkom is daar heelwat mense wat bekommernis het oor die koste-aspekte en ek dink dit is 'n aangeleentheid wat aangespreek moet word. Dankie.

**MNR JAN MALAN: KEMPTON PARK**

Dames en here, ek het eintlik so iets verwag. Ek moet vir u sê, ek het baie uitgesien na die bespreking om te sien hoe vêr mense oor hierdie saak gedink het en ek is verbaas en aangenaam verras.

Mr Fred Daniels, Cape Town, thank you very much for your constructive talk. U praat van die seminaar, dit is baie interessant. Ek dink dit kan baie vrugbare inligting na vore bring. Ek sou so 'n voorstel baie sterk steun. Mnr Daniels sê ook ons proses is te lank. Hy sê die geloofwaardigheid van privatisering kan moontlik daardeur aangetas word. Daar is baie politieke konnotasies in hierdie saak. Dit is 'n baie gevoelige saak. Ek glo nie dat 'n mens in privatisering vinnig moet ingaan nie. Dit is 'n baie belangrike aangeleentheid. Dit is vir ons baie nuut. Daar is nie 'n bloudruk nie. 'n Mens moet deur jou eie ervaring jou pad vind en daarom glo ek dat 'n mens hierdie saak in fases moet hanteer.

Mnr Gawie Nortjé, baie dankie ook vir jou positiewe bydrae. Waarom privatiseer? 'n Baie belangrike vraag. Dit is maar altyd die vraag. Jy weet, my Voorsitter van die Bestuurskomitee sê, privatisering ja, elektrisiteit, waarom? Nou my antwoord. Ek dink mens kan dit kortliks opsom deur te sê dat as jy wil innovasie hê, dan moet jy 'n man op sy eie sit. Ons is baie geneig om in 'n groef te raak en ek dink privatisering sal innovasie stimuleer. En dit is wat ons so nodig het. Ons moet uit heride groewe kom van die tradisionele elektisiteitsonderneming en die tegnologie het vandag so ontwikkel dat jy met rasse skrede hierdie ding uit sy groef kan ruk, en jy kan 'n geweldige groot kapitale of ten minste bedrae geld realiseer deur dit te ondersoek en uit te voer. Ons het dit in Kempton Park terloops tot 'n groot mate reeds in die praktyk bewys. Dan natuurlik die ander saak is motivering. 'n Mens kan jou werksmense motiveer tot op 'n stadium en daarna kan jy hom net nie meer motiveer nie. Dan moet jy iets in sy sak plaas.

Ons kan met die huidige stelsel dit net nie meer doen nie. Ons hande is gebind tot 'n groot mate. Ek dink dit sal een van die groot waaroms beantwoord. Gawie noem van artikel 14a en b die balans van die uitstaande lenings. Ja, ek glo hy het genoem, ek glo dat daardie Wet sal definitief gewysig moet word want daar is nuwe stelsels, nuwe ondernemings wat in die moderne tyd gebou is wat uiteraard baie groot kapitale lenings uitstaande het en dan is daar ouer stelsels wat so te sê afgelos is van die lenings, en ek sou sê as 'n mens privatisering as 'n beginsel regdeur moet trek, dan sou dit heeltemal onregverdig wees dat die een persoon 'n stelsel kan aankoop teen die uitstaande lening wat omtrent zero is en die ander ou wat 'n baie hoë kapitale lening nog teen hom het. So ek glo daardie artikel 14 sal definitief geduring saamgelees moet word.

The AMEU to finance the financial study and Kempton Park to be the model? Baie interessant. Ek kyk na my raadslid. Ek weet nie, hy sal vir u dalk beter kan sê of ons daartoe bereid sal wees. Wat my betref, natuurlik, ons het heelwat werk op hierdie gebied gedoen en ons sou dit baie graag wil verder voer. As ons as 'n model sou gebruik kon word, my eie personeel is rooiwarm oor hierdie hele aangeleentheid. Ek moet net altyd die vrae beantwoord oor hoe ver ons gevorder het. My middelbestuur is baie goed gemotiveerd oor hierdie saak en ons het net die grootste probleem om hierdie inligting af te gee na die vloer toe, waar dit moeiliker is om hierdie gedagte te verwerk. 'n Mens wil nie te veel inligting afgee na die werksmense toe nie, want dit kan verkeerde konnotasies tot gevolg hê. So op hierdie stadium nog sensitief, maar ons het in Kempton Park baie ver gevorder met ons eie personeel in hierdie saak.

Die mense dink soos besigheidsmense. Mnr van der Schyff, ek is verheug om van u te hoor van die Elektisiteitsbeheerraad af en van die Ministrie van Privatisering. Ek het ook daardie mense ontmoet, vir mnr Pieter van Huyssteen en sy manne. Baie pragtige mense. Ek was nou die dag by RAU by 'n konferensie waar die manne gepraat her, ek het 'n groot riem onder die hart om na daardie mense te luister. U sê daar is baie probleme op ons pad. Ons glo dit, maar ek wil vir u sê dat ek het 'n probleem as ons ons probleme op plaaslike valk, op munisipale valk sou gaan vergelyk met die probleme op staatsvalk. Ek dink daar is enorme probleme op staatsvlak in hierdie opsig, maar in die munisipale opset is die probleme geensins so ingewikkeld nie. Ek wil nie daarby sê dat dit eenvoudig is nie, maar ek glo dat 'n mens hierdie twee aspekte heeltemal uitmekaar moet hou. Ek dink op munisipale vlak sou dit vir ons baie makliker wees om te privatiseer as byvoorbeeld 'n staatsdepartement. Baie dankie vir u konstruktiewe bydrae. Ek wil vir u vra waar u omgaan met die belangrike mense by die Ministerie van Privatisering, dat u gerus ons belange daar kan bevorder.

U praat van die lisensie wat nie nodig is nie. Soos ek die Wet lees sluit Artikel 6 'n hele aantal organisasies uit, maar hy sluit beslis nie 'n privaat onderneming uit nie. Soos ek hom lees en interpreteer, sou dit vir my lyk dat as 'n elektisiteitsonderneming geprivatiseer sou wees en hy sou dan die voorsieningsowerheid word wat dan uiteraard die laaste sê sal hê oor wat moet gebeur en wat moet nie gebeur oor elektrisiteit in daardie omgewing nie, dan sou hy beslis dan na my mening onder 'n lisensie moet opereer wat uitgereik is deur die elektisiteitsbeheerraad.

Mr Dennis Kneale, yes I think you are addressing the problems resulting from the MOS Act more than this problem that we have discussed here. The MOS Act already dictates that your people are authorised to test and inspect 30% of the available monthyly or annual inspections and installations, and this is being done. The electrical contractor to be more professional. Thank you very much. We are in dear need of that and I think we will all appreciate it if you can give the message across to your members.

Mr Frank van der Velde, thank you for your re-inforced contribution. Take over of skills. Keep the people involved.

Ja, natuurlik, ek is 'n groot voorstaander daarvan dat die mense wat die diens nou lewer moet betrokke bly – Keeps the people involved. Why privatise? Hier kom die vraag weer. Profits must be to the benefit of the consumer obviously, and the end of the day the consumer must be the beneficial. What control need local authority have over the private company? Well, initially of course this control will deminish as time goes on and as the repsonsibility is taken over by the private company, because as we know that if the control should be more than 50%, then privatisation will just not work. Privatisation will only work if the company can operate on its own. It must not be controlled by the Council otherwise it will just not work.

Now tariff increases will be handled of course by the Electricity Act as Mr van der Schyff said.

Dit sal ingestel word om die verbruiker te beskerm en ek dink dit moet so voortgaan. Ek glo nie dat 'n geprivatiseerde onderneming moet toegelaat word om na willekeur tariewe te wysig en te verhoog nie. Miskien kan hy tariewe verlaag, ek weet nie, dit kan wees. Dit kan ook gebeur, maar in die reël sou ek sê is dit goed dat daar 'n beheerraad is wat kyk na tariewe om die verbruiker te beskerm. Weer eens net om die vraag beter te beantwoord, is dat 'n geprivatiseerde onderneming sou sy tariewe kon vergelyk met sy bure oor munisipale grense. En ek dink 'n mens sou baie vinnig kon sien of dit 'n sukses is al dan nie.

Mr Marshall you talked about the UK experience, well I think there is a lot of difference between the UK experience and what we are trying to do in local government in South Africa. It is a totally different kettle of fish, and I have not all the information on the UK, so I am not really equipped to answer that one.

Dan, die Adjunk-Stadstesourier van Boksburg, ag u weet, Stadstesouriers is maar redelik bedreig deur hierdie saak en ek kry 'n negatiewe toon uit wat ek al gesê het, maar ek wil net vir u sê ek sê vir my Stadstesourier ten minste sal ek beter finansiële dissipline in my organisasie kan inkry as ek self oorneem. Dit is 'n baie groot probleem. Finansiële in plaaslike bestuur, jy weet, die Stadstesouriers, sê hulle is die moeders van die Raad se geld. Ek sê nee, al wat julle is, is julle is die tellinghouers wat in die pawiljoen sit. Ons is die mense wat die spel volgens die reëls speel en ons moet verhoed dat geld uitgegee word, en ons moet seker dat geld sinvol uitgegee word.

Hulle tel die geld na dit uitgegee is. So, my boodskap aan daardie Stadstesourier is hy moet positief begin raak en sien wat is die voordeel van die saak. Aan mnr Piet Botes van Roodepoort, dankie vir u inligting oor Eskom en dan natuurlik die Ontvanger van Inkomste wat u van praat. Baie dankie.

**MNR J N ROSSOUW: MMABATHO**

**Vraag 1:** Dit word aanvaar dat dit nie die referent se bedoeling is dat die Elektrisiteitsonderneming slegs geprivatiseer sal word uit die geledere van daardie betrokke Departement van 'n gegewe Munisipaliteit nie. Dit kan enige doelgerigte onderneming wees, mits die stappe, in die breë trekke soos in die referaat gevolg word. Dit kan organisasies soos Bonuskor, geprivatiseer Elektrisiteitsonderneming op 'n streeks basis wat ander ondernemings oorneem. Die voordele is voor die hand liggend – 'n monopolie is die enigste nadeel.

**Vraag 2:** Hoe sien die referent die rol wat die Inspektoraat van die Departement van Mannekrag sal speel in 'n gestigde geprivatiseerde Elektisiteitsonderneming. Sal dit slegs 'n horisontale verskuiwing wees van die Munisipaliteit na die nuwe maatskappy toe?

**MNR J G MALAN: KEMPTON PARK**

**Antwoord op Vraag 1:**
Op bladsy 4/5 van die referaat word die 'nadele' van konsentrasie van ekonomiese mag behandel. Dit behoort vermy te word. Die ideaal sou wees om die geledere van die betrokke departemtn te betrek, mits natuurlik daardie geledere opgewasse is vir die taak in die nuwe dispensasie. Die bestuur is altyd die belangrikste want sukses word deur bestuur tot groot hoogtes bepaal.

In die kor termyn word oornames nie op streeksbasis voorsien nie, tensy omstandighede dit voor die handliggend maark. Makro ondernemings kan neig tot ondoeltreffendheid, terwyl 'n te klein onderneming nie die voordele van ekonomie van skaal kan benut nie.

**Antwoord op Vraag 2:**
Ja, indien die geprivatiseerde onderneming onder lisensie van die Elektisiteitsbeheerraad opereer, is daardie onderneming inderdaad die voorsieningsowerheid en sal dit nodig wees om die verantwoordelikhede in terme van die betrokke wetgewing by die voorsieningsowerheid te laat berus in soverre wetgewing op die bedrywighede van die voorsieningsowerheid as gebruiker van toepassing is.

Die munisipaliteit word 'n verbruiker van die voorsieningsowerheid en sy eie installasies is onderhewig aan sy eie toesig as gebruiker in terme van die wet.

# THE IMPLICATIONS OF PLANNING AND DESIGN DECISIONS IN ELECTRICITY DISTRIBUTION

**by Mr Trevor Gaunt, Constulting Electrical Engineer, Hill Kaplan Scott**

**MR A H L FORTMANN: PRESIDENT**

Mr Trevor Gaunt grew up in Harare and graduated from Natal University, Durban. He received graduate apprenticeship training in Switzerland with a manufacturer and spent a short period in England with consulting engineers. He returned to the then Rhodesia Electricity Supply Commission (now ZESA), working in the protection and commissioning section and later in system planning.

He came to South Africa in 1979 to join Hill Kaplan Scott, where he is now a Director, with particular responsibility for high voltage and electricity supply engineering.

He is a Registered Professional Engineer, a Fellow of the Institution of Electrical Engineers and a Fellow of the South African Institute of Electrical Engineers and a Member of the SA Association of Consulting Engineers.

He is married and has four children.

Trevor, will you please present your Paper.

*Mr Trevor Gaunt*

**SYNOPSIS**

The developers of electricity systems have to make investment decisions for an uncertain future. The investment has to meet various requirements, including flexibility, reliability and capacity for growth, and still yield an economic return. The decisions made in the planning and design stages determine how effectively these needs will be met. This paper examines some of the basic planning and design decisions, the conditions which affect them, and the wider implications of what are often seen as purely technical issues. The adoption of some standards which differ from present practice in many South African supply authorities is recommended.

**OPSOMMING**

Die ontwikkelaars van elektriese stelsels moet besluite neem oor beleggings in elektriese stelsels vir 'n onsekere toekoms. Hierdie belegging is onderworpe aan sekere vereistes soos bv. aanpasbaarheid, betroubaarheid en die kapasiteit vir groei en moet steeds ekonomies lewensvatbaar wees. Die besluite wat gedurende die beplanning en ontwerp stadiums gemaak word, bepaal hoe effektief die betrokke behoeftes bevredig word. Hierdie verhandeling ondersoek sekere basiese besluite in die beplanning en ontwerp van stelsels, die faktore wat dit beïnvloed en die wyer implikasies wat heel dikwels geklassifiseer word as tegniese kennis. Daar word aanbeveel dat standaarde wat verskil van die huidiglik nagevolg word deur baie Suid-Afrikaanse voorsieningsowerhede, aanvaar moet word.

KEYWORDS:
Townships, distribution, design demand, diversity, voltage drop, economics, load factor.

## CONTENTS



## 1. INTRODUCTION

One hundred years ago, in his Presidential Address to the Institution of Electrical Engineers, Graves claimed "...the problem of distribution is becoming understood". (Ref 1). Since then the subject has been addressed in meetings, conferences and journals. Why it is worthwhile for us to discuss the planning and design of electricity distribution systems now? I would answer by way of an example.

HKS designed the electricity distribution system for a residential township for a particular government department, to the approval of their electrical engineers. The township lay within the jurisdiction of another government departement they wanted changes and the system was redesigned to meet the new requirements. Both systems were based on LV aerial bundle conductors. The township layout did not change; the two systems differed in the design parameters and system accessories. Both systems were priced by the contractor on a bill of quantities basis - the redesigned system cost 45% more than the original. The more expensive system was installed.

The lifestyles of the township residents will not be changed by the additional expenditure, no is the quality of their electricity supplies likely to be noticeably different. Was one scheme an

excessive capital investment? Or was the other inadequate?

This example shows the inter-relationship between the key elements of modern distribution system planning and design shown in Table 1.

**Table 1: Key elements of distribution system planning**

| |
|---|
| 1 For what requirements (loads, performance, etc) should the system be designed? |
| 2 What network configurations and equipment characteristics are needed to meet the requirements? |
| 3 What should the distribution system cost? |

These are important questions because:

1. South Africa needs over 60 000 new homes per year up to the year 2 000. Electricity supplies will require an annual capital investment of R100 million at today's prices if conventional residential distribution systems are built. Such investment is constrained by the country's ability to pay and must be appropriate to the consumers' needs.
2. The components of electricity distribution systems are expected to remain in service for over twenty years. The systems themselves will operate for fifty years or more. Technical, social and economic changes will substantially modify the demands madeo n the systems during this time.
3. We have to make large investments for an uncertian future. The investment has to meet a range of needs, such as flexibility, growth and ease of maintenance and still yield an acceptable return.

If we are to meet the needs of our growing populationg and, at the same time, ensure an economic return, we must take a fresh look at present standards in the planning and design of distribution networks.

This paper explores the implications of the many decisions which are taken in the planning and design process. It considers the social, technical an economic changes that can influence electricity systems, examines the basic planning and design process and makes recommendations regarding policy formulation and standards for systems.

The scope includes new and existing townships. The emphasis is on residential townships, but many aspects can be applied to commercial and industrial distribution systems.

## 2. AN UNCERTAIN FUTURE

In 1956, RW Kane asked in his Presidential Address to the SAIEE:

"Is it too much to assume that in time and not too far away either, with increased earning ability and the acquiring of urban habits, these (native) townships will become another large outlet for the domestic consumption of electricity". (Ref 2)

Thirty years on, we are witnessing the development he anticipated.

What will happen during the next thirty years and how do we allow for it in our electricity supply planning?

The inventiveness and adaptability of engineers have produced a wide range of sophisticated products and systems for use in electricity distribution. Social, political and economic changes will spur further technical development. Some predicted changes are shown in Tables 2, 3 and 4.

Engineers need to develop new techniques and equipment appropriate to the changing requirements and the uncertainty of the future. Specialist engineers and engineers with a broad approach to overall systems will be required in increasing numbers to design, implement and operate the networks created to supply new and growing consumer demands.

In general, the need to design systems for long lifetimes without modification will diminish and medium term economics (10-15 years) will become more important.

**Table 2: Social and political change**

| |
|---|
| a) Increased urbanisation, property subdivision and rezoning, changes in Group Areas regulations, population growth and increased employment will lead to increases in residential density. Existing reticulation systems will therefore have to be modified and reinforced. Future needs should be taken into account in the design of new systems. |
| b) Natural energy resources, such as wood, will become scarcer and more expensive. Changing lifestyles will increase the social value of electricity, and the per capita consumption of electricity by domestic consumers will increase. Demand management will change the characteristics of loads. |
| c) A social "right of access to energy" will develop, as has happened with "right to water supply", because electricity will support an improvement in the quality of life. It is therefore important to find ways of supplying at least some of the benefits of electricity at prices which are subeconomic by present standards. |
| d) Regulatory aspects will change. The present emphasis on high safety levels may be reduced as people become more accustomed to the use of electrical systems. New formats for defining acceptable standards will be needed. |
| e) In spite of high levels of unemployment shortages of skills will continue, partly because training systems will lag behind technological change. Therefore design, construction and maintenance will attempt to reduce the effects of skills shortages. |

## 3. GUIDELINES – A BRIEF HISTORY

The design process, though simple, involves many decisions. A substantial quantity of data is needed to determine the best way of planning and building a system.

When electrical engineers started building distribution systems they had no formal guidelines to follow. Descriptions of how schemes were built and of the design parameters used were important subjects of papers presented to institute meetings and published in engineering journals.

In 1926, Botting identified one of the chief points for discussion as "estimating the probable demand in, say units sold per month, and the probable maximum demand in kilowatts for deciding on size of generating unit" (Ref 4). In comparing the consumption figures of 25 municipalities he also found "that, generally, the load factor improves along with the total load".

Significant work was carried out in America and England in the 1930s and 1940s to survey the demands of domestic consumers and the diversity of loads (Ref 5, 6).

Substantial experience was also gained in South Africa. In 1951, a paper by Gillet (Ref 7) on the private development of the reticulation of Welkom, attracted 16 detailed discussion contributions. The system implemented was based on a 6,6 kV underground cable ring with 400 kVA single transformer substations, each supplying about 100 houses. Although many aspects of the design were criticised by the contributors to the discussion, this description of the Welkom system was the most significant South African reference for several years.

A substantial guideline on the design of electricity distribution for housing estates was published in England in 1954 (Ref 8). The recommendations were based on theoretical analysis and

**Table 3: Economic change**

a) When the inflation rate exceeds the interest rate, investment decisions based on cash flow discounting are reduced to investing as much as possible before the price increases. In such conditions, supply system planning will be based on the limits of available capital, flexibility and avoidance of risk.

b) The decreasing ratio of gross national product to government expenditure shows that the public is becoming less able to finance government expenditure. In the long term government expenditure must be more productive or the country will become bankrupt. There will be significant changes in the application of subsidies and the level of services provided. The return on investment from electricity developments will be emphasised. The intended privatisation of Eskom may be a part of this change.

c) The industry structure is changing. In 1982, 170 local authorities were members of the AMEU. By 1987 the number had grown to 200. Municipalities are taking over parts of the Eskom network and new supply authorities are being established to operate the electricity systems in new towns. The privatisation of some supply authorities, the elements of competition and the regulation of monopolies are likely to influence both distribution methods and the price of electricity for different categories of consumer in different parts of the country.

d) The standards for and cost of electricity supply will depend on its usage. In general, a "better" system has little impact on domestic consumers, but may well affect a commercial or industrial consumer's activities.

e) For a long time technical development and economies of scale reduced the cost of electricity in real terms. The falling price stimulated the use of electricity for many applications. Since 1973, however, energy has been a more important component of economic structure. In the absence of major technological advances, the cost of energy is likely to remain steady in real terms.

extensive studies of new housing estates. A standard design load was recommended. Diversity and unbalance correction factors were provided, and guidance was given on network design and practical aspects of implementation.

In 1966, the 1954 report was updated to adopt a range of values for the design load, to take account of the growing effect of off-peak heating, and to modify the diversity expression (Ref 9). In 1972 the recommended selection of the design load was again revised (Ref 10).

In South Africa a series of guidelines (Ref 11, 12, 13), based on the British recommendations, culminated in a Code of Practice published by SABS in 1983 (Ref 14). In 1986 this Code of Practice was withdrawn by SABS and responsibility for maintaining it was taken over by the AMEU. Papers at AMEU Meetings and a major workshop have offered alternatives to the guidelines for consideration by system designers. (Ref 15, 16. 17).

## 4. PLANNING AND DESIGN OBJECTIVES

Perhaps disagreement over the best way to design and build a distribution system arises because the people and organisations involved all have different objectives and, therefore, make different design assumptions.

### 4.1 The supply authorities' objectives

Fraser identified the following as the objectives of an electriticy distribution authority (Ref 18):

**Table 4: Technological change**

a) New applications for electrical energy, such as electric cars, will be developed to the extent that they become economic. Time of use may add to the present peak load. Alternatively, consumers may be encouraged to fill in the valleys of demand. Load characteristics will change differently in different communities.

b) New or modified materials will allow the construction of new forms of equipment and change the character of electricity distribution systems. Developments in cable insulation, transformer steels and switchgear technology will change price structures and equipment design. Recent reports of compounds which are superconductors at 338° (65°C) are being taken seriously by researchers (Ref 3). The effect of these developments will depend on the price at which the new materials can be produced.

c) The application of "intelligent devices" in metering, protection, load control, switchgear and operations control will increasingly open new opportunities for system designers. Solutions now constrained by a lack of suitable equipment will become possible in future. The complexity of electronic interfacing will encourage the development of modular systems, combining several functions which can be selected by appropriate settings or commands. However the widespread use of centrally controlled computer installations may be limited by the high cost of programming. The consequence of changes in equipment will extend beyond the physical aspects. For example, the development of robust and reliable prepayment meters will affect a supply authority's meter reading, billing and cash flow.

d) The use of computers to solve small design problems efficiently will increase design productivity by trimming all excess equipment and material from an installation until it just meets the parameters adopted. There will be economic pressure to replace conservative, empirical "factors of safety" with deterministic and probabilistic analysis.

e) Technical changes often render industry standards obsolete by the time they are published. More standards will be performance based, and procedures will be adopted for faster amendment of existing standards, without losing the benefits of standardisation.

- To supply electrical energy in adequate quantities at the lowest price to all who are able to pay the costs involved.
- To take reasonable steps to protect the public and consumers from the dangers of electricity.
- To provide supply of high reliability with due regard to economic considerations.
- To maintain voltage and frequency within permissible limits.
- To encourage the exploitation of electricity for the benefit of all sectors of the community.

Most of these objectives are difficult to quantify, illustrating the problems identified by Downey in assessing the efficiency of public authorities (Ref 19). Downey described two aspects of importance in electricity supply:

- To achieve a market related return on capital invested.
- To adopt organisation structures which are not too large to manage efficiently.

The following have also been expressed as further objectives of supply authorities:

- To increase income for a municipality.

- To create employment.
- To promote education and training.

Another objective of a supply authority can be identified in the approach taken to the development of new townships. If the authority undertakes the development for its own account, the minimum network is installed initially and reinforced if and when required. If the distribution system is installed by the developer, or by the authority at the developer's cost, then the supply authority requires the installation of full services adequate to supply ultimate loads. This difference in approach indicates the following objective:

- To minimise the cost to the authority and the effort involved in operations, maintenance and reinforcement, where capital is provided at no cost to the supply authority.

### 4.2 Property developers' objectives

Where property developers are responsible for the cost of providing an electricity distribution system, their objective will be to keep the capital cost to a minimum. This ensures that total development cost is kept below the acceptable market level. The potential for maximising profits is limited by the efficiency of competing developers. The minimum cost objective is tempered by factors affecting the marketability of the development, such as the visual appearance of the distribution system and the safety of residents.

### 4.3 Consumers' objectives

The consumers want reliable supplies at the minimum cost.

In general, where technical aspects of a purchase are unknown or not understood by the purchaser, assessment is made on the basis of price. Since most domestic consumers do not understand the technical and economic details of electricity supply, they are generally guided in their assessment by their publick representatives and by comparison with domestic consumers elsewhere.

On the other hand, commercial and industrial consumers are often technicaly and financially competent to quantify their quality and cost requirements. The optimum combination of quality and cost varies, depending on the industry and the consumer.

### 4.4 Designers' objectives

The designer generally adopts the objectives of the organisation he represents.

Yet there is always a further objective - to develop practical design methods. The development of complex routines to achieve greater theoretical precision is useful only where the data on which the design analysis and synthesis will be based is itself reliable and practical. To increase the speed and consistency of design, greater use is being made of computers. The limits of validity of the different approaches to the solution of distribution problems have to be identified, together with the nature of design choices. Then suitable mathematical algorithms can be developed.

Design is essentially a compromise between improved technical performance and additional cost. Good design take a wide-ranging approach to the definition of the need and the formulation of the solution. In addition careful attention is paid to detail. Good design is distinguished from ordinary design by innovation: that subtle combination of the conventional and the novel (Ref 20).

### 4.5 Comparison of objectives

Many aspects are common to the objectives of more than one interest group, often with a different desired value or weighting.

These aspects have to be considered in the context of external references:

- regulations which apply to the supply authority
- the natural and man-made environments
- competition for scarce resources
- acceptance by society.

Differences in the objectives of the main interest groups are indicated in Table 5.

## 5. DESIGN PROCESS

The main steps in the design of an electricity distribution system are:

- definition of objectives
- network design
- component selection and sizing
- load monitoring and system reinforcement.

Once the objectives have been defined in a way which is acceptable to the supply authority, developer and consumers, the preliminary network design can be proceed.

### 5.1 Network Design

Low voltage distribution networks are usually designed as radial feeders because the performance is adequate for most consumers supplied at 400/230 V. Larger supplies are made available at higher voltages such as 11 kV. At this voltage level, ring and mesh networks (often operated open to reduce the complexity of protection) are usually adopted to increase the reliability of supply and decrease outage times in the event of an interruption (Ref 21).

Unless a radical departure is made from the standards usually adopted for supplies to the main categories of consumer, the nework design is likely to follow current practice. In a few insances the opportunity to plan large and entirely new systems may permit the adoption of "unusual" networks for the medium voltage systems. At Motherwell near Port Elizabeth, for example, an intermediate medium voltage was adopted to supply load centres within the township, allowing a substantial saving.

Economic constraints and new technology are likely to cause changes in the network configurations adopted for many systems. For example, 22 kv instead of 11 kV has been adopted for several medium voltage distribution systems. A reduction in the quantity of switchgear reduces network capital costs, but also reduces the flexibility of operation and extension of the system.

### 5.2 Component Selection and Sizing

The components of the distribution system have to meet the following main criteria:

- thermal rating, under load and fault conditions
- volt drop rating.

Components are selected according to the conditions under which the system will function, depending on the operating, maintenance and other performance objectives adopted.

The parameters used in calculating the size of system componenets depend on the characteristics of the consumers.

Costs do not vary linearly with the capacity of the components. The economies of scale of one type of equipment are offset by the increased expenditure needed for an associated component. For example, if larger distribution transformers are used, the low voltage cables become longer and heavier.

Component sizing attempts to optimise the cost of the whole system. The preliminary network design may be modified as the design details are developed, to reduce the cost of the system. The lifetime cost should be taken into account by capitalising the cost of losses. This may lead to a choice of equipment ratings

larger than needed to meet the thermal and voltage constraints.

### 5.3 Load Monitoring

The loads which develop are unlikely to be eaxactly the same as those assumed in the design. If the loads do not reach the levels predicted, system performance is not affected. When the loads exceed the design loads it becomes necessary to reinforce the distribution system. This situation can be identified by monitoring the loads or the system voltages. Alternatively, if the consumers' load characteristics are well known, the need for reinforcement can be identified by monitoring consumption.

Monitoring is necessary if an authority is to avoid complains of low voltage. However, monitoring takes time to administer and provides no immediate income, so a decision to act may only be taken when a problem is identified by consumers. If this happens, it is possible that excessive and unidentified losses will cost the supply authority more than the saving made by deferring reinforcement.

## 6. LOAD PREDICTION

The loads for which the network is to be designed have a major influence on the cost of the network. Therefore it is important neither to overestimate the loads, resulting in over-capitalisation, nor to underestimate them and incur higher operating and reinforcement costs.

### 6.1 Industrial loads

Loads in industrial townships are heavily dependent on the type of industries. Average loads per hectare, based on expected development, are used in planning the distribution system, even though the energy intensity of different consumers within the same industry varies widely. A major objective in industrial township design is flexibility to supply large loads wherever they are required (Ref 22).

### 6.2 Commercial loads

Loads in commercial areas can be correlated with area and

**Table 5: Electricity supply objectives of different interest groups**

| ASPECT | SUPPLY AUTHORITY | CONSUMER | PROPERTY DEVELOPER | GENERAL PUBLIC (SOCIETY) |
|---|---|---|---|---|
| Safety | Comply with regulations at minimum cost and recommend changes where appropriate | Ensure safety of own installation within own cost constraints | Comply with regulations at minimum cost | Ensure safety of public, consumers and system operators |
| Quality of supply and reliability | Meet consumers' requirements at an acceptable price | Quality to be suitable for application, at an cceptable price | - | Adopt parameters for equipment and system standardisation in national interest |
| Appearance | - | Personal assessment of appearance may influence desire to locate in area | Appearance shall not detract unduly from the marketability of a development | Importance of appearance varies widely |
| Operations and maintenance | Minimise need for (and cost and complexity of) O&M within constraints of safety, reliability and investment objectives | O & M should not cause undue interruptions of supply | - | - |
| Fraud and theft of supply | Prevent or detect theft of energy | (Honest consumers have no objective) | - | Common law approach to theft |
| Flexibility | Provide flexibility for future development at acceptable cost | - | Avoid additional costs unless clearly justified | - |
| Income | Maximise income to cover costs and provide surplus, within constraints of regulations | Consumers will use electricity to the extent that its price is lower than the benefit | - | Regulate supply authority income to be compatible with national economic objectives |
| Investment | Minimise the lifetime cost of the system to the authority | Minimise initial cost of supply | Minimise capital investment of the overall development | Use scarce capital to obtain the optimum benefit for the community |
| Design | Provide system meeting safety and quality of supply objectives at minimum lifetime cost | Obtain acceptable quality of supply at acceptable cost | Minimise investment without detracting from marketability of development | Comply with regulations and socio-economic objectives of society |
| Management | Operate an efficient trading enterprise. Provide employment, education and training to win acceptance of public and influence groups such as Councils | - | Comply with the requirements of the supply authority which will take over the system | Adopt industry structure and organisations which are effective and efficient |

allowable bulk factors. In most towns there is a tendency to develop large properties with high loads, so it is important to design systems similar to those in industrial townships, with the flexibility to supply large loads wherever they occur. Distribution systems in commercial areas are therefore installed to meet demand and upgraded as required.

### 6.3 Residential loads

Load prediction for residential townships is one of the most important factors affecting the cost of residential distribution systems (Ref 16, 17).

Residential loads are influenced by:

- the economic class of the consumers
- family characteristics
- community habits (shift work, Sunday activities, etc)
- climatic conditions
- load control methods (ripple control, load limit switches or circuit breaker tariffs)
- the cost, ease of use and availability of and social preference for alternative energy sources.

The load prediction must take into account the effects of load growth through the increased use of electricity or increasing consumer density. Some guidelines recommend the adoption of initial loads with provision for later reinforcement to meet load growth (Ref 9, 10).

Research into the characteristics of loads in residential townships is being carried out in several centres in South Africa.

### 6.4 Design loads

A system is usually designed to supply and assumed maximum load. Most of the time the load will be less than the design load. However, there is always risk that the maximum load will exceed the design load for a short period. The higher load may occur randomly for individual consumers or, under abnormal conditions, for the whole system.

The average load of an individual consumer is the total load divided by the number of consumers. The after diversity maximum demand (admd) is the average individual demand at the time of system maximum demand.

Some guidelines regarding the selection of design admd are desribed below.

#### 6.4.1 SA Code of Practice for Design of Residential Townships.

SABS 0150 (Ref 14) gives typical admd values for various types of residential property as follows:

| TYPE | ADMD (kVA) |
|---|---|
| High income housing | 5 - 8 |
| Middle income housing | 2,5 - 5 |
| Low income housing | 1,5 - 2,5 |

#### 6.4.2 SA Code of Practice for the Wiring of Premises

SABS 0142 (Ref 23) recommends that the individual maximum load in private residences be estimated as:

Load (kW) = ½ (0,06 x total no of lamps + 5 + A + load of fixed cooking appliance) + water heater load + motor loads

where A = covered area in 100 m² in excess of 100 m²

For a large number of consumers the individual load is diversified by a factor of about three.

On this basis the admd of houses of about 100 m² area, with electric stove and electric water heate, is about 2,5 kW.

#### 6.4.3 UK Recommendations for Residential Townships

The UK engineering recommendation P5/3 in 1972 (Ref 10) recommended adoption of a typical inital admd and the identification of the means of reinforcement (provision of additional substation sites or larger transformers) for extention up to twice the initial admd. The recommended admds are related to the type of central heating installed. The findings of an extensive study of the demands of domestic consumers were as follows:

| Type of housing | Actual admd | Recommended design admd |
|---|---|---|
| a) Local authority housing with gas central heating | Mostly less than 1,5 kW None exceeded 3 kW | 1,5 kW |
| b) Local authority housing without central heating | Mostly 1,3-2,0 kW, all under 3 kW | 2,0 kW |
| c) Private housing similar to (b) | Mostly 1,3-2,5 kW, a few up to 4 kW | 2,5 kW |
| d) Larger privately owned dwellings with non-electric central heating | | 2,0 kW |
| e) Larger privately owned dwellings without central heating installed | | 3,0 kW |

#### 6.4.4 Proposals for adoption in South Africa

Since the above recommendations relate to colder UK conditions, we propose that the admds for domestic consumers shown in Table 6 should be adopted in South Africa.

Where the domestic consumers live in a factory or mine township the above figures should be increased by 30 to 50%, because of the similarity of habits of the consumers.

**Table 6: Recommended design admds for residential townships in SA**

| Type of housing | Type of winter | Recommended design admd |
|---|---|---|
| (a) Local authority sub-economic | Warm | 1,5 |
| | Cold | 2,0 |
| (b) Local authority economic and similar size private housing | Warm | 2,0 |
| | Cold | 2,5 |
| (c) Larger privately owned dwellings | Warm | 2,5 |
| | Cold | 3,0 |
| (d) Luxury houses (stands over 750 m², pools, saunas, air conditioning, and/or underfloor heating) | | 4,0 - 5,0 |

### 6.5 Coincidence factors

The similtaneous maximum demand (MD) is the total load of a number of consumers (n) at a specific time. Consumers reach their individual maximum demands (I) at differnet times. The average contribution (admd) made by each consumer to the simultaneous maximum demand, compared with his individual maximum demand, is termed the coincidence factor (CF).

CF = MD ÷ nI = admd ÷ I

The choice of CF for small groups of consumers is an important

scaling factor for the sizing of the components of the supply system. It is used in calculating the transfer capacity of transformers, circuit breakers and heavily loaded conductors.

Bary (Ref 6) hypothesised that the coincidence factor of a consumers folows the form

$$CF_n = CF_\infty + \frac{(1 - CF_\infty)}{n} \quad (1)$$

and that $CF_\infty$ depends on the class of consumer as characterised by the appliances installed, the monthly load factor and the methods by which the supply authority controls the use of electricity. Bary found that test data compiled in 1938 and 1939 fitted his assumed empirical equation reasonably well and that $CF_\infty$ varied from about 0,25 to 0,65 for domestic consumers.

The coincidence factors used in the UK reports of 1954 and 1966 are based on the form hypothesised by Bary. (The factors are not given in the reports but can be derived from the loss of diversity factors in the reports - see Appendix 1). The coincidence factor in these reports is dependent on the admd adopted.

Hamilton (Ref 5) and Rusck (Ref 24) took a statistical approach to the coincidence factor, deriving.

$$CF_n = CF_\infty + \frac{(1 - CF_\infty)}{\sqrt{n}} \quad (2)$$

Rusck found that $CF_\infty$ in this relation lay between 0,1 and 0,2.

Hamilton identified that $CF_\infty$ depends on the spread of individual demands at the time of maximum demand and the period over which the peak load occurs.

The differences between the values of $CF_\infty$ identified by Bary and Rusck arise from two factors:

- the character of the load, defined in terms of the type and number/consumer of electrical appliances, and the load factors of the consumers
- the period over which the maximum demands are measured, eg simultaneous, quarter hour and half hour.

### 6.6 The effect of coincidence factor on the definition of admd

The admd is defined as the system maximum demand divided by the number of consumers as n tends to infinity. If a coincidence factor of the form $a + bn^{-1}$ is used then there is little change in the admd once groups of over 100 consumers are considered. The same change occurs only for 10 000 consumers when a coincidence factor of the form $a + bn^{-1/2}$ is adopted.

In practice, demands and coincidence factors are often stated in the following form:

amdm at substation = 3 kVA
coincidence factor for 11 kV feeder = 0,9
coincidence factor at load centre substation = 0,85

This example effectively adopts a coincidence factor of the form $a + bn^{-1/2}$. Therefore when admd is quoted at the substation level, it is important to define the form of the coincidence factor relation which is to be used. No ambiguity arises, however, if the admd is quoted for an infinite number of consumers and a loss of diversity factor is adopted.

### 6.7 Loss of diversity

An alternative analyses of the statistical distribution of individual demands, similar to that of Hamilton and Rusck and based on the approach by Davies and Paterson (Ref 25), brings a shaping factor for the spread of individual demands into the coincidence factor relation. It also formally introduces the concept of the confidence which can be placed on the estimate of the load of a sample of consumers. (See Figure 1).

This analysis defines the "loss of diversity", LD, from the admd as the sample size decreases:

$$LD_n = 1 + \frac{Z_{\alpha/2}}{s\sqrt{n}} \quad (3)$$

where $Z_{\alpha/2}$ = area under the standard normal distribution for the selected confidence level $(1-_\alpha)$
s = load shaping factor of distribution curve for the class of consumers, $\bar{I}_{/\delta x}$ (where $\bar{I}$ = admd)
n = no of consumers

This loss of diversity factor cannot be compared directly with coincidence factors. However, the coincidence factors can be expressed as loss of diversity factors according to $LD_n = CF_n \div CF_\infty$.

Figure 2 indicates the loss of diversity factors derived from different sources.

It is not easy to assess which of these different relationships is the most suitable for use in system design insufficient information is available regarding practical installations. Data is being collected for South African installations of different characteristics. Until the results are available, designers will have to make design decisions on the basis of their own experience. ilt is most important, that the basis adopted for a design is clearly identified, especially where comparisons (such as cost) are made between different designs.

**Figure 1 – Normal distribution**

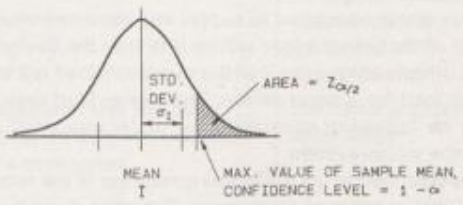
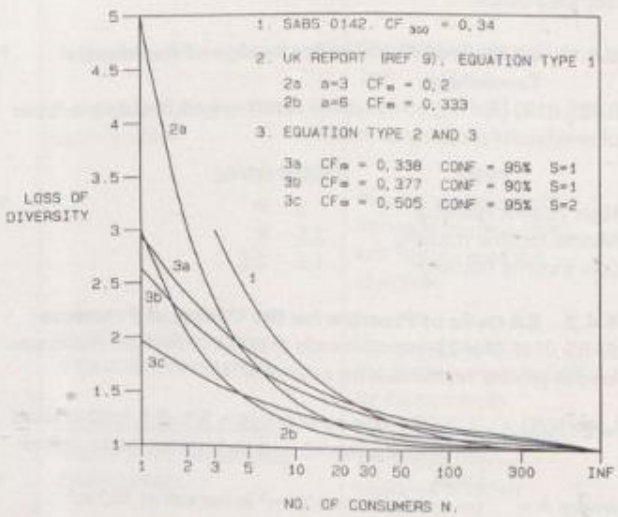



**Figure 2 – Loss of diversity**




### 6.8 Significance of load shaping factor

The load shaping factor, $s = \bar{I}_{/\delta x}$, describes the spreak of individual maximum demands in terms of the mean maximum demand or admd.

In the UK recommendations the loss of diversity factor (and hence coincidence factor) is a function of the admd. Hig admds are assumed to occur where there is a substancial electric cen-

tral heating load. High coincidence factors are associated with these consumers because there is a high probability that the demands of individual consumers will be at or near their maximum values at the same times.

In SABS 0150 the coincidence factors are independent of the admd. The individual maximum demand is defined by the assumed admd, or the admd is defined by the individual maximum demand.

There has been a tendency in South Africa to limit the maximum demand of the individual consumer by one or more methods, such as:

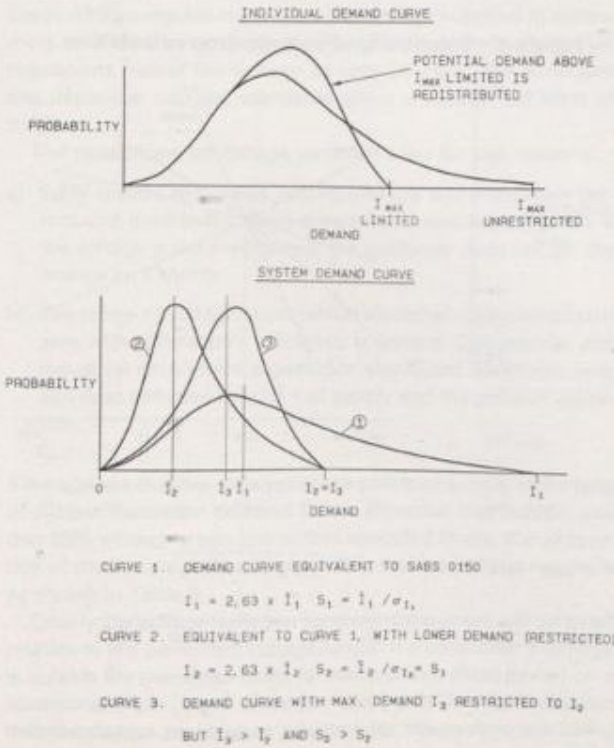
- ripple control of water heating
- switches or relays to disconnect the water heater when the stove is switched on
- load limiting circuit breakers
- demand tariffs.

The restriction on demand does not prevent the use of energy entirely. In most instances, it only defers it to a leter period. Therefore the duration of demands close to the restricted maximum demand is extended. When the individual maximum demand is constrained, the mean demand will be closer to the individual maximum demand than when the individual demand is not constrained.

This was clearly illustrated during the early development of Welkom (Ref 7). For the first couple of years the only houses were for mine employees. They had electric stoves, electric water heaters, and sockets in each room for portable electric heaters. The design was based on 4 kW per house (100 consumers) with a high diversity factor. During the first winter a maximum after diversity demand of 4,3 kW per house was recorded with 500 houses connected. Because there were constraints on the available supply, 4kW load limiting breakers were fitted to all domestic installations, reducing the after diversity demand to 6-3 kW.

A limit imposed on individual maximum demands modifies the distribution curve of loads, as illustrated in Figure 3.

**Figure 3 – Modification of load distribution curves by demand limiting**




CURVE 1. DEMAND CURVE EQUIVALENT TO SABS 0150

$I_1 = 2,63 \times \hat{I}_1 \quad S_1 = \hat{I}_1 / \sigma_{I_1}$

CURVE 2. EQUIVALENT TO CURVE 1, WITH LOWER DEMAND (RESTRICTED)

$I_2 = 2,63 \times \hat{I}_2 \quad S_2 = \hat{I}_2 / \sigma_{I_2} = S_1$

CURVE 3. DEMAND CURVE WITH MAX. DEMAND $I_3$ RESTRICTED TO $I_2$

BUT $\hat{I}_3 > \hat{I}_2$ AND $S_3 > S_2$

When coincidence factors (or loss of diversity factores) appropriate to systems where the individual demand is not restricted, are applied to the design of systems with restricted individual maximum demands, the actual admd will probably be under-estimated.

Where many consumers have the same habits, the shape of the load curve is modified in a similar way: both admd and s will be higher than in a normal township of otherwise similar characteristics.

## 7. VOLTAGE DROP CALCULATIONS

On a balanced three-phase system, the current in each phase is equal and no current flows in the neutral. In practice, the loads are variable and unbalanced and the out-of-balance current flows in the neutral.

The effects of load imbalance and loss of diversity have to be taken into account when calculating the voltage drop in a distributor. This is done most simply by applying an unbalance correction factor to the volt drop calculated for a balanced load with all consumers taking a demand equal to the admd. A loss of diversity factor is applied to allow for loads exceeding the admd.

A simplification usually made is to express all loads along and at the end of the cable as a terminal load and calculate the cable loading in kVA.m. The voltage drop in a feeder is then given by:

$$V = a\, k_l\, k_v\, L \left[ \frac{nd}{2} + nt \right] \times \frac{VD}{E^2} \times 100 \qquad (4)$$

where V = volt drop (% of nominal phase-neutral voltage) in the most heavily loaded phase
a = admd (kVA)
$k_l$ = loss of diversity correction factor
$k_v$ = unbalance correction factor
L = cable length (m)
nd = no of consumers distributed along the cable
nt = no of consumers at cable end
VD = volt drop (mV/A.m) for selected cable, assuming balanced load conditions
E = rated line voltage (V)

Charts have been prepared to give a graphic solution to this equation (Ref 14).

### 7.1 Unbalance correction factor

In most cases the unbalance correction factor is a much simplified representation of the statistical distribution of the loads across the phases, taking into account the variability of demand and the effect on volt drop of the non-constant neutral current.

In SABS 0142 (Ref 23) the unbalance correction factor is applied to the cable impedance. It is independent of the number of loads supplied since, in most cases, a single load of constant unbalance is supplied. A similar method, using a constant unbalance correction factor, has been proposed for township distribution design (Ref 16). Such methods are inappropriate for township distribution because the effect of unbalance depends on the configuration of the feeder and the number of consumers.

In the UK recommendations (Ref 8, Ref 9) an unbalance correction factor was based on the imperical determination of unbalance:

$U = N^{-1/2}$, where N = no of consumers.

A mean value for the effect of unbalance on voltage drop was adopted:

$F1 = 1 + 4,14U$

A second correction factor was applied for the effect on voltage drop of the loss of diversity of a sample of consumers:

$F2 = 1 + k/aN$
where $k = 8$ (Ref 8)
or $k = 12$ (Ref 9)
and $a =$ admd

The combined correction factor $k_i k_v = F1 \times F2$.

Davies and Paterson (Ref 25) took an alternative, statistically based approach to the formulation of unbalance correction factors for unbalanced distibution systems. They calculated the value of

$$\frac{\text{balanced voltage regulation } \bar{V}}{\text{std.dev. of volt drop along phase conductor } \delta_v}$$

for feeders with distrubuted, branched and terminal loads.

Two important points arise from Davies and Paterson's approach. The extent of unbalance allowed for in the design is determined by the confidence level adopted. Further, the unbalance is affected by the shape of the maximum demand current distribution, s. (see Equ 3 in 6.7).

Davies and Paterson analysed distributed loads along a feeder, with $s = 1$. Unbalance correction factors derived from their analysis are indicated for different confidence levels in Table 7, together with corretion factors from the 1966 UK recommendations (Ref 9).

In 1981 a statistical method was described for calculating demands and voltage drops from the energy demand curves for specific types of consumers (Ref 26). The method was used to check previous designs made in terms of the 1966 UK recommendations and gave voltage drops averaging 15% less for a given network.

**Table 7: Unbalance correction factors**

| TOTAL CONSUMERS | $k_v$ AT CONFIDENCE LEVEL | | F1 FROM UK RECOMMENDATIONS |
|---|---|---|---|
| | 99% | 95% | |
| 3 | 3,33 | 2,65 | 3,39 |
| 6 | 2,74 | 2,23 | 2,69 |
| 9 | 2,46 | 2,03 | 2,38 |
| 12 | 2,27 | 1,90 | 2,20 |
| 15 | 2,15 | 1,81 | 2,07 |
| 18 | 2,06 | 1,75 | 1,98 |
| 21 | 1,98 | 1,69 | 1,90 |
| 24 | 1,92 | 1,65 | 1,85 |
| 27 | 1,87 | 1,62 | 1,80 |
| 30 | 1,83 | 1,59 | 1,76 |

## 7.2 Cable parameters

The voltage drop (VD) in mV/A.m for a selected cable under balanced load conditions can be replaced with the cable impedance expressed in ohms/km.

The resistance of a cable is specified by SABS as the maximum resistance which the cable may have at 20°C (Ref 27). In the same specification "standard" values of resistance are given which are lower than the maximum values, and correction factors are provided for different conductor temperatures. For cables with low load factors, in which the peak loads occur for only short periods and do not approach the continuous thermal rating of the cable, the operating temperature is unlikely to exceed 40°C. In fact, the UK recommendations were based on conductor temperatures of 30°C. For large cable sizes the reactance of the cable becomes significant relative to the resistance.

The cable parameters based on the standard resistance (Ref 27) adjusted to 40°C operation, and typical reactances (Ref 28) are shown in Table 8.

**Table 8: Impedance of PVC multicore cables**

| CONDUCTOR AREA $m^2$ | IMPEDANCE (OHMS/KM) AT 40°C | |
|---|---|---|
| | COPPER | ALUMINIUM |
| 10 | 1,86 | - |
| 16 | 1,17 | 1,91 |
| 25 | 0,748 | 1,22 |
| 35 | 0,537 | 0,876 |
| 50 | 0,380 | 0,616 |
| 70 | 0,276 | 0,443 |
| 95 | 0,210 | 0,330 |
| 120 | 0,171 | 0,265 |
| 150 | 0,144 | 0,216 |
| 185 | 0,124 | 0,181 |
| 240 | 0,106 | 0,147 |
| 300 | 0,096 | 0,125 |

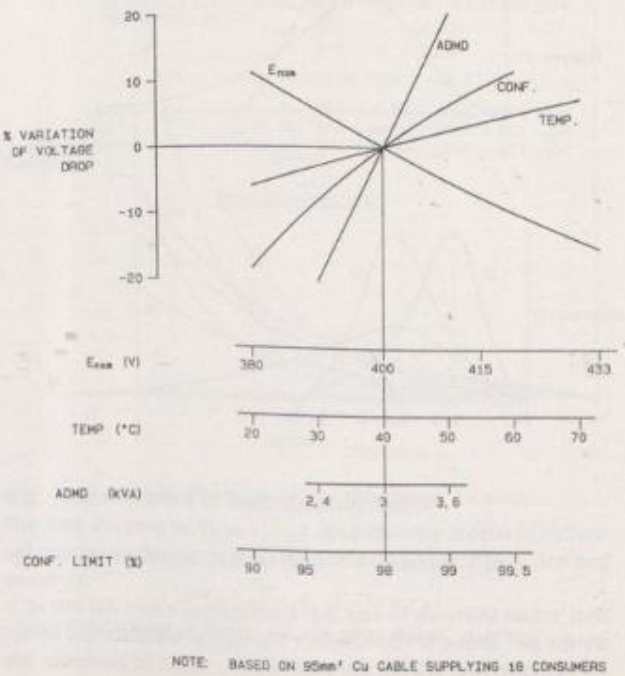
## 7.3 Sensitivity

The percentage volt drop along the length of a given cable is sensitive to the following factors assumed in the design:

- nominal voltage of the system
- admd
- assumed cable resistance
- confidence limits adopted.

These are illustrated in Figure 4.

**Figure 4 – Sensitivity of voltage drop calculation**




NOTE: BASED ON 95mm² Cu CABLE SUPPLYING 16 CONSUMERS

The choice of 380 V instead of 400 V as the design voltage for the feeder depicted in Figure 4 has the same effect on the calculation of per cent volt drop as:

- an increase of design admd by about 10% (eg 3,3 kVA instead of 3 kVA), or
- the adoption of maximum allowable cable resistances at 60°C instead of standard values at 40°C, or
- the adoption of a higher confidence level for the unbalance correction factor (eg 99,4% instead of 98%).

When the calculation of volt drop is made using a chart, the values of cable resistance nominal voltage and confidence levels have been defined by the disgner of the chart, but are not useally declared. Similar uncertainty arises in the application of computer "desighn" programs using undisclosed parameters and formulae.

## 8. ECONOMICS

Good engineering design take into account the total system costs.

### 8.1 Cost of losses

Distribution network losses occur mostly in transformers and cables. The size of these components according to the expected maximum loads, within confidence limits higher than 90%. Even at the time of system maximum demand, the currents and voltage drops in less heavily loaded feeders and phases will be much lower than those operating at the design limit. Further, the loads in a residential distribution system will be well below the admd most of the time.

The cost of losses is significantly affected by the load factor in the different components of the system. The load factor of individual domestic consumers with unrestricted demand is typically between 0,05 and 0,15 and the load factor of the transformers will not normally exceed 0,3. The load factor in the medium and low voltage cabling is usually about 0,25.

The capitalisation of losses has been described in detail in a paper presented to the AMEU by Palser (Ref 29).

### 8.2 Limits of voltage regulation

South African regulations require the voltage supplied to consumers to vary by not more than ±5% of the declared voltage. UK regulations permit the voltage to vary by ±6%. The American and Japanese national standards allow a voltage variation of ±10%.

The restrictions on voltage variation arise for two reasons:

a) Early meters measured amprere-hours and maximum current and, even today, there are some current related tariffs. If the voltage is not maintained, the customer does not get the energy he expects.

b) The range of voltages over which electrical equipment operates with satisfactory efficiency is limited. Commercial and industrial consumers experience significant additional voltage drop between the point of supply and the point of utilisation.

If we assume that the voltages at the points of supply at the time of system maximum demand follow a normal distribution, and that 99% of consumers are within specified limits, the proportion of consumers with voltages within various voltage ranges is as shown in Table 9.

Clearly the voltage variation for most consumers will be small relative to the permitted voltage range. If a consumer's voltage is outside the permitted limits for more than a short period or a occasional basis (say 4 times per year) then it is an indication that the design parameters adopted for the system are being exceeded in practice. The system should be monitored and reinforced where required.

**Table 9: Range of voltages at system maximum demand**

| DEFINED OVERALL VOLTAGE VARIATION | 10% | 15% | 20% |
|---|---|---|---|
| Range of voltages about the mean | % of consumers within voltage range | | |
| ± 2% | 69,7 | 50,8 | 39,4 |
| ± 3% | 87,7 | 69,7 | 56,0 |
| ± 5% | 99,0 | 91,2 | 80,2 |
| ± 7½% | >99,99 | 99,0 | 94,7 |
| ± 10% | - | 99,96 | 99,0 |

The additional cost of losses incurred in adopting a wider permitted range of supply voltage depends on the loss load factor. Since the loss load factor in residential distribution systems is low, it is usually economic to extend the permitted voltage range. Therefore it is proposed that the permitted voltage range in residential townships be extended to + 5, - 10% ofnominal voltage.

The adoption of this wider voltage range would generally result in reduction of the total capital and operating cost of systems.

An aspect of the practical implication of the wider voltage range is illustrated in Appendix 2.

### 8.3 System Reinforcement

An important choice for system designers is whether to install a system adquate for the maximum load which could develop, or to adopt a lower design load and provide for the reinforcement if and when the system requires it.

Obviously the practical aspects of reinforcing a system in an old residential area have to be considered. The presence of other services, surfaced driveways and sidewalks and the need to maintain access for residents all add to the costs of reinforcement. An economic choice can only be made if these costs are quantified. It is also necessary to quantify the risk that the additional initial capital investment will not be productive. The extra capacity may not be required or be located in the position to meet the needs of load development; in either case additional capital investment at an early stage would give little or not economic return.

It would be intersting to know the extent of utilisation (or the spare capacity) of existing distribution systems around the country.

### 8.4 System Lifetime

The assumed system lifetime also has economic implications for the supply authority. Many older municipalities operate systems which were built long ago and have been fully paid for. But these systems are not replaced. The implication for the system designer is that a higher capital investment in components and systems to reduce maintenance, operations and administration is justified if a longer system lifetime is assumed.

### 8.5 Maintenance, operations and administration

Few supply authorities keep comprehensive fault records and many do not carry out planned maintenance programmes. Nor do the supply authorities keep separate records of the full costs of maintenance, operations or administration.

It is often difficult, therefore, to identify the effects of additional capital investment on the running costs of the system.

This is a basic issue underlying the selection of components appropriate to the objectives of the network.

## 9. COMPONENT SELECTION

The selection of system components must take into account how each component affects the performance of the system, by itself and in combination with the other components.

The main objectives in component selection are shown in Table 10.

Usually the cost objective is incompatible with the other objectives and compromises have to be sought.

**Table 10: Component selection objectives**

1. To avoid system failure
2. To ensure the safety of the public and system operators
3. To avoid components being damaged by the effects of failure of other components in the network
4. To restrict the extent and duration of outages when failure occurs
5. To reduce maintenance requirements
6. To avoid unnecessary expenditure

Reliability analysis of electricity supply systems has been mainly directed at the generation and transmission elements. Distribution systems are more difficult to analyse bacause of the larger number of combinations in which the components can be assembled. However, reliability indices have been proposed which are suitable for application to distribution systems (Ref 11). Reliability indices are useful for the comparison of alternative configurations of network components, but need to be based on reliability (or failure) data appropriate to the different components.

Safety is particularly difficult to quantify. To what extent has each additional safety measure introduced during the last 50 years increased operator and public safety, and at what cost? Are the safety standards in electricity supply design consistent with safety in other public services, such as roads? Such questions remain unanswered.

In the absence of quantitave techniques, supply authorities adopt standard practices for network design and component selection. The practices in different countries differ significantly. To a lesser extent the standard practices of supply authorities in South Africa also differ. Table 11 indicates some standard practices in South Africa and some of the alternatives which could be used. In several instances an alternative practice, used by responsible supply authorities elsewhere, is not covered by South African standard specifications or guidelines.

These alternatives affect reliability, maintenance, safety and cost. The adoption of some practices also affects the suitability of others. Therefore a complex set of alternatives is presented to the system designer.

Simply analysis of the financial or other impact of a specific choice may be misleading. For example, the admd-cost relation analysed with one set of assumptions can be significantly different from that based on different assumptions (Ref 8, Ref 30).

An example of the multiple effects of a single choice is illustrated in Table 12.

It is important to recognise3 that standard practices adopted several years ago may no longer be appropriate. Social, economic and technological changes similar to those identified in Section 2 lead to changes in objectives and in how they are attained. South African distribution system practice has followed UK standards in most respects. Perhaps serious consideration shoul be given to alternative methods and equipment used in Europe, America and developing countries.

**Table 11: Some alternatives for network design component selection**

| STANDARD PRACTICE | ALTERNATIVES |
|---|---|
| Medium voltage is 11 kV | Higher or lower medium voltage levels |
| All underground cable armoured | Underground cables not armoured but screened |
| All distribution transformers are three-phase units | All distribution transformers are single phase units; two or three transformers are installed where three-phase supplies are required |
| Cable-transformer connection through a ring main unit | Cables connected directly to transformers, through off-load isolators or load-break connectors |
| Each transformer protected by a primary fuse | Individual transformers unprotected, or a group of transformers and associated cabling protected by one fuse |
| Corrosion-resistant steels used for transformers and kiosks | Painted or galvanised steel or glass fibre enclosures used for equipment housings |
| Transformers hermetically sealed | Bolted transformers with breathers used |
| Fully underground distribution | Part or all of distribution overhead |
| Metering installed in kerbside kiosks | Metering installed on the consumers' premises |
| Medium voltage system effectively earthed | Impedance, resistance or Peterson-coil earthing or medium voltage system |
| SABS voltage withstand ratings adopted | IEC voltage withstand ratings adopted |
| Multiple earthing of LV systems | Single point earthing of LV systems |
| Individual service connections from distribution kiosks | Tee connection of consumers' service cables to distribution cables |
| Distribution system located in road reserves and public spaces | Mid-block distribution |

## 10. CONCLUSIONS

The planning and design of electricity systems involves a complex combination of many decisions. THe scop of decisions includes:

1. The size of the load to be supplied, the distribution of individual loads at the time of system maximum demand and the loss of diversity assumed to occur within the overall system.
2. The voltage limits imposed on the supply system, the statistical confidence limits adopted in the design and the procedure used to allow for the voltage drop arising from unbalanced loading along a feeder.
3. The load factor and loss load factor assumed for individual consumers and all components of the system.
4. The reliability and availability desired at each level of the system, eg individual consumer, distribution kiosk or transformer.

**Table 12: Effects of choice of metering system**

| CHOICE | IMPLICATIONS | | |
|---|---|---|---|
| | NO METERS | CONVENTIONAL METERS | PREPAYMENT METERS |
| Locate meter in house | N.A. | Unsuitable | Yes |
| Consumer confidence in meter reading | N.A. | Low with kerbside metering | High |
| Is load-limiting necessary | Yes | No | No |
| Affects admd and diversity assumptions | Yes | Only with load limiting | Only with load limiting |
| Isolator needed for dis-connections | Yes | Yes | No |
| Size of meter/distribution kiosk | Medium | Medium. Large for kerbside metering | Few required, small |
| Meter readers required | No | Yes | No |
| Routine installation inspection | Required | Done by meter reader | Required |
| Billing system | Easily incorporated in rent billing | Necessary | Not required |
| Bad debts | Yes | Yes | No |
| Theft of service | From upstream of circuit breaker | Limited by kerbside metering | From upstream of meter |

5. The lifetime of the system and the need for (and cost of) reinforcement, extension and maintenance during this assumed lifetime.
6. The selection of network designs, components and installation techniques in accordance with local standard practice, concepts adopted from elsewhere, or alternatives developed for a specific application.

The decisions affect:

1. The capital cost of the system.
2. The performance of the system and the quality of electricity supply.
3. The operating, maintenance and administrative costs of the supply authority.
4. The flexibility with which the system can be modified to meet changing conditions.
5. The cost of electricity supplied to consumers.

This paper has descibed some of the alternatives which can be adopted. It explained the background, so that an appropriate choice can be made. The adoption of standards which are different from the present practice in some South African supply authorities is recommended; in particular for the design demand, loss of diversity, unbalance and permitted voltage variation. Designers and supply authorities should also consider adopting networks and components used elsewhere which be appropriate to the needs of some South African communities.

Above all, this paper has tried to show that the art and science of electricity distribution planning and design should not be reduced to a paint-by-numbers exercise. Appropriate engineering designs will only be achieved with a proper understanding of the broader implicaitons of our technical decisions. Then we can meet the multiple objectives of the many interest groups involved in electricity supply.

## 11. ACKNOWLEDGEMENTS

The contribution of three important groups is acknowledged:

a) The clients and supply authorities with whom HKS has worked. Some have encouraged the development of innovative approaches and appropriate design. Others, by their opposition to changes in standard practice, have tested the concepts as they have developed and have provided a better understanding of the factors which are important to different people.
b) The researchers and system designers who, by publishing research results, descriptions of systems and operating experience, have built up a valuable record of electrity supply engineering.
c) My colleagues at HKS who contributed their comments and valuable criticism.

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## APPENDIX 1

### COINCIDENCE FACTORS USED IN DIFFERENT REPORTS

The 1954 and 1966 reports published in UK (Ref 8,9) provide for a demand of N consumers according to the formula:

Demand = $aN + k$

where a = admd and k is a constant

When N= 1, the demand of 1 consumer = $a+k$
The demand of N consumers without diversity = $N(a+k)$
Therefore the coincidence factor applicable to N consumers is

$$CF_N = \frac{aN+k}{N(a+k)}$$

For $N = \infty$, $CF_\infty = \frac{a}{a+k}$

$$CF_N = CF_\infty + \frac{1-CF_\infty}{N}$$

which is the form of equation (1) in section 6.5.

In the 1954 Report, k= 8 and 8= 3.

In the 1966 Report, k= 12 and a was given a range of values, typically 3 and 6.

The coincidence factors derived from these parameters are shown below. For comparison, the coincidence factors from SABS 0150 (Ref 14) are also indicated.

| No of Consumers N | Coincidence factor CF | | | |
|---|---|---|---|---|
| | k = 8 a = 3 | k = 12 a = 3 | k = 12 a = 6 | SABS 0150 (1983) |
| 1 | 1,0 | 1,0 | 1,0 | 1,0 |
| 2 | 0,64 | 0,60 | 0,67 | 0,68 |
| 5 | 0,42 | 0,36 | 0,47 | 0,50 |
| 10 | 0,35 | 0,28 | 0,40 | 0,46 |
| 20 | 0,31 | 0,24 | 0,37 | 0,42 |
| 50 | 0,29 | 0,22 | 0,35 | 0,38 |
| 100 | 0,28 | 0,21 | 0,34 | 0,38 |
| ∞ | 0,27 | 0,20 | 0,33 | - |

**Note:** This table illustrates an internal discrepancy in SABS 0150 between the coincidence factors (expressed as diversity factors( in Table 2 and the diversity correction factors in table 3.

## APPENDIX 2

### THE EFFECT OF VOLTAGE DROP ON CONSUMER DEMAND

In distribution system design, loads are usually defined at nominal voltages, and losses are ignored except in economic evaluation.

Figure A illustrates a simplified distribuiton feeder supplying a load of nominal value 3 kVA. Most residential loads are constant resistance loads, not constanct power loads. Therefore when the terminal voltage of the load drops 5% the load falls by about 10% (Load = $V^2/R$)

Figure B illustrates the system designed for a 10% voltage drop. The total power delivered has fallen futher, by nearly 20%.

In each case, the current attributable to the 3 kVA load decreases with voltage drop, instead of increasing as it would with a constant power load.

Therefore if voltage drop calculations are based on nominal loads and nominal voltages, the practical voltage drop is likely to be lower than expected from the calculations.

The reduction in load with falling terminal voltage is used by supply authorities to reduce demand when generating capacity is constrained. The reverse effect is also seen when replacing an overloaded distribution transformer; improved voltage conditions produce a significant increase in the load supplied from the uprated substation.

**Figure A – Conditions for 5% voltage drop**

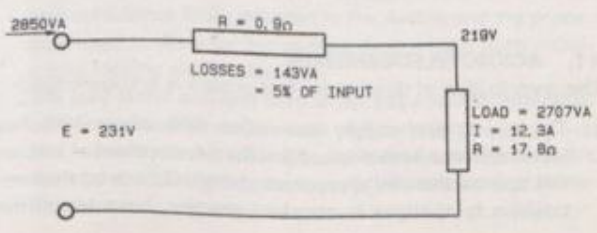
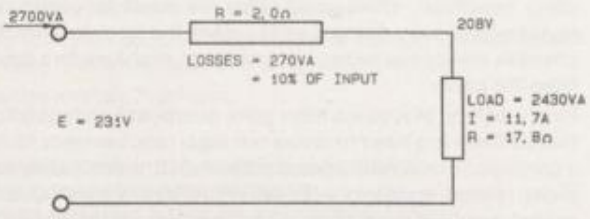


FIGURE B. CONDITIONS FOR 10% VOLTAGE DROP




**MR V A RAYNAL PRENG: AFFILIATE**

Mr Gaunt is to be congratulated on presenting a comprehensive and thought provoking paper. In his introduction, the author cites an example of how the same reticulation can cost 45% more by altering certain design parameters and accessories.

No doubt such cases do occur, but it must be rather the exception than the rule. Experience in planning and design must indicate an average cost per erf for the general run of residential townships, and the majority of developers and Town Electrical Engineers have a pretty good idea what costs to expect – allowing for cost escalation.

A difficult problem today is how to reduce costs in the face of rising inflation. Obviously one way is to reduce standards – both in continuity of supply and quality of supply – but is this acceptable to the Town Electrical Engineer who is responsible for the maintenance and operation of a system for its assumed 25 years of useful life?

In his chapter on "Planning & Design Objectives" the author is quite right in pointing out the conflicting interests of developers and supply authorities. The developer – who today generally pays the entire costs of an internal residential reticulation system is mainly concerned in providing this system at the minimum cost. On the other hand – the Town Electrical Engineer would like a system that provides for low-cost expansion, maintenance and operation. To overcome this conflict of interests, the Dept. of Community Development's guidelines were produced in 1983 and were recently revised by a Sub-Committee of the AMEU under the Chairmanship of Mr Jules van Ahlften. It was hoped that an equitable approach to both interests would be met by the production of these guidelines.

They have produced a criterion that both parties have – in principle – agreed to, and generally the results to date have apparently been satisfactory. However, the author has criticized three sections of the guidelines which he apparently considers are in need of improvement to meet the present-day demand for cost-effective planning and design.

These are:
1. Load prediction
2. Volt-drop calculations
3. Reliability of supply

I would like to comment on these three aspects as well as on the topic of "Economics."

1. **Load Prediction**
*i.e. The Determination of a Realistic After-Diversity Maximum-Demand (ADMD)*

The author, in Table 6 – recommends that the ADMD's in the present guidelines be reduced generally by 40%. His arguments are based on UK practice. Considerable thought and research has been given to this subject by several bodies in this country and the values of ADMD I illustrate in Fig. 1 gives a realistic picture of what one can expect in an all-electric South African home.

Fig 1

COST OF COMPONENTS OF ELECTRICAL RETICULATION IN TOWNSHIPS (APPROX. 800m$^2$ ERVEN)


These figures correspond with those generally specified by Reef Municipalities and recently I had occasion to have them verified in a new township south of Johannesburg. This new township of 120 dwellings, comprising mainly 3-bedroomed houses in a medium income group township, had to be fed temporarily by one 22/11kV transformer, pending a change-over from 11 kV to 22kV for the permanent supply. A 500kVA transformer was used and when the change-over took place last week its load had exceeded 600kVA i.e. an ADMD of 5kVA. When comparing our load pattern with the UK therefore, we must remember that the majority of homes in the UK use gas as well as electricity and, furthermore, make extensive use of off-peak metering.

2. **Volt-Drop Calculations**
This particular subject is extremely controversial and the 1983 guidelines came under severe attack from several quarters for its handling of this subject. So mus so that the revising Committee set up a special Sub-Committee to deal with this subject. I was chosen as Chairman and my two Sub-Committee members were Mr Swanepoel of Boksburg Town Council and Mr Allan Gower of the Durban Corporation. Resulting from several months of intensive research, a set of tables was produced which is a vast improvement on the 1983 guidelines as far as obtaining results simply, rapidly and accurately.

Mr Gaunt has given considerable attention to this subject in his paper. No doubt his esoteric approach is worthy of a thesis on this subject, but for practical purposes I recommend that designers will gain considerable benefit from using the new volt-drop tables in the revised guidelines.

3. **Reliability of Supply**
Last year Mr Gaunt delivered a paper on this subject at the SAIEE Workshop at the CSIR on "Cost Effective Distribution and Reticulation." In his paper he highlighted the costs of reliability and whether they can be afforded in this day and age. In other words, the provision of HV "Rings" is costing us millions of rands every year and are we getting our money's worth from this unproductive expenditure?

Lets look at what HV cables costs in relation to other items of expenditure.

Fig 2

COST OF COMPONENTS OF ELECTRICAL RETICULATION IN TOWNSHIPS (APPROX. 800m$^2$ ERVEN)


The sectors in this "Pie" show average percentages of costs of the various components of a typical 11kV reticulation. The highest cost is for HV cabling (25%). The guidelines mention in Section 8, that "It is desirable to provide an alternative HV supply to all substations."

When one considers how often this alternative supply is used, and the cost of providing it, one wonders if it is a luxury we can ill afford. To give an example, in 1949 one third of all HV consumers and load centres on Johannesburg City Council's system were not on a distribution "Ring." Today practically all substations are on a ring. However, early records give no indication that consumers suffered unduly form unreliability of supply.

A fair estimate of the cost of a dual supply to every substation is about 5% of the total cost of the reticulation system. When one considers where costs can be cut – perhaps some thought will be given this aspect.

4. **Economics**

The steady increase in the costs of electricity since the oil crisis 15 years ago has had a profound effect on the capitalization of costs – in particular in regard to transformers and cables. A great deal of attention is now being paid to "Total System Costs" and the "Cost of Losses" as emphasized in Mr Gaunt's paper.

*Take the case of LV cables.* In the design of a township reticulation, one has to determine a realistic ADMD. Based on this parameter we then determine the sizes of LV distributors based on a rational volt drop. If LV cables are too small, we not only lower the quality of supply but we incur higher copper losses. If LV cables are too large, the initial cost of the reticulation is high and we are guilty of excessive expenditure, but in the long run, overall operating costs are lower. All in all, therefore, it seems to be a bigger crime to under-design than over-design.

Take the case of minisubs.

Today practically everyone buys low-cost transformers for minisubs. But the cost of the transformer is only about ⅓ of the total cost of the minisub. Now, is it more economical to buy a 315kVA minisub that will run at full load, or a 500kVA minisub that will run at ⅔ full load?

A 500kVA minisub costs about 12% more than a 315kVA minisub. However, copper losses for the same load show a saving in energy cost that make a 500kVA minisub more eceonomical than a 315kVA in the long term.

I hope these comments have given you some food for thought.

**MR M P P CLARKE: RANDBURG**

Mr President, change in life is inevitable, technical change is often beneficial, often good. That we need to continually revise what we are doing is self evident. But let us be sure that changes are for the better. I would like to highlight two points from the paper.

Firstly, safety. Maybe we have gone overboard on regulation, maybe there is a need to revise our legal requirements (this is a particularly interesting possibility when one compares electricity related accidents with vehicle related accidents). But I cannot agree that as people become more accustomed to using electricity, so lower safety standards will be necessary. Most of us know that electrical accidents in sophisticated societies are just as numerous and severe as in other societies. Let us look intelligently at changes in the law for the overall benefit of all.

Secondly consider the question of standards: more accuracy in designing is one thing but "cut" designs for the sake of "moulding" consumer's habits is another. Consumers energy needs will be met; if we do not supply them our competitors will.

And this includes the quality of supply. Manufacturers are also cutting costs and that usually means a greater sensitivity to voltage variations. Computor installations and other electronic devices are becoming increasingly commonplace, to name only one type of equipment. I have personal experience of a more modern installation being unable to operate on an "old" computor supply line. And consumers are all becoming more aware of supply breaks. They are more and more demanding of the quality of the supply.

Mr President, let us not be afraid of change, but let us not rush into change just to be seen to be changing.

Thank you

**ATTIE VAN DEN BERG: KRUGERSDORP**

Mr President, I found Mr Gaunt's paper very informative and he is to be congratulated. However, if you refer to page 36 where the present Standard Practice is compared to possible *alternatives* I wish to comment as follows:-

Dealing with the maintenance of electrical distribution systems both new and old designs it is found in practice that a sound underground cable system is less labour intensive, more reliable than overhead systems. Vandalism is another problem.

Currently all distribution systems installed by the Westrand Regional Service Council are underground systems for obvious reasons. We are experiencing pressure from certain bodies to revert back to cheaper methods, i.e. overhead systems etc. to stretch the budget and satisfy more people yet to be supplied with electricity.

The Governments approach to provide equal and similar systems for all communities creates problems for designers. It is however, a pity if political consideration in future would change the thinking of designers to revert back to overhead distribution systems.

Infrastructures presently provided in black and other townships are *under* utilized as consumers are not in a position to use and pay for their electricity accounts at todays prices *unless* subsidized. This problem is a major one and needs the urgent attention and investigation of Regional Services Councils.

Present policy is to install all meter cubicles on boundaries to enable meter readers to read the meters on a regular basis. Consumers are more security minded and huge boundary

walls and dogs are about, especially in black and Indian townships.

To install meter equipment on consumers premises again, will create problems solved years ago.

Tee joints on supply cables are very cumbersome and fault finding is more difficult and is not recommended.

Dankie mnr die President.

## MR WILLEM NAUDÉ: ENERGY, POST AND TELECOM DEVELOPMENT DEPT. DEVELOPMENT BANK OF SOUTHERN AFRICA

Mnr die President, baie dankie vir die geleentheid om 'n mening te lig tov mnr Wallis, mnr T Gaunt en mnr Botes se bydraes.

In my veld het ek met die *ańdér* Kategorie verbrúiker te doen nie. Dié mense in die landelike gebiede in die selfregerende lande. Hulle het nie Beltel of 'n telefax nie. Ironies, dat baie min van die mense elektriese krag in hulle huise het, terwyl by party dorpsgebiede minisubs en hoëmastighe uittroon.

The Development Bank of Southern Africa finances development including, bulk supplies and electrical reticulation in existing residential areas where the affordability is low. Large amounts of money is neede to develop and it is generally accepted that the provision of energy, if available i.e. electrical power can improve the standard of life for the underdeveloped areas. Phased development is needed with appropriate technology, so that high capital investment of over designs for the next 30 years could be allayed and phased and resources spread to the other needing areas. This way there is more time to educate the consumer to pay for the service he is now receiving highly subsidized or free.

Ways and means to reduce the cost of electro bulk supply and reticulation methods are needed desperately. This is manifested when one experiences the cost to supply electricity in rural areas where the distances between consumers are relatively high and the areas of residential towns even bigger.

Mr President I applaud any effort, even if it means change and moving into uncertain areas, to improve existing technology to the benefit our aim to expand the usage of electricity in an appropriate and cost effective way.

Mnr die President, my pleidooi teenoor ons aas ingenieurs is, dat terwyl ons vashou aan die bekende, die goedgetoetste, en goedgeheural in die laast 30 jaar, die beste, raak die taak onmoontlik om koste effektiewe metodes te implementeer in die onderontwikkelende gebiede. In ons land in die huidegetyd, het u vereniging in baie belangrike taak om nie net 'n bydra te lewer tot die ontwikkeling van ons onafhanklike en selfregerenal lande nie maar ook die leiding te neem in die ontwikkeling van innoverende deregaterende en koste effektiewe tegnologie.

Baie dankie

## MNR L. PRETORIUS: UNIVERSITEIT VAN PRETORIA

Dit gebeur seker nie dikwels dat 'n universiteitsdosent 'n bydrae lewer tot 'n vergadering van die VMEO nie. Dit is egter vir my aangenaam om dit te doen.

Mnr Gaunt moet geluk gewens word met sy referaat: Hy het na my mening al die aspekte aangeraak, wat benodig word by die beplan en ontwerp van elektrisiteitsnetwerke. Ek gaan my bydrae net tot enkele aspekte beperk.

### 1. Tegnologiese veranderings

Ek wil net 'n woord van waarskuwing rig oor die optimisme oor supergeleiers. Hoë spanning veroorsaak hoë elektriese veldsterktes wat soos ons almal weet genoeg probleme veroorsaak. Net so gaan hoë strome hoë magnetiese veldsterktes veroorsaak wat weer genoeg ander probleme tot gevolg gaan hê.

Die toepas van "intelligente toestelle" sal ook gekortwiek word deur die ernstige tekort aan die nodige geskoolde mannekrag.

### 2. Eiendomsontwikkelaars se doelwitte

Die volgende in mnr Gaunt se referaat is nie vir my duidelik nie: "This ensures that total development cost is kept *below* the acceptable market level." Is minimum koste dan nie die aanvaarbare nie?

### 3. Ontwerper se doelwitte

Ek stem volkome met mnr Gaunt saam dat die ontwikkeling van komplekse roetines om groter teoretiese presiesheid te verkry, is slegs nuttig as dit op betroubare data gebaseer is. Die verkry van betroubare data is 'n probleem en ons het in Suider Afrika nog nie voldoende data nie. Die Dept Elektriese Ingenieurswese aan UP is besig met navorsing in hierdie verband. U moet egter nie baie opgewonde raak nie, want as ons deesdae iets wil doen, moet ons self die middele bekom en u weet self hoe skaars geld, maar veral kragstelselingenieurs is. Ek is beskikbaar vir onderhandelinge.

### 4. Voorgestelde MAnd vir gebruik in Suid-Afrika

Volgens inligting wat ek hierdie jaar by Pretoria se Elektrisiteitsafdeling gekry het, moet die volgende syfers gebruik word:

| Tipe behuising | Tipe winter | MAnd, kVa |
|---|---|---|
| Groter huise privaatbesit | Warm<br>Koud | 3,5<br>4,2 |
| Luukse huise | Kour | 8 |

In laasgenoemde geval is daar twee kleiner gebiede in twee verskillende voorstede waar die gemete syfer 12,5 kVA is.

5. Maksimum aanvraag, diversiteit, gelyktydigheid en spanningsval Simbolelys

MA = maksimum aanvraag (algemeen)
MAnd = maksimum aanvraag na diversiteit (admd)
MAb = maksimum aanvraag by bron. Bron kan wees transformator, substasie, ens.
MAv = maksimum aanvraag van een verbruiker
MAvgem = gemiddelde maksimum aanvraag per verbruiker (I)
DF = diversiteitsfaktor
GF = gelyktydigheidsfaktor (CF)
B = aantal verbruikers

**Definisies:**

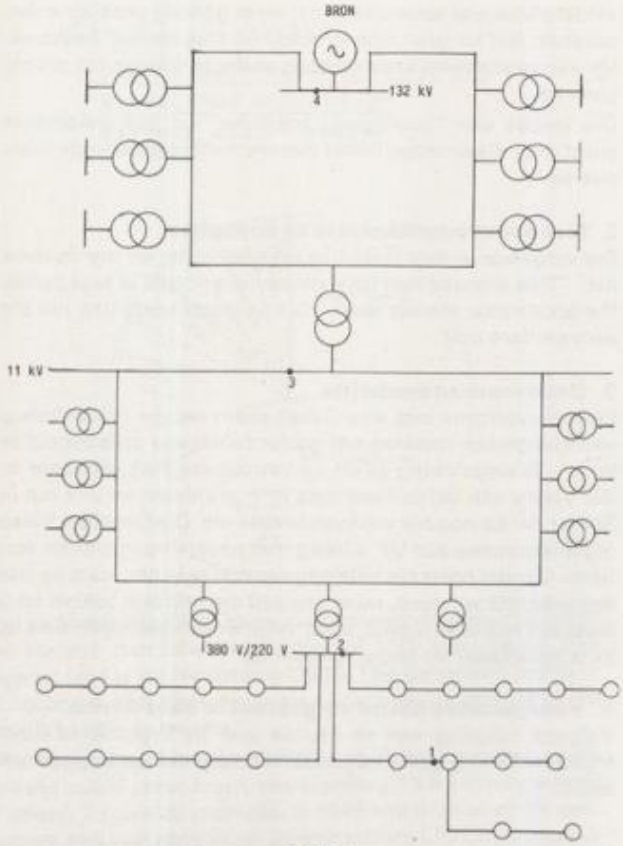
$$MAnd = \frac{MAb}{N} \quad \text{.....} \quad (1)$$

$$MAvgem = \frac{\Sigma MAv}{N} \quad \text{.....} \quad (2)$$

$$DF = \frac{\Sigma MAv}{MAb} \quad \text{.....} \quad (3)$$

$$GF = \frac{MAnd}{MAvgemm} \quad \text{.....} \quad (4)$$

Bogenoemde definisies stem ooreen met dié wat mnr Gaunt in sy referaat noem. In sy referaat sê hy dat N na oneindig neig. Dit is nie nodig dat N na oneindig neig nie, want die MAnd in dieselfde stelsel wissel van punt tot punt. Byvoorbeeld punte 1, 2, 3 en 4 in figuur 1.




FIGUUR 1

Van (1) is MAb = (N)(MAnd) ..... (5)

Van (2) is ΣMAv = (N)(MAvgem) ..... (6)

Van (3), (5) en (6) is DF = $\frac{(N)(MAvgem)}{(N)(MAnd)} = \frac{MAvgem}{MAnd}$ ..... (7)

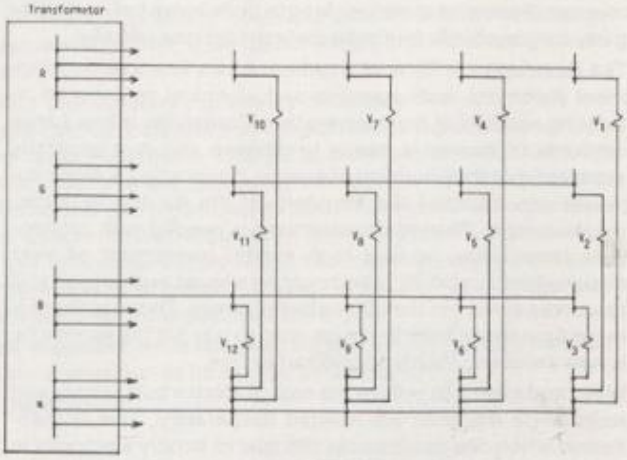
Van (4) en (7) is DF = $\frac{1}{GF}$

Die verband tussen DF en GF is dus eenduidig en al die bespreking oor die effek van gelyktydigheid op diversiteit, verlies aan diversiteit en lasvoringsfaktor lyk vir my onnodig.

Verwys nou na figuur 2

Diversiteit tussen die verbruiker op dieselfde fase lei tot die voordeel van dunner kabels en kleiner transformators; bv. diversiteit tussen verbruikers $V_3$, $V_6$, $V_9$ en $V_{12}$

Diversiteit tussen bv. $V_1$, $V_2$ en $V_3$ het geen voordeel nie, maar 'n nadeel ten opsigte van spanningsval: Indien die maksimum aanvrae van $V_1$, $V_2$ en $V_3$ gelyktydig en ewe groot is, is die neutraalgeleier se stroom nul en die spanningsval in die neutraalgeleier ten opsigte van hierdie 3 verbruikers nul. Ongelukkig is daar diversiteit en die maksimum aanvrae is nie ewe groot nie en sal daar dus 'n neutraalstroom wees. Dit moet dan by die berekening van spanningsval in ag geneem word.




FIGUUR 2

# NEW DEVELOPMENTS IN DISTRIBUTION EQUIPMENT UP TO 33 KV (CIRED 1987)

## by Mr Gordon Davies, City Electrical Engineer, Pietermaritzburg

**MR A H L FORTMANN: PRESIDENT**

Mr Gordon Davies received his academic education at Glenwood High School, Durban and his technical education at the Natal Technical College and the University of Manchester Institute of Science & Technology where he received the degree M.Sc Electrical Engineering.

Gordon gained Graduate Membership of the Institution of Electrical Engineers in 1951 and Associate Membership of the S A Institute of Mechanical Engineers in 1960.

Mr Davies is in possession of the Government Certificate of Competency in Electrical Works 1954 and Mechanical Works 1960.

From 1947 to 1955 Gordon was Assistant Electrical Engineer with the Electricity Department, Durban City Council.

He undertook a graduate apprenticeship at Witton Works of GEC from 1955 to 1957.

He obtained a Diploma in Industrial Administration from the Birmingham College of Technology.

Mr Davies was transferred to Johannesburg while with GEC as Commissioning Engineer, from 1957 to 1961.

He joined Pietermaritzburg Electricity Department as Assistant City Electrical Engineer in 1961 and was promoted to City Electrical Engineer in 1978.

He is a Fellow of the Institution of Electrical Engineers and Fellow of the South African Institute of Electrical Engineers and is also a Registered Professional Engineer.

Ladies and Gentlemen, I present to you Mr Gordon Davies.

*Mr Gordon Davies*

# CIRED CONFERENCE 1987

by Gordon Davies

The Ninth International Conference on Electricity Distribution took place in Liege and was attended by close on 1000 delegates from 37 countries including 5 from South Africa.

The program was as follows:

**Monday 4 May –**
Session 1: Substation Equipment

**Tuesday 5 May –**
Session 2 : Distrubances and Protection in Supply Systems or
Session 3 : Cables and Overhead Lines

(These two Sessions were held simultaneously so that it was only possible to attend one or other of the Sessions)

**Wednesday 6 May –**
Session 4 : Operation & Control in Public Supply Systems or
Session 5 : Utilisation of Electrical Energy in Industry & Services

(Once again these were alternative Sessions)

**Thursday 7 May –**
Session 6 : Design & Planning of Public Supply Systems.

A total of 100 papers were delivered at the Cired Conference. I have endeavoured to concentrate on those papers which have a high content of new development and which I consider to be most useful to the AMEU. I have only dealt with papers from Session 1, 3 & 6. Some of the papers delivered provided information on equipment which had been in service for some years and these have also been included.

Session 1: Substation Equipment

**e.01 CORRECTION OF INTERNAL FAULTS IN METAL-ENCLOSED MV SWITCHGEAR OF HIGH SHORT-CIRCUIT CAPACITY; EFFECTS ON SWITCHGEAR ROOMS AND THEIR SURROUNDINGS; PROTECTION OF PERSONNEL**
**Herbert Grassner Austria**

The authors discuss the safety aspects of metal-clad switchgear. Modern switchgear is being subjected to higher short circuit currents and is expected to withstand these for longer periods.

Fault currents of between 40 and 60 kA are becoming the norm. It is pointed out that tests to determine the behaviour of metal clad switchgear under conditions of arcing due to an internal fault are provided in the following standards

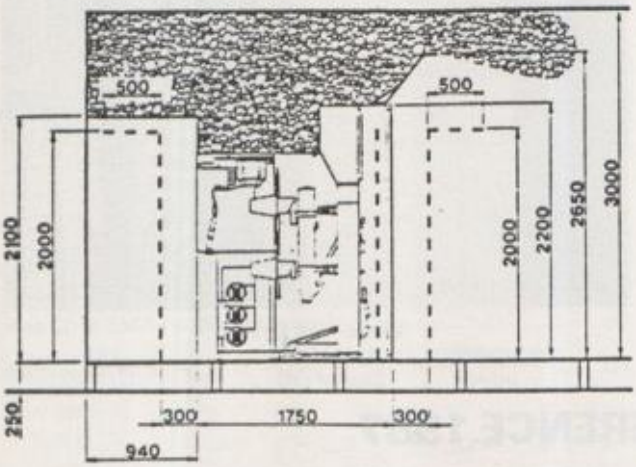
IEC 298 2nd edition including appendix AA
CENELEC – Harmonization document HD-187-5-3

However, it is not obligatory for the manufacturer to apply these tests, but is subject to agreement between the manufacturer

and the user. Figures 1 and 2 show diagrammatically two ways of ensuring the safety of operating personnel.

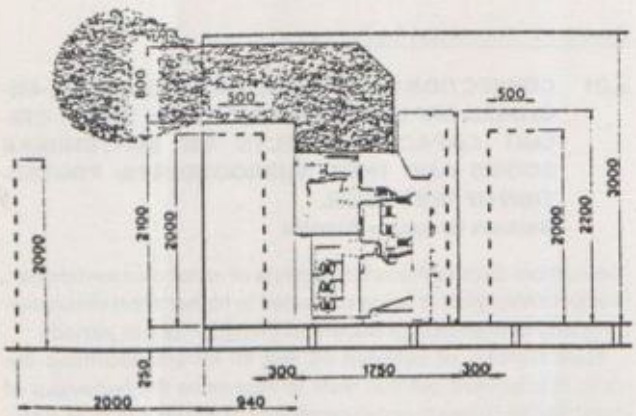
The arc tests specified in IEC 298 Appendix AA were also created with the protection of service personnel in mind, and consequently the following should be taken into consideration:

- The effects of arcing due to internal faults are determined by the short-circuit capacity of the supply and by the tripping time of the protection relay.
- Observing high standards of safeguarding ensures increased protection of personnel in the event of arcing due to an internal fault.
- In the event of arcing due to an internal fault in should still be possible for service personnel to operate switching devices without putting their personal safety at risk.
- High-energy arcs and prolonged arcing durations must not result in partition walls being burned through.
- Ejected gases, combustion residues, dust and vapours should be conducted away in such a way that personnel are not hampered in the performance of their duties. The safest method is to lead off gases directly into the open air by means of conduits designed spesifically for this purpose.




Version A Figure 1

Pressure relief upwards.
Gases are ejected via guiding sheets into the switchgear room.




Version B Figure 2

Pressure relief upwards.
Gases are ejected via an off-take directly into the open air.

## e.02 IN-SERVICE SAFETY OF SF6-INSULATED AND METAL-ENCLOSED MV COMPACT DISTRIBUTION SWITCHGEAR

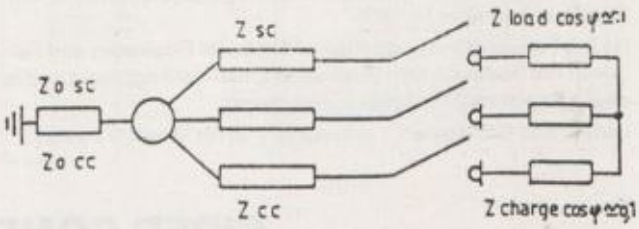
**Y. Bokshorn, R. Dides of France, G. Gallet**

In this paper the evolution and development of SF6 switchgear is discussed.

When the SF6 MV switchgear was initially used, the lack of experience did justify the extreme prudence regarding safety. Though the reliability of the design and construction, and the inherent safety of this type of product make a fault quite unlikely, as possible internal fault has not been completely excluded.

An analysis of possible dangers led us to the most unfavourable and theoretical case of a manual operation of the ring main unit switch after a leakage of SF6. The tests showed that switchgear submitted to dielectric and interrupting tests becomes vulnerable only when there is virually no more SF6. With a percentage of approximately 20% of SF6, and because of the excellent dielectric qualities of the air/SF6 micture, the probability of a fault occurence remains extremely low. Consequently, it was decided to select as a "fault scenario" a loss of SF6. The tests consists in creating a non-interruption in the switch when replacing the SF6 by air at atmospheric pressure, and using a very severe test circuit (inductive load current interruption), hence the test designation as: non-breaking test.

The internal are is initiated when the non-breaking conditions referred to previously take place, and is maintained for the maximum duration to allow the primary substation circuit breakers to clear the fault and as per the diagram here below:




To judge the effects and decide on an assessment, criteria and means have been defined to match those prescribed by Publication 298 of IEC:

- there should be no flying-off of large solid material (exceeding 60g) from the front portion of the tested switchgear;
- a mounting frame of 1,5 x 1,5 m provided with square black cottong cloth pieces being placed in front of the tested switchgear, at a distance of 30 cm so as to simulate the person who operates the unit, no piece of cloth should ignite;
- no fragment or part, whatever its size, should be projected through the above mentioned frame;
- the doors, covers, etc fitted in the front portion must remain solidly secured and not open;
- the effectiveness of the earthing connection must be preserved.

## e.03 LONG TERM BEHAVIOUR OF INSULATION-ENCLOSED M.V. – SWITCHGEAR

**J A Koningstein, A Montfoort, B Noordhuis, H F Reith, J Sikkenga Netherlands**

The service experience of insulation enclosed (cast-epocy resin) MV switchgear is evaluated by the authors.

A comparison is made between metal enclosed and insulation enclosed switchgear.

Factory-assembled switchgear is defined as switchgear with an external, complete enclosure. If this enclosure is made of metal, intended to be earthed, the gear is called "metal-enclosed

switchgear". Both designs, metal-enclosed and insulation-enclosed switchgear offer protection to the operator against hazardous approach. Both designs have their special characteristics. The safety of a metal enclosure is dependent on:

- the effectiveness of the earth connection
- the potential difference that occurs deuring earth faults
- the degree of integrity of the earthing circuit.

On the other hand, the safety of an insulation enclosure is dependent on:

- the effectiveness of the insulation
- the level of leakage currents when touching
- the degree of degradation of the insulation surfaces.

So there is a fundamental difference between metal-enclosed and insulation-enclosed equipment. The metal enclosure does not provide complete protection without a reliable earthing system, which is not a part of the switchgear.

Checking of the effectiveness of the earthing connections in practice is very important.

The insulation enclosure provides protection of its own and is an inherent part of the switchgear.

This paper indicated that tests done on insulation encased switchgear which had been in service for more than 20 years showed that none of the failures could be traced to the case resin, whereas the next paper (e.04) indicated there was a reduction of insulation level of 17% after 20 years of service.

## e.04 RISK OF DEFECTS IN MEDIUM-VOLTAGE DISTRIBUTION SUBSTATIONS BY OVERVOLTAGES IN CONSEQUENCE OF AGEING OF THE INSULATION DURING SERVICE

**W. Heib, J Sattler, W Stolz Germany**

The authors discuss the failure of equipment in substations caused by overvoltages. Three different types of overvoltages can in principle, be found:

power-frequency, switching and atmospheric overvoltages.

In complete underground networks only power-frequency and switching overvoltages should be taken into account. In overhead networks and in combined overhead/underground networks the atmospheric discharge phenomena determine the overvoltage behaviour.

From the calculation of the overvoltages the following conclusions can be drawns:

- Even in the case of an unfavourable point of the lightning stroke overvoltages higher than 100 kV can only occur in substations which are connected with overhead lines on wooden poles. In addition, this statement is valid only for very short lengts of connecting cables. With longer cables the high attenuation reduces the overvoltages below 100 kV because of the relatively long connecting cables.

## e.05 MV NETWORK CONDITIONS WITH INCREASED TRV-STRESSES TO MAIN CIRCUIT BREAKERS

**G.C. Damstra, H.G. Kistemaker, R.J.R. Waumans Netherlands**

Normally the Transient Recovery Voltage (TRV) stresses for outgoing circuit breakers in MV cable-networks are rather moderate and in accordance with the existing IEC publication 56-2.

Under certain conditions the TRV-stresses on the main circuit breakers, between the feeding transformer and the MV-busbar system can be considerably more severe, depending on station lay-out and type of connections between transformers and MV-switchgear.

Tests were carried out through which a comparison has been made between circuit breakers of different quenching principles such as minimum oil, air blast, magnetic air, vacuum, SF6 puffer type and rotating arc.

Remarkably none of these circuit breakers had difficulties in interrupting 16 kA at 10 kV under increased TRV conditions values far above the actual network conditions were applied.

Tests were carried out on eight circuit breakers, representing six different quenching principles. Some of them (minimum oil, air blast, magnetic air) are well known in MV networks. Others (vacuum, SF6 puffer and SF6 rotating arc) are more recent and less generally in use

Table 4 shows the quenching principles and ratings for the tested breakers.

**Table 4: Type and ratings of test breakers**

| breaker no. | quenching principle | $U_N$ 40 Hz (kV) | nom.break. power (MVA) | $I_k$ (sym.) (kA) | $I_n$ (A) |
|---|---|---|---|---|---|
| 1 | minimum oil | 10 | 250 | 14 | 630 |
| | minimum oil | 12 | 250 | 12 | 630 |
| 2 | minimum oil | 12 | 415 | 16 | 400 |
| 3 | air blast | 10 | 400 | 23 | |
| 4 | magnetic air | 12 | 520 | 25 | 800 |
| 5 | vacuum | 12 | 415 | 20 | 630 |
| 6 | vacuum | 12 | 415 | 20 | 630 |
| 7 | SF6 rot. arc | 10 | 350 | 20 | 630 |
| | SF6 rot. arc | 12 | 350 | 16 | 630 |
| 8 | SF6 puffer | 11 | 350 | 18 | 630 |

**Table 5: Test results (3 ø, first pole-to-clear)**

| breaker no. | type | TRV freq. (kHz) | RRRV (kV/us) | Amplitude Factor |
|---|---|---|---|---|
| LV injection | | 38 | 2,74 | 1,79 |
| 1 | minimum oil | 40 | 3,59 | 1,73 |
| 2 | minimum oil | 39 | 3,27 | 1,71 |
| 3 | air blast | | 0,61 | 0,85 |
| 4 | magn. air | | 0,54 | 0,84 |
| 5 | vacuum | 39 | 2,03 | 1,40 |
| 6 | vacuum | | | 1,39 |
| 7 | SF6 rot. air | 39 | 2,47 | 1,46 |
| 8 | SF6 puffer | 39 | 2,20 | 1,48 |

The tendency to build HV/MV substations with short connections between transformer and MV circuit braker will be continued for reasons of cost, space and loss reduction.

The rate of rise of the recovery voltage for transformer circuit breakers with short connection bwtween both breakers, generally exceeds the specified value by IEC.

The TRV conditions for the feeder circuit breakers are within or lower than IEC due to the presence of neightbouring feeders connected to the same bus.

Up to now failures have not been found and all the circuit breakers investigated show remarkable ability to withstand increased TRV steepness.

Also modern quenching principles as vacuum and SF6 show good interrupting perfomrance at high Rate of Rise of Recovery

Voltage. New designs have to be tested in an appropriate way to be sure that this performance is maintained in the future.

### e.06 A COST EFFECTIVE MODULAR DESIGN FOR HIGH DENSITY LOADS

**R.J. Coomer Australia, A.L. Hoi, J.W. Robinson**

This paper describes a modular circuit breaker concept which halves the number of 11 kV circuit breakers in a mesh network and reduces the electrical design time of a typical distribution substation to 1 or 2 man days. Other benefits include improved protection and standardisation of design and operating procedures.

Two devices have been developed to simplify the implementation of the modular circuit breaker concept. One is a 15 kV isolated group intertrip relay for tripping up to four circuit breakers at local and remote sites during system faults. The second is an economical microprocessor-based network controller for integrated backup protection and supervisory control

Figure 1 shows an example of a typical 3-feeder mesh network supplied from a zone substation using a modular circuit breaker configuration. Three radial feeders are run from independent sections of busbar at the zone substation through a number of intermediate consumer substations, and end in a mesh point. Loading is arranged so that the two feeders can carry the full load of the mesh network.

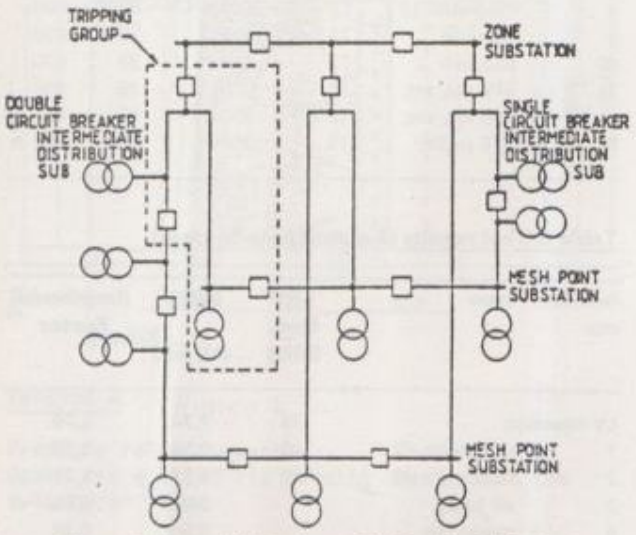



**Figure 1: Zone Substation with Double 3-Feeder Mesh Arrangement**

### e.09 A NEW AND IMPROVED WAY OF PROTECTING MV TRANSFORMER CIRCUITS

**M.C. Oakes United Kingdom**

The author describes a unique SF6 fuse-link suitable for use in ring main units. This novel single-phase device, called a DYSCON interrupter, could be referred to as a single shot circuit breaker with an inherent time grading feature. It offers the following advantages:

(i) Improved co-ordination, particularly with regard to fuse-links on the LV side of the transformer.
(ii) Very low $I^2R$ loss, leading to a fully encapsulated design.
(iii) Very high normal current ratings, up to 400A.
(iv) High service voltage up to 36 k V.

It comprises two parts as illustrated in figure 1

The first part, the fuse canister (11), which is disposable, incorporates a simple low voltage TLF fuse-element (5) fixed at one end to a disc electrode (3) and at the other end to support finger (6). The canister body is electrically isolated from the fuse-element and support conductors.

When inserted into the housing, the canister is connected by spring loaded contact fingers (12) to the terminal of the coil. The outer terminal of the coil is connected to the upstream fuse-element finger mounting cup (7).

Normally current will flow from the cable, through the support conductor to the disc electrode, through the fuse-element to the support finger and out through the bushing to the transformer. Under overload conditions, the fuse-element will melt according to its time current characteristic and an arc will become established. Due to inherent electromagnetic loop forces, this arc will very rapidly commutate to the wall of the canister, at which point the coil will become energised and in passing full fault current will generate a magnetic field, as shown schematically in figure 2. Since the arc cuts the magnetic field substantially at 90°, Lorenz forces cause it to rotate at high speed around the disc electroce and as the canister is filled with SF6 gas, at current zero the arc will become extinguished.

Of course, under earth fault conditions, the arrangement described so far would result in singel phase operation which some utilities might find unacceptable due to problems of LV voltage imbalance and ferroresonance. This problem has been overcome by the development of a self-powered cascade tripping system. In this special arrangement chemical actuators, of the type used in conventional current limiting fuses, are incorporated into the Interrupter canisters as shown in Figure 6. Application of a small signal voltage across the actuator terminal, 17 and 18, causes it to eject a striker pin which results in the element support finger 19 pivoting and thereby rupturing the fuse-element. Extinction of the arc created occurs in the normal manner described earlier.

### e.11 A NEW TECHNICAL STEP FOR PROTECTION AND CONTROL OF HV/MV SUBSTATIONS

**J M Nativel France, P Bornard, M Oddi**

The authors describe a new technique for protection and control of HV/MV substations. The aim is to increase substation security, while enhancing quality of supply. The technique has the following characteristics:

- protection relays ont he HV side of HV/MV transformers which do not require auxiliary power to trip the breakers. The relays which have a very low energy level (4,5mJ for a single phase resistive fault) are connected to a new tripping device known as a "striker pin". The striker pin is an electromechanical device with stored mechanical energy.
- a low voltage wiring implemented in a telephone technology:
- the implementation of different automatic functions in the substation computer.

**Overcurrent relay**

This independent time protection in implemented by a "double phase to ground" relay. The current transformers, associated to the feeder circuit-breakers, are used both as measuring transducers and power source.

**Resistive earth fault protection**

An inverse time-delay overcurrent relay allows to trip the only feeder affected by a low level single phase fault. This protection is energized by a specific toroidal current transformer, which provides at the same time the necessary power and an image of the zero-sequence current.

As the neutral point, on the French MV distribution system, is grounded through an impedance limiting the current to 300 of 1000 A, selectivity is achieved due to the fact that the unbal-

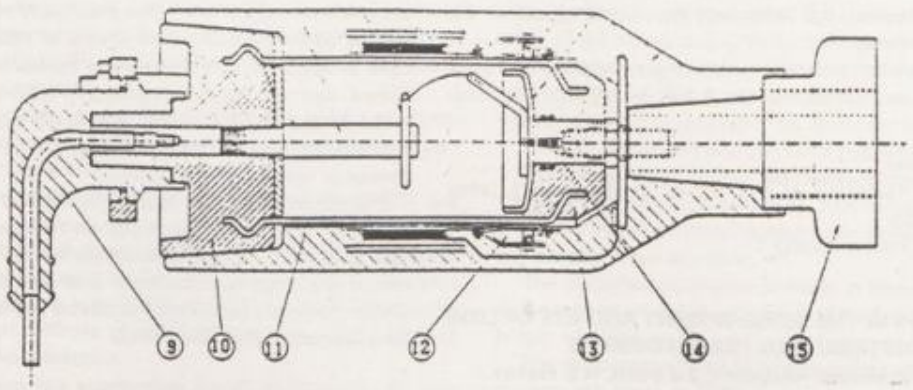



**Figure 1: Cross sectional view of Dyscon Interrupter**

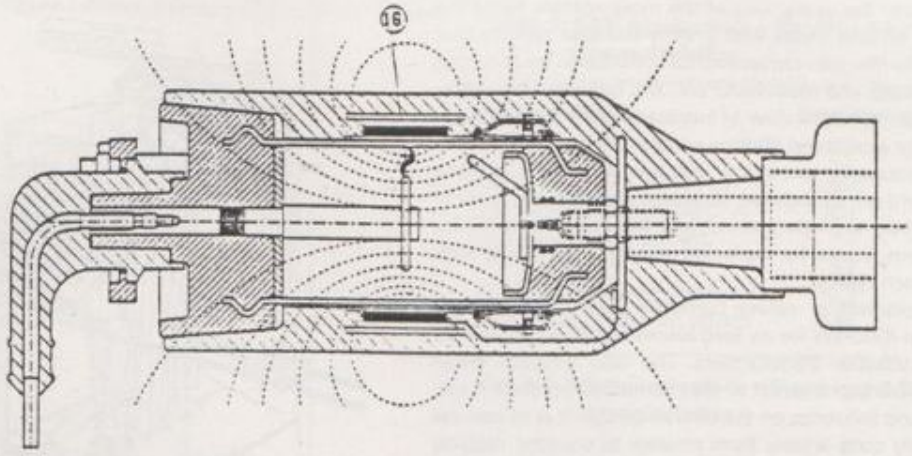



**Figure 2: Schematic view of Dyscon Interrupter under conditions.**

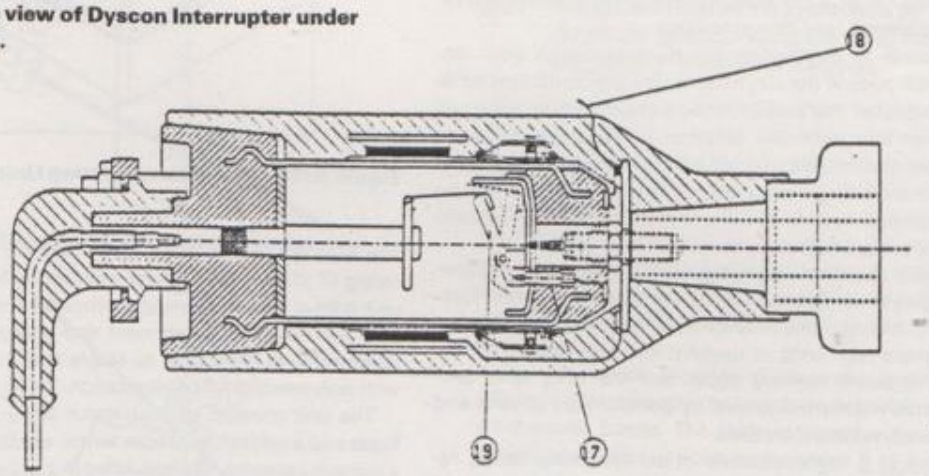



**Figure 6: Cross sectional view of tripable Dyscon Interruptere**

LEGEND:

1. DISC SUPPORT CONDUCTOR
2. CERAMIC HEAT SHIELD
3. DISC ELECTRODE
4. ELECTROMAGNETIC COIL
5. FUSE ELEMENT
6. ELEMENT SUPPORT FINGER
7. FINGER SUPPORT CUP
8. ELASTOMERIC HOUSING
9. 200A SEPARABLE ELBOW TO IEEE/ANSI STD 386
10. FUSE CANISTER MV INSULATION
11. DISPOSABLE FUSE CANISTER
12. SPRING LOADED CONTACT FINGER
13. LV INSULATION
14. FILLING & SAMPLING VALVE
15. 600A BUSHING TO IEEE/ANSI STD 386
16. ARC
17. CHEMICAL ACTUATOR
18. INPUT CONNECTION TO CHEMICAL ACTUATOR
19. PIVOTED ELEMENT SUPPORT FINGER

anced current on the faulty feeder is higher than the capacitive zero-sequence current on the healthy feeders.

This inverse time-delay relay replaces the present automatic device which locates the faulty line by switching out all the feeders successively.

A substation minicomputer, which is generally the one used for telecontrol, is in charge of the 3 following automatic functions:

- ripple control,
- automatic reclosing of the feeder ciruit-breakers (after short-circuit)
- frequency load shedding

### e.13 TRENDS IN THE DEVELOPMENT AND USE OF LOW LOSS DISTRIBUTION TRANSFORMERS

**K Frewin United Kingdom, J J Seed, A G Fisher**

There have been many improvements in distribution transformer design over the years, one of the most notable being the development of core steels with greatly reduced specific loss values. Transformer loss characeristics continue to be of central interest to utilities and manufacturers, and have recently taken on greater significance in view of increases in the capitalisation values used for evaluating lifetime costs of equipment.

The implications for use of low loss transformers in an Area Electricity Board are considered, both with regard to the types of transformer likely to be purchased, and the scope for reducing existing system losses by replacing old high loss units with those of modern design.

Typical capitalisation values currently used by Uk supply authorities are 4000/kW for no-load losses and 550/kW for load losses on distribution transformers. The ratio between these figures is of particular interest to the manufacturer, since it can have a profound influence on the overall design. It is of interest that ratios vary quite widely from country to country, ranging from 7:1 in the UK to 3:1 or less in parts of the Middle East, reflecting the different load characteristics.

Developments in distribution transformer design and construction which reduce the electrical losses are continuing to be made. it is expected that steady improvements will be achieved in the medium term, with the prospect of major reductions in no-load losses several years hence when radically new types of core material are introduced. Some of the new designs will be suitable for general Area Board use at medium voltages; others are more likely to be limited to specialist applications.

Area Boards are now reviewing their transformer replacement strategies in the light of a rising trent in replacement forecasts. There is an economic case for early replacements of some old transformers with units of modern low-loss design, on the grounds of reduced running costs, but the long term programme will be mainly influenced by general load growth and plant deterioration considerations.

From England a representative of an Electricity Board reported that in general the optimisation process is left in hands of the manufacturer, who will be provided with the necessary data from the buyer. He also mentioned the difference in approach of this matter by Area Boards and private companies, due to different policies with respect to pay-back time.

### e.16 THE RING DISCONNECTING UNIT WITH FULL RANGE FUSES – A NEW CONCEPT IN SYSTEM PROTECTION

**G J Clarke, R Rosen United Kingdom**

This paper describes a simple, low cost unit requiring minimal maintenance which is capable of protecting the transformer and disconnecting either the transformer or feeder cable. It is not a complete substitution for the conventional ring main unit, in that all operations must be carried out with the equiopment dead and the absence of potential establisehd before any operations are undertaken, but does give the supply enigeer a third choice for the connection of transformers. In addition, the unit when used in conjunction with remotely operable load break sectionalizers, can provide a cost effective future distribution system which is responsive to faults and yet will significantly reduce the excess switching carried out on today's system for maintenance purposes only.

Full range fuses can be provided in the unit for transformer potection. The fuses are designed to safely interrupt low and high fault currents, and additionally have a time-current characteristic designed to coordinate well with upstream and downstream protective devices. The device has become known as the Ring Disconnecting Unit (RDU).

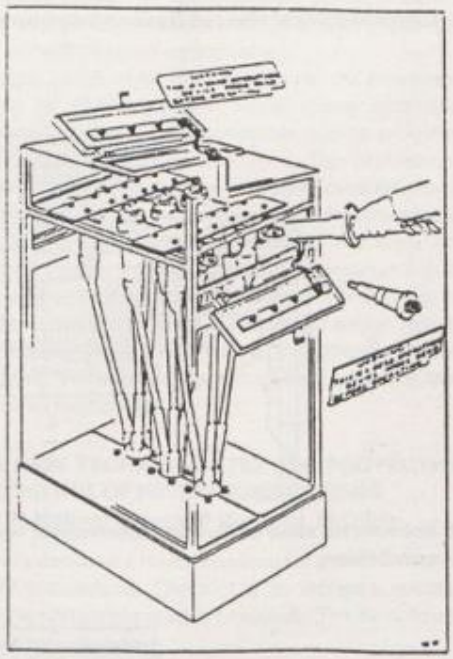


**Figure 3: The Ring Disconnecting Unit**

The RDU is rated to 24 kV, 630A with a 3 second through fault rating of 13.1 kA. The design philosophy has been to produce a unit with a simple operating procedure which disconnects cables without cable movement and accepts all the cable types common in Europe such as single and three core construction with polymeric or paper insulation.

The unit consists of an isloator body, disconnecting plugs, fuses and a cabinet. In simple terms, a cable core is connected to a contact assembly encapsulated in a polymeric housing. A busbar similarly moulded into the housing makes provision for connection to transformer or cable circuits. Connection between these is made using a cast resin "plug" incorporating an appropriate metal link. Insertion of the plug creates the electrical connection; removal and replacement by similar plugs of different construction provides isolation, or an earth or test point.

## Session 3: CABLES AND OVERHEAD LINES

### d.03 THE SAX SYSTEM – A NEW MEDIUM-VOLTAGE DISTRIBUTION MODE

**Antero Hinkkuri, Ilpo Lehtinen of Finland**

This paper deals with a medium voltage overhead construction

which is used as an alternative to aerial bundled conductor.

In view of the extensive township reticulation schemes which will have to be undertaken in the near future this type of construction might well prove less expensive and possible more reliable particularly because the lightning withstand capability of serial bundled conductor in a high isoceraunic area like South Africa is as yet unproven.

This design, known as the SAX System, for use on medium-voltage distribution networks is reported to have improved performance under severe lightning conditions.

The aluminium alloy conductors, insulated with XLPE, are configurated in a similar manner to a conventional bare wire overhead line, but with reduced spacing between the phases. Because the phases are insulated, clashing of the conductors under wind conditions is no longer a problem and experiments have shown that millions of brief contacts can occur without breakdown of the insulation.

The conductors are suspended on specially designed cost epoxy resin insulators from which are hung arc protected suspension clamps. Figure I shows a typical single circuit 3-phase SAX line.

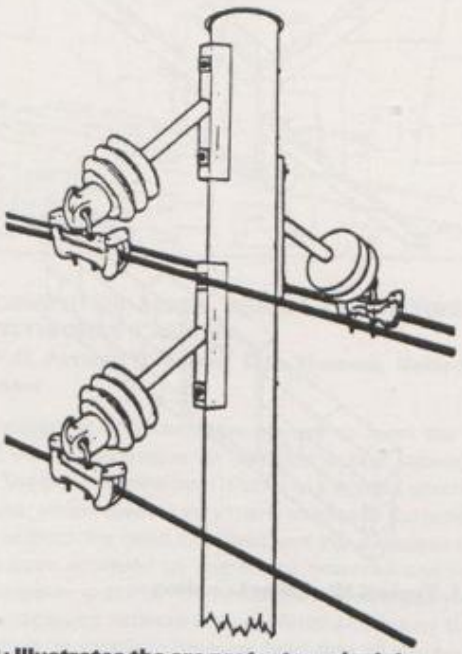


**Figure 1: Illustrates the arc protector principle**

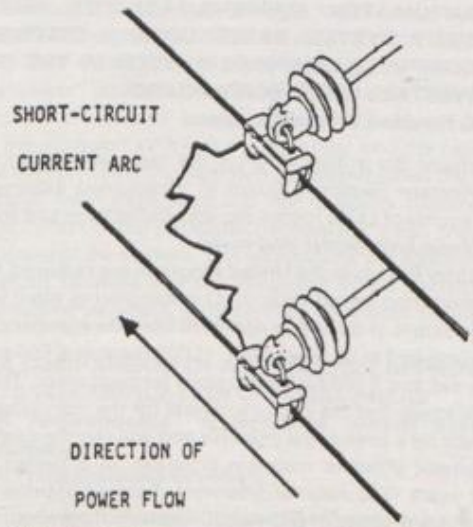



**Figure 2: Illustrates the arc protector principle**

At the attachment point, the insulation is removed from the conductor and the clamp grips, and is in electrical contact with the bare conductor. This ensures that any flashover cuased by overvoltages takes place between the clamps and because of the mass of the clamp, arcing to the conductor, which might result in burn down, does not occur.

It is believed that even though the line may suffer a direct lightning stroke at mid span the flashover will occur at the pole.

Wagner, Hilemand and Los have published papers in the IEEE transactions which discuss the predischarge phenomena occuring between parallel conductors. They have also shown that flashovers caused by direct lightning on power transmission lines are concentrated at poles.

The insulated conductor is made in three standard sizes and the suspension hardware is designed for a maximum span length of 100m.

The important electrical and physical parameters of the conductors are given in Table 1.

**Table 1: SAX conductors – Electrical & Physical Characteristics**

| CONDUCTOR | SAX 35 | SAX 70 | SAX 120 |
|---|---|---|---|
| DC resistance + 20°C, /km | 0,986 | 0,493 | 0,288 |
| Nominal loading 20/80°C. A | 200 | 310 | 430 |
| 1 s short circuit current 40°C/200°C, kA | 3.2 | 6.4 | 11.0 |
| Ultimate tensile strength, kN | 10.3 | 20.6 | 35.5 |
| Weight of conductor, kg/km | 146 | 255 | 406 |

**Table 1: SAX conductors – Electrical & Physical Characteristics**

### d.04 PROBLEM LINKES TO CHANGES IN THE ARRANGEMENT OF DOUBLE CIRCUIT LINE CONDUCTORS

**JL Lillien, P Vercheval Belgium**

Conductor contact problems arise in 15 kV double circuit lines when short circuit currents flow in one circuit. The heating of conductors combined with the electro-dynamic forces give rise to horizontal and vertical displacements of such magnitude that contact occurs. A sophisticated mathematical model has been developed at the University of Liege which takes into account the sag increase due to temperature rise in the conductor, as well as influences on movement due to wire elasticity, the inert mass of suspension strings, and the particular arrangement of each span.

The continuous increase in short circuit currents in the distribution networks now causes serious problems linked to electro-dynamic forces. The authors consider that these problems should be studied as soon as the ration $\frac{0.02\ I^2}{}$ is greater than 1.

I : r.m.s. intensity of the short circuit current (kA);
d : distance between phases (m);
m: mass of conductor per length unit (kg/m).

Values higher than this critical one are often obtained for almelec spans close to HV/MV) transforming substation (e.g. 70/15 kV).

### d.08 SIC : CABLE SYSTEM WITH BUILTOIN TERMINATIONS

**F H Kreuger, R J van Aalst Netherlands**

The authors describe a method of terminating plastic insulated cable in the 10 to 20 kV range without the necessity of applying a stress relief core.

This is achieved by building the field grading into the cable itself by applying a non-linear resistive silicon carbide core screen over the insulation during manufacture. The SIC cable system is preferably used in cases where many terminals have to be installed in a relatively small area. The factory-made SIC screen is already present before installation. No delicate removal of a fixed semiconducting screen is needed. A simple removal of the earth screen is sufficient. The SIC cable system is preferably used for short connections. Here the extra price of the SIC layer is balanced against the shorter installation time and cheaper accessories. With longer lengths the gain in jointing time and material is offset by the higher cost of the SIC cable.

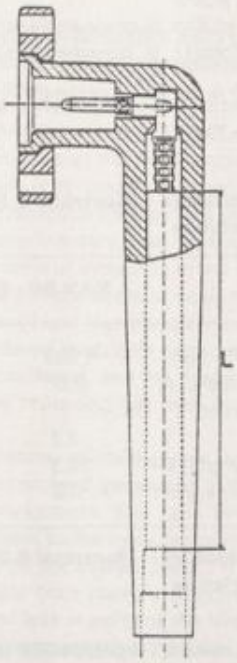


**Figure 8: Connector for Sic system**

## d.16 IMPROVED DESIGNS FOR LV NETWORKS IN URBAN AREAS

**D O Brien Ireland**

The Electricity Supply Board have been using the following low voltage Distribution Equipment/Designs since the late 1960's:

- LV Distribution Fuse Panels with up to six fused outlets in indoor and package type 10 kV/LV substations.
- Four Core Mains Cable with 90° sector shaped solid aliminium conductor, XLPE insulation and Low Density Polyethelene sheath (sizes 4 x 185, 4 x 120, and 4 x 70 sq mm) for offloading the LV panels.
- Overground Sheet Steel Minipillars for service connections in housing estates to individual houses. These minipallrs are designed to accept three main cables and twelve service cables.
- Concentric Service Cable – sizes 25/16 and 35/25 sq mm for services to individual houses.
- Tee and Service Resin Filled Joints for services to small Commercial and Industrial consumers.

The author describes the design changes which have been implemented in the last 5 years. These are:

- Fully shrouded LV panels have been introduced arising from safety considerations (up to 1983 all LV panels were shrouded)
- A fully shrouded minipillar has been introduced for housing estates. The new design enables the use of easy and safe live techniques for termination disconnection of service and mains cables.

  A shrouded special minipillar has been introduced for use in Industrial Estates for servicing small Industrial Units. In addition to providing cheaper services to customers, these minipillars facilitate easy disconnection and termination of service.

Two types of minipillars are used in housing schemes:

**Service-Minipillar**

**This is capable of accepting up to three 4 x 185mm² mains cable and twelve single phase concentric service cables.**

**Sectionalising Minipillar**

This pillar has sectionalising facilities be means of solid links and is capable of accepting four 4x198 mm mains cable (two cable on each side of the ficed contacts). The sectionalising minipillar does not have the facility of connecting single phase service cables.

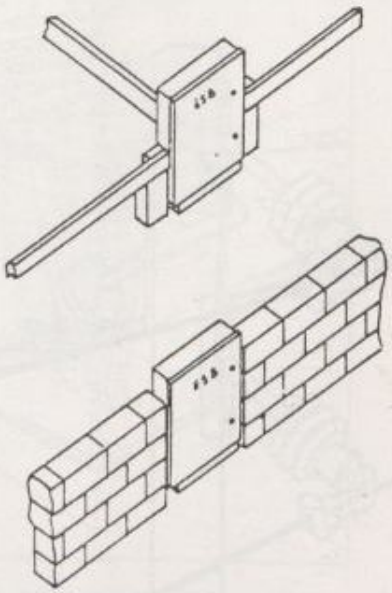


**Figure 1: Typical Minipillar Location**

Session 6 : Design and Planning of Public Supply Systems

## a.04 AUTOMATED MAPPING/FACILITIES MANAGEMENT SYSTEM BASED UPON A DISTRIBUTED COMPUTER GRAPHICS SYSTEM IN THE SOUTH WESTERN ELECTRICITY BOARD

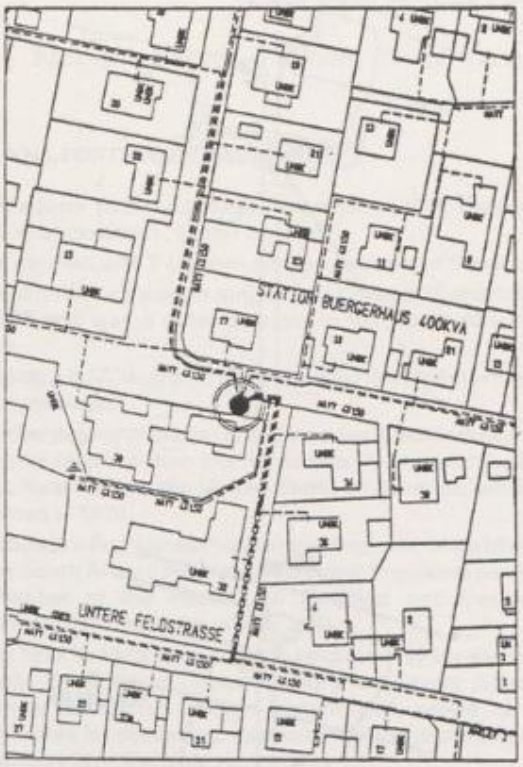
**G Hoyland United Kingdom**

In this paper the author outlines the task undertaken by the South Western Electricity Board in transferring existing hand drawn records of cable routes etc. into digital form and superimposing these onto digital land maps.

Electricity Boards in the United Kingdom are required, by law, to maintain map based records of underground plant and cables. The extent of the task is apparent from the number of maps that are required to be processed, 11 000 maps at 1:500 scale for urban areas and 7 000 by 1:2500 scale for rural areas. The point is clearly made that the capture of data for the computer based record will be a protracted exercise and will require continuous management effort to maintain progress. In a period of just under 2 years 1500 map records were digitised together with a considerable number of Schematic Network diagrams.

The author does not include a typical cable route plan pro-

duced from the digital information in the computer but included is a drawing from the following paper in this section.




## a.06 COMPUTER AIDED DESIGN OF DISTRIBUTION NETWORKS (CADARN)

**K.C. Parton, D. Evans, C.P. Thomas, United Kingdom**

The development of a computer system to meet the special needs of the very extensive 10-15kV distribution network is described. The basic requirement is to have a system which is very easy to use, which enables very many studies to the rapidly carried out without the need to collect and input masses of data. This has been achieved by combining powerful and sophisticated computer graphics with efficient network analyses software. By digitising network arrangements and linking the computer system to existing computer held data all the necessary parameters are available to allow analyses to be carried out. As well as the load flow and fault analyses facilities, the system includes a reliability package. Since the main objective of analysis of the 10-15kV distribution network is to optimise the design a "loss minimiser" facility is included. This facility produces a table showing kW of network losses; the capitalised cost of these losses; the expected kWh lost due to faults; and the capitliased value of the lost kWh. The design is optimised when the system losses have been minimised and the reliability maximised. A brief description of the computer hardware is given and, finally development of the system. This will provide the addition of further analysis facilities and the integation of the system into a comprehensive database engineering information system.

## a.11 A COMPARISON OF ALTERNATIVE APPROACHES TO ELECTRIFICATION OF RURAL AREAS

**K Argiropoulos D Gonzalez United States of America**
**S Hadjumichael Greece**

Two methods for the electrification of rural areas are examined. The basic characteristics of the Short Feeder method is the construction of several HV/MV substations from which relatively Short (30-50km) MV feeders cover small areas of radius up to 30 km.

In the Long feeder method, the basic idea is to construct a central HV/MV substation for which MV feeders of length 100-150 km or longer cover the entire area. In this case it is necessary to solve voltage drop problems by using voltage regulators, sectionalizers and fuses on the main feeders to reduce the number of outages and secure the system's reliability. Here the most significant factor is economics. As rural electrification projects are regarded more as a social service rather than a profitable investment, it is of critical importance to minimise the total cost. In the typical example presented, the cost of the Short Feeder method is 8 times the Long Feeder one. An additional advantage of the Long Feeder method is the significant reduction in time in which a project can be completed.

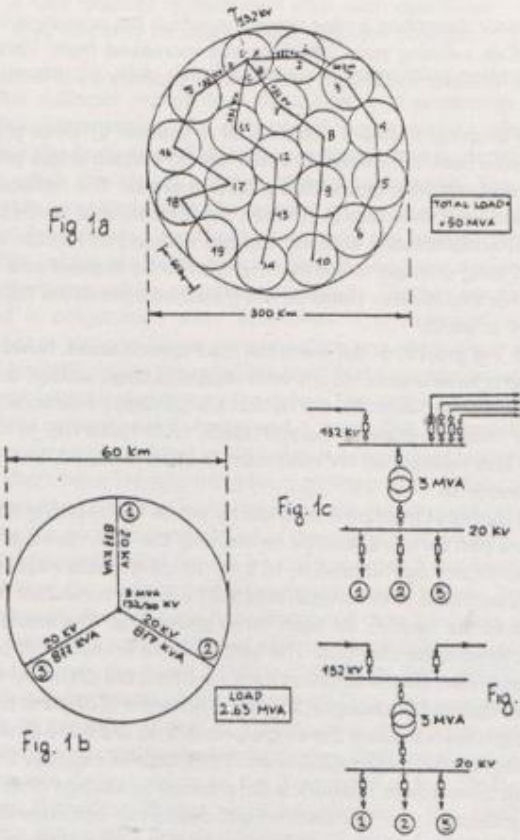
In order to present and compare the two methods, the authors use the following example of a rural area which is typical for developing countries:

1. 50 MVA total power demand
2. Average Power Factor 0.7 lagging
3. Area radius of 150 km.

The load is considered to be uniformly distributed over the whole area.

Voltages are 132 kV HT (High Tension) and 20 kV MT (Medium Tension). Some other characteristics of the system are:

- Three wire unigrounded configuration
- Delta-wye grounded connected distribution transformers
- MT (20 kV) line conductors : ACSR 120




**Figures 1a-1d: Short Feeder Method**

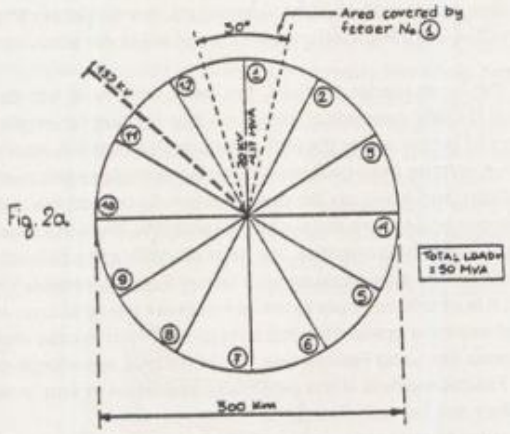



Fig. 2a

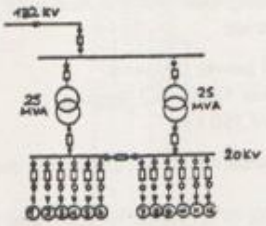



Fig. 2b

**Figures 2a-2d: Long Feeder Method**

## a.12 INCREASE IN OPERATING VOLTAGE TO TRIPLE THE CAPACITY OF A RURAL MV NETWORK

**F Farrel, R Travers, C McLoughlin Ireland**

This paper describes a pilot project in which the operating voltage of an existing rural MV line was increased from 10kV to 17.3kV, thereby increasing its effective capacity by a factor of three.

The existing network consists of a system of three-phase three-wire back-bone lines, to which are connected single-phase two-wire branches, connected phase-to-phase. The network is operated with the neutral isolated frmo earth, and earthfaults are not automatically cleared, but are allowed to remain connected long enough to permit the fault to be located and isolated. For this reason, the lines are insulated against the full line voltage to earth.

With the growth of the electrical load in rural areas, however, problems have arisen, mainly with regard to large voltage drops and losses. Furthermore, the network is generally inadequate to supply medium-scale industrial loads (500-1000kVA) in rural areas, and instead, an HV extension is often required, at rather great expense.

The authors describe a method by which the capacity of the network can be increased by converting the 10kV three phase lines to 17,3kV operation (i.e. 10 x 3). To do this it is necessary only to earth the 10kV netural, and to fit a fourth conductor, connected to the neutral, on each three-phase line. The insulators do not need to be changed. The single-phase branches, at present connected phase-to-phase, are reconnected phase-to-neutral and operate unchanged at 10kV. This point is of great economic significance, since the single-phase lines are three times as extensive as the three-phase lines. The effective capacity of the existing three-phase network is determined by voltage drop and energy losses, and the conversion described can, therefore, achieve a three-fold increase in capacity. On a given line, a load of P kVA at 10kV results in the same relative voltage drop and losses as a load of 3P kV.A at 17.3kV.

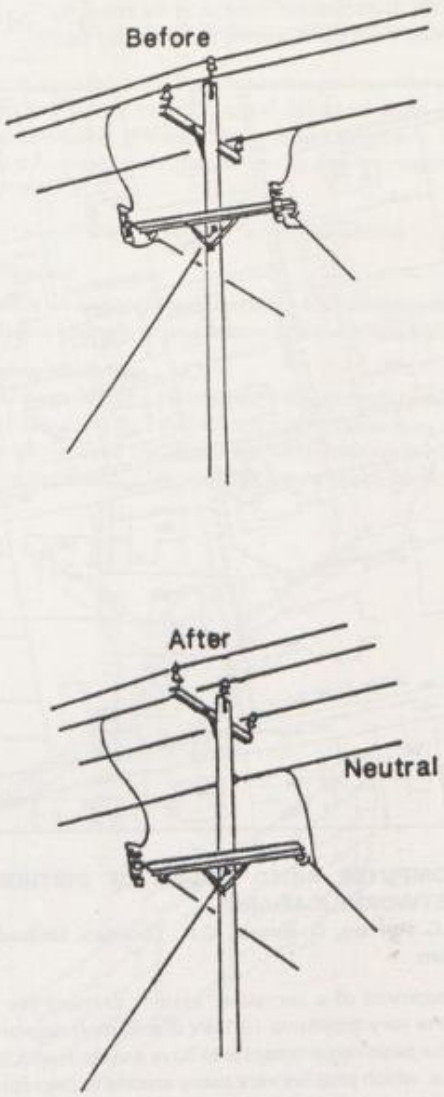



**Figure 2: Single Phase Branch Before & After Conversion**

## a.14 SWEDISH POLICY FOR EXPANSION OF RURAL ELECTRIFICATION

**Thomas Bohjort, Christer Samuelsson Sweden**

The authors discuss the Swedish policy on rural electrification. Several interesting facts arise with regard to use of transformers and low voltage lines. Standard ratings for transformers of 100, 200, 315 and 500 kVA are recommended. Transformers with a capacity of less than 100kVA should not be used. For only slightly more than the cost of a 50kVA transformer, a considerably higher degree of flexibility can be provided. Low voltage distribution lines are built with aluminium self supporting cable of by using buried cable. Recommended cross-sectional areas of overhead self supporting cable are 50 and 95mm$^2$ with corresponding values of 50, 95, 150 and 240 mm$^2$ for buried cables. It has been found that it is cheaper to plough down buried cables than to provide the same service by means of overhead self supporting cable. A buried cable is also less vulnerable and is, environmentally preferable. It is therefore recommended that LV lines should always be buried where the ground permits.

# STATIC RELAYS FOR POWER SYSTEM PROTECTION IN THE MEDIUM VOLTAGE RANGE

Malcolm Barnes - Brown Boveri Technologies (Pty) Ltd - Relay Division Pretoria West

**MR A H L FORTMANN: PRESIDENT**

Mr Malcolm Raymond Barnes was born on 26 September 1947 in Queenstown, Cape Province.

He is married with 2 children and is a resident of Sandton.

Malcolm matriculated at Kingswood College, Grahamstown in 1965 and was a radar operator in the South African Air Force.

He holds a B.Sc. degree in electrical engineering from the University of Natal.

A further degree of Master of Engineering (Electric Power Systems) he received from the Rensselaer Polytechnic Institute, Troy, New York in the United States of America, which he obtained in 1976.

Malcolm is a Registered Professional Engineer and a Member of the South African Institute of Electrical Engineers as well as a Member of the Institute of Electrical and Electronics Engineers (United States of America).

From 1972 to 1978 Malcolm was employed by the Electricity Supply Commission, Johannesburg as Senior Electrical Engineer (Protection Design Department), where he was responsible for design and application of the protective relay systems at EHV and UHV substations.

From 1979 to 1981 he worked at ASEA Electric South Africa Limited as Manager (ASEA Relay Department).

Then from 1982 to 1984 he became a Consulting Electrical Engineer – Associate Hill Kaplan Scott Inc.

From 1984 to now he firstly became a Technical Director of Stromberg (S.A.) (Pty) Limited.

When in 1987, following a merger overseas, Stromberg in SA were taken over by ASEA Electric SA Limited, he became General Manager of the combined ASEA/Stromberg Relay Division.

In 1988, ASEA and BBC merged in South Africa to form Brown Boveri Technologies (Pty) Limited, where he remains as General Manager of BBT Relay Division.



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## 1. BACKGROUND

It is not economical or practical to design and build a High Voltage Electric Power System so as to completely eliminate the possibility of failure in service of the primary electrical equipment. Faults will and do occur, however infrequently. Special equipment is normally installed to detect these distrubances and to autoamtically initiate corrective measures. These detection devices are referred to as "Protection Relays" or merely as "Protection".

The Protection Relays do not prevent faults but their basic purpose is to limit the extent of the damage to Primary Electrical Equipment and to safeguard the continuity of supply. Both of these requirements make it necessary to detect faults as quickly as possible and then to promptly disconnect the faulty item of primary equipment.

Some of the earliest protection systems used Fuses to protect against faults involving excess currents, such as short circuits. The fuse acts both as a detection device and an interruptiong device and is adequate for this purpose for many applications, particularly at lower voltages. Although fuses can detect and interrupt fault currents very quickly, often within the first half-cycle, they have a number of limitations when used as a protection device in a power system:

- ★They only detect faults associated with excess current
- ★ The operating characteristic cannot be adjusted or set
- ★ A fuse requires replacement after each operation
- ★ They can only be used at relatively low voltages

Consequently, the development of protection systems for higher voltages moved to a combination of protection relays and circuit breakers. The purpose of the protective relay is to detect the fault, to evaluate the conditions and to determine if and when the circuit breaker should be opened. The circuit breaker operates under the control of the protection relay to open the primary circuit and to interrupt the fault current. Protection relays are fairly delicate devices and are designed for relatively low values of current or voltage. So they are normally used in conjunction with "Instrument Transformers" such as Curent or Voltage Transformers, which provide current or voltage input signals to the relay at a level that a protection relay can accept without damage to the relay. The commonly used secondary currents are 5 Amps and 1 Amp. The commonly used secondary voltage level is 110 Volts. It is important to stress that the Instrument Transformers form an integral part of the protection and any errors or limitations of these devices will obviously affect the accuracy and speed of the protection system.

Electromechanical Relays of various types have been available from the earliest days of electrical power supply. Some of these early designs have been improved over the years. One of the most successful types of electromechanical protection relays has been the Inverse Definite Minimum Time (IDMT) Overcurrent Relay based on the Inductuion Disc. The operating principle of this relay is that of an induction disc motor operating against an adjustable restraining spring. With the introduction of electronic devices such as the Transistor in the 1950's, Electronic Protection Relays were introduced in the 1960's and 1970's. Since then, the development of relays has been related to the general development of electronics.

By the late 1960's extensive experience in the use of electro-

nics in simple protection systems enabled the development of many quite advanced protection schemes and the first high-voltage substations were equipped protection schemes and the first high-voltage substations were equipped with Static Protective Relays. Over a period of time, these have been extended to cover other equipment such as transmission lines, motors, capacitors and generators. New measuring techniques have been introduced, more accurate measurements can be performed and high overall quality, reliability and performance of the protection system for a high voltage power systems have been reached.

Developments in the 1970's concentrated on improving reliability through improved design of printed circuit boards leading to integrated circuits and general improvements in substation designs, particularly earthing. In general, most static protective relays of that time were designed to match or improve on the basic electromechanical performance features. Improvements introduced included low current transformer burden, improved setting accuracy and repeatability and improved speed. Also during this period, experiments were made in Europe, Japan and the U.S.A. to test computer based protection systems based on the availability of digital electronics.

In the 1980's many relays have been developed using digital electronic techniques. Microprocessor based digital relays have to a large extent replaced the analogue electronic relays for MV applications. Microprocessor Relays not only provide all the performance features of the older analogue electronic relays, but introduce many other useful features. This is particularly true with IDMT Overcurrent relays, where it was both difficult and expensive to provide the Inverse Time characteristics by means of analogue electronic circuits. It is much easier to provide the most commonly used characteristics such as Definite Time, Normal Inverse, Very Inverse, Extremely Inverse and Thermal characteristics using different algorithms stores in the microprocessor's memory.

The Overcurrent Relay is undoubtedly the most common type of protection relay used by electricity supply authorities for protection on Distribution Systems. This paper concentrates on the various features of modern Static Overcurrent Protection Relays in relation to the older electro-mechanical relays which are still commonly used on distribution systems today. The purpose of the paper is to clarify some of the arguments for and against protection relays particularly for Medium Voltages applications. Figure 1 shows a typical Induction Disc Relay next to a modern Microprocessor Relay.

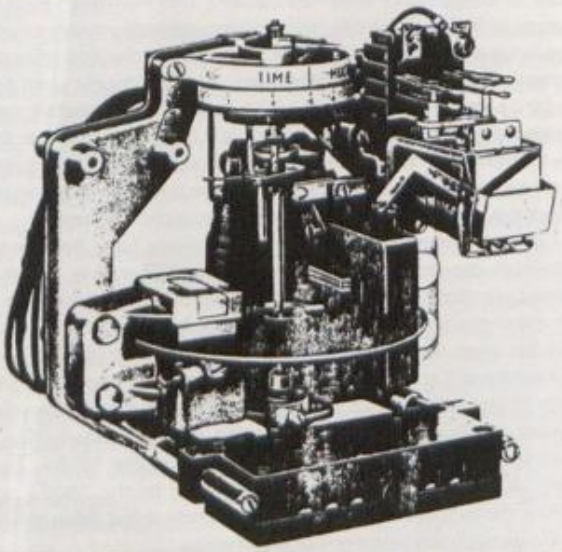



**Figure 1(a): Induction Disc Relay**

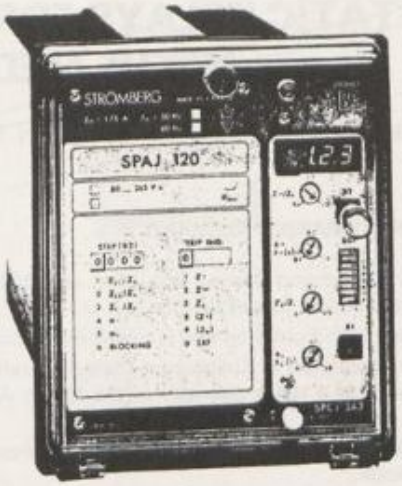



**Figure 1(b): Microprocessor Relay**

## 2. WHAT IS A STATIC PROTECTION RELAY?

Static Relays are those in which the disigned response is developed by Electronic or Magnetic means without mechanical motion.

This means that the disignation "Statix Relay" covers the electronic relay both of the of the Analogue and Digital designs. In recent years, very few relays fo the Analogue type are being developed or introduced for the first time. Most modern Overcurrent Relays are of the Digital type. There are many reasons for this, the main ones being associated with Cost, Accuracy, Flexibility, Reliability, Size, Auxiliary Power drain, etc. Many of these reasons will become evident during the course of this paper which will concentrate on relays of the Digital type. Microprocessor Relays are of the Digital type.

The main objective of using Static Relays is to improve the sensitivity, speed and reliability of a protection system by removing the delicate mechanical parts that can be subject to wear due to vibration, dust and corrosion. During the early development of Static Relays, the use of static components was particularly attractive for the more complicated relays such as Impedance Relays, Directional Relays, Voltage Regulating Relays, etc. On the other hand, the early static IDMT Overcurrent relays were expensive because it was difficult to match the Inverse time characteristic using analogue protection circuits. The battery drain associated with these static IDMT relays was also high and this also discouraged the use of this type of relay for Medium Voltage applications. The general developments in the field of electronics and the introduction of digital circuits has overcome many of the above problems. Using modern Microprocessor Relays, almost any characteristic is possible and economic, even for the simplest applications such as Overcurrent relays and Motor Protection Relays.

## 3. WHAT IS A MICROPROCESSOR RELAY

A Microprocessor Relay is a digital electronic relay which derives its characteristic by means of a pre-programmed series of instructions and calculations (Algorithms) based on the selected settings and the measured current and/or voltage signals. For example, the formula used to derive the Inverse Time characteristics in an overcurrent relay that comply with IEC 255 and BS 142 is mathematically defined as follows:

$$t = \frac{k \times b}{\frac{(I)^a}{(I_s)} - 1}$$

Where t = Relay Operating Time (sec)
k = Time Multiplier Setting
I = Actual Current Level (Amp)
$I_s$ = Set Starting Current Level (Amp)

| | a | b |
|---|---|---|
| Normal Inverse | 0,02 | 0,14 |
| Very Inverse | 1,00 | 13,50 |
| Extremely Inverse | 2,00 | 80,00 |

The analog current and/or voltage signals to be measured must first be converted into a suitable form before they can be processed by the microprocessor. Input matching transformers are used to scale the signals to levels suitable for electronic processing and also provide galvanic isolation between the electronic circuits and the external circuits.

The measured signals are converted into digital form by an 8-bit Analogue-to-Digital convertor. The measurement levels of current and voltage are adjusted to obtain a resolution of < 1% in the measurement at rated input levels. In addition to a sufficient resolution, the current relays also require a large dynamic range to handle short-circuit currents. This is realized by using a programmable amplifier, which extends the dynamic range of current measurements up to a level of 50 x $I_n$. A typical block diagram of a microprocessor relay is shown in Figure 2.

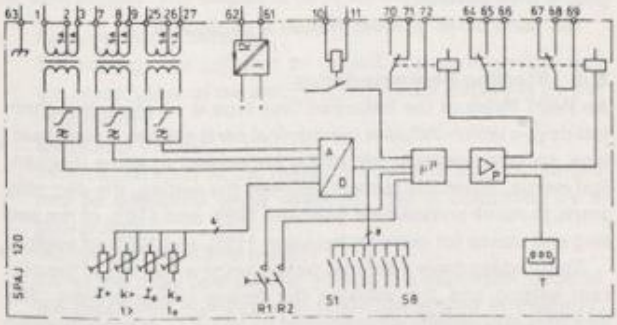


**Figure 2: Block Diagram of a 2 O/C + 1 E/F Microprocessor**

Relay Implementation of the multiple protective functions always requires measurement of instantaneous values of signals. A sampling interval of 1ms fulfulls these requirements and assurs retrieval of sufficient measurement information, for instance, at saturation of main current transformers. With the help of the microprocessor, an additional measurement function has been implemented, namely the peak-to-peak measurement. This advanced approach removes practically all ambiguity of functions due to current asymmetry as shown in Figure 3.

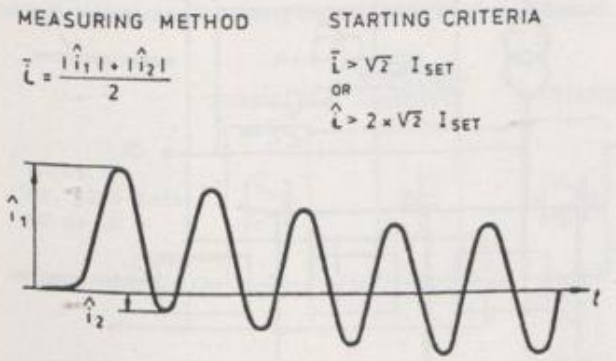



**Figure 3: Peak-to peak Measuring Method**

## 4. UNIVERSAL MICROPROCESSOR OVERCURRENT RELAY

Electromechanical Relays are designed specifically for particular protection applications and they usually have a limited setting ranges. For example, a different relay is necessary when a "Very Inverse" characteristic is required or if a setting is required that is outside the range of the standard relay. This means that at the time when an electric power system is being designed and specified, considerable thought must be given to both the type of protection characteristic that will be required and the likely setting of the relay to ensure that the correct relay is specified.

The concept of many modern microprocessor relays is to provide a protection relay that covers all likely protection requirements in one relay. This includes wide setting ranges and, in addition, several selectable characteristics and options to cover many protection applications. Microprocessor Overcurrent Relays are typically selectable for Definite Time, Normal Inverse, Very Inverse, Extremely Inverse, Longtime Inverse and sometimes a Thermal characteristic as well to cover all likely application requirements. In addition, several output options are often provided to enable the user to select, for example, whether he requires a overcurrent "starting" output contact or not. From a users point of view, this delays the decision of which characteristic and setting range is required to the time of commissioning.

The concept of a Universal Realy tends to improve the availability of protection relays from the manufacturers by making them "stock" items. From a manufacturers point of view, this minimises the number of relay types that have to be manufactured and held in stock and allows him to provide a faster and better service to the users of protection relays. This also tends to reduce the cos of protection relays by reducing the number of variations.

The following table summarises the available characteristics and setting ranges of a modern Microprocessor Overcurrent Relay in comparison to a typical Induction Dist IDMT Overcurrent Relay:

| | **Static (Digital)** | **Electromechanical** |
|---|---|---|
| Characteristics | Selectable:<br>& Definite Time<br>& Normal Inverse<br>& Very Inverse<br>& Extr. Inverse<br>& Long Inverse | Separate Relay:<br>or Definite Time<br>or Normal Inverse<br>or Very Inverse<br>or Extr. Inverse<br>or Long Inverse |
| Current Inputs | 1Amp and 5Amp | 1Amp or 5Amp |
| Thermal Current Withstand | | |
| Continuous: | 3Amp/15Amp | 2 x setting current |
| for 10 sec: | 25Amp/100Amp | - |
| for 3sec: | - | 20Amp/100Amp |
| for 1sec: | 100Amp/300Amp | - |
| Overcurrent Setting | Continuous<br>50% - 250% | Plug Setting<br>50% - 200% |
| Earth Fault Setting | Continuous<br>10% - 80% | Plug Setting<br>or 10% - 40%<br>or 20% - 80% |
| Time Multiplier | Continuous<br>0,05 - 1,0 | Continuous<br>0,1 - 1,0 |
| High-set Overcurrent | Included<br>0,5 - 20 times | Extra Add-on |
| High-set Time Delay | Included<br>0,05 - 100 sec | Extra Add-on |

## 5. TECHNICAL FEATURES OF A MODERN MICROPROCESSOR RELAY

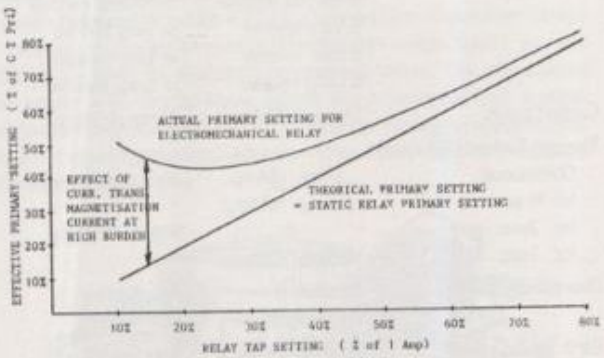
### 5.1 Current Transformer Burden

One of the disadvantages of the IDMT Relays of the Induction

disc type is that they have relatively high C.T. burdens when compared to Static IDMT relays. The ohmic value of these burdens varies with the setting as shown in the table below. As the setting is reduced, the burden on the C.T. is increased. Induction disc relays have a burden typically specified as 3 VA. Modern Static relays, on the other hand, have a very low burden or less thant 0,02 ohm for the 5 Amp input and 0,10 ohm for the 1 Amp input, which is independant of setting. The table below shows the calculated ohmic burden of a 1 Amp Induction Disc Relay at the various settings compared to a Microprocessor overcurrent relay.

| Setting % | Induction Disc Relay Burden (ohm) | Microprocessor Relay Burden (ohm) |
|---|---|---|
| 10% | 300 | 0,10 |
| 15% | 133 | 0,10 |
| 20% | 75 | 0,10 |
| 25% | 48 | 0,10 |
| 30% | 33 | 0,10 |
| 35% | 24 | 0,10 |
| 40% | 19 | 0,10 |

The main consequence of the high burden is the poor performance of the C.T./Relay combination under high fault current conditions, particularly when low CT ratios are used. The high burdens can affect the actual primary setting achieved by the C.T./Relay combination. The example below shows that, with an Electromechanical relay, the actual primary setting increases even though the plug setting is reduced on the relay. With the static relay, almost any primary setting is possible. This means that on a distribution network using static relays, relay co-ordination is still possible at high fault levels even for very low relay current settings and low C.T.Ratios.




## 5.2 Accuracy of Settings

The current and time-multiplier settings on a Microprocessor relay are done with the aid of a digital display, which is part of the measuring unit. The accuracy and repeatability of the settings on this type of relay is far greater than for Electromechanical relays. Setting accuracies of ±1% and operating accuracies of ±3% of set value for the static relay compare very favourably with the ±7,5% accuracy of the Electromechanical device. The accuracy of the Elecromechanical relay is also dependent on frequency and the presence of harmonics further affects accuracy.

This greater accuracy and repeatability of the static relay, generally independent of harmonics, combined with a negligable "overshoot" means that reduced grading intervals are now possible especially when these relays are used in combination with the faster operating $SF_6$ and Vacuum, switchgear. This is clear when one recalls that the grading times are dependent on the following.

- ★ Errors in C.T.'s
- ★ Errors in the Relay Operating Time
- ★ Relay "overshoot" Time
- ★ Circuit Breakers Operating Time
- ★ Safety Margin

It is practical to consider grading intervals of as low as 0,2 sec when using Microprocessor relays in combination with $SF_6$ or vacuum breakers.

## 5.3 Reset Times

Electromechanical IDMT relays have reset times of up to 10 secs at Time Multiplier Settings = 1, which means that during autoreclosure sequences an integration effect can take place and co-ordination can be lost. This situation can occur when the disc has turned some distance in response to a fault in the network cleared possibly by some other breaker with an autoreclosure feature. If the fault is still present when the breaker recloses and if the disc has not fully returned to its reset position, the relay would take less time than calculated to trip. Unco-ordinated tripping is then possible.

The reset times of Static Relays is negligable.

## 5.4 Starting Characteristics

An IMDT Relay of the Induction Disc type is an electromechanical device which includes mechanical parts such as a disc, bearings, springs, contacts, etc which are subject to some mechanical inertia. When the current exceeds the setting, the disc only starts to move somewhere between 103% and 110% of the setting and closes for currents between 115% and 120% of setting.

Static relays have a definite pickup point within 5% of the current setting and this initiates the timing characteristics. The pickup is also usually accompanied by an L.E.D. indication which makes it easy to check the accuracy of the current setting during testing of the relay.

On some static relays, this "start" signal is available on separate pair of output contacts which can be used to for indication or to initiate a simple busbar protection scheme. This type of busbar protection when used on metalclad MV Switchgear is superior to frame leakage protection because it covers both phase-faults and earth-faults in the switchgear and avoids the necessity of insulating the switchgear and cable glands from earth. The principle of this type of protection is illustrated in Figure 6.

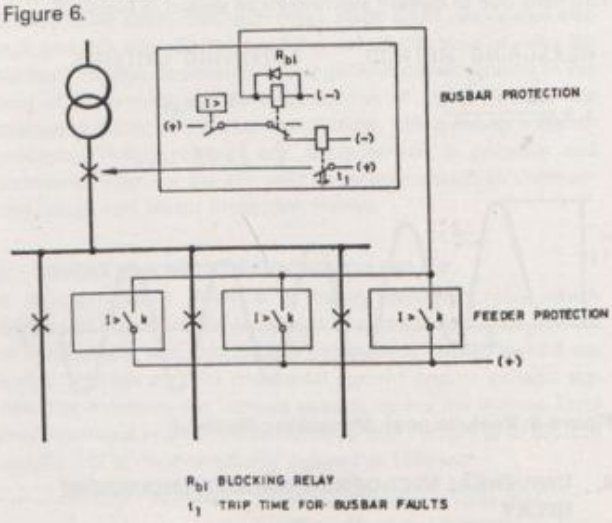



**Figure 6: Busbar Protection scheme using Starting Contact of the Static Overcurrent Relays**

### 5.5 High-set Instantaneous Overcurrent Element

In Microprocessor overcurrent relays, a high-set overcurrent element is provided as a standard feature and often has a timer associated with it to provide a time delay. If not required, it can be set to be "out-of-service". Because of the measurement method, the transient overreach is very low and the instantaneous overcurrent setting can be set much closer to maximum fault current for a fault at the remote end of the feeder. The transient overreach is the tendency for the relay to respond to the DC-offset which is commonly present in most fault current waveforms. To avoid this problem on electromechanical relays, the setting of the higset element has to be at least twice the calculated maximum fault current, making the protection less effective.

High-set overcurrent protection is particularly useful on the higher voltage side of a transformer where it provides fast protection for most faults on the HV side while the time delayed overcurrent relays provides protection for the faults on the lower voltage side of the transformer.

### 5.6 Digital Display

Some Microprocessor relays are provided with a 4 digit numerical data display. The display is used for the following:

- ★ Accurate Relay Settings
  The settings are adjusted by means of potentiometers but the actual value of the setting is accurately displayed on the data display.
- ★ Measured Values
  Information such as the measured value of the line current can be displayed when required. This is controlled by a pushbutton.
- ★ Memorised Fault Information
  When the relay operates for a fault, the maximum value of the measured currents and times are stored in memory. This information can later be recalled to assist in the analysis of the cause of the fault.
- ★ Indications and Status Information
  Other functions and information such as the number of starts, blocking information etc. can be displayed.

### 5.7 Auxiliary Power Requirements

Electromechanical IDMT overcurrent relays do not require an external source of auxiliary power to operate the relay. They take their power requirements from the C.T. and this is the main reason for their high burden mentioned earlier. However, this "zero battery drain" during quiscent conditions has allowed municipal engineers to fit tripping batteries and chargers of limited capacity at small stations for tripping purposes only. With the introduction of Static relays, which require an auxiliary power supply to drive the electronic circuits and the output relays, users were reluctant to change these small battery and charger arrangements to accommodate additional power requirements. This is not normally a problem in larger stations because the station battery usually has sufficient capacity for the relay auxiliary supply, typically at voltages of 30VDC, 110VDC or 220VDC. Some manufacturers overcame this problem by building a C.T. powered auxiliary supply card into the static relay or providing a C.T. powered supply card as an optional extra. However, this tends to defeat one of the main advantages of static relays, which is their low C.T. burden.

Consequently, in Microprocessor relays a lot of effort has been made to reduce the auciliary supply requirements as much as possible by using circuit techniques, such as CMOS, which require very little power. Auxiliary power requirements of 3 Watts and lower can be achieved depending on the type of relay.

To simplify matters further, Universal Power Supplies for relays have been developed to operate over a wide voltage range and cover several "standard" voltages. For example, an 80V - 265V Universal Power Supply is suitable for 110VDC or 220VDC station batteries and will operate right down to 80 volts. This type of power supply is independent of polarity and can be supplied from AC or DC. It uses a Pulse Width Modulation (PWM) technique which is self-regulating, short-circuit and overload protected. It is also protected against ripple and transients in the auxiliary supply voltage. In practice, battery voltages in a substation can vary over a fairly wide range. During the "boost" charging cycle the voltage can be up to 30% higher than nominal and has often been the cuase of power supply overheating in early static relays. Conversely, during low charge situations the voltage can fall as low as 80% of nominal. The Universal Power Supply can easily accomodate this wide fluctuations without any additional heating or loss of performance. A block diagram is shown in Figure 7.

Some of the benefits of a PWM self regulated Universal Power Supply units are as follows:

- ★ The same relay can be used in several applications for a wide range of battery voltages. Future developments will result in one power supply for all standard battery voltages from 30V - 220V.
- ★ Battery fluctuations due to the charger do not affect the relay performance
- ★ Low battery voltage, within reasonable limits, does not affect the relay performance.

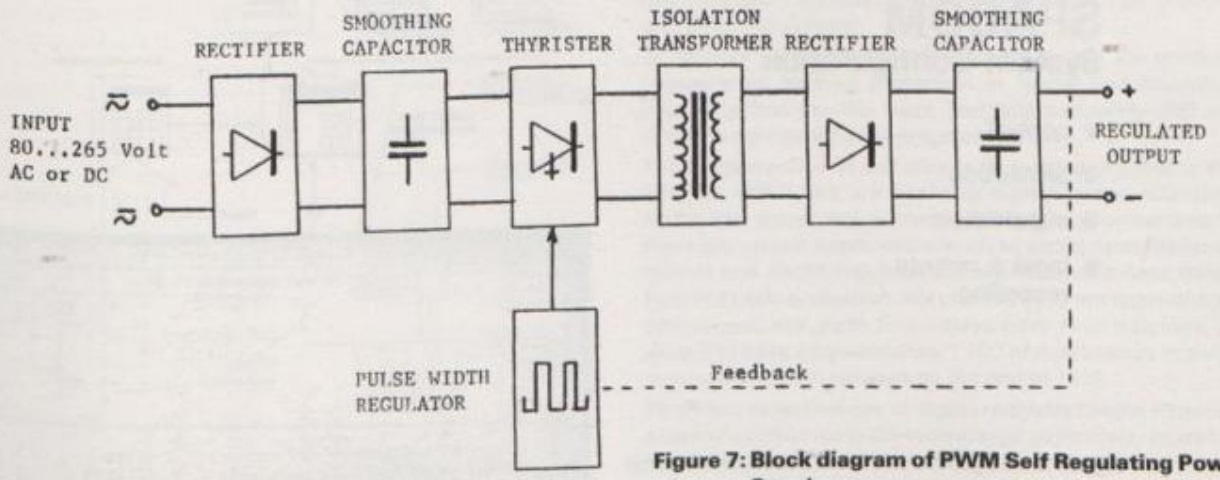



**Figure 7: Block diagram of PWM Self Regulating Power Supply**

★ In small stations where not station battery is available or economic, auxiliary supply can be arranged from a Capacitor Storage Unit fed from both the V.T. and the C.T.'s. This unit will provide auxiliary power to the relay even when no current is flowing in the primary circuit. Because of the relay's Universal Power Supply, fluctuations of voltage due to the variations in the supply do not affect relay performance. A typical connection of a Capacitor Storage Unit supplying a relay using a PWM self regulating power supply is hown in below. The Capacitor Storage Unit also provides the energy to trip the circuit breaker where there is no tripping battery.

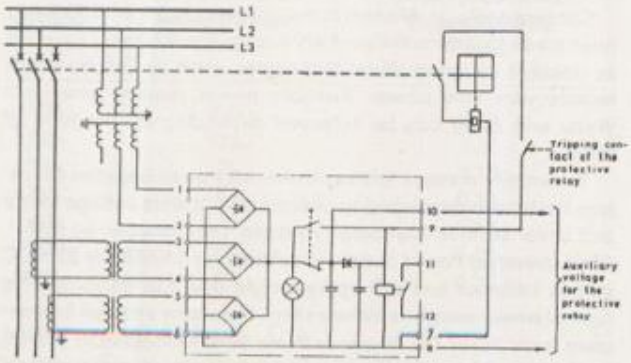



**Figure 8: Capacitor Storage Unit supplied from both the C.T.'s and a V.T. to provide auxiliary power for the relay and for tripping the circuit breaker**

## 6. TYPE TESTING OF STATIC RELAYS

### 6.1 Type Tests

To ensure that Static Protection Relays of all types comply with reasonable requirements and are suitable for application for power system networks, many national standards organisations such as BEAMA, ANSI, SEN, etc introduced stringent testing requirements for Static Relays. These requirements are now included in the international recommendations by IEC. The following electrical Type Tests are normally applied by manufacturers to ensure that relays comply with the requirements of IEC 255.

★ Insulation Test Voltage : 2kV, 50 Hz, 1 min
IEC 255-5

★ Impulse Test Voltage : 5kV, 1.2/50 msec,
IEC 255-5 0,5 Joule

★ High Frequency Interference Test : 2.5 kV, 1mHz
IEC 255-6

★ Spark Interference Test : 4....8 kV
SS 436 15 03

### 6.2 Self Supervision

Perhaps the most important feature introduced by microprocessor relays is that of continuous self-supervision. One of the classical problems of the older protection relays lies in the absence of any ready means to identify a fault in the relay. As protective relays are, for most of their lives, in a quiescent state, regular secondary injection tests are necessary to ,prove that the relays are fully operational.

The microprocessor relays, on the other hand, utilise their capacity during quescent periods to continuously monitor their circuits and will provide an alarm if a failure occurs. The digital readout can be used to diagnose the problem. This enchances protection system reliability on a continueous basis and intervals between manual inspections can be prolonged.

Digital devices tend to work either 100% or not at all. Consequently, it is very easy to check a Microprocessor relay on a regular basis and achieve a very high certainty that the relay is fully operational. By pressing the button requesting the display of the phase current, a reading that matches the ammeter on the panel confirms the following:

★ The C.T.'s are healthy
★ The wiring from the C.T. to the relay is O.K.
★ The relay is working

If necessary, a trip-test can be done from the relay to insure that the relay output trip contacts are working and that the breaker trip coil and mechanism are O.K.

## 7. THE FUTURE OF PROTECTION FOR DISTRIBUTION SYSTEMS

With the second generation of microprocessor relays now coming into use, the emphasis is on the broader use of the protection relays as data acquisition units and also for the remote control of

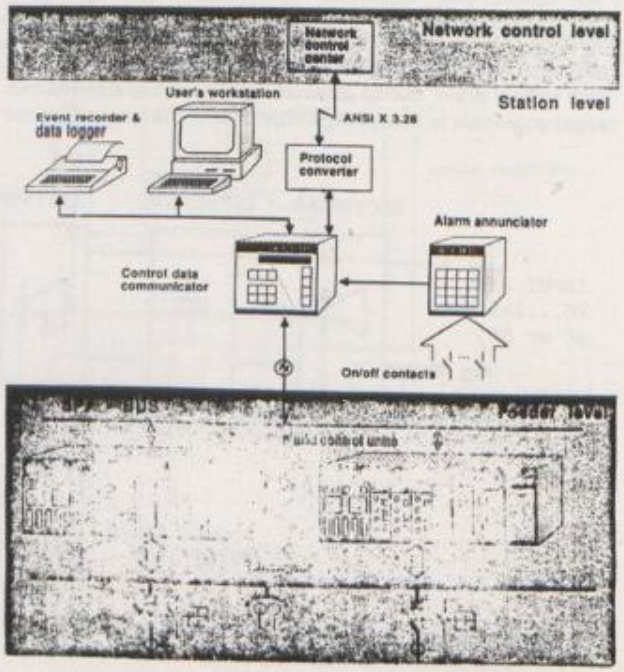



**Figure 9: Integrated Protection and Control for Distribution Substations.**

the primary switchgear. Protection relays continuously monitor the primary system parameters such as current, voltage, frequency, etc. as part of the protection function of detecting faults. Since faults seldom occur, protection relays are expected to fulful the protection requirements for a very small portion of their lifetime. By utilising the protection relays for other duties during the periods when the power system is normal, it permits integration of the various systems such as Protection, Supervisory Control and Data Acquisition and results in savings on other interface components such as measuring transducers for current and voltage, meters, circuit breaker control interfaces, etc.

Improvements in digital communications by means of optical fibres allows the information available at the relay to be transferred without interference to the substation control level for information or event recording.

The following information is typically available from the relay.

* Measurement data of current and voltage
* Information stored by the relay after a fault situation
* Relay setting values
* Status information on the circuit breakers and isolators
* Event information

The communication link to the relay can also be used for control purposes

* Circuit breaker Open/Close commands
* Remote Reset of the relay or autoreclosure module
* Changes to the protective relay settings

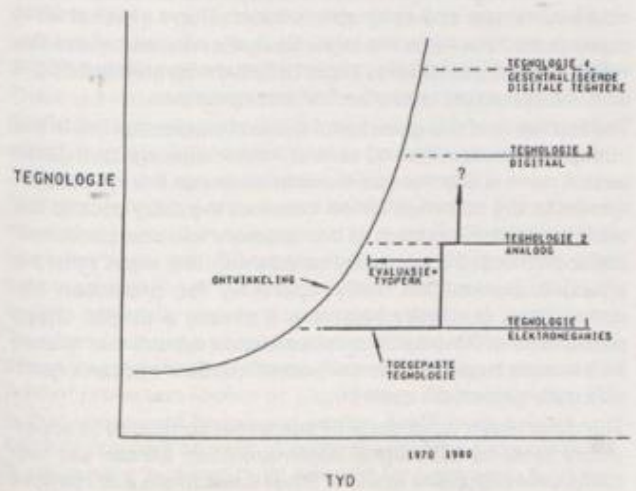
Figure 9 shows the components of an integrated protection and control system that could be implemented in future distribution substations.

**MNR LEON WEYERS: PRETORIA**

Mnr Barnes se bydrae is sterk 'n motivering vir die aanvaarding deur verspredingsingenieurs van 'n hoer vlak van tegnologie in beveiliging met spesifieke verwysing na oorstroomrelés in medium spanning toepassings.

Deurentydse tegnologiese ontwikkeling (teen 'n toenemende tempo) bied beter, meer elegante tegnieke en toerusting wat kritiese evaluasie moet deurstaan voordat dit algemene toepassing geniet. Hierdie proses kan as volg grafies voorgestel word:

**Grafiese Voorstelling van Ontwikkeling op die Gebied van Oostroom/Tyd-Relés**




Die evaluasietydperk strek vandat die tegnologie ontwikkel is totdat dit algemeen toegepas word en verskil van gebruiker tot gebruiker. Oorgang van een tegnolgie na 'n volgende voordat die nuwe tegnologie volwassenheid bereik het, hou risiko's in terwyl deur 'n trae oorgang 'n gebruiker homself die voordele van ontwikkeling ontsê.

Alhoewel Pretoria onlangse ondervinding het van probleme met digitale tipe instrumente en met kragvoorsieningskaarte in elektroniese oorstroomrelés, word daar in sulke gevalle na spesifieke probleme gekyk en nie algemene waarhede afgelei nie. Oorstroomrelés gebaseer op digitale tegnieke is 'n volwasse produk wat die beproefde oorstroom/tyd verwantskappe wat in beveiliging van elektriese stelsels gebruik word, soos deur mnr Barnes toegelig, nader aan die ideale relé bring en met vertroue gebruik behoort te word.

U kommentaar op die volgende punte mag egter 'n bydrae maak tot meer sinvolle gebruik van hierdie tegnologie:

– Daar bestaan by my twyfel oor die meriete van die foutinformasie stoor-tipe-fasiliteite wat van hierdie relés bied. Dit is 'n fasiliteit wat móét bydrae tot die koste van die instrument en wat, veral in eenvoudiger toepassings beperkte praktiese waarde het;

– Van die nuwer generasies relés beskik nie meer oor 'n aanboord toetspropfasiliteit nie en spesiale toetsblokke moet in die beveiligingskema ingebou word om toegang te verkry tot die stroomtransformator- en klinkbane van die instrument;

– Meer beveiligingskemas is oneffektief as gevolg van verkeerdelike instellings van relés byvoorbeeld as gevolg van stelselkonfigurasies wat verander sonder dat relé-instellings daarby aangepas word, as wat toe te skryf is aan tekortkominge van 'n relé per se.

– Wat toekomsverwagtinge betref sal die hoë koste van enige tipe kommunikasiekanaal 'n beperkende faktor bly in die toepassingswaarde van geïntegreerde beheer en beveiligingskemas op 'n laer vlak is as wat tans deur toesigbeheerskemas bedien word.

**MR KEN MACKAY: ESKOM**

I should like to open my contribution by congratulating Malcolm Barnes on the content and presentation of his paper. Malcolm has highlighted the advantages of digital protection relays without being too soft on the disadvantages, here I refer especially to the standing drain imposed on the substations auxilary supply.

It is still to early in the life cycle of digital protective relaying to have accummulated a meaningful service history of the equipment, but it is interesting to note the extent to which Eskom is applying these products in its present generation of protection equipment.

At an EHV (220kV to 765kV) level the relays are employed primarily as back-up protection in feeder and bussection/coupler schemes. We have had approximately 300 such relays in service for an average of one year.

For the protection of our distribution networks, that is from 22kV to 132kV, we are applying digital relays extensively. Again the relays are primarily for back-up protection, but there are certain applications such as radial rural feeder protection and shunt capacitor bank protection where they do form the main protection. We use five different types of digital overcurrent and earth fault relays from four suppliers, and expect to have approximately 1 000 of these relays in service in our distribution network by the end of 1990.

This fairly extensive use of digital relays by Eskom represents a vote of confidence in the technology, particularly as we have satisfied ourselves that the relays can survive in the harsh electrical environment encountered in a substation. We have

in fact submitted all of these relays to the high voltage interference tests described in recommendations such as the IEC 255-4 before we considered installing them in our network.

Turning now to the issue of the standing drain imposed by these relays on the station auxiliary supply, I must say that the device described by Malcolm is an ingenious solution to the problem for MV applications. In many of the smaller more remote Eskom HV substations where we install digital relays with the pulse-width modulated power supplies, we also of course have analogue electronic relays with power supplies that only tolerate a variation of ± 20% in the supply voltage level. Eskom has a one week inspection cycle at these substations, and accodingly we try to size the batteries to supply the standing load for this period if the battery charger fails. To further supplement the battery we have recently introduced an AC/DC converter unit which is powered by the station auxiliary supply. The DC output voltage of the converter is selected to be higher than the nominal battery voltage but below the charged output voltage. If the charger fails the batteries discharge to the output voltage level of the converter which then takes over the standing load, this maintaining the battery charge at a satisfactory level.

Malcolm touched on the subject of the next generation of protection equipment, and I'd like to conclude my contribution with a brief introduction to the approach we in the Protection Engineering Section are adopting to what is already being termed Phase 3. We recognise that the dramatic improvements in processing capability allow an increasing number of functions to be competently handled by common hardware.

This is inevitably leading to the integration of the traditionally seperate but related substation secondary processes of protection, telecommunications, metering and control. While accepting that this integration offers numerous benefits to all disciplines, we in protection will not compromise two fundamental principles; the security of the protection, that is its resistance to unnecessary operation, must not be reduced; and yet it must be dependable i.e. it must operate when required to do so, even if a centralized substation processor or data highway is lost.

The divergent requirements of the various disciplines have highlighted the need to adopt a systematic approach to Phase 3 development, and accordingly the Digital Control System Section at Megawatt Park is pro-pounding a structured development methodology throughout Eskom. They are presently at the stage of establishing the various users requirements and the attached figure gives an indication of how we see the protection function fitting in to the overall substation secondary process. The rent stage of the project will be the further functional decomposition of the protection functions and we hop to produce a specification that will take Eskom through to the next century. We will never achieve this without the full co-operation of the major manufacturers like Malcolms' company, and it is heartening to see the strides they are already taking in this direction.

**MR MALCOLM BARNES: AFFILIATE**

I would like to thank both the contributors for their interesting responses and certainly I think their very constructive contributions to what I have had to say. In response to Mr Weyers's questions in particular, if I can just raise the first question, I really doubt the merit of some event information facilities offered on some relays. It must contribute to the cost of the instrument without, especially the simpler applications, having particular practical value. Now, I think what we have got to bear in mind is, with a micro processor relay, the concept to protection has changed a little bit and I think we should perhaps take this into consideration when we ask about the merit of this ditital display and the electronices associated in producing that.

Firstly, one of the things that we should bear in mind here is, that this information generally contributes to the sort of communication that we have with the piece of equipment. I mean, remember in the old days when we had an induction disc relay, when we had current flowing through it, we could see it moving and so on. And then we went from that to electronic relays where we had no communication at all. We had this box sitting there and if something happened you could not see what was going on. Now this digital display does definitely contribute to this, how can I say, we are getting back our opportunity then to find out what is going on. It also, sort of, really comes to this other question that he mentioned. This question about the test facilities. Why don't we have a test block on this type of relay any more? Now the main aspect of it is that this little digital display can give you a direct reading of any information that the relay is measuring. So for example, if you go along there and you press this button and you look at the current flowing in phase A it will give that current to you in a directly read out form. So we don't believe that people really need to come and poke little pieces of plugs and things into the relay any more. You can actually get that information directly. It also, in my opinion, contributes to what is the most important value of the micro-prosessor relay and it comes back to the question of testing and reliability. I think if we think about protection, it sits there on the power system or on a piece of switchgear for years at a time and unless you come back and test it, you don't know if it's going to work or not when a fault occurs. So what many of us do is we have a secondary injection test set and we arrive on site, we put the test set down and then we check the relay. Then we walk ou the substation, then for another year and, in some industries, I don't think they ever do that any way, so, they never have an opportunity for checking the relay.

Now this particular display definitely overcomes that problem. The relay, the micro-processor itself, because it's got nothing much to do in between faults, continuously monitors it's own circuits both the software and also the hardware. Now, when you come and press that button and you look at the current, this is telling you a lot of things and if you do that every day you know that your relay is working every day. This is a question of reliability because when you press that button and you read a current that more or less matches up with what your ammeters are telling you, you have confirmed that you CT's are working; you have confirmed that the wires between you CT's and your relay are working and you have confirmed that the relay is working. So this whole question of secondary injection for relays is to a large extent reduced. I still believe that people who want to, can always come and do secondary injection testing, but it is not as important as it used to be provided every now and again you come and have a look at what currents are flowing in the relay. So that's why we believe the value of this digital display supercedes whatever little it might cost. So that cover really the first two questions.

The last issue of this question of the communication link in the intergrated protection and control, I think what we have got to bear in mind is that the communication link on this type of system lacks the communication between the relay back to the other parts of the system, is the relatively low cost communication method. It's not a dedicated thing, if it wasn't there it wouldn't prevent the relay operating for protection circumstances, but really what it is it's really a simple, cheap plastic type of fibre optic communication system that is used for example by people like the post office. So it's not an expensive communication system.

The other major advantage of this is that compared to supervisory systems with digital communication we can use modums over telephone lines for small substations and I believe

that is quite a substantial cost saving in comparison to things like pilot wires. I don't think I have any comments to make on Ken McKay's paper. I think he really addressed some new issues and broaden out in what I had to say for which I thank him very much. If there are any other questions from the floor, I think we would welcome it. Thank you very much.

**MR GENE HEŸDENRŸCH: MIDDELBURG**
Mr President, I have just one question for Mr Barnes. He mentioned in his paper that the starting current facility of static relays could be utilized to reduce the conventional "frame leakage protection" of metalclad medium voltage switchgear and then also the associated insulation of the switchgear. The question is how is this accomplished? Thank you.

**MR MAX CLARKE: RANDBURG**
Mr President, all I want to know is if these relays are so reliable already and going to be even more reliable and they are showing us amps, why bother to put an ammeter on the pannel?

**MR E TOMS: SABS**
The President has introduced me so I'll go straight into my contribution, which is based on a philosophical consideration bearing in mind that one aspect of reliability must be the minimum time before failure of components in these electronic relays and although I don't know any detail information, it would seem to me that some one of these electronic protection units must contain perhaps 50 or 100 times as many active elements as the electro-mechanical equivalent. The consequence of this numerical difference in active components would seem to me to result in a reduced system failure period and I would like to ask Mr Barnes how this problem is addressed? Thank you.

**MR DENIS FRASER: DURBAN**
Mr President, I would just like to ask Mr Barnes to describe the application of these relays to the normal sort of pilot-wire protection schemes such as the Salcor. Thank you.

**MR KEN MURPHY: SOMERSET-WEST**
Mr President, rather recently when we ordered some switchgear, a representative marketing some of the static relays said to me "Ken its nice switchgear you're getting but what a pity you didn't specify our latest relays." I am just wondering what the reaction is of the switchgear manufacturers these days, because each party seems to have its own relay that it is marketing today. How do they feel about us specifying a different brand of protection to their standard on their switchgear? Thank you.

**MR MALCOLM BARNES: AFFILIATE**
Unfortunately I don't have a slide of the so called 'bus-bar' protection scheme using starting on it, but if you turn to page 9 of the notes that we issued to you on this protection paper. There is a little drawing there that basically indicates how this particular system works. I think one thing we must remember about 'frame leakage protection' as far as 'bus-bar' protection of medium voltage switchgear is concerned, is that 'frame leakage protection' only covers earth faults and if you bear in mind that in most municipal and in many industrial applications the earth fault current is limited certainly on the 11kV side to something of the order of 300 or 600 amps. So an earth fault is not really mainly a catastrophe as far as when it is a 'bus-bar' fault but a phase to phase face fault is and phase to phase 'bus-bar' faults do occur. Now this is the purpose of this type of protection shown on page 9 here. The whole idea of it is that you would have your normal IDMT over current and earth fault relays on each circuitbreaker of the 4 shown there. If you have a 'bus-bar' fault, only the incomer see's fault current the other feed circuits do not. And what would happen then in that case if you can see where the over current relay operates there, it operates through a timer then to trip the incoming breaker fairly quickly, something in the order of 50 to 100 milly seconds. You must remember that on a normal 11kV system if you have a radial system any way when you set the relay you start off with the furthest one operating the fastest and then the next one further up the system a little bit slower and when you get back to the transformer this is the slowest protection because to co-ordinate down the system the time delay set on this relay is the longest. So what we are trying to do here is to by-pass that long time delay because the closest fault in other words the 'bus-bar' fault right at the transformer gives you the most fault current and it could create the most damage and to reduce the damage obviously we have to reduce the time as quickly as possible and hence the circuit. Now if for example the fault occured on a feeder, to prevent this incomer operating then, is that the circuits on the outgoing feeders pickup, you know say for example we had a fault on feeder number 1 the first one, the relay associate with that the starter part of the relay picks up immediately not after a time delay it then goes back and blocks that tripping circuit in other words it opens the circuit to the timer and we do not flip the incomer. So thats called the 'bus-bar' blocking system to give you faster bus-bar protection on in a medium voltage application.

The second question from Mr Max Clarke in connection with the amm meters on the panel. Yes I agree with you I think the amm meters could be done away with on the panel its just that I suppose its a question of time and it probably will, I noticed in one of the overseas magazines from a switchgear manufacturer who have developed a very integrated system for their switchgear which includes the amm meter, watt meter and everything all in one digital system and I think in time thats probably what we will see. The disappearance of an amm meter and using of the relay for measurement of an amm meter and amps and vols and watts etc.

Now if we come to this question of the meantime between failures of electronic equipment and how it performs in the real world compared to electro-mechanical devises. Now I would tend to agree that electronic devises do have a lot more components and one would have a tendency to think that this thing is going to fail a lot quicker. Now, this is based on an assumption that an electro-mechanical devise performs very well and that it performes better or at least equal to the electronic devise, which I don't think is the case. We mentioned some of these aspects of burden of electro-mechanical devises and I think some of you perhaps being in the sugar industry and have come across relays that get electro-mechanical relays that get sort of jammed up with things like sugar particles and what not in the bearings than can not operated at all and so on, would perhaps realise that something like electronic devises have as good a chance of being reliable as an electro-mechanical devise. Some of the early electronic relays I think, that did try to do this on the basis of analog circuits where there was a lot of heat involved, you know disipation in components, a lot of currents, auxillary supply in relays, there was an element of unreliability but how we tried to maintain reliability of modern micro-processor relay is to use the micro-processor during its pre-period of no faults around of continuously monitoring all the elements of the electronics and its able to look at both the program and also it checks voltages and various other factors within the micro-processor, within the circuits, to ensure that the relay is healthy and if something goes wrong it operates a little elements or a little relay contact that then can give some sort of alarm that it is the case. Ofcourse that is probably a better situation than you would find within electro-mechanical relay where you wouldn't know that the relay was faulty until you

came back for your next annual check or whenever people do check the relay. I don't have any figures on mean time between failures of these components.

The question from Mr Fraser of Durban about the application of pilot-wire protection. It is true that static relays and digital relays are used today for pilot-wire protection. We must always try and look at the situation that really 'points' us in the direction of going to a new technology before we sort of really just blindly, go for it. One of the main problems with a normal type of Salcor-type of pilot-wire protection is the interference coming in on your pilot wires does not interfere with the operation of the relay or damage the pilots and certainly in Eskom in my experience in Eskom is that, people would be tending to go away from this type of protection because of all the interference and problems with pilots. The new approach to it is to use fibre optic pilots and instead of sticking them under the ground, they put them inside the overhead earth wire, its some fibres that go inside and they are made up when the earth wire is made and this prevents the other aspects of contractors digging up the pilots while they are laying cables in other trenches or making roads and things under power lines.

The approach there is to use a digital communication, with a digital type of pilot wire protection at each end and the fibre optic cables are ofcourse not subject to interference from lightning in other fields and for that type of protection I think its still very early days, and I think people are only starting to use the early systems by using fibre optic pilot wire protection round about now. Its one of the ones thats lagged behind a bit

The last question from Mr Murphy concerning the specification of relays on switchgear, I don't really want to comment on behalf of the switchgear manufacturers but I think users often tend to leave the choice of the relay to the switchgear manufacturer. Basically they say, listen we want a circuit breaker of such and such a capacity and such and such rupturing capacity and so many amps and so on and then leave it at that. Now that's fine as far as the manufacturer is concerned because that gives him the opportunity to use the very cheapest relay that he can buy. That makes him ofcourse more competitive with some of his competitors. Now from the users point of view this is not always a good thing. If you want something little better than the cheapest then I think you should be happy with the situation as it is. Really I believe that people should take an interest in what they are having on their switchgear panels and should tell the manufacturer what they want.

## DIGITAL RELAYS
### ESKOM EXPERIENCE

1. Transmission Protection (220 - 765kV)
   - Back-up Protection
   - 300 Relays - 1 Year's Service
2. Distribution Protection (22 - 132kV)
   - Main Protection: Rural feeders
     Capacitor banks
     Bus sections
     Busbar overload
   - Back-up Protection: Distance schemes
     Pilot wire schemes
     Transformers
   - 5 Relay types - 4 Suppliers
   - 1000 Relays by 1990
3. High Voltage Interference Tests
   - IEC Recommendation 255-4

AMEU September 1988

## DIGITAL RELAYS
### Quiescent Burden

Remote Stations - No Supervisory

PWM and Conventional Power Supply Units

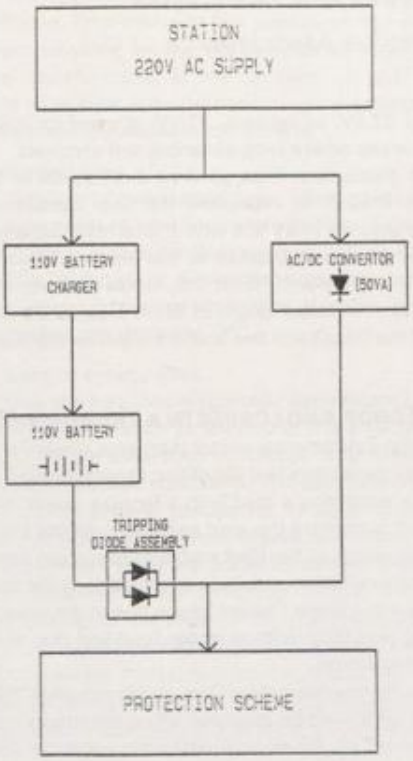
+/- 20% Permissable Voltage Variation

One Week Inspection Cycle

AC Assist Unit

AMEU September 1988

BLOCK DIAGRAM FOR CONNECTION OF AC/DC CONVERTOR
FOR BATTERY CHARGER FAIL ASSIST

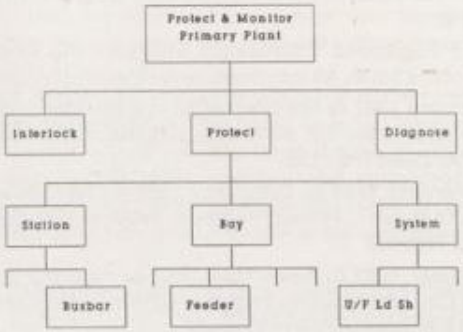



## PROTECTION ENGINEERING SECTION
### Future Technologies

INTEGRATION

- With Telecomms, Metering, Control
- No sacrifice in Security
- Dependability in Stand-alone Mode

APPROACH: STRUCTURED METHODOLOGY




AMEU September 1988

# THE APPLICATION OF SHUNT CAPACITORS TO RURAL DISTRIBUTIONS SYSTEMS

P.J. Newham, Pr Eng. - Rapha Pretorius Associates

**MR A H L FORTMANN: PRESIDENT**

**Mr Peter James Newham** was born on 17 February 1955.

His highest qualifications are as follows:-

a) B.Sc. Eng. (Electrical) (Pretoria), 1976

b) B.Sc. Eng. (Honours) (Electronic) (Pretoria), 1979 and

c) Government Certificate of Competency (Factories, Electrical) No. 990

Peter is a Registered Professional Engineer and Graduate Member of the South African Institute for Electrical Engineers.

Since January 1987 to the present he is a Director of Rapha Pretorius Associates Inc. He is also a Director of Powerplan Systems Analysis (Pty) Ltd.

From December 1983 to December 1986 he was Chief Distribution Engineer – Primary Network Projects with the City Council of Pretoria.

From October 1982 to November 1983 he held the post of Assistant Chief Distribution Engineer – Primary Network Projects with the City Council of Pretoria.

From July 1979 to September 1982, Peter held various positions in the Telecommunication Section of the City Council of Pretoria.

From 1977 to 1979 he did his military service.

Mr Newham won the Siemens award for the best final year thesis at the University of Pretoria in December 1976.

His specialized activities include:-

a) High voltage distribution networks and substation design.

b) Power system analysis and demand studies.

c) Power system modelling and associated computer software, including creation and management of system data bases.

d) Relay protection co-ordination.

e) Special investigations for municipal power systems.

f) Reactive power compensation for distribution systems.

g) Supervisory contol of distribution networks.

h) Plant maintenance and trouble-shooting.

i) Project engineering and management.

I now ask Mr Piet Goosen and Mr Peter Newham to present their papers.


## ABSTRACT

Using examples selected from a series of investigations the methodology of applying shunt connected power factor corrections (PFC) to rural lines is covered. Methods of calculating the optimum application of PFC, highlighting "short cuts" that have been developed and tested during a series of studies are given. The economics of PFC application are demonstrated using case study examples.


## INTRODUCTION

Rural distribution lines are a way of life, being the most economical, and often the only practical method of providing power to areas with a medium to low density population. The performance of these lines, dictated by their length and exposure to the elements, is often unsatisfactory, as most people who are supplied with electricity in this way will readily testify.

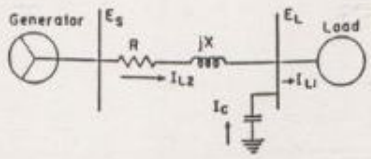
In South Africa rural distribution lines can generally be grouped into two fairly distinct classes. The fist, normally operating at a voltage level of 6.6 kV or 11 kV is utilised to supply areas on the fringes of cities and towns while the second operating at voltages of 22 kV, or recently 33 kV, is used for less densely populated areas where long distances are involved.

The two distribution lines used as a reference in this paper have been chosen to represent the two classes described above. The first, an 11 kV line with a total installed length of approximately 30 km, is located to the east of Pretoria, and is known as the Onbekend North line, while the second, a 22 kV line with a total installed length of km, is located immediately to the east of the Onbekend line and is known as the Riegerspoort line.

## VOLTAGE DROP AND LOSSES IN A TRANSMISSION LINE

The following fundamental vector diagrams show the effects of adding shunt capacitors to a simplified representation of a transmission line supplying a load with a lagging power factor (Cos øL). Without capacitors the load and line currents are identical. Adding a capacitor at the load end, and assuming the load current to remain constant, results in a reduction in the line current, $IL_2$. This results in lower system losses due to the lower $I^2$ (R+ jX) losses, and increased voltage at the load end due to the lower I(R+ jX) voltage drop.

It can be clearly seem from the vector diagram that a minimum point for $IL_2$ will be obtained when the reactive portion of the load current ($IL_1$SinøL) is equal to the capacitor current (Ic)





The only other methods available for reducing the line losses are by reducing line current using a higher voltage level, increasing conductor sizes thus reducing line resistance, or reducing line reactance by moving the lines closer together eg. adopting a trefoil rather than a flat arrangement. An increase in voltage may also be obtained by using a line regulator (autortransformer), but these introduce additional losses due to their reactance. Series capacitors can also be used, but their application has to be carefully calculated and monitored. Adequate series bank protection is also complex. These methods are extremely costly when compared to that of shunt connected PFC.

## STEPS INVOLVED IN THE APPLICATION OF SHUNT PFC TO A RURAL DISTRIBUTION LINE

### When can PFC help?

The following conditions have been found to economically justify the use of PFC on rural distribution systems:

a) *Low voltage complaints*

Low voltage complaints, particularly when originating frm consumers located near the ends of a rural distribution system, are cuased by excessive voltage drop under high load conditions. Together with low voltage (which can normally be compensated for the tap settings on distribution step-down transformers), is the problem of poor regulation, where consumer voltages can change excessively depending on loading conditions on the line.

b) *Overloaded lines*
The problem of overloaded lines, often caused by "creeping" expansion of rural lines and additional loading leads to the situation where conductors may not be able to safely carry the load current. Alternative methods of either re-conductoring or providing alternative supplies are extremely costly when compared to PFC.

c) *The need to extend lines.*
The limit of a rural line is normally determined by the allowable voltage variation at the end of a line section, which is caused by the difference in voltage drop under minimum and maximum load conditions. The definition of this voltage variation for general concumers as determined under the Electricity Act, is a maximum of plus or minus five percent of nominal, (these limits are presently subject to much discussion). Generally when designing a rural line somewhat wider tolerances are allowed for economical reasons, with figures of plus five and minus ten percent being used in some instances. It was reported that low voltage complaints generally occurred when TV pictures began to shrink and fridge motors overheat, at a voltage of approximately minus twenty percent.

Applying PFC will often allow extention of an existing or new line without the expense of providing alternative supply point/s.

d) *The kVA Tariff*
Where a supply authority purchases its power on a kVA tariff basis, the reduction in monthly maximum demand charge (currently between R15 and R18 per kVA), will almost always justify the installation of PFC, whether on a rural distribution line or elsewhere in a distribution system.

**The Collection of data.**
Often the most tedious and time consuming aspect of any PFC project is the need to have sufficient data on hand. The two main groups of data required for a rural line are:

a) *Load data*
The first requirement is to measure th line loading at source, and prefereably at all major junction points. Measurement of active and reactive power and voltage are required, and recordings of end of line voltage are invaluable for cross checking calculations.

Several types of instruments are available for such measurements, ranging from simple chart recorders through printer type instruments. An instrument develop during the course of the investigations whereby loading data is directly recorded on floppy disks for later analysis has proved invaluable in bypassing time consuming, error prone data transfer.

b) *System data.*
The collection of system data can be the easiest or worst part of a rural line study, depending on how well records have been kept up to date. Typical data required are lengths of lines, construction, impedance, and if possible, consumer loading, or at least transformer sizes. Consumer billing data is an invaluable source of such information, although somewhat tedious to analyse.

**Analysis of data**
Placement of PFC on rural lines can be done with simple rules of thumb eg. a common rule for the application of PFC a rural line is the so-called two thirds rule, where the capacitor is placed at two thirds of the distance along the line. This method is however very ineffective as can be proven with a little accurate analysis.

In the last few years with the advent of the Personal type of Computer, extremely powerful and cheap computational power has become available. Parallel to the development in the hardware has also been the software, and several extremely effective load flow and fault level analysis packages have become available. Initially these were somewhat difficult to use as their interface bore much resemblacne to the punch card format originally used, but recently have become user friendly with data libraries, menu driven commands and extensive error checking on the data.

The use of such programs can result in the optimising of a system to a degree no previously possible. Various scenarios which previously would have taken months to analyse, can be modelled literally within second, while some programs even offer routines to optimise the placement of PFC according to certain rules eg. minimum system loss or maximum end of line voltage.

With such a program however, complete confidence in the system model is required, and verification of theoretical results with those measured on site is essential. Our (painful) experience in the use of such programs for analysis purposes is that 60 to 70 percent of the time is actually spent entering and varifying the model 20 percent on doing the actual analysis and the rest in producing output results in the desired format.

The following steps are generally required to "get a model going":

a) *Identify the system to be modelled.*
Modelling each rural distribution system down to the individual consumer entails much time consuming effort, and shoul only be used if accurate calculation of system losses is desired. We have found through several detailed studies that the network to be analysed can be greatly simplified, without introducing significant errors in the calculation of voltage profiles. Small spurs can be reduced to an equivalent load, and the main backbones of the system broken up into approximate 1 km sections, with associated equivalent loads.

b) *Calculation of system loading.*
When building the system database it is impractical to enter an actual (measured) load for each general consumer. In building the database we generally use the suze of the supply transformer for active power demand, and use a fixed power factor, generally 0,9, to calculate a value for reactive power demand. The facility to ratio loads, which is available in most load flow programs, is then used to set up specified load conditions. Larger consumers, eg. a factory will need special consideration, as they will typically have a different load profile to that of the general consumer.

The type of loading must also be analysed and taken into account. Load can be generally divided into constant power loads, eg pumpts, where a variation in voltage does not cause a change in loading, or constant impedance load where a change in voltage leads to a significant change in loading. Most load flow programs are able to cater for a combination of both types of load.

c) *Modelling of the source.*
It must be remembered that the source for the rural line to be modelled is not ideal, and it is almost always necessary to model some distance back into the supply system to allow for automatic tap-changers, as well as voltage drop.

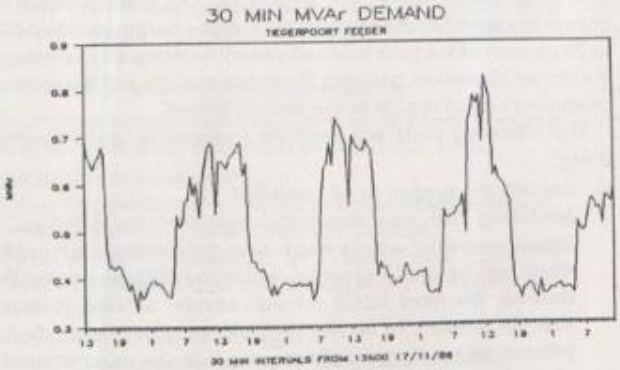
d) *Model verification.*
This is the most important section of any system study, for new or existing systems. For an existing system adjusting loading should lead to a point where values measured on site coincide with those given by the program. This process should be repeated for several loading conditions.

For a new system this can be a little more difficult, and spot loads should be used, and the results carefully checked with simplified manual methods.

Typical errors which always seem to occur in data input are misplaced decimal points (not normally picked up by program error checks), isolated sections of the system, (normally picked up), or incorrect referencing of impedance data in a library (not picked up by program error checks). All of the above render any program output useless, although the output often appears to be correct.

**Decision as to the amount of PFC to apply.**

The quickest method of determining the amount of PFC to apply to a particular distribution line is to refer to the measurements of kVAr loading. In the following example of Tiegerspoort it can be clearly seen that the kVAr loading can be split into two clearly identifiable groups, that under minimum load conditions and that under normal load conditions.




The kVAr loading under minimum load conditions is caused mainly by the magnetising currents and losses in the distribution transformers. Fixed capacitor banks are best for correction under this loading condition.

Under maximum load conditions kVAr loading increases sharply on the Tiegerspoort line, but surprisingly the Onbekend line does not show a similar trend. This was found to be mainly due to the extensive use of pumps on the more remote "farming" load fed by the Tiegerspoort, as opposed to the "residential smallholding" load fed by the Onbekend line. The ideal method of compensating for this increased kVAr load is the use of automatically controlled capacitor banks which are only switched in when necessary.

**Determination of the optimum placement for PFC**

PFC is always most effective when placed at the load. The economical size of Capacitors lies between 200 and 400 kVAr in the 6,6 to 22 kV voltage range. Using the load flow program, with these capacitor sizes, and starting with the major load junctions points of a rural distribution system, enables the solution to be optimised with simple trial and error in a shot time. Alternative system configurations can also be easily investigated.

It should be noted that one or two km does not have a great influence on the results, and PFC should be located for easy access by maintenance personnel. General maintenance staff can normally provide an invaluable input in this regard.

**INSTALLATION AND PROTECTION OF PFC ON RURAL LINES.**

**Installation**

PFC on rural lines is normally installed on an existing pole beneath the powerlines, requiring no additional structure.

The capacitors are usually connected in an unearthed star arrangement to avoid zero sequence (earth fault) currents that may be detected by the sensitive earth fault protection normally utilised on such lines.

The capacitors themselves normally incorporate additional measure, (which cannot be mentioned here for patent reasons), to reduce the possibility of damage under transient voltage and current conditions typically caused by switching surges and lightning. In addition zinc oxide (not grapped!) type arrestors are normally coupled directly to the capacitors.

**Protection**

The primary protection for capacitor banks on a rural line is usually provided by means of suitably graded fuses in drop-out isolators. These isolators should incorporate high speed contact separation with suitable arc-quenching measures, and be provided with a mechanism to isolate all three phases in the event of a single-phase fuse operation.

Unless specifically designed for capacitor switching, isolators should not be operated live, as prestriking can occur, leading to excessively high voltages on the capacitors.

**Switched capacitor banks**

Switched capacitor banks have not yet been widely applied in South Africa, although their use in the USA is widespread. Generally the switches have been of the oil-insulated type. As maintaining these is always a messy job, $SF_6$ and vacuum type switches are now being increasingly utilised.

The switches themselves are extremely compact, and are normally controlled by kVAr demand as measured on the line, together with an overvoltage interlock. Simpler schemes are often applied, particularly time switch or ripple control.

**Harmonics**

Harmonic currents can cause problems with capacitors. The impedance of the supply together with the capacitors form a resonant circuit, and if harmonics are present at or near this frequency they will be amplified to an extent determined by the level of harmonic generation, and the damping provided by the loads. These harmonics can overload the capacitors. In the case of rural lines only minimal harmonic generation is usually present, and the load damping is significant. Only in exceptional cases (eg. Factory with large thyristor controlled motors) could this become a problem.

**BENEFITS PROVIDED BY PFC ON A RURAL LINE**

The attached table illustrates the benefits obtainable by applying shunt capacitors to a typical rural line experiencing minor problems with end-of-line voltage. The table is derived from the result of several investigation, and will not necessarily be applicable to all rural line situations.

The most significant benefits are:

a) *Reduction in line losses*
In the case of fixed shunt capacitors an overall reduction in line losses of around 15% will be obtained. This saving increases to approximately 21% with the addition of switched capacitor banks. Economically this saving is not normally enough on its own to justify the application of the capacitors.

b) *Increase in energy sales*
With the increase in voltage comes a significant increase in

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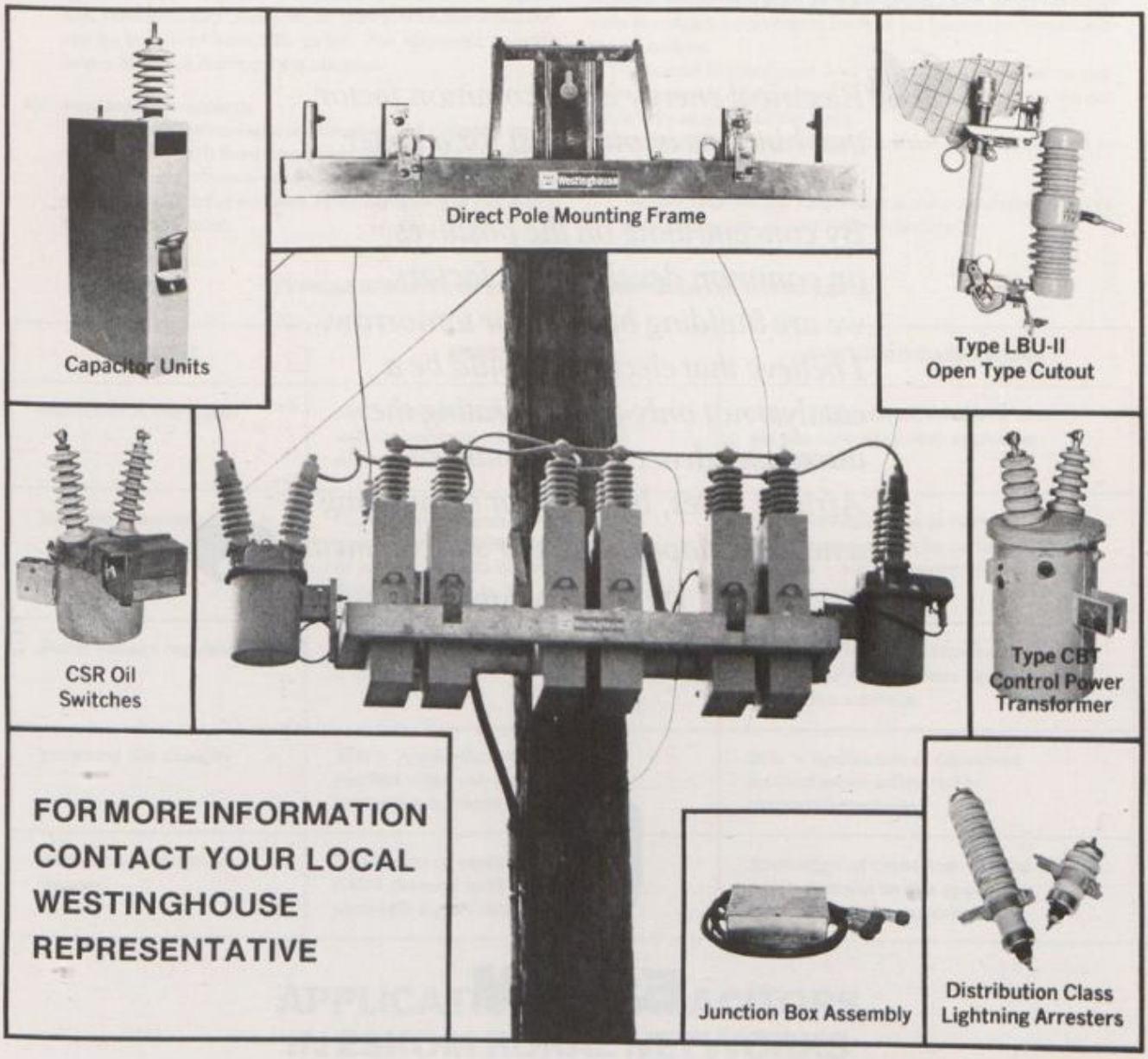


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power consumption. Although this increase is difficult to quantify eg. a geyser will heat up more quickly and thus switch off earlier, the increased revenue can be significant. Combined with the savings in line losses these savings will normally justify the installation of fixed capacitor banks.

c) *Improvement in Voltage and Regulation*
Shunt capacitors are the most economical means of improving voltage on a rural distribution line. Fixed capacitors however only result in a marginal improvement in regulation. With switched capacitors on typical lines the regulation can be improved from 20% to 5%. The economic benefits over alternative methods are obvious.

d) *Increased line capacity*
The economic advantages of increased line capacity, in the order of 12% with fixed capacitors and 20% with switched capacitors are obvious when compared to alternatives of providing alternative supplies, re-conductoring or going to a higher voltage level.

**CONCLUSION**

There is no doubt that shunt capacitors are probably the most effective means of improving the operation of a rural line.

In the past trial installations have given problems. mainly due to capacitor design and incorrect application. The Tiegerspoort installation installed as a result of detailed studies as described above, incorporatin improved designs has survived a full season, including several reported direct lightning strikes to the line nearby (500 to 600m) the capacitors. it is interesting to note that although equipment such as transformers and surge divertors were damaged, no problems have as yet been experienced with the capacitors.

The use of modern load flow programs is essential to optimum placement of capacitors, but as with all computers the output is only as good as the input.

The installation of capacitors therefore is still dependent on the following maxim:

"Sound engineering judgement is the cornerstone of capacitor application on distribution feeders."

**TYPICAL BENEFITS OF PFC ON UNCOMPENSATED RURAL LINES**

| BENEFIT | FIXED BANKS | SWITCHED CAPACITORS |
|---|---|---|
| Reduction in line losses | 15% - Economic benefit on its own will not normally justify application of capacitors. | 20% - Economic benefit on its own will not normally justify application of capacitors. |
| Increase in power sales | Higher voltage leads to higher power consumption by certain types of loads - Hard to quantify accurately Approximately 2 to 3% | Higher voltage leads to higher power consumption by certain types of loads - Hard to quantify accurately Approximately 2 to 5% |
| Better voltage regulation | Improvement in regulation marginal 2 to 3% | Regulation improved drastically - Application of capacitors justified alternative methods. |
| Increased line capacity | 15% - Application of capacitors justified when compared to alternative methods. | 20% - Application of capacitors justified when compared to alternative methods. |
| Reduction in Maximum demand | Application of capacitors justified if kVA demand tariff is applied by upstream supply authority. | Application of capacitors justified if kVA demand tariff is applied by upstream supply authority. |

# APPLICATION OF CAPACITORS IN ESKOM RURAL NETWORKS

AUTHORS : P.V. GOOSEN AND E. FRANCOCCI - ESKOM

## 1. INTRODUCTION

The value of power factor correction in industry is well understood and widely applied for direct money saving when a kVA tariff applies. Additionally, for new installations power factor correction results in handsome capital savings.

Although capacitors have found wide-spread application in the rural power distribution networks in the U.S.A., in which have many similarities with South Africa, we are only now cautiously starting to apply this technology in our rural reticulation networks.

This move is greatly encouraged by pressure to supply customers at the most economical tariff and also to improve the quality of existing supplies.

## 2. BASIC THEORY

Capacitors are used for both series and shunt compensation and a general review of their principles is therefore appropriate.

### 2.1 Series compensation (see figure 1)

Series capacitive compensation is applied on long hv lines for reducing the effect of indicutive impedance. It increases the maximal real power that may be transmitted without jeopardizing the stability of the network:

$$P = (V1.V2.\sin a) / XI$$

where V1 = sending-end voltage
V2 = receiving-end voltage
a = angle between V1 and V2
XI = line's inductive impedance

A capacitive impedance Xc in series with the line reduces the total impedance from X1 to (X1-Xc).

Series compensation is only needed to the extent that enables full utilization of the line current rating. More often than not, the capacitor's current rating becomes the limiting factor for power transfer.

Eskom typically installed Xc values are in the order of 0.4 pu of X1.

Although a series capacitor may only be rated for .10 pu line voltage, it may be required to sustain many times line voltage unless protected by bypass elements. The cost of these expensive additional components like bypass arc-gaps with associated control and protection, or very powerful zinc oxide voltage-limiting surge arresters and associated switchgear, make series compensation less competitive at lower system voltages. This is despite the fact that for the same voltage regulation, a series bank will require a smaller kvar rating than equivalent shunt bank.

Series compensation works well on long low-loss hv lines because the line impedance may be considered as purely inductive. This is well illustrated by the X/R ratios of Eskom's 275 to 800 kV lines which range from about 10 to 20, ie the inductive part of the impedance at 50 Hz is 10 to 20 times greater than the resistive component. Although series compensation does not influence line losses, it has the advantage that no switching is required since the level of compensation is automatically regulated by the value of the line current.

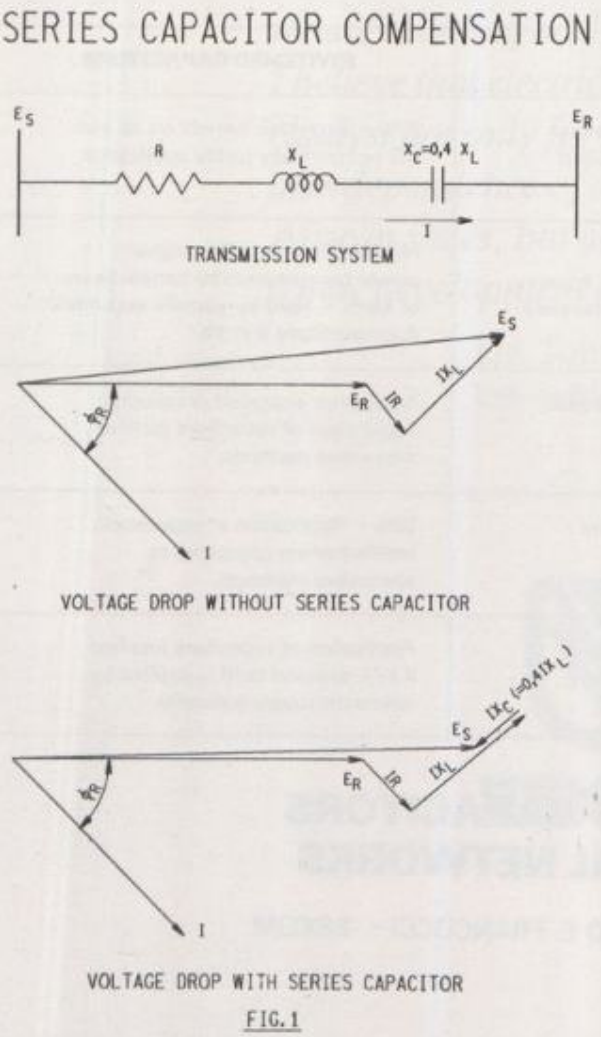


FIG. 1

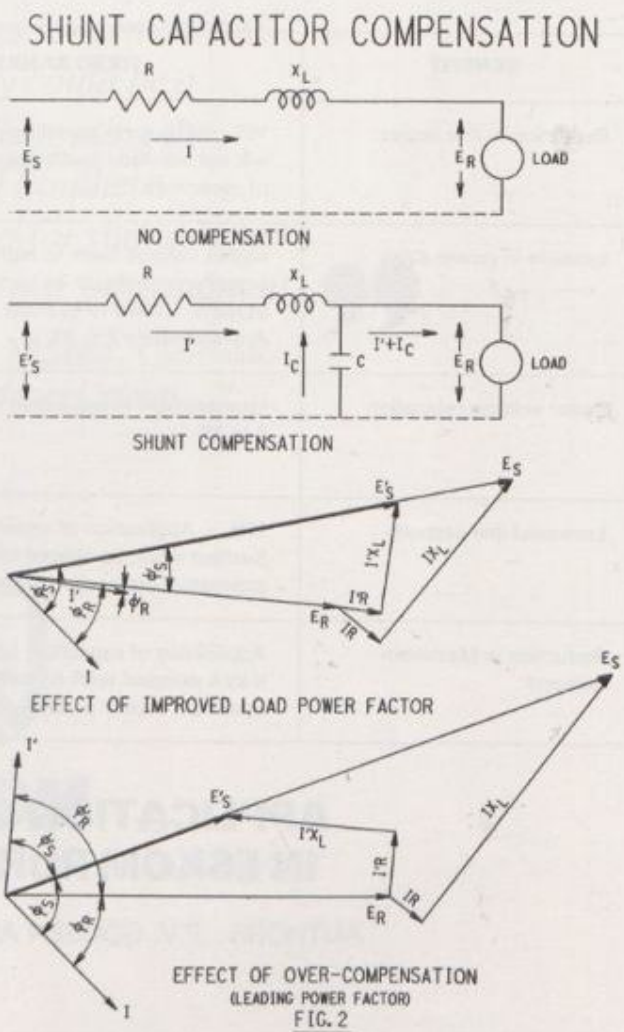


FIG. 2

### 2.2 Shunt compensation (see figure 2)

Shunt capacitive compensation of hv lines provides reactive power at the terminals to counteract inductive volt-drop on the line impedance due to inductive load. Since it reduces the line current, the resistive line loss is reduced.

#### 2.2.1 Surge Impedance Loading (SIL)

At the beginning of its life, a line typically operates at a low current level and its inherent distributed capacitance over-compensates its own inductive reactive power requirement. As the load grows, balance of reactive power consumption (proportional to

load current squared) and generation (proportional to voltage squared) is achieved. This particular condition is called the Surge Impedance Loading (SIL).

### 2.2.2 Evolution of shunt compensation

Lightly loaded medium to long hv lines start off being compensated by fixed shunt reactors at either end to compensate for the excessive Mvar generated. Eventually as the load grows, reactor disconnecting switches and finally switched shunt capacitive compensation at the receiving-end, may be installed to controle voltage regulation as loading exceeds the SIL.

Once shunt reactive and capacitive compensation are available. one can control the full range of load conditions. In multi-line situations operating advantages are achieved by allocating all switched shunt compensation elements to substation busbars, instead of having them dedicated to individual lines.

2.2.3 Shunt compensation as voltage division

Shunt compensation can be explained as voltage division. The network at a point can be characterized by an ideal voltage source in series with a purely inductive impedance (X/R ratio > 10). Furthermore, since the in-phase current of real (MW) load, drawn from such an inductive source, produces a volt drop component normal to the receiving-end voltage, this load current has little influence on the magnitued of the receiving-end line voltage. On the other hand however, inductive load current produces a directly subtracting in-phase volt drop.

Practical first order voltage regulation levels can therefore be obtained by considering only reactive elements

$$Vb = X/(X+Xn)$$

where Vb = local busbar voltage, pu
X = impedance of compensating reactor or capacitor
Xn = network equivalent impedance

### 2.2.4 Regulation calculations using Mva, Mvar ratings

For conceptual thinking it is useful to convert the above impedances to power ratings:

$$Q = V.V/X$$

where Q = 3-phase reactive power, Mvar
X = reactive impedance, ohm
V = line voltage, kV

Because compensating equipment is characterized by their 3-phase power rating and the network equivalent impedance is often specified indirectly as "MVA fault level", these ratings are useful in calculating the voltage variation effect to be expected from a compensating element.

$$Vb-Va = Qr/Qn$$

where Vb-Va = busbar voltage variation, pu
Qr = 3-phase power rating of reactor (negative sign for capacitor)
Qn = MVA fault level

From the voltage variation resulting from switching a known value of compensation one can now also quickly determine the "MVA short circuit level" of the network.

## 3. RURAL DISTRIBUTION LINES

From the total cost of approximately R18 500 per km for 22 kV rural line, it is quite clear that the maximum number of users must be served with a particular line.

A voltage variation figure of ± 7.5% is commonly used by Eskom to guarantee the regulation at the point of supply.

Contrary to hv lines, the X/R ratio for rural lines can be as low as 1. This is explained by noting that, in selecting the conductors and their arrangement, no provision need to made for controlling corona discharges. Sizing can be optimized purely on voltage drop, mechanical strength, current carrying capacity and cost considerations. The conductors are often tailored to the extent that the end sections and spurs are tapered down.

With the poor X/R ratios given, both inductive and resistive volt drops are important. While the resistive volt drop caused by the real load (MW) can only be compensated by source voltage control, the inductive volt drop caused by lagging load current may be controlled by centralized power factor correction for the many small loads.

The supply design strategy assumed is therefore to start out with maximum voltage, controlled by an automatic on-load tap changer. As the voltage downstream drops to unacceptable levels, automatic series voltage regulators may be used for boosting. Then at points calculated for the best centralized effect, fixed or switched shunt capacitor banks may be added. Although not acting on the same components of the volt drops, capacitors are preferred to series regulators from a cost and losses point of view. Final adjustments to the voltage of individual customers is done with the taps of their supply transformers.

Computer load flow programs, reliable load data and network parameters are essential for optimizing lines and compensation. Given a line system and a loading situation, such a program can determine the optimum sizing and placing of shunt capacitive compensation.

The value of fixed compensation must give acceptable voltage profiles for low and high loading conditions. If the cost of automatically switched capacitors can be justified, an improved level of compensation can be achieved for higher loads.

Optimum placing of compensation is determined by minimizing the network's kW losses. A 30% reduction is not uncommon. This optimization is best performed by a computer. Capacitors can generally be sized to suit requirements. 150 kvar, 300 kvar, 750 kvar and 1000 kvar have been provided.

Conditions on a line may change to the extent that re-conductoring and therefore also relocation or replacement of banks, are required.

Erection of a fixed bank in one day presents no problem when existing pole structures can be used. Two days are required if additional poles have to be planted.

## 4. CONCLUSIONS

The application of fixed and switched shunt capacitors are being used more and more in the Eskom rural distribution networks in order to provide the maximum number of electricity customers with cost-effective service.

From the hv networks and industrial power factor correction, the theory of shunt capacitive compensation is well understood. For application in Eskom's rural networks, the low X/R ratio in these networks must be given proper consideration, but modern computer technology has become available at affordable prices to study and optimize the solutions. These studies and solutions do however require reliable data bases of the network parameters and actual operating conditions for low and high loads, in order to obtain the best results.

Local technology is available to solve the combination of socio-economic and technical problems presented by the electrification of sparsely populated rural areas in South Afrika and the best possible use should be made thereof.

Mr Piet Goosen obtained his B.Sc electrical engineering degree from Pretoria University in 1969 and his honours degree from the same University in 1971.

From 1970 to 1972 he was Engineer-in-training with ESKOM and in 1972 he became Project Engineer for the Apollo-Cahora Bassa Project.

From 1972 to 1974 Mr Goosen was seconded to AEG Berlin for training in HVDC technology in general, and automatic control systems in particular. He was involved as design engineer for design, development and simulator testing of control systems for Apollo-Cahora Bassa Project.

In 1979 the Apollo operation was handed over to ESKOM Region and he was transferred back to Head Office as Senior Engineer in the Protection Design Division with continuing involvement in the Apollo project.

From 1980 to 1986 he was Senior Engineer in the HV Plant Section, responsible for Power Capacitors and Static Compensators and the development, simulator testing, layout, installation commissioning, acceptance testing, operation and protection optimisation of SVC's.

From 1986 to date Mr Goosen is Chief Engineer for the High Voltage Power Equipment Section in the Transmission Engineering Department.

*Mr Piet Goosen, addressing the delegates and Mr P J Newham seated*

**MR KAREL BILEK: AFFILIATE**

As the theory has been exhausted by previous speakers, let's take a look at some points of practical application.

Perhaps the most important is the acceptance of a power factor correction scheme by the operating personnel at operating level. Frequently I have found that the benefits of capacitor installations are known to the engineer but were not understood by operating personnel and the capacitors were regarded as an extra load, an engineers toy, a nuisance in general. With such an attitude, the capacitors fall into misuse on the first suitable opportunity. I have had some success with the following explanation:

The concept of an electric motor consuming apart from the active, working power also the reactive, magnetising power is accepted by most electricians. That these powers come from a power station and have to be paid for is clear. Now, all that is needed for understanding is to see the capacitor as a generator of reactive power, the small private power station. Unfortunately it is limited to producing reactive power only, but it can and should be placed close to the point where such power is consumed.

The voltage support provided by the capacitors can be in this way intuitively grasped.

The same analogy explains why for compensation of the base reactive load, mainly a magnetising current of permanently connected transformers, the permanently connected capacitors are suitable and why for fluctuating reactive power demand the switched capacitors are preferred.

Another problem is that the capacitors may not fulfil unrealistic expectations. The voltage support that the fixed capacitor bank provides will be only several percent. Its effect on voltage regulation can hardly be seen. The switched bank will improve the voltage during the time of high demand only but its cost is much higher. The light flicker will not be cured by the switched capacitor bank as the switching cycle of the bank is far too slow. The typical discharge period after switching off is several minutes before the bank can be re-energized. The short time demand of reactive power during large motor starting will be multiple of average demand and the capacitor presence, being dimensioned for average demand, will therefore not make much difference. Luckily there are seldom large motors fed by excessive, the voltage change will exceed a maximum tolerable limit of 3 percent.

It must be recognised that the capacitor is only one of the tools for ensuring quality of the electrical supply. It is also an economical tool as the payback period measured in months proves.

The reliability of the capacitors is the key to the successful application of theory into practice. The performance in accordance with IEC specification may not be sufficient if the capacitor rated values are not chosed according to actual conditions. A common error is the automatic assumption that the capacitor rated voltage equals to the system rated voltage. The basic insulation level (BIL) is not always maintained on the wooden pole construction line and this could be vital to the capacitors. The inherent ability of capacitors to absord the surges cannot be relied upon unless the star point of the bank is earthed. As earthing of star point conflicts with standard earth fault protection, surge arrestors are needed to control BIL. They should be of metalic oxide, gapless type, capable of conducting the surge charge to earth. The presence of a capacitor next to the arrestor will increase the peak current through the arrestor, so the type with high specific energy should be selected (approx. 4 kJ/rated kV). The preferred connecting point of the arrestor is between the line fuse and the capacitor or the capacitor switch. Use of disconnector, a popular component of distribution class arrestor, is not recommended. The fuse on line side of arrestor should prevent a lockout of line.

The fusing of these capacitors is done by drop-out fuses. Fuse link type "T" e.i. slow is preferred, rated between 1.2 and 1.4 times capacitor nominal current. This fusing factor may appear low but the "T" link has already a built in overcurrent factor of 1.5. The drop-out fuses are not intended to be the switching device. On the switched bank the two switches can break the load current prior to handling the fuses. On a fixed bank the occasional re-insertion of a blown fuse after a storm would have to be accepted, but for healthy link removal the short interuption of the supply should be practised. Where

this is not acceptable, perhaps the loadbreak fuse/holder assembly can be considered. While providing less arcing and less contact damage, the speed of loadbreak is not sufficient to avoid overvoltages on capacitor.

The main reason for installing capacitors is usually excessive voltage drop. Logically the voltage will be selected as the governing parameter to control the switching. The settings of the right voltage level and the right amount of hysterisis are difficult to predict. An operation counter, if installed, will provide an inexpensive way to confirm the correct setting. The changes in the load pattern over a time may require the re-setting of controls. Low maintenance requirement limits the choice of available switches. Two or three single phase switches, with vacuum as a switching medium, are used.

The last problem for which we have no easy solution is the lack of information on the immediate status of the capacitors. Apart from the remote control system, which is recently tried by ESKOM, my advice is to locate the capacitors close to the regular route of operating personnel so the position of drop out fuses can be observed.

**MR CHRISTOPHER D. NASH**

Many thanks and congratulations to both Peter Newham and Piet Goosen for such well presented papers on a topic which currently is in vogue. As Mr Goosen points out Eskom have recently, as he puts it, cautiously started to apply capacitors to rural networks. Given todays socio-economic climate and the need to supply electric power as cheaply and efficiently as possible to the furthest reaches of our society, capacitors have an important role to play.

Capacitors have an almost mythical quality and our engineers, with the exception of those whose tasks have enforced an involvement, generally give capacitors a wide berth. Certainly the engineers concerned with rural electrics seem to fit this category. This is understandable as their engineering culture is derived from that of Europeans who do not fit capacitors into rural networks. This need not be the case as there exists vast knowledge and experience in North and South America, developed over some 55 years in application of capacitors to rural systems as this was one of the first major applications of capacitors on that continent.

Capacitors have been around since the first world war. Their application at that time was very limited as they were voluminous and expensive. Typically a capacitor about the size of a desk may have produced only 25 KVAR and would have been expensive to produce. In the thirties the introduction of aromatic hydrocarbons (pcb) wrought a quantum leap in capacitor technology which massively decreased the volume versus output ratio and therefore the manufactured and installed cost of capacitors. Subsequent events such as further world wars, the oil crisis, and latter day demand for energy versus spiralling costs of producing and supplying electrical energy have been the stimulus for spending more and more R & D funds in capacitor development.

Materials and manufacturing techniques that have developed have dramatically reduced the volume and cost as well as dramatically increasing their efficiency and inherent strength. Today we can fit 20 units into the space of that same desk, but will each have an output of 400 kvar not 25. These units would have losses of less than 0.1 watt per KVAR (99.99% efficiency) and can withstand discharges in excess of 1 000 times normal current. Further they are now environmentally accepted since the pcb has been replaced with non-toxic impregnants.

Capacitors are possibly the best value for money purchase that an electrical engineer can make and, as the investigations that Mr Newhams firm have proved, are eminently suitable for installation in the hostile environment of the rural reticulation systems in South Africa. In order to derive the greatest benefit from capacitors however, it is necessary to be able to provide complementary equipments to protect and control these capacitors. This equipment must also be economically priced to justify installation and similarly able to withstand the environment. Through the years of development and application of capacitors to rural systems in USA, purpose made equipments such as load break drop out fuse isolators, oil and vacuum capacitor load switches, voltage current and var controllers plus other ancillary equipments, all specifically designed for rural installations, have evolved. The application has been so commonplace that US utilities and capacitor manufacturers hold stock of capacitors and components in pre-engineered form such that immediate installations can be made. This point demonstrates that the technology of applying capacitors to rural systems is very mature. We have no need to re-invent this wheel.

The benefits of installing capacitors that have been enumerated by the previous speakers are:

Reduction in losses
Release of system capacity/deferment of expansion
Improvement of voltage regulation
Increase in energy sales/decrease in energy purchase

All of these benefits provide an economic payback. In other words, the installation of capacitors will pay for itself in situations where the load particulars require them to be installed. By nature, capacitors are a maintenance free device and are therefore not costly to own. All in all capacitors are a gift.

Given local licensed manufacture of capacitors and, for the most part, of the companion equipments, coupled with the availability of application guidance, every incentive is provided for local authorities to take advantage of this gift.

**MR P GOOSEN: ESKOM**

I wish to put perspective and some background into the use of these capacitors. I think we can only but agree with Mr Nash that capacitors have come a long way, have improved dramatically and now are right for applying into the rural distribution area. Thank you.

**MR ACKERMAN: ESKOM**

I would like to ask Mr Piet Goosen, this is fine. We are having a look at compensation along the particular line, but you know with our rapidly developing networks, how often should we have a look and see what our loadings are, and when do we change capacitors?

**MR A H L FORTMANN: PRESIDENT**

I think that is a good question, because you know lines are expanding all the time, and I suppose you'll have to adjust your capacitor banks continually.

**MR P GOOSEN: ESKOM**

Mr Ackerman asked the most difficult question, I think. I think the basic criteria would be when your consumers start complaining about the voltages again, then you should have a relook and a restudy. I think they are the early warning device in our networks typically.

**MR P NEWHAM: AFFILIATE**

If I may I would just like to amplify something that was said there. One of the things that is not generally realised about a power factor correction capacitor is that it is inherently self-correcting, depending on where you compensate to. Since your power factor, which is basic what you are compensating to new unities depend on the tan of the reactive power divided by the active power. You will find that if you correct it to mere unity, you can have som 20% to 30% load increase or decrease around that point, without actually effecting your power factor to a drastic degree. When correcting a line or even an

industrial installation or anything like that, people often say, we will correct to about 0,99 power factor. It is actually advantageous to correct to closer to unity power factor, because that gives you such a flexibility in your load conditions. You can drop 20% to 30% of your load before you go particularly far leading to an extent that your voltage is going to rise, or you are going to start effecting your meters. Or you can add conversely, 20% to 30% more load to a line before your actual power factor has actually gone a lot worse. So this is just one of the hidden benefits that is of interest.
Thank you.

**MR DENIS FRASER: DURBAN**
Mr President I wonder if Eskom have done economic studies on the application of capacitors. This strikes me that you know there may be some cost justification through a reduction in line losses through operation at a better power factor, and also by improving the voltage at the consumers terminals. Do we cause them to use more kilowatt/hours, and get more revenue from them?

**MR P GOOSEN: ESKOM**
I thought that point would come up Mr Fraser. I think the basic criteria we are looking at, is actually a voltage profiles on the systems. We have a certain commitment to supply consumers at certain voltage levels, and I think that is the first line that we follow. The others are actually sort of fringe benefits. We do not purposely go and put in these capacitors just for loss reduction. Obviously it has an advantage as well, but the very first point is actually the voltage control. I think Mr Newham has mentioned these, perhaps in a different order, but saying that the losses perhaps is lower down or highter down, and the voltages are also not very important. But on the Eskom side, I think certainly the voltages would be the first criteria. Could I get Mr Ackerman perhaps also to give his views.

**MR JIM TOMS: SABS**
All the ideas that have been presented so far, work on the basis of 50 hz. With the advent of power electronics, non linear loads are becoming the fashion rather than the exception, and in consequence of this, harmonic voltages are created on the network, by certain consumers, and these effect other consumers and they also effect things like power factor compensation capacitors which are strung across the network and provide very nice short circuit paths for these harmonic currents and also they increase the losses. Is this aspect taken into account in planning for power factor compensation? Or do we blithely assume that the energy loss in the capacitor is going to be based purely on the 50 heards consideration.

We all have these non linear loads in our possession and things like thypistor controls which will increase dramatically in the next 20 years.

Thank you.

**MR P NEWHAM: AFFILIATE**
I think I did mention in passing that harmonics are probably one of the worst enemies, apart from peak over voltages of capacitors. Now I think one would just go into the actual mechanics of this. Harmonics are not generated by normal 50 hz generators power stations. They are generated by non linear loads. These harmonics have got to find somewhere to sink themselves into the system. Capacitors provide an easy path. Now the series impedence of the system plus the capacitor together form a parallel resonant path. The level of the harmonic on its own, is generally not dangerous, except under exceptional conditions. I will just list a couple of them that are really bad. Thypistor control winters are probably the worst enemy in this country; followed by unbalanced operational arc furnises. They are generally not too bad because they cause such an effect, that everybody knows about it, when they are corrected and single phase traction. The railways has this delightful habit of taking a single phase supply off at 132 kV or something like that, rectifying it, and feeding the locomotives with it. But the basic problem comes with the capacitor when this resonant circuit formed by the impendence or inductance of the supply and the capacitor forms a resonant circuit. Now the ampitude of this resonance is to determine, firstly, by the generated level of the harmonic, where ever it be, (it can typical for six pulse winders be in the order of third, fifth, or seventh harmonic for twelth pulse winders, which is the bigger winders, and the larger arc furnises, it in the higher ranges of 7, 11 and 13, and often the 25th harmonic) you will get resonance.

The amplitude of this resonance residence will be determined by the damping of the system and amplitude of the generated harmonic. Its when one of these generated harmonics falls into the resonant frequency that you start getting problems. Now we are fairly lucky on the rural distribution line, by the nature of the construction they are fairly long, they have lots of little loads strung off at various intervals and the actual correction applied there is not very large. Fog levels are also fairly low, because these things are fairly far down your system. So your resonant frequency points are fairly higher, and generally well out of the danger point of the resonant conditions. The actual danger comes of power factor corrections when your resonant conditions starts falling into the area, where your harmonic generation is prevalent. This typically occurs when you are looking at loads of som 5, 10, 15 MVA, factory load whos typical power factor would be in order of 0,7 and 0,75. When you correct power factor at this point, you start to get your dangerous conditions. Generally capasitors are pretty tough animals. They can take an awful lot of harmonics before they actually get damaged.

I haven't got all the details of the various EC specifications and things here. Typical of the specifications, this forms the basis for Capasitors IEC 70. But specifically the capasitors for rual lines are over designed, to get away from the need to have to put either two new reactors in series with the capacitor bank. This basic forms a high impedence at the particular harmonic, and thus shunts the harmonic elsewhere in the system to cause damage elsewhere. Or parellel type filters whereby you shunt the harmonic to earth, in other words you actually tune the filter at a certain resonant point. So you can either block the harmonic out or push it elsewhere in the system, or you can sink the harmonic. Depending on the rural line, you are pretty well out of danger, unless you've got a factory with a large set of thyristors drives, or you have railway traction. A point that maybe of interest, when you're measuring for power factor correction on the rural line, you should always have a look at the harmonics at the same time. It is not always an easy thing to do, the instruments are a little scarse in South Africa to do such things. We've actually gone so far as to try and develop an instrument which is working quite successfully to do this. I think one of the worst enemies of the capacitor is the harmonic. When they are treated with care, ther's no problem, especially not on a rural line unless there is railway traction nearby.

Thank you.

**MR GEOFF BICK: AFFILIATE**
I'd like to address a question to Mr Goosen. You stated that externally fused capacitors only should be used on these rural schemes. Now, we have a certain technological biased towards manufacturing internally fused capacitors, although as he mentioned we can attract to externally fuses. If we're looking at a system that basically one wants to install and then leave, with an internally fused capacitor, you have 48 elements, you loose one element, that is a 2 percent imbalance.

Whereas externally fused you've got a maintenance person wondering around, checking which capacitors have gone. We feel that there is actually a savings on not having to do so much maintenance. I'd like Mr Goosen's comments on this.

**MR P GOOSEN: ESKOM**

Mr Bick, the reasons for us not preferring to have the internal fuses on these installations is, the internal fuses are meant to work with a protection system which monitors the operation of these fuses. So if we just look at internal fuses, over time we would expect them to fail progressively and there would be nothing to tell us that something has gone wrong. The end result would be that the last fuse would go and the next step would then be probably an explosion of the can. If we rather apply the external fuse system, that is without any internal fuses at all, we would get failure of the elements, the current would increase, and eventually the external fuse would blow to indicate this condition. The internal fuses and external fuse don't actually operate nicely together. The internal fuses are reducing the current when the faults are occuring, where we would actually like just the opposite to occur.

# ALDERMAN/RAADSHEER ROBBIE DE LANGE

**MR A L H FORTMANN: PRESIDENT**

This will be Alderman de Lange's last Technical Meeting of the AMEU that he will attend as a Councillor and I wish to call upon him to address this meeting.

**RDH. DE LANGE: OOS-LONDEN**

Geagte President, ten eerste baie dankie vir die voorreg om 'n paar woorde van afskeid te rig aan u en al my kollegas op die vooraand van my uittrede aan 'n munisipale loopbaan. Vandag 6 September is my 43ste jaar as stadsraadslid. My kennis van die VMEO gaan terug na die jaar 1948 toe ek my eerste konvensie bygewoon het. Ek dink dit was in Margate, saam met mnr Arthur Foden.

Ek is terdeë trots op die feit dat ek 'n erelid is van die VMEO en dit is my oorwoë mening dat die Vereniging **een** van die belangrikste is in die munisipale stelsel. Tegniek is tog een van die belangrikste faktore in die eeu van die rekenaarstelsel. Die administrasiestelse is 'n natuurlike skakel, maar praktiese uitvoering en die opbouing is murg en been van enige ontwikkelende land. Ek voel gelukkig in die wete dat daar waardige opvolgers sal wees, vir baie lank waardige voorgangers, en dat die organisasie 'n groot en gereelde bydrae sal maak tot die opbouing en vooruitgang van 'n wonderlike land soos Suid-Afrika.

Mnr die President, ons gaan 'n nuwe era tegemoet met die 26 Oktober verkiesings en my bede en vertroue is dat daar nouer samewerking en onderlinge vertroue sal wees tussen raadslede en amptenare. So 'n verhouding kan alleenlik 'n goeie verhouding teweeg bring tot voordeel van ons samelewing as 'n geheel.

Ten slotte my dank aan u mnr die President, en lede van die uitvoerende Raad, Bennie van der Walt, 'n uitstekende sekretaris vir sy bydrae en vriendelikheid.

To the Affiliate Members a word of thanks for their support of this organisation and their contribution in the development of the system of Electrification, especially in this age of a mad world who are using crazy methods to break down what has been built up over the years.

My persoonlike dank aan die Burgemeester van Potchefstroom 'n man na my hart, die Stadsklerk mnr du Plessis en mnr Fanie Steyn, ek sal sê 'n "up and coming engineer".

Nogmaals dankie vir die vriendskap en kameradie wat ek van u almal ontvang het. Mag die VMEO gaan van krag tot krag vir die groot taak wat voorlê.

**MNR A H L FORTMANN: PRESIDENT**

Dit is met weemoed dat ons van Raadsheer de Lange moet afskeid neem. Ons wens u alle sterkte toe met u aftrede na 26 Oktober, maar ek is seker dat ons u nog by ons byeenkomste sal sien. Alderman de Lange, Gods richest blessing, and may you have many many more years of happy association with the AMEU.

*Raadshere Johan Oosthuizen en Robbie de Lange saam met Alwin Fortmann, President van die VMEO.*

# VMEO OPLEIDING TOEKENNINGS
# AMEU TRAINING AWARDS

*Technical Training Centre AMEU award: The R250 prize has been awarded to Mr C B Rossling, a final year apprentice electrician who completed his N4 certificate course at the Proteaville Technical College with distinction and passed his trade test with a B+ symbol in August 1987. Mr Rosslind received his prize from Mr F L U Daniel, Electrical Engineer, Cape Town.*

*Mnr P J Wood, 'n student aan die Tegniese Kollege Maitland, wat werksaam is by die Kaapse Stadsraad, was die wenner van die VMEO toekenning asook die Juta toekenning, naamlik 'n wisseltrofee en boekbewys vir "Die beste en mees verdienstelike student in Elektrotegniese Ingenieurswese." Op die foto word die toekennings aan mnr Wood oorhandig deur mev H H Viljoen.*

*Die prys vir die mees verdienstelike vakleerling aan die Roodepoortse opleidingsentrum, word hierdie jaar gedeel deur mnre T J de Beer en M Wentzel. Saam met hulle op die foto, verskyn die opleidingsbeampte, mnr W D Boshoff.*

# **SESSIE VOORSITTERS:** JULES VON AHLFTEN: **SESSION CHAIRMEN** JAN LOUBSER

*Mnre Hannes Marais, hulp sekretaris, Bennie van die Walt, sekretaris in die VMEO, Jan Loubser en Jules von Ahlften gesamentlike voorsitters van die besprekingssessies, Alwin Fortmann, President en Fred Daniel, Aangewese President.*

## ONDERWERPE VIR BESPREKING

**V1. Vrae oor sisteem en verklaarde spannings vir laagspanningstoevoere in residensiële dorpsgebiede en spanningsvalberekenings – deur Mnr A H L Fortmann:**

Dit wil voorkom of daar algemene eenstemmigheid tussen die geledere van die VMEO bestaan dat die aanvaarde verklaarde spanning na huishoudelike verbruikers in residensiële dorpsgebiede 380/220 volt is en dat die geassosieerde sisteem se spanning 400/231 volt is.

Toe die nuwe spanningsvaltabelle (G4) vir die Riglyne opgestel is, het 'n sekere mate van onenigheid ontstaan omtrent watter spanning vir die berekening van spanningsval gebruik moes word.

As in gedagte gehou word dat spanningsreëling vir transformators by arbeidsfaktor van een, vanaf ongeveer 1,12% vir 630 kVA tot 1,42% vir 200 kVA onder vol vrag toestande varieer, die spanning by die LS terminale effens laer sal wees, sê 395/228 volt, indien aangeneem word dat die mediumspanning konstant op 11 kV bly.

In die praktyk word gevind dat die werklike gemete spanning by die transformator LS terminale nader is aan 400/231 volt as aan 380/220 volt.

Deur die 380/220 volt as noemer te gebruik het dit die effek dat vir dieselfde ontwerp *kVA* die berekende persentasie spanningsval $[(231/220)^2 \times 100\% - 100\%] = 10{,}25\%$ is, wat hoër is as wanneer 231 V gebruik word as noemer.

Dieselfde persentasie spanningsval kan verkry word as 'n kleiner ontwerp kVA gebruik word. Nogtans is die waardes wat in die Riglyne gebruik is, tabel G1, onveranderd gelaat, met die gevolg dat die persentasie spanningsval van 10,25% hoër is, gesien slegs uit die oogpunt van die stelselspanning.

Om die transformatorkapasiteit te bereken moet die stelselspanning, nl. 400/231 V gebruik word en dit is om hierdie rede

## TOPICS FOR DISCUSSION

**Q1. Question on system and declared voltages for low voltage supplies in residential townships and voltage drop calculations – by Mr A H L Fortmann:**

It appears that there is general agreement in the ranks of the AMEU that the accepted *declared* voltage to domestic consumers in residential townships is 380/220 volts and that the associated *system* voltage is 400/231 volts.

When the new voltage drop tables (G4) of the Guidelines were drawn up, a certian amount of controversy ensued about which voltage should be used for voltage drop calculation purposes.

Bearing in mind that voltage regulation for transformers, at unity power factor, varies from approximately 1,12% for 630 kVA to 1.42% for 200 kV.A under full load conditions, the voltage at the LV terminals will only be slightly lower, say 395/228 volts, if the medium voltage, say 11 kV, is assumed to remain at 11 kV.

In practice it will be found that the actual measured voltage at the transformer LV terminals is closer to the 400/231 volts level than the 380/220 volts level.

The effect of using 380/220 volts as the demonitator is that for the same design *kVA* the calculated percentage voltage drop is $[(231/220)^2 \times 100\% - 100\%] = 10{,}25\%$, which is higher than when 231 V is used as the denominator.

The same percentage voltage drops can be obtained if a lower value design kVA is used. However, the values used in the Guidelines, table G1, have not been altered with the result that the percentage voltage drops are therefore 10,25% higher from the system voltage aspect alone.

To calculate the transformer capacity the system voltage, viz 400/231 V must be used and therefore, for this reason it is also considered more practical to use one voltage only, viz 400/231 V for all the calculations.

The old and new British Guidelines use the system voltage of 415/240 V when calculating percentage voltage drops.

dat dit ook aanvaar word om meer prakties te wees deur slegs een spanning nl. 400/231 V te gebruik vir alle berekeninge.

Die ou- en nuwe Britse Riglyne gebruik 'n stelselspanning van 415/240 V in die berekeninge van persentasie spanningsval.

In die praktyk is bevind dat die arbeidsfaktor van 'n wooneenheid 0,95 nalopend is en die gemete arbeidsfaktor in 'n substasie 0,97 nalopend is. Om praktiese redes word 'n arbeidsfaktor van een in die RSA Riglyne gebruik wat van die veronderstelling uitgaan dat 'n wooneenheid 'n suiwer weerstandslas is.

Die stroom deur 'n weerstand is laer as die toevoerspanning laag is. Byvoorbeeld is die stroom laer in 'n stoof met 'n laer spanning en derhalwe is die resulterende kVA-las laer.

Indien die huislas gesien word as 'n vrag uitgedruk in kVA, dan is die stroom hoër indien die getal 380/220 V gebruik word inteenstelling met 400/231 wat 'n direkte weerspreking is van die vorige paragraaf.

Na my mening is die spanning wat gebruiki behoort te word 400/231 volt, maar die komitee belas met die hersiening van die "Guidelines For the Provision of Engineerin Services In Residential Townships" waarvan ek 'n lid is, het besluit dat hierdie spanning syne vir die berekening van spanningsval 380/220 volt moet wees.

**VRAAG:**

Onder hierdie omstandighede vir die berekening van spanningsval, watter spanning behoort gebruik te word - 400/231 volt of 380/220 volt?

Die mening van afgevaardigdes sal waardeer word.

In practical it has been found that the power factor of a residence is 0,95 lagging and the power factor measured at the substation is 0,97 lagging. For practical purposes unity power factor is used in the RSA Guidelines which implies that the house load can be considered a pure resistive load.

The current that flows through a resistance is lower when the supply voltage is lower. For example in a stove, the current is lower with a reduced voltage and therefore the resultant load kVA is lower.

If the house load is considered to be a load expressed in kVA then the current is higher when the fiture 380/220V is used as opposed to 400/231 V which is a direct contradiction to the previous paragraph.

In my view, the voltage which should be used is 400/231 volts, whereas the committee concerned with the revision of the "Guidelines For the Provision of Engineering Services in Residential Townships" and of which I am a member, ruled that this voltage, viz for calculating voltage drop, should be 380/220 volts.

**QUESTION:**

Under these circumstances of calculating voltage drop, which is the voltage that should be used - 400/231 V or 380/220 V?

The opinion of delegates will be appreciated.

**MR FORTMANN: PRESIDENT**

When you use 5 kVA ADMD and you use the figures 380/220 volts, you arrive at a certain current. Now, you've got your current flowing in that conductor. But when you get back to your transformer you now suddenly change to different voltage. When you change to different voltage of 400/231 you can't very well use that same current there, that you have just calculated to determine what that consumer of 5 kVA ADMD was using. You've now got to switch to something else. And this is what I'm saying. You're mixing up your kVA's, 5 kVA ADMD at 380/220 V is not 5 kVA ADMD at 400/231 V, it's something else. And yet we're using 380/220 V to determine, to draw up tables for the guidelines.

**MR H D BECK: EAST LONDON**

Mr Fortmann is correct in saying that the accepted *declared* voltage to domestic consumers in residential townships is 380/220 volts and that the associated *system* voltage is 400/231 volts.

In the Electricity Act, 1987 – Regulation 9 it is stated that:

"(1) the standard pressures at which electricity is supplied to consumers by any undertaker shall be as follows:

(a) For pressures below 500 volts, the standard pressure at the consumers' terminals shall be 220/380 Volts for 3-phase alternating current systems.

(2) In the absence of any agreement to the contrary, the pressure at which electricity is supplied shall not vary from the standard or agreed pressure by more than 5% for any period longer than ten consecutive minutes.

(4) The board may, on application, permit a departure from the stipulated standard pressures, frequency and tolerances."

It is considered that worst-case design parameters should be used. Pending a future decision regarding voltage levels and tolerances, 380/220 V should be used with the required after diversity maximum demand figure to calculate volt drop in the low voltage distribution network and 400/231 volts for the distribution transformer rating.

**MR V RAYNAL: AFFILIATE**

To answer Mr Fortmann's question. The sub-committee dealing with volt drop calculations, use 220 volts as the declared voltage for the following reason. That ADMD's apply on full load and if we take a case where an ADMD is 5 kVA, we expect the voltage then to be a 220 volts at the loaded voltage of the system. If we took the voltage to be 230, which is the open circuit voltage of the transformer, the corresponding current would be 21,7 amps. In other words, if we work out the volt drop at 220 volts, the current is higher, it's 22,7 and ther percentage volt drop is then as the denominator in 220 volt. So you get a pesimitic reading. I you take the voltage as 230, the current then is 21,7. It's a lower current and your denominate is 230. So you get a lower volt drop and as you point out in your remark Mr President, that it's a 10,7% difference. So the Guideline Sub-committee took the cas which we felt was the one in reality that the voltage at the consumer's terminals was 220 volts.

**MR A H L FORTMANN: PRESIDENT**

Yes, thank you Mr Raynal. You're building a safety factor into that, but isn't is wiser to build a safety factor in by saying the ADMD is 5 kVA but let us make it, say for example 5,5 or 6 kVA and build it in that way.

**MR V RAYNAL**

Well, Mr Chairman, I think most people will agree that on full load the voltage is 220 volt. It starts off with 230 volts at no load. It's unrealistic to consider a voltage of full load is 230 volt on a 380/220 volt system.

**MR A H L FORTMANN**

Except under full load conditions and with unity power factor with the impedence of the transformer you probably get a voltage drop down to, at the terminals any way, of say 228. Sot it's nowhere near to 220, it's near to the 231 mark.

**MNR KEES VAN ALPHEN: SABS**

Die SABS-komitee vir SABS 1019 'Standaardspanningstrome en -isoleerpeile' waarop die VMEO sterk verteenwoordig is, het by onlangse besprekings tot die eenparige besluit gekom om die wêreldstandaardspanning soos in IEK 38 gegee te aanvaar, naamllik:

**Standard voltage at consumer terminals : 230/400 V permissible voltage varations: ± 6%**

Two AMEU members on the SABS committee representing large municipal undertakings having a 240 V or 250 v reticulation system did not foresee much problem in dropping their system voltage to fall within the proposed 230/400 V ±6%.

In order to accomodate the many municipal undertakings operating a 220/380 V system, the permissible voltage variations will be 230/400 V + 6% – 10% with the ultimate goal that their systems will be brought within the limits of 230/400 V ± 6%.

This step was welcomed by the Domestic Appliances Manufacturers Association of South Africa (D A M A S A) as it will be possible to reduce duplication by no longer having to supply appliance for 220 V and 240 or 250 V systems.

In reply to the question by Mr Ackerman, the SABS committee debated at length whether to adopt the limits of ± 7,5% as used by Eskom in their low voltage reticulation systems. It was recognized that:

(a) Eskom operate extensive rural distribution systems where larger tolerances are a necessity to be able to supply electricity at an economically acceptable cost;

(b) consumer awareness and expectations will exert an even increasing pressure on supply authorities to improve their quality of supply; and

(c) the adoption of 230/400 V ± 6% will enable local industry to manufacture appliances to comply with international standards.

It is often not appreciated that the large voltage variations as are presently existing in many systems require the South African appliance industry to manufacture more expensive equipment. At the same time local industry is often exposed to unfair competition from cheaper imported equipment made to narrower IEC tolerances.

These appliances may not last that long in South African systems with larger voltage but the damage to the South African economy is done.

The South African public is at present still rather docile and tolerant with respect to a large variation in voltage supply. This, however, may well change and consumer awareness could adopt a more agressive approach with regard to a better quality of supply.

How will SABS 1019 affect the Regulations to the Electricity Act? Mr Coen Scherman is the AMEU appointed convener to formulate with the Department of Manpower a policy with regard to the amendments to the Regulations and a possible time limit to be set with respect to narrowing the voltage limits to 230/400 V ± 6%.

This will affect the standard no-load voltage of distribution transformers in a matter which will subsequently be discussed in the SABS committee for SABS 780.

**MNR FORTMANN: PRESIDENT**

Die ding waarteen ek dit het is basies die volgende: Ons is besig om 'n sekere na diversiteit kVA te gebruik en dan strome uit te werk en spanningsval uit te werk gebaseer op 380/220V. Dan gaan ons oor, dan moet ons die grootte van die transformator bepaal. Dan skielik gebruik ons nie meer daardie spannings en strome nie, dan slaan ons nou oor na 400/231 V, want dit is die nullasspanning van die transformator en ek sê ons is besig om twee verskillende stelle syfers, deurmekaar te maak en ek persoonlik dink dit is nie reg nie. Ons moet of die een óf die ander een gebruik om ons berekeninge te doen.

**MNR L PRETORIUS: UNIVERSITEIT VAN PRETORIA**

Mnr die Voorsitter, dit is net bloot my persoonlike mening wat ek nou hier uitspreek – gelukkig is ek 'n redelike onafhanklike ou hier en nie aan iemand verbonde wat hom gaan bekommer oor wat ek sê nie. In elk geval, ek verstaan mnr Fortmann se probleem. Ek het dit altyd so gesien (kom ons vergeet van die wysigings wat kan kom, ons bly maar by wat dit is, en afgesien van Pretoria en Port Elizabeth), is die verklaarde nominale spanning 380/220V. Vir die doel om aan die wet te voldoen is dit dan die verklaarde spanning, en die feit dat die nullasspanning van die transformators 400/231 V is, is 'n bonus. Dan kan ons baie meer spanningsval toelaat onder hoë lastoestande. Dankie.

**MNR DENIS ACKERMAN: ESKOM**

One of the things I really wanted to ask right at this particular stage is: Why are we determined that we want plus 6 or minus 10% volt drop, or why is it that we are always working on 5% volt drop?

It is one of those particular things that tend to get lost in history and if you start looking at low income areas, and I think Gordon Davies in his paper said that he can save 30% of the cost of reticulation by going to 7,5%, what is the option? Why are we going for the 5% in the first place? So why do we change it now to plus 6% and minus 10%. So I'd just like to ask if anybody has an idea why we are working on the 5% in the first place. Thank you.

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**V2. Vraag oor vooruitbetaal meters – deur Mnr P J Botes:**

Veronderstel vooruitbetaal kW.h meters word aanvaar, in watter mate word die bestaande konvensionele sisteem beïnvloed?

Vrae wat te vore ko mis as volg:

- Sal dit raadsaam wees om die konvensionele meters te behou ten einde die hoeveelheid kW.h verkoop te kontroleer?
- Sal dit raadsaam wees om die onvensionele meters te behou ten einde die voorsiener in staat te stel om van tyd tot tyd, sê elke ses maande, die verbruik by hierdie kontrolemeters met die werklike verbruik van individuele verbruikers te vergelyk ten einde enige onwettige verbruik vas te stel?
- Sal die verskaffer geredelike toegang tot hierdie vooruitbetaalmeters vir inspeksie doeleindes hê?
- Waar sal die ideale ligging vir die installasie van hierdie vooruitbetaalmeters wees?

**Q2. Question on prepayment meters – by Mr P J Botes:**

Assuming prepayment kW.h meters to be acceptable, to what extent would this system affect the conventional system?

Questions that come to mind are the following:

- Would it be wise to retain the conventional meters to enable the checking of the amount of kW.h sold?
- Would it be wise to retain the conventional meters to enable the supply authority to compare from time to time, say every six months, the consumption at these "check" meters with the consumption of individual consumers in order to ascertain any possible illegal consumption?
- Would the supply authority have ready access to the prepayment meter for inspection purposes?
- Where would be the ideal position for installation of the prepayment meters?
- Would the supply authority be expected to bear the cost of the prepayment meters in a residence?

- Sal van die voorsiener verwag word om die installasie koste van die vooruitbetaalmeters te dra?
- Sal die voorsiener die vooruitbetaalmeters teen sy koste moet installeer of teen die koste van die verbruiker?
- Kan lede wat ondervinding van instaliasies van hierdie meters, hoofsaalik in SUid-Afrika het, inligting oor hulle bevindings tot op datum, verskaf.

- Would the supply authority have to instal the prepayment meters at its cost or at the cost of the consumer?
- Can members who have experience, mainly in South Africa, of installations of these meters, provide information of their findings to date.

**MR P J BOTES: ROODEPOORT**

There are different prepayment kWh meters on the market in the process of development and some in the process of being launched. Different modes of operation are offered for instance a meter controlled by a credit card principal, programmed and actuated for an amount of money that is paid. This type only involvea electric kWh metering and may permit a person some kind of credit as deemed fit. The other type or rather a system similarly programmed can perfor kWh electric consumption, wast consumption, rates and taxes. Its consumption is relayed via a repeater station covering 200 units, to the control centre where the consumption of electric energy, water consumption, amounts for tax etc. is typed out on a computer terminal. There are other, of course normal types also, on the market. The important fact is that these meters are substantially more expensive than the normal meters. The electricity supply committee of the AMEU wishes however to advise members that no credit card meter or system is approved as yet, and wishes to advise members to bear this in mind and wait for approval first.

Mr Chairman, I think that at this moment we can ask the questions that are laid down here, and need to be answered this morning. Would it be wise to retain the conventional meter to enable the checking of the amount of kWh sold? Would it be wise to retain the conventional meter to enable the supply authority to compare from time to time, say every six months, the consumption at these check meters with the consumption of individual consumers in order to ascertain any possible illegal consumption? To both these questions I would say yes, but I would like to hear what the members say.

**MNR KOOS ALGERA: RUSTENBURG**

Mnr die Voorsitter ons het volgens mnr Botes se kennis alreeds sover gegaan dat ons binnekort die eerstes van hierdie laasgenoemde stelsels gaan installeer. Dit is nie meters nie, volgens my opinie, aangesien dit alles behartig en nie net meet nie. Ek wil graag net antwoord op die vrae van mnr Botes, ek dink hy het skynbaar al die antwoorde gegee maar die eerste een sou ek sê, om die meters te behou sal miskien in die beginstadium raadsaam wees, omdat 'n mens dan kan kontroleer of die toerusting dan reg is wat jy geïnstalleer het, en dit is wat ons raad besluit het. Vir die eerste ses maande tot 'n jaar gaan die kontrole gedoen word. Die tweede vraag, sou dit ook raadsaam wees alhoewel die toerusting wat geïnstalleer word soos mnr Botes net genoem het, sou daar gepeuter word en krag miskien probeer gesteel word, dan word daar 'n alarm gegee, en 'n uitdruk gegee by die sentrale punt, – by die betaalpunt, sodat daar dadelik ondersoek ingestel kan word na die peutering. Die derde vraag, sal die verskaffer geredelik toegang tot hierdie vooruitbetaalde meters vir inspeksie doeleindes hê? Ek kan geen rede sien hoekom nie, want ek dink die verordeninge laat 'n mens toe om enige installasie te inspekteer.

Die volgende vraag, waar sal die ideale ligging vir die installasie van hierdie vooruitbetaalde meters wees? Die beste posiisie vir die apparaat wat geïnstalleer word in myns insiens in die kombuis waar die huisvrou dit kan sien want die apparaat het ook 'n digitale klok in en gee vir jou aanduiding hoeveel krediet beskikbaar is. Hy gee ook 'n waarskuwing sou die krediet aan 'n einde kom. Met ander woorde dit is maklik beskikbaar in die kombuis om gesien te word. Die volgende vraag is, en ek dink die volgende twee vrae hang saam, sal van die voorsiener verwag word om die installasiekoste van die vooruitbetaalde meters teen sy koste moet installeer of teen die koste van die verbruiker? Mnr Botes het genoem dit is 'n duur stelsel, dit mag moontlik wees, maar volgens die slim mense van die Tesouriedept. wat daarop ingegaan het, behoort hierdie stelsel homself binne 4 jaar na 5 jaar te betaal deur besparings, en die besparings word bewerkstellig deurdat daar nie meterlesers sal wees wat hoef rond te gaan en meters lees nie. Daar word nie rekeninge uitgestuur nie en daar is geen slegte skulde nie. 'n Ander voordeel is dat die geld wat die Stadsraad inkry, vooruit inkom en nie 2 maande na die tyd eers betaal word vir jou rekening nie. Daar word nie opsporings gedoen vir slegte skulde nie en af en aanskakel van krag omdat daar slegte betalers is nie. Ek weet daar was 'n vraag gewees by een van ons hoëveld takvergaderings, wat van al die werksgeleenthede wat tot niet gaan deur die mense wat betrokke is daarby? Ek dink hulle kan weer gebruik word in ander rigtings soos byvoorbeeld die vervaardiging van hierdie toerusting, en die inspeksie van hierdie toerusting miskien. Op die laaste vraag, ek glo nie iemand het 'n antwoord daarop nie – in sovere dit die stelsel wat ons gaan installeer aangaan, want dit gaan nog geïnstalleer word.

Mnr Voorsitter ek dink dit is een van die probleme wat die mense het wat die goed gaan vervaardig. Ek kan dit ook noem dat dit is geheel en al Suid-Afrikaanse ontwerp en 'n Suid-Afrikaanse produk en u weet wat die vooroordele is van die Swartes, as dit nie êrens in 'n Blanke gebied in werking is nie en bewys is dan wil hulle dit nie hê nie, want anders kom dit neer op diskriminasie en daarom het ons Stadsraad gevoel dat dit is miskien die beste tyd om dit wel 'n kans te gee om dit self te bewys en ons gaan dit doen in blanke gebied. Daar word voorgestel aan die mense wat dit gaan installeer om een eienaar te hê en dit is die myn wat se huise bedien gaar word daarmee. Dankie.

**MNR P J BOTES: ROODEPOORT**

Is dit nou nuwe huise of is dit bestaande huise waar die stelsel geïnstalleer word, met ander woorde is daar reeds 'n gewone meter en word hierdie meter nou bykomend geïnstalleer of gaan altwee geïnstalleer word van die begin af?

**MNR KOOS ALGERA: RUSTENBURG**

Mnr die Voorsitter, dit is in huise wat reeds bestaan en wat in gebruik is vir baie jare al. Daar is meters geïnstalleer by die huise en dit is hoekom ek sê dit gaan parallel met die meters geïnstaller word om 'n soort van 'n monitorstelsel te wees op die meters, en aangesien ons die verbruik maandeliks kan uitkry, kan ons dit vergelyk met wat verbruik is.

**MNR WESSEL BARNARD: ELEKTRISITEITSBEHEERRAAD**

Mr Chairman, I just want to make a few brief comments. I think we must for a few moments just think back how this whole thing originated. You know the Minister called a meeting a couple of years ago to discuss this whole problem. The problem is that electricity, the sale of electricity, is the only commodity that is sold to a vast spectrum of consumers, without

them knowing of what it is going to cost. It is only after they have consumed this that they are called on to pay and this resulted in a large number of people not being able to pay their accounts. They were not only blacks, they were all race groups, but they were the very low income group and at that meeting the principal was accepted that a scheme should be evolved whereby people can at the beginning of the month decide how much of this commodity they can afford to buy. We believe that most people are fundamentally honest, but if you at the end of the month find that you can't pay your account plus the reconnection fee and you can't live then because you are committed to an electrical supply, that's your form of energy, then you start resorting to all sorts of steps to have that power restored. So that is where the problem arose.

Now I took out statistics just last week, and in Soweto today the average consumption is about somethin under R30 a month. Now if we are going to install a system which I believe in some cases will cost of the order of R6 000 per consumer, you can virtually afford to give them electricity free for twenty years at the same cost. One must look at this problem, you have two aspects of it; you have the low income group and you have the more affluent group. The affluent people if they can't pay the end of the month they go to the bank and borrow the money but the poorer people have just got to be cut off. Then you again get this whole problem of how much money you can allocate to this. You also have the case of existing consumers where there are meters and you have new houses. The way I see it is this that the pressing problem at this stage is to have a very cheap, simple device. Where you have existing meters, where the consumer can decide how much he is going to have for the month, he can put that money into the meter, or buy a token for it. He can use that amount and when he runs out of electricity he does without it until the next month. The local authority can continue to read the meters as a back-up check on this. In other words you can have a low-grade device with a high-grade auditing of the system. Then on the other side, when you start getting into the more sophisticated systems, particularly in new housing developments with efficient people, you then don't have to do any auditing, you can have a sophisticated measuring device and switching device in the house. So I think I have had meetings recently on behalf of the Control Board with a number of manufacturers and they have quoted prices of R600 and more and I said to them that's fine. That's probably the way you wanted to develop, because that's probably where the profit lies, but the crying and pressing need is hundreds and thousands of cheap switching devices, I said I think it should be no more than about a fifty to a hundred rand, that one can install in existing houses where there is great difficulty in the consumer being able to monitor his own consumption for the month.

**MR V RAYNAL: AFFILIATE**

I'm glad Mr Botes brought up the subject because it is highly controversial. The South African Institute of Electrical Engineers, hel a mini-workshop on the subject in Megawatt Park in July, and there were a hundred people who attended. We had to turn them away, there were so many others who wanted to come. Now, the whole, to summarize what the results of this workshop were, it should be of interest, are as follows:

It was found that the problems have encountered or the magnitude, was social, cost and security. As far as social is concerned the next question is who should have pre-payment meters? There is a stigma attached to it. A sort of a doubt on the honesty of a consumer and his ability to pay for the electricity. So, that was a problem that couldn't be resolved. Secondly the cost is at present at least R700 per meter. Now our practice is installing, once organizing, an installation of over a thousand meters in Soweto, and it is not only electricity, but also water. Now this presents quite a problem and the meters are going to be inside the houses, but in an old township, and that is one of Mr Botes's questions, where should you put the meter? Obviously, there are going to be difficulties in fitting these meters into existing townships. It is very much easier to plan to put them into new townships.

The vandalism aspect is a very real one as Mr Barnard pointed out. The profit on consumers only spending thirty rand, must be about two or three rand a month. Now, when you are putting in something at that cost, it will take several years to pay it off.

I just want to reply to Mr Botes's questions. I would say that the answer, whether existing meters should be kept, I say yes, because in terms of the Electricity Act I can mention this resale of electricity, Clause 11/1 Act 41 of 1987 Regulations 11 and 13 and Regulations 11/1 apply in this case that a consumer is entitled to a standard of metering approved by BS or BSS. At the moment I don't think any sort of manufacture of prepayment meters has got the approval of the SABS as far as the accuracy is concerned.

The other questions about cost, as far as I know, the installation of these thousand meters, are being handled between the Soweto Town Council and the developer. I am afraid it is sub judice to say just who is going to pay for it all, but I can't say more than that. Finally, I suggest that this is a very apt topic for a future AMEU meeting.

**MNR P J BOTES: ROODEPOORT**

Kan ek net vra, ek dink mnr Beesley van Howick het ondervinding in Rhodesië. He has had experience in Rhodesia. I think Bulawayo, on low cost provision of electricity to low cost housing.

**MR WILLIAM BEESLEY: HOWICK**

What Mr Botes is talking about is the system that we had in Bulawayo in the African housing area, where we had load limiters and they paid for their electricity on an estimated consumption. We fixed the installation that was put into the house, power and lighting. We controlled the powerside and we knew just how much consumption approximately would be used in the month and we will be able to access what the cost would be. We included that cost in the rent that was paid before they actually used the electricity. It worked quite well, I think Cyril Hart is one of the affiliates here who knew that scheme better than I do. He worked on it a lot longer. It worked very successfully.

**MNR RUDI COETZEE: AFFILIATE**

Mnr, die president, ek wil net graag noem, ons is al direk betrokke by hierdie aspek vir die laaste drie jaar self. Twee jaar lange ondersoeke is deurgevoer. Oorspronklik het Eskom 'n spesiafikasie opgetrek vir die meter self, dit is vooruitebtaalde energiemeters. Sover is ons prototipe en die produksie-eenheid deur al die laboratoriumtoetse. Dit het nou wel agt maande geneem maar dit is deur. Eskom, sover ek weet, gaan nog veldtoetse doen alhoewel ons reeds betrokke is by dertien verskillende installasies in die land van baie klein af, (5 toets-eenhede) tot 1 500 eenhede. Kan ek net noem dat oor die jare, veral die jaar wat die meters in die veld is, heelwat ondervinding opgedoen is uit die verbruikersoogpunt. Graag wil ek noem dat die koste van ons meter nog steeds onder R500 is. Ons meter kan ook water doen, daar is geen probleem daarmee nie, en bo en behalwe dit, met behulp van die, as ek dit in Engels kan noem, die "dispenser" (ek weet nie wat is die Afrikaanse naam daarvoor nie) hou jy rekord van elke persoon se aankope van kaarte, sy verbruik, wanneer laas hy 'n kaart gekoop het. Dit is 'n lae koste manier om tred te hou van wie koop nie kaarte nie, en wie koop wat. Ons het gevoel dit is die eenvoudigste, en uit 'n finansiële oogpunt die mees kosteeffektiewe manier om die storie te doen.

Die eerste meters is buite in die muur ingebou. Ons ondervind wel 'n bietjie temperatuurprobleme daar, want in die kas gaan dit op tot omtrent 70°C omgewingtemperatuur. So met elektronika sal jy wel 'n bietjie probleme ondervind. Ons kyk wel na die probleem. Die ander installasies, veral in die Vrystaat en die res, of óf in die huis óf in die garage. In die nuwe uitbreidings is die meter ingebou langs die verspreidingskas. In ander installasies, bestaande installasies, is hy óf net so teen die muur opgesit, óf hy is in 'n ander tipe kassie teen die muur vasgesit. Maar ons ondervinding was nogal baie indrukwekkend. Wat uitgekom het, is dat die meter eenvoudig moet wees om te werk. Ons ondervinding is dat mense nie 'n probleem daarmee het nie, solank dit eenvoudig is. Verder met die hele verstandhouding, dié van noodkredietkonsep, die verbruik van die krediet, hy gee nie om of dit piesangs of liters is nie. Al wat hy in belang stel is, dat as die meter by 0 is weet hy, hy gaan uitskop. Verder stel hy belang in wat sy gemiddelde verbruik per maand is. Ons het ook gevind dat ons stelsel werk op 'n kaartstelsel. Hy vertrou nie die kaart as hy dit aankoop nie en wil graag toets of die kaart wel werk by die punt van verkope en ons het wat ons noem die "checker-eenheid" ontwikkel en 'n baie eenvoudige toets wat hy deurvoer sonder om sy kaart uit te vee. Ek kan net noem, die "dispenser" self, bo en behalwe die feit dat hy rekord hou, 'n databasis rekordhou van alles, kan hy ook kaarte toets wat teruggebring word.

Die hele konsep is om die prys so laag as moontlik te hou, maar ons het gekyk na hierdie aspek. Op Eskom se aanbeveling, nadat ons eers die eerste spesifikasie van Eskom baie noukeurig nagevolg het, lyk dit nou asof die laer koste-eenheidkonsep waar aardlekkasie in oorstroombeveiliging meer 'n ope tipe spesifikasie het, minder akkuraatheid, in daardie geval sal mens seker voorstel dat die meter wel behoue bly, d.i. die konvensionele meter, maar ons hoop om hierdie eenheid, ek weet nie met die huidige inflasie, of mens wel iets op die mark sal kan sit vir die aanbevole R250 per eenheid nie. Die sekuriteit agter die hele konsep is seker die grootste faktor wat gekoppel is aan die prys. Met lae sekuriteit kan mens met iets laag wegkom. As jy redelik hoë sekuriteit wil hê, sal mens nie die prys veel onder R300 kan kry nie. Ons is wel besig met die ontwikkeling van die lae koste-eenheid wat aardlekkasie en oorstroombeveiliging het. Wat ons ook hoop om in te set in hom is om hom te beheer deur dit verstelbaar te maak. 5 ampère, 15 ampère, 30 ampère, met ander woorde jy kan hom beperk ook wat sy stroom aanbetref. Bo en behalwe dit sal dit dan die koste van die verspreidingsnetwerk in 'n woongebied laag hou.

**MR H D BECK: EAST LONDON**

1. To date, price of prepayment kilowatt hour meters has been several times the price of conventional meters. Provided that the prepayment kilowatt hour meter has a register equivalent to that of the conventional meter there should be no need to provide a duplicate unit.
2. Periodic readings of the energy registers are necessary to ensure that the Supply Authority is not defrauded. East London City Council has several hundred cash prepayment meters in service and the energy register is read each time the cash container is emptied.
3. In the case of cash prepayment meters, it is essential that the Supply Authority has ready access.
4. By their nature, prepayment meters should be installed in the residence.
5. As with conventional metering equipment, the Supply Authority would be expected to bear the cost of the prepayment meters in the residences, in accordance with the Electricity Act Regulations which were published recently. The Cape Standard Electricity Supply By-law provides for the consumer to pay rental or charge for metering.
6. Conventional energy metering equipment for domestic premises is already installed at the cost of the Supply Authority. Prepayment meters would accordingly be installed at the Supply Authority's cost. Cost of installation would then be recovered through the tariff.
7. As previously stated, East London City Council has several hundred cash prepayment meters in service. Electricity for these prepayment meters supplies is metered in terms of Scale 4 – Sub-Economic Housing – of the East London Municipality : Electricity Tariff. This is applicable only to a supply of electricity to bona fide private residences built under Municipal Sub-Economic schemes where prepayment meters are installed. Cost of energy supplied on this tariff is about 11% higher than the normal Domestic Electricity Tariff. Because they have a fairly complicated mechanism, the cash prepayment meters give more trouble than a conventional kilowatt hour meter;

With increasing price of electricity, the cash receptacles have to be emptied more frequently;

Because of increasing price of electricity, etc., it has been necessary to modify coin receiving aperture of older prepayment meters in use in East London.

**MNR JAN LOUBSER: BENONI**

Mnr die Voorsitter, net deur u dalk aan mnr Coetzee. U weet die gewone elektriese energie meter wat ons kry, is onsettend akkuraat, en as ons in ag neem die prys wat ons vir daardie apparaat betaal, dan is dit 'n werklike baie lae prys. Is daar enige aanduiding dat as ons algeheel oorslaan na hierdie voorafbetaalde meters, of daardie prys ook moontlik sal kan afkom tot iets meer aanvaarbaar.

**RUDY COETZEE: AFFILIAAT**

Mnr die Voorsitter, ek kan net weereens noem dat die oorspronklike spesifikasie van Eskom, dit is NWS 1824, maak seker dat hierdie meter moet onder die strafste omstandighede, klas 2 meter, voldoen. Daarby bedoel ek by aarbeidsfaktor van 0,5 by 'n spanningsval van 20%, by 'n stroomtrekking van reg aan die onderkant van die bereik, met ander woorde ek praat hier van tussen die 100 mill-ampére en twee ampére en dan bo en behalwe dit, by enige temperatuur tussen minus 10°C en plus 55°C. Nou die groot probleem, daarmee is, ek moet sê, dat daardie spesifikasie op elektronika, jaag die prys 'n bietjie op, maar ek sou sê uit 'n koste oogpunt definifief nie meer as R5 to R10 op die komponente wat nodig is om die meters so akkuraat te maak nie. Wat ek wel dink, in die toekoms, indien ons gaan na massa produksie, en ons kry die ondersteuning reg deur die land, sal die koste definitef heelwat afkom. Ons groot probleme is veral die voorsieners van komponente. Hulle speel nog nie heeltemal saam wat die prys aanbetref nie, maar dit is direk gekoppel aan hoeveelhede. Ons voel dat die prys kan definitief afkom, maar ons het definitief soveel as moontlik positiewe kritiek nodig om ons te help om sekere faktore wat kan help tot die bydrae van 'n laer koste-eenheid. Een aspek byvoorbeeld is die terminasie van 'n meter. BS37 wys al vir 90 jaar lank dat die drade moet van onderaf inkom. Ons vind nou dat so 'n terminasieblok is heeltemal onnodig, en net deur so iets uit te sny, sny mens klaar omtrent R30 to R40 uit die koste uit. So ons voel dat sodra die kostes of die hoeveelheid meters hier in ons geval byvoorbeeld, 'n duisend verbygaan steek per maand, en ons kan begin kyk na heeltemal outomatisering in die produksielyn, kan ons definitief heelwat afkom wat die meterprys aanbetref.

**MNR C ADAMS: PORT ELIZABETH**

Mnr die Voorsitter, ek het ook 'n vraag vir mnr Coetzee. Hy het gemeld dat die prys van die meter omtrent R300 sal wees. Wat sal die koste wees van die "dispenser" wat hy genoem het, en ook wat is die prys van die kaarte self.

**MNR RUDY COETZEE: AFFILIAAT:**

Goeie vraag. Eerstens kaarte het weereens te doen met massa produksie as ek dit heel eerste kan antwoord. Ons prys is gebaseer op 'n weggooi, 'n dun plastiekkaartjie. Dit is nie te sê dat hy hoef weggegooi te word nie. Hy kan wel hergeprogrammeer word. Op die oomblik is sy koste net onder die 10c. Ons voel dat sodra hoeveelhede volgende jaar begin styg, praat ons van ongeveer 5 tot 6 sent vir so 'n kaartjie. Wat die "dispenser" gedeelte aanbetref, eerstens is dit, kom ons noem dit 'n "black-box" gedeelte wat koppel aan 'n standaard IBM persoonlike tipe rekenaar, die program loop op hierdie stories. So as mens reeds 'n rekenaar het, hoef jy slegs die "black-box" aan te skaf. Die storie het ook 'n mikro-rekenaarkaart en hy het hierdie gemotoriseerde kaartleser, geprogrameerde lesers, en werk uit omtrent op 'n vyf duisent rand self. Maar ons voel weereens die aspek wat inkom, hoeveel van hierdie tipe apparaat 'n mens nodig het, is die feit het die meters vir elke huis sy eie sekuriteitskode, of gaan mens vir 'n areakode? Sover veral in die Vrystaat en so aan, het ons net gebiedkodes, en ons vind dat in die areas waar jy nie vandilisme of politieke probleme het nie, kan 'n mens die kaartjies voor die tyd programeer met een "dispenser" en jy kan hulle oor enige toonbank verkoop. Dit egter kan jy nie doen as elke meter se eie sekuriteitskode moet hê nie. Dan moet daardie persoon kom, en homself identifiseer elke slag by 'n aankope. Ek hoop dit beantwoord u vraag.

**DENIS ACKERMAN: ESKOM**

Mr Chairman, my view on meters and so forth is very well expounded already in quite a number of cases, and just as a matter of interest for the people here. At present there are two and a half million connections, supply connections, of which are metered in South Africa at the moment. And in order to supply the rest of South Africa who needs electricity, we will have to have another two and a half million points of supply. And two and a half million points to supply and having a look at meters, lets say at R450-00 a meter, is 1,3 billion rand, and can our country really afford it? The other, I would just like to reply to Mr Botes. I think one of the things is, we are installing a system similar to Rustenburg. We are going to do this in our new suburb in Sandton and the customer is paying over there. The other thing is, would the supply authority be expected to bear the cost of the prepayment meter in a residence. Gentlemen I think here, even if the supply authority does bear the cost, the customer still pays anyway via the tariff. I think the other thing that I would like to just particular comment on, and that is, check meters and looking for illegal consumption and so forth. I wonder how many supply authorities really have a pro-active role in, trying to establish how much theft is taking place in their particular municipality and where is it taking place anyway. I think it cost quite a bit to have somebody acting as policeman to this particular type of work. I know we are very fortunate in that we tend to pick-up illegal activities, shorting out of meters and that type of thing, purely by accident more than a pro-active mode. I think that is what I would like to say. Thank you.

**MNR KOOS ALGERA: RUSTENBURG**

Ek wil net verder sê, daar moet duidelik onderskeid gemaak word tussen 'n meter en 'n stelsel en soos mnr Ackerman gesê het, is dit identiese goed wat hulle gaan installeer, en dit gaan oor wat mnr Botes uiteengesit het oor jou eiendomsbelasting, jou dienste wat jy kry. Jou watermeter en jou elektrisiteitsmeter word alles in een saamgevat. Daar is geen ekstra rekenings wat uitgestuur moet word nie. Geen deposito's wat moet bly lê by 'n voorsieningsowerheid nie. Dit is einlik 'n stelsel, dit is nie 'n meter as sulks nie. Dan die ander punt wat ek net wil noem wat mnr Barnard gesê het, dat die stelsel kos ses duisend rand, per punt, is eintlik nie heeltemaal korrek nie. Die prys wat aan ons gekwoteer is, is R500 to R600 geïnstalleer, wat insluit 'n pulsende watermeter. Met ander woorde, as 'n mens dit opbreek in komponente gaan dit baie goedkoper wees. Die oorspronklike koste sluit in natuurlik al die radio beheer toerusting en ook jou basiese eenheid by die betaalpunt, wat 'n rekenaar insluit. Dit is wat die koste opjaag, in die begin stadium. Maar soos die eenhede vermeerder so sal dit per eenheid goedkoper word.

**MNR VELDSMAN: KPA GEMEENSKAPDIENSTE WES-KAAP**

Mnr die Voorsitter, ons gaan binne die volgende jaar seker ongeveer 3 duisend van die meters in Kahailitsha installeer. Die koste van die meter was 'n groot faktor gewees. Die instansie wat meeste van of 'n groot deel van die behuising gaan doen en wat 2 duisend van hierdie meters ongaan finansier het vir ons 'n koste perk gestel van ongeveer R450-00 en ons moes toe maar kyk met wat ons met die R450 kan doen. Hulle is bereid om die koste van die meter by die verband by te voeg. Ons het toe maar besluit ons sal nou daardie paadjie vat. Ons het ook na 'n meter gekyk omdat in swart woongebiede veral in die Wes-Kaap, water nog nie gemeter word nie, en die mense baie min vir water betaal, en dit vir ons op hierdie staium 'n redelike groot probleem is, het ons gekyk na 'n meter wat ook in die toekoms daardie fasiliteit kan hanteer. 'n Ding wat vir ons baie belangrik was, is om te kyk na die sekuriteit van die stelsel as sulks, dat jy die ding so peuter-vry as moontlik moet maak van jou aansluitingspunt op die erfgrens tot by die verdeelbord of by die meter in die huis. Dit was vir ons baie belangrik, en ons het gekyk na, en ons beweeg na die punt toe waar ons direk met ons kabel inkom, binne in na die meterkas toe. Ons sluit natuurlik dan die kassie in die buitenste muur uit waar jy miskien op 'n stadium weer moontlik 'n punt kan kry waar jy krag van kas onwettig kan gebruik. Ons het ook gekyk daarna, en ook in daardie opsig moet ons voorsiening maak en weer 'n bietjies verder na die stelsel kyk. Waar gaan jy jou aardgeleier, ten minste, jou neutraal aard? Gewoonlik is dit tradisioneel in die kassie buite die huis en nou is daardie fasiliteit nie daar nie. Ons het toe met die metervervaardiger gaan kyk an 'n aardpunt geskep in die meterkas self in die houer van die meter waar ons die neutraal en die aardgeleier bymekaar koppel. Die ander punt wat vir ons baie belangrik was is ook dat as die verbruiker met die ding peuter, die krag afgeskakel word. Dit kry ons ook in die meter. Dit is die rigting waarin ons gaan beweeg. Die koste van die meter wat ons nou op hierdie stadium het is R425-00 plus AVB, maar ons kyk definitief na laer koste van die meter. 'n Ding wat net baie belangrik is, wat ek graag wil noem voordat ek klaar maak, is dat ons glo dat om jou stelsel behoorlik te monitor en jou verbruik te monitor dit baie belangrik is dat jy 'n kaart aan 'n meter koppel, aan 'n spesifieke meter, soos die vorige here hier genoem het met die "dispenser", sal jy dit nou daar moet doen. Jy sal die erfnommer aan die meter moet koppel, aan die spesifieke meter. Dit gee vir die persoon wat die kaart koop ook meer sekuriteit want hy weet as hy oor die kop geslaan word, as sy meter gesteel word, dan beteken hy vir niemand ander enige iets nie. So in plekke waar jy 'n bietjie onrus het, sal jy daardie probleem kan uitskakel. Laat ek net noem hierdie is nie die stelsel nie, dit is 'n meter. Maar hy kan later omgeskakel word na die stelsel toe.

**MNR JAN MALAN: KEMPTON PARK**

Mnr die Voorsitter, ek nil net aansluit by Koos Algera. Ek praat ook oor die stelsel. Ons is almal baie bekommerd oor die koste. Dit klink astronomies hoog as jy praat van R700 vir 'n meter, maar as u kyk na die finansiële analiese, ons het 'n analiese gedoen asof Kempton Park oornag sou kon oorskakel na hierdie stelsel toe, dan kyk jy na 24 duisend eenhede. En dan is die groot faktor in hierdie analiese eintlik

die rente wat jy ontvang op die geld wat jy nou 10 weke vroeër kry, die besparing op die rekeninge wat jy nou nie hoef op te maak nie, en uit te stuur nie, dit word op die lang termyn eintlik kleingeld. Die groot besparing lê in die rente, en dit is die belangrike aspek wat 'n mens moet oorweeg. Op die langer termyn is dit die besigheidsaspek van die saak. Die ander ding is die wat 'n mens in aanmerking moet neem natuurlik is die uitstaande skulde op in, ek praat nou van die swart gebiede. Ons het so bietjie betrokke geraak by Tembesa wat ons buurman is, ek en was geskok om te hoor dat in Tembesa ek kan dit maar seker sê, is daar iets soos R16 miljoen uitstaande op elektrisiteit alleen. Tembesa is 'n relatiewe klein dorp. Nou as 'n mens na daardie rentes op daardie gelde neem, en jy kan dit verhoed met so tipe installasie, dan word dit meer sinvol. Wat betref die meter of konvensionele meters sou behou, ek dink nie, dit klink vir my na belts and braces. Ek sou liewerste verkies dat ek in grootmaat meter in die substasies sou installeer wat die gebied voer, en dan op so 'n manier kontrole kan uitvoer of daar groot distribusie verliese is, al dan nie.

**MR DENIS FRASER: DURBAN**

Mr Chairman, just two brief questions that I would like to put to Mr Coetzee. The first is on the life expectancy of these devices. As far as I'm aware its usual to talk in terms of a 10 year life with electronic devices which, possibly is conservative, but I think largely through absolescence so I'd like to know what the anticipated life expectancy is. The second relates to some thought as to standardisation or interchangeability of systems. I think we are in a development phase with these devices now, and consideration should be given to interchangeability and standardisation, to try and avoid ending up with systems which are incompatible, and perhaps being locked into one manufacturer. Lets try and avoid having a Betamax and a VHS in prepayment meters. Thank you.

**RDL. TALJAARD: BENONI**

Ek wil net graag met die vergadering deel dat die Elektrisiteitsafdelings is eintlik nie alleen nie. Al die ander afdelings is ook besig daarmee. Ek dink spesifiek aan parkeermeters. Op die oomblik is daar ontwikkeling in Suid-Afrika aan die gang waarin die eerste parkeermeters, die kaart parkeermeters, reeds op proef gestel word in Durban en op ander gebiede hier in die Transvaal. Die tyd het gearriveer waarin jy gaan betaal voor die tyd vir 'n kaart, hetsy dit nou vir elektrisiteit gaan wees of om te gaan parkeer. Dan wil ek net verder byvoeg om te sê dat die Suid-Afrikaanse Poswese, dit is nou die telefoon, dié wat jy voor betaal, die gewone telefoon in publieke hokkies, die kaarttelefoon, is ook reeds in Pretoria geïnstalleer. Ek weet die eerste 200 is reeds vervaardig, so die tyd om vooruit te betaal is hier en gaan bly, dit is net hoe ons dit gaan doen.

**MR RUDY COETZEE: AFFILIATE**

Mr Chairman. It is two difficult questions. We know that electronics fails twice. When you install it and at the end of its life. So to get rid of the first one what you do is in your factory, you actually take it through a soke and you hope that you get rid of about 99% of the failures that way. That has got a lot to do with the quality control of the factory itself. You also don't know what happens during shipping of these meters and so on. After that, I can mention that we've based our design and the whole concept on a minimum of a 25 year life, so a lot of design philosophy is being incorporated into the design of these meters, as they would call by electronic language, military spesifications, regarding the metal parts the mechanical moving parts the electronic components selected. It is still very difficult to exactly predict. All we can say is that Eskom has a very interesting test that they carry out on proto types and on the production units. It is actually a very severe temperature cycle test and the way I understand it, is that this actually simulates about 10 years ageing life of electronics. It does have an influence on the electronics and it also had about a 0,1% influence on the accuracy of the meter, but this is as much as we know at this stage. It is like all new devices. You cannot really say that the thing is going to last for 25 years. All you can say is that with the design and the quality that you put into it, you'll hope to get the 25 years out of it. What we have done, is we've investigated and looked at TV manufacturers and made sure that our quality control is a lot better than theirs.

The second one is on the interchangeability. It is a very difficult thing. It's a beginning phase. It is not impossible for us to make use of re-usable cards for instance. When it comes to the coding and all that, that depends a lot on what is inside, what proses is used and what type of field interphase electronic devices are used inside the meter. So that is a very difficult aspect. I guess you could come to a card size, you could come to a magnetic track. There's three standard tracks on a magnetic card. We could come to an agreement that you use the same track on the card. You use the same type of cards. Possibly you can even look at possibly the "dispensers", the kind of device that is also a standard device, but it's a very difficult thing. It was also the case with the personal computers and the guy that was the biggest, he eventually takes over. We don't know if that is going to happen, preferably there should be 3 or 4 suppliers in the country. Thank you.

**MR L HUNT: WHITERIVER**

In the past we have made big efforts to get our consumers to have their meters installed outside their houses. So having seen a very elegant system, where they built meter walls into the front fences, or at the boundaries of properties, we decided to go for that, and all our new Townships have these meter walls. So when it was decided that we would take over the supply to the new coloured Township developed at White River, we heard these horrifying tails about bad debts, and having been offered these prepayment meters, we decided to go for it. The ones Mr Coetzee has just mentioned in fact. Now, we installed these in the meter walls at the boundaries of the properties in lockable meter boxes and our department keeps a key and the householder keeps a key for these meter boxes, so that there is a fair security, and that these is not going to be any tampering with these meters.

All consumers are metered on maximum demand, as well as kWh meters at Whiterivier, householders, commercial and industrial, everyone. We find that the cost of these meters at R450 does not greatly exceed the cost of the kWh meters, together with the cost of the thermal maximum demand ammeters, so that from that point of view there is not much difference. We have also installed some of these meters in flats, in the white Townships, so that no charge can be made against us of discrimination or anything of that nature. They have been well accepted both by the white consumers and by those in the coloured Townships. The cost of installing meters is the cost for the consumer. It is all built into the connection fee which does not differ greatly from one type of meter to the other so that there is not that problem. We have considered the certain advantages to be as follows:

There is no consumers deposit to be paid. There is no need for meter readings to be taken. There is no need for cut-offs and re-connections, and there are no bad debts. The consumer can buy as many cards as he wants so that he can always have a reserved card at home in case his meter starts to run down. The number of units left to the benefit of the consumer are shown on the meter so that he knows exactly where he stands as far as what he has got left. There are also no costs for

accounting and postage, and there are no arguments at the Counter as far as this is concerned. So from that point of view we are so far very happy with this system. There is just one question that remains. It has not gone through a lightning season as yet, because we only installed them earlier this year. So we are holding thumbs that there will be no adverse effects when the next lightning season comes. Thank you.

**MNR P J BOTES: ROODEPOORT**
Mnr die Voorsitter, voordat ons afsluit, net 'n klip in die bos. Kom ons neem 'n groep huishoudelike verbruikers, sê 400 vir argumentshalwe, en ons meter hulle op die hoogspanningskant. Ons neem die gemiddelde maandelikse verbruik en ons stuur elkeen 'n rekening. Dink u nie dit sal 'n baie beter effek hê nie, want ek dink diversiteit sal daardie tipe van ding baie goed uitwerk. Ek dink dit behoort te werk. Ek dink dit is iets wat probeer moet word. Ek wil dit graag nie in Roodepoort probeer doen nie.

Net 'n interessante opmerking. Raadslid Hieberg het my nou net hier langsaan vertel dat onlangs was hy by die SDR gewees waar 'n voorlegging gegee is van hierdie tipe meters en die swartes het dadelik geobjekteer teen hierdie tipe meters en gesê hoekom word dit nog nie in die blanke gebied geïnstalleer nie. So ek noem dit maar net vir kennisname.

**MR A H L FORTMANN: PRESIDENT**
Some years ago you, might recall John Barnard from Arthur Trevor Williams, I think he in fact propagated this. He suggested why not meter a whole suburb and average out the accounts, base the account on one meter for a whole suburb.

**MNR JAN LOUBSER: BENONI**
U weet mnr Hunt het nou iets baie interessant gesê. Hy het gesê geen deposito's, kan u u voorstel, wat is 'n water en ligte deposito deesdae op 'n gewone huis in 'n dorp R400, dit kan al vir die meter betaal. Dit is 'n baie interesante opemerking daardie.

**MNR SCHULTZ: AFILIAAT**
Mnr die Voorsitter, ons het 'n redelike gedetaileerde opname gedoen vir twee swart dorpsgebiede hier in die Pretoria SDR vir die benetting van die dorpe. En in antwoord op die voorstel van mnr Botes, wil ek net die syfers kwoteer wat ons gekry het by die opnames waaruit 'n groep van die twee dorpies, 'n totaal van 600 bestaande wooneenhede benet was, en die stelsel uitgebrei moes word, is gevind dat daar verbruikers is, wat so min as 60 eenhede 'n maand gebruik, van die wat bestaande installasie het. Wat met ander woorde net ligte het. Die huise het almal 30 ampére stroombrekers ingehad, so dit was eintlik beperk vir 'n 'hot plate' en 'n paar ligte. Daar was egter in dieselfde dorp, dit is nou wel net 'n 5 persent, so dit is 'n baie klein afwyking, maar verbruikers wat soveel as twee duisend eenhede 'n maand gebruik het. So die voorstel om 'n enkel meter in te sit en die hele dorp te meter en dit dat gelyk op tussen almal te verdeel dink ek is 'n baie onregverdige stelsel, omdat die ou wat net ligte gaan gebruik, nou die man subsidieër wat behoorlik elektrisiteit vermors, of soos in hierdie geval, die geval was die ou vir drie ander ouens onder in die straat verkoop het vanaf sy hoofstroobreker. Dankie mnr die Voorsitter.

**MR HENK TURKSTRA: AFFILIAAT**
Mnr Loubser het nou net hier genoem die kwessie van geen deposito's, en een van die vorige sprekers het genoem die moontlike winste wat gemaak kan word op die addisionele inkomste as gevolg van die rente op vooruitbetaling van die gebruik van elektrisiteit. Maar hierdie twee goed werk moes as 'n anomolie teenoor mekaar. U verloor die rente op die deposito, in elk geval nou, so ek dink nie hierdie argument gaan nou heeltemal op nie.

**MNR J LOUBSER: BENONI**
Dit is natuurlik so dat die elektrisiteitsverbruikers kry nie die rente op daardie deposito's nie.

**MNR J AHLFTEN: VOORSITTER**
Ek dink soos mnr Raynal voorgestel het moet die saak verwys word na die aangewese President, wat dit moontlik by sy komende konvensie kan laat verder bespreek. By daardie tyd behoort daar heelwat inligting te wees, wat mens kan oor besluit. Baie dankie vir u bydraes. Dit was 'n baie interesante bespreking.

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**V3. Vraag oor die gebruik van oorhoofse bondel geleiers in areas met 'n hoë weerlig konsentrasie – deur Mnr M P P Clarke:**

Die gebruik van oorhoofse bondelgeleiers het dramaties verhoog in die afgelope paar jare, by uitstek in die laagspanning kategorieë.

Groot hoeveelhede van hierdie kabel is reeds in groot gedeeltes van Suid-Afrika geïnstalleer waar daar 'n buitengewone hoë konsentrasie weerlig is.

**VRAAG:**
Wat is die ervaring van verbruikers van oorhoofse bondelgeleiers, in beide die mediumspanning en laagspanningreeks, in areas met 'n hoë weerligkonsentrasie?

**Q3. Question on the use of aerial bundled cable in high lightning areas – by Mr M P P Clarke:**

The use of aerial bundled cable has increased dramatically in the last few years, in especially the low voltage range.

Much of this cable has been installed in parts of South Africa with exceptionally high lightning incidences.

**QUESTION:**
What is the experience of users of aerial bundled calbe. both medium voltage and low voltage, in areas with a high lightning incidence?

**MR M P P CLARKE: RANDBURG**
In Randburg we installed our first 0,5 km of LV ABC about 6 years ago. It replaced a troublesome open wire LV line on the same poles as a rural 11 kV line.

We have not had any failure or problems since, in spite of one incident of a car hitting an intermediate pole in the line. The pole was replaced and it was not even necessary to re-tension the ABC.

A second line of similar length was erected about a year later. In this particular case it was a simple open wire LV line in a heavily tree lined street – and I don't need to remind any supply engineers what that means! I am happy to report that no further supply interruptions have been experienced.

Most important, both installations have been through some extremely violent summer storms.

Since that time we have developed an SABS specification. My

information is that one manufacturer is already producing to this specification and that a second manufacturer is about to do so.

I understand that ABC of all voltages is being used at a rate measuring now in the 100's of km per year in South Africa.

We need to know what our colleages are doing and what they are experiencing and I believe SABS need feed-back on the performance of materials manufactured to the specification.

I look forward to a wide response to this appeal.

**MNR JAN LOUBSER: BENONI**

Mnr Clarke, ek kan vir u sê ons ondervinding in Benoni is soortegelyk aan die wat u het, ons het nie so baie geïnstalleer soos wat u het nie. Ons het nog geen weerlig probleme gehad nie, en die betrokke kabel is nog net soos die dag toe ons dit geïnstalleer het.

**MNR P J BOTES: ROODEPOORT**

Mnr die Voorsitter, u sal die ongeluk wat ons gehad het, in die dorpsgebied Dobsonville, waar die dogtertjie gebrand het onthou en waaroor daar heelwat probleme gekom het. Sedertdien het ons die netwerk in Dobsonville weer beskou, en ons het dondelgeleiers daar opgerig. Ons het ook verder gegaan en ons het 'n besluit by die Raad gekry dat ons die hele Roodepoort waar daar swak oorhoofse lyne is, sal vervang met bondelgeleiers. Dit werk ook so dat op daardie stadium toe ons 'n besluit moes neem, het ons groot waterbreke gehad. Groot water verliese, en meeste van die staal pype wat gelek het, moes vervang word met asbespype gevolglik moes ons 'n aardgeleier ïnstalleer en ons het die geleiers van die oorhoofse lyne afgehaal en dit gebruik vir aardgeleiers. Dit verkoop aan die waterdepartement teen 'n voordelige prys. En ons het die bondel geleiers opgesit teen ook 'n redelike prys as gevolg daarvan. Die hele Roodepoort-Noord, is gedoen en ons is besig om ander plekke soos Discovery te doen. Dit is reeds vir 'n aantal jare wat one daarmee besig is. Ons het geen probleme eintlik sover met hierdie stelsel gehad nie. Ons hoop maar net in die toekoms dat hierdie goed net die duurte of die lewens duurte sal hê, dit is nog nie eintlik vasgestel nie. Verder het ons geen probleme nie, en ons is baie gekonfeit op die oomblik in die installering daarvan, en ek dink dit gaan voor die wind, ons is baie tevrede met laagspannings benetting van hierdie bondel geleiers. Dankie.

**MNR KOOS ALGERA: RUSTENBURG**

Ek wil graag vir die mense wat dit geïnstalleer het vra, word dit ook gedoen in gebiede wat 'n redelike hoë inkomste gebied is, of word dit net in, soos mnr Botes genoem het, byvoorbeeld Dobsonville wat 'n swart gebied is, gedoen?

**MNR P J BOTES: ROODEPOORT**

Meneer, orals waar daar oorhoofse lyne was. Ek dink dit lyk baie beter as 'n oorhoofse lyn. Dit is my persoonlike opinie. Ons hak hom bo aan en ons vat die dwarsarms weg en hy lyk baie netter.

In nuwe dorpsgebiede gebruik ons ondergrondse kabels.

**MR L HUNT: WHITE RIVER**

Mr Chairman, we, in the same coloured townships that are mentioned earlier, we chose to install aerial bundle conductors. It was recommended by the Consultants who planned this scheme, and we accepted it. We are very satisfied with it. We have no experience yet of lightning problems as a result of the use of the ABC's. We also know that there are not going to be fireworks by throwing chains over the lines and so forth, and as far as that is concerned, we are very happy. But what we don't know yet is what the life of these are going to be, but in any case we are planning, in one of our oldest established townships, where there is a heavily tree lined street, to replace existing overhead wires by ABC as soon as we can get around to it. Thank you.

**MR B DUDLEY: AFFILIATE**

Mr Chairman, I think we are at the base of information where I'm always checking on people that have been making use of aerial bundle conductors. Being a supplier of the system, and having introduced this into the Republic of South Africa myself. I'm pleased to hear the response of course. I must say from all the enquiries I've made, and in particular people in high lightning areas, and I have not had a single report back of failure due to lightning. With regard to the life expectancy of the system at the very big outset of the marketing of the system in South Africa, we went to SABS, and they very kindly did a test for us. It was related to something that we do know, we put a piece of the bundle conductor and a similar piece of normally produced PVC conductor through an agency test at SABS, and I think, if I speak under under correction, about 35 years. The PVC had been completely destroyed and the XLPE of the bundle conductor showed no defect. Thank you.

**MNR P J BOTES: ROODEPOORT**

Mnr die Voorsitter, ek het nie alles gesê wat ek behoort te gesê het nie, dit val my nou by. Ek wil dit net noem dit is 'n taamlike groot gebied wat ons gedoen het, en die instandhouding is feitlik nul. Dit is net die verf van die pale, daar is feitlik geen instandhouding aan die stelsel nie. Ek wil net noem dat ons 'n nuwe dorpsgebied wat in plotte verdeel is, genaamd Bruinsig daarom die Ruimsig golfbaan, en ons is besig om dit te retikuleer met hoogspannings 11 kV bondelgeleiers. Dankie.

**MR ROGER MARTIN: AFFILIATE**

With all the experience that we've had with supplying aerial bundle conductors. When it comes to lightning, I think you should make a clear distinction with regard to induced over coltages and direct strikes, and also with regard to low voltage systems and high voltage systems. When it comes to the high voltage system, induced over voltages due to near strikes is far less with the conventional open overhead line. However, if there is a direct strike onto the high voltage aerial bundle cable, you are most likely going to have a fault. I know of one case on a high voltage 11kV bundel conductor where there was a direct strike, and it did damage the installation and it had to be replaced. But that is the only single case. Thank you very much.

**MNR J LOUBSER: BENONI**

Jy weet, ek het al dikwels gedink oor hierdie tipe geleier. Is dit nie amper dieselfde ding soos wat Vanderbijlpark een tyd ondergronds geïnstalleer het nie? U sal onthou 'n paar jaar gelede was hierdie los geleiers wat aan mekaar gedraai is ondergrond geïnstalleer en ek dink hulle het nog baie daarvan in werking. Ek sou graag opinie wil hê.

**DR R ANDERSON: NATIONAL ENERGY COUNCIL**

Mr President, I think, a little word of warning is probably needed at this stage on the lightning effects on these overhead aerial cables as mentioned by the last speaker. It will depend on a number of things, not only on the voltage, and I do go with him when it comes to 11kV. There could be the possibility of failure depending on how frequently the steel suspension is earthed and so on, and what is the installation level between the steel and the conductor? The earthing is very important indeed. If the earthing is good, will it cost more in fact to provide sufficient earthing to in fact protect such a line? I think there are many aspects particularly at 11kV which still need to be looked at, and I would suggest that perhaps these should be approached, or the CSIR and Eskom combined project, which is looking at lightning effects on various types of line. The leaders of that project should be approached with

the idea of making some measurements on this type of cable in lighning seasons. As far as being struck, is concerned it takes quite a long time, to get a line struck directly by lightning. I think indused surges are quite okay in most cases, but direct strikes don't happen so very often. So it will take a little while, especially with those municipalities operating in non- or lo-lightning areas to get any effects at all. For example I think, our friend from White river, wouln't get very much lightning compared to us in Pretoria, but I may be wrong. I'll argue with him when I see the map. The point I am trying to make is that if you are not in a very high lightning area you probably will have quite good experience for a while until your line is struck. All I'm saying is a note of warning, at this stage before really going into this in a big way. Thank you.

**MNR KEES VAN ALPHEN: SABS**

Max Clarke het 'n belangrike onderwerp oor oorhoofse bondelgeleiers aangesny. Met die oog op strawwe weerligtoestande in die Republiek moet die onderwerp miskien na uitrusting wat met die bondel geleiers verbind is, uitgebrei word, veral in die medium spanning gebied van 11kV en 22kV.

One of the advantages of ABC is its relative immunity to induced over voltages from indirect lightning strikes. However, the effect of a direct strike may be the more destructive. The earthed screen of some types of ABC may be solid enough to withstand the effect of a direct lightning strike, but on others the heat generated by the lightning arc may be sufficient to burn a large hole in the screen and the exposure of a phase conductors to a lightning surge may be the more prominent.

I would therefore propose that Mr Clarke's enquiry be extended to the performance of equipment connected to medium voltage aerial bundle conductors, particularly the distribution transformer.

Today we find miniature substations connected to ABC systems. Are these transformers protected by surge arrestors and what service experience has been gained? A new development is the pole-mounted substations connected to ABC systems. Earlier Ben Jansen referred to this type of substation which is also receiving attention by the SABS within the scope of cost-effective power distribution. Any service experience from these installations.

It would appear that in this field of fast developing technology more work should be done in establishing good practice in the use of ABC. Thank you.

**MR ROGER MARTIN: AFFILIATE**

With regard to the surge arrestors and the surge protection. This is something that should be looked at when you look at the class of arrestors that are going to be used. In the USA they had a lot of problems when they first introduced XLPE cables, where they connected them to conventional open overhead lines. They developed a special class of arrestor known as the riser pole arrestor, which they put on these overhead lines to try and give protection to their pad mounted transformers. With the advent of metal oxide arrestors you can have a much more compact arrestor, and now you can put your arrestor directly on the switchgear. In cases with high voltage aerial bundle cable, in all the installations we've done we've always used surge arrestors on the pole mounted transformers, and when mini-subs are used this is a question that should be addressed and I think surge arrestors should be used at the mini-sub, as you always get the voltage dapting effect at your open point. Thank you.

**MR E DAVIES: PIETERMARITZBURG**

My comment really doesn't have anything to do with lighning, but it might be of interest. We wanted to use some 11kV aerial bundel conductor, but we found that we couln't use it, basically because our earth fault level was too high for the capability of the cable, so we had to in fact go to underground cable. It is quite serious because on another part of our system, we have another supply authority DDA who've gone ahead and used aerial bundle conductor at 11kV and is grossly underrated from earth fault capabilities. Thank you.

**MNR KOEN SCHERMAN: PRETORIA**

Mnr die Voorsitter, ek sou graag deur u aan mnr Botes wil vra. Ek lei af met die verandering wat hulle aangebring het, het jully gebruik gemaak van hulle bestaande pale want hy het gemeld hulle haal net die dwarsarms af. Ek sou graag wou weet watter veranderinge was nodig aan hulle oorspronklike kraglyn ontwerp, byvoorbeeld ten opsigte van trekkragte, trekspannings en deursakkings om voorsiening te maak vir die aanbring van bundelgeleier. Baie dankie.

**MNR C COETZEE: ROODEPOORT**

Mnr die Voorsitter, in werklikheid het ons nie die antwoorde beskikbaar vir mnr Scherman nie, maar ons het in samewerking met die verskaffer die nodige regstellings aan die lyn gedoen. Dankie.

**MNR P J BOTES: ROODEPOORT**

Meneer, ek wil net byvoeg tot die kwessie van die pale het ons so behou. Ons het net die bestaande pale gebruik, en die lyn daarop opgerig. Dit is staalpale.

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**V4. Vraag oor die wet op masjinerie en beroepsveiligheid – Deur Mnr J K von Ahlften:**

Die Wet op Masjinerie en Beroepsveiligheid van 1983 is reeds vir ongeveer 3 jaar in werking.

**VRAAG:**

Watter effek en resultate het die Wet op Masjinerie en Beroepsveiligheid gehad op veiligheid en op die organisasies wat dit moes implementeer.

**Q4. Question on the machinery and occupational safety act – by Mr J K von Ahlften:**

The Machinery and Occupational Safety Act of 1983 has been in operation for approximately three years.

**QUESTION:**

What effect and what results has the Machinery And Occupational Safety Act had on safety, and the organisations that have to implement it.

**MNR J K VON AHLFTEN: VOORSITTER**

Met u goedkeuring het ons mnr André du Plessis vandag hier. Ons vra hom om die vrae te hanteer wat betrekking het op die Wet op Beroepsveiligheid en ek dink die eerste vraag wat ons aan die orde stel is vraag vier.

**MNR A DU PLESSIS: DEPARTEMENT VAN MANNEKRAG, PRETORIA**

Geagte mnr die President, dames en here, om te kan evalueer moet daar eers gekyk word na wat ons doelstellings was. Voordat ons hierna kyk moet ons kortliks kyk na waar die Wet

vandaan kom. Die Wet op Fabrieke, Masjinerie en Bouwerk 1941 (die ou Wet) en die regulasies daarkragtens uitgevaardig. Alhoewel die regulasies van tyd tot tyd gewysig was, of nuwe regulasies wat bygekom het soos byvoorbeeld die regulasies oor elektriese installasies, het die bedoeling van die wet nooit verander oor die jare nie. Hierdie wet het voorsiening gemaak vir "die registrasie en beheer van fabrieke. Werksure en werkstoestande in fabrieke, toesig oor masjinerie en die voorkoming van ongelukke in fabrieke en op bou- en uitgrawingsterreie." Veiligheid moes in 'n groot mate by hierdie plekke in geinspekteer word wat natuurlik 'n onmoontlike taak is.

Tans, natuurlik is die doel van die Wet op Masjinerie en Beroepsveiligheid 1983 (die MOS-wet) "om voorsiening te maak vir die veiligheid van persone by die werkplek of in die loop van hulle diens of in verband met die gebruik van masjinerie: Om 'n adviesraad vir Beroepsveiligheid in te stel."

Soos u seker al ervaar het, bevat die MOS wet die filosofie dat veiligheid gemeet moet word aan die risiko wat aanvaarbaar is vir die werknemer omdat absolute veiligheid 'n onbereikbare doel is en absolute beheer onwenslik is.

Ten eerste moet daarop gelet word dat die Wet *alle* werknemers (selfs huishulp en plaaswerkers) met die uitsondering van diegene wat onder die Wet op Myne en Bedrywe ressorteer. Selfs die Staat is nie uitgesluit nie. U is dus almal betrokke.

Ten tweede moet gelet word op die belangrike eienskap van die Wet, naamlik dat dit erkenning verleen aan die feit dat dit onmoontlik is om vir elke moontlike risiko wat daar vir veiligheid en gesondheid in die werksituasie bestaan, by wyse van sekonde wetgewing voorsiening te maak. U sal toegee dat soveel meer gevare van 'n mindere as van 'n meerdere aard in elke werkplek bestaan en ook dat geen twee werkplekke dieselfde is nie. Daarom is dit 'n haas onbegonne taak om alles deur middel van regulasies te probeer reël. Die Wet maak egter op 'n positiewe wyse daarvoor voorsiening dat met goeie begrip, samewerking en kommunikasie tussen werkgewer en werknemer, daar ooreengekom kan word wat 'n aanvaarbare risikofaktor by elke werkplek is. Met dié doel voor oë word daar voorgeskryf dat die werkgewer veiligheidsverteenwoordigers uit die geledered van sy werkerskorps moet aanwys en dat hy veiligheidskomitees in die lewe moet roep. Waar voorvalle plaasvind, moet dit deur die werkgewer self met die nodige aandag ondersoek word en regstellende stappe geneem word.

Sonder om in besonderhede in te gaan, is dit die doelstelling van die Wet dat die werkers binne die raamwerk van wetgewing in staat gestel moet word om enige gevare wat hulle identifiseer onder die aandag van die werkgewer te kan bring deur middel van veiligheidsverteenwoordigers en om in die veiligheidskomitees saam met bestuur te kan beraadslaag oor watter stappe geneem behoort te word om vieliger werktoestande in die werkplek te skep. Selfs vakbonde begin op hierdie gebied 'n al hoe groter rol speel.

'n Klemverskuiwing van Regulering na selfregulering het plaasgevind. Omdat veiligheid nie by 'n werkplek in geïnspekteer kan word nie, moes voorsiening gemaak word dat veiligheid vinne die werkplek funksioneel is. Die betrokkenheid van die werkgewer en die werknemer moet geaktiveer word om vanself te werk. Die Staat se rol behoort slegs toesighoudend van aard te wees. Voorheen was daar baie regulasies waar die mening van 'n inspekteur deurslaggewend was. Regulasies word nie meer so geskryf nie bv. dat planne van fabrieke nie meer goedgekeur moet word deur 'n inspekteur nie. Hier speel die Adviesraad vir beroepsveiligheid 'n belangrike rol omdat werkgewers en werknemers saam met die Staat op die Raad dien om die Minister te adviseer oor alle regulasies wat uitgevaardig word.

Die inspekteur se rol het ook verander. Waar inspekteurs vroeër baie voorskriftelik was, word nou hoofsaaklik gekonsentreer op die veiligheidsbestuurstelsel van die werkgewer – dus selfregulering. Waar selfregulering nie plaasvind nie, moet die Staat as katalisator werk om dit aan die gang te kry. Soms vind daar soos in enige chemiese reaksie 'n heftige reaksie plaas.

What has been achieved.

The machinery and Occupational Safety Act was passed by Parliament in February 1983 and promulgated in October 1984. It is no easy task to assess quantitavely to what extent the major objectives of this Act have been achieved.

These objectives can be summarised as to provide a basic framework for the protection of the health and safety of workers, and also to provide for the general safety of machinery primarily through the mechanisms of selfregulation and minimum interference by the State.

Some critisism has been levelled at the legislation that it would seek to abdicate the State's role in the field. The fact is that a practicable and enforceable system of self-regulation is perceived to be a key element to ensure workability.

The MOS Act is an epitoral of deregulation when compared with its predecessor or similar legislation. The process of deregulation is being continued with the current redrafting of all existing regulations and has the added spin-off of far fewer inspectors being necessary for enforecement.

Private sector is involved in the drafting of regulations. Some of yourselves have been involved in a working committee when the Electrical Machinery Regulations were finalised (to name a few: Jules van Alften, Ian Loubser, Koen Schoeman). A good example of deregulation is the old regulations C51 and C55. Only competent persons may enter substations and work near live electrical equipment. Now it reads "no person other than a person authorised thereto by the user." Jules can tell you a lot about the redrafting of regulation C1. "Responsible person."

All so-called "welfare" provisions have been and are being removed from legislation, and no serious adverse effect have been seen.

Die praktiese effek van die selfreguleringsmaatreëls was dat daar 'n groot korps van nuwe "inspekteurs" in die werksfeer ontstaan het wat ook 'n baie goeie voorbeeld van deregulering en privatisering is. Daar word beraam dat daar meer as 50 000 veiligheidsverteenwoordigers landswyd aangewys is en nagenoeg 18 000 veiligheidskomitees ingestel is. Verder is daan ongeveer 40 000 persone aangestel ingevolge regulasie 4 van die Algemene Administratiewe regulasies. Dit is waar bestuursbetrokkenheid begin en die as waarom die veiligheidstelsel by die werkplek draai. Hierdie persone en liggame bedryf veiligheid op 'n daaglikse basis en 'n groot mate van sukses is al behaal. Na beraming is ongeveer 320 000 voorvalle verlede jaar by die werkplek deur die werkgewers ondersoek. Veiligheidsbewustheid het baie toegeneem by die werkplek.

These persons and bodies have had a major impact on safety awareness at works and have resulted in a very welcome and beneficial spill-over into the field of domestic and traffic safety as well.

Comparable figures are hard come by, but it would seem that the RSA as a whole does compare favourably with developed countries in its overall safety achievement. We do seem to have a disproportionately high fatality rate per capita, but it is no easy task to analyse and compare national statistics accurately. Our own year on year figures do point a positive picture, though. From a 1950 figure of more than 4% disabling injuries amongst our workforce to a 1986 figure of 1,8% and a provisional 1987 figure of 1,68 indicates some measure of success.

The training of various levels of management and the work force in techniques of accident and disease prevention, has been greatly stimulated by the advent of the Machinery and Occupational Safety Act. Looking only at the NOSA figures, this is clearly demonstrated:

| | | |
|---|---|---|
| 1960-76 | 70 000 | 4 400 |
| 1976-83 | 128 000 | 18 300 |
| 1983-86 | 130 000 | 43 300 |
| 1983-87 | 169 000 | 42 300 |

The legislative programme has also progressed dramatically since the MOS act came into force in 1984. The following sets of regulations have been gazetted:

| | |
|---|---|
| 1. GENERAL ADMINISTRATIVE REGULATIONS | 10/1986 |
| 2. ELECTRICAL INSTALLATION REGULATIONS | 10/1985 |
| 3. GENERAL SAFETY REGULATIONS | 5/1986 |
| 4. ASBESTOS REGULATIONS | 4/1987 |
| 5. ENVIRONMENTAL REGULATIONS | 10/1987 |
| 6. DRIVEN MACHINERY REGULATIONS | 2/1988 |
| 7. GENERAL MACHINERY REGULATIONS | 8/1988 |
| 8. ELECTRICAL MACHINERY REGULATIONS | 8/1988 |

Regulations to be re-written:
10. FACILITIES REGULATIONS - Complet 1986
11. DIVING REGULATIONS - draft ready.
12. ELEVATOR AND ESCALATOR REGULATIONS
13. PRESSURE VESSELS AND BOILER REGULATIONS
14. ENGINEERS CERTIFICATE OF COMPETENCY - draft 8/1988

NEW REGULATIONS
15. LEAD REGULATIONS - draft out 1988
16. COSHH REGULATIONS.

Met al die selfreguleringspogings wat in die Wet ingebou is, kom die selfreguleringsaspek in regulasie 5 van die Elektriese Installasieregulasies, 1985, nog nie tot sy volle reg nie.

Na oorlegpleging met die VMEO en die EAV dat nie minder as 70% van installasies waar installasiewerk uitgevoer was geïnspekteer en getoets moet word voordat toestemming vir aansluiting verleen kan word.

Die EAV het my reeds genader dat hierdie perk verlaag moet word maar solank 'n hoër persentasie as 70% inspekteer word, sal 'n verlaging geen sin maak nie. Uit u jaarlikse opgewes wat u indien, merk ek dat 'n heelwat hoër persentasie installasies as die minimum van 70% inspekteer en getoets word voor aansluiting. Ek glo dat daar 'n rede voor is en sal graag van die VMEO wil verneem wat dit is.

**MNR J J BOSHOFF: VANDERBIJLPARK**

Die elektriese installasie-regulasies was seker een van die eerste neigings tot devolusie van gesag en was sekerlik ook bedoel om meer verantwoordelikhede aan elektriese kontrakteurs oor te dra en om groter verantwoordelikheidsin by hulle te kweek.

Ongelukkig lyk dit asof baie van hulle nog nie die verantwoordelikheid aanvaar het nie en die volgende optredes word nog dikwels aangetref.

1. Versuim om die nodige vorms in te vul en toetse te reël.
2. Die voltooiing van die sertifikaat van nakoming ten opsigte van instalasiewerk waarvan die installasie-elektrieiën ooglopend geen kennis dra nie soos weerspieël in die volgende:
(a) Die installasie-inspekteur word soms na die terrein waar die werk gedoen is, gevolg aangesien die installasie-elektrisiën blykbaar nie weet waar dit is nie.
(b) Die foute wat tydens die toets gevind word, dui daarop dat die werk nie vooraf getoets was nie en dat die installasieinspekteur gebruik word om die foute uit te wys.

Daar word soms bewerings gemaak dat sommige kontrakteurs (installasieelektrisiëns) bereid is om teen vergoeding sertifikate van nakoming vir andere te teken.

Daar word ook soms bewerings gemaak dat kontrakteurs in hul kwotasies aan kliënte voorsiening maak vir die betaling van opvolgtoetsfooie deur die kliënt. Sulke bewerings kan egter vanselfsprekend nie gestaaf word nie.

Weens die ondervinding hierbo genoem word daar in my dorp nog steeds sowat 80% to 86% installasies getoets.

Ons het in die afgelope tyd enkele gevalle van bogenoemde optredes deur kontrakteurs wat lede van die Elektriese Kontrakteursvereniging is onder daardie organisasie se aandag gebring en die betrokke lede was op die vingers getik.

Ek voel dus dat veel vermag kon word deur samewerking met die Elektriese Kontrakteursvereniging alhoewel alle kontrakteurs natuurlik nie lede is nie en alhoewel daar ongelukkig ook gevind word dat aktiewe lede van die vereniging hulle ook skuldig maak.

**ATTIE VAN DEN BERG: KRUGERSDORP**

1. Ons was 'n bietjie onkant betrap omdat veiligheidsverteenwoordigers ingevolge artikel 9 aangewys word. Dit is gedoen, maar die opleiding kon nie dadelik geskied nie omdat opleidingsmateriaal ontbreek het. Gevolglik is dit heelwat later eers gedoen.
2. Die standaardisering van amptelike inspeksievorms en ondersoek van ongelukke is in boekvorm uitgegee. Dit kon egter nie so toegepas word nie want by 'n stadsraad is departemente nie binne een gebied gesetel nie en sou boeke rondgestuur moes word vir kontrolering deurt die Veiligheidsafdeling.

Ons het gevolglik ons eie inspeksievorms van werkplekke saamgestel, wat by ons plaaslike drukker beskikbaar is. Die twee dokumente word na voltooiing aan die Veiligheidsafdeling voorsien en op lêer (register) geplaas.

3. Die aanwysing van veiligheidsverteenwoordigers vir kantore is verminder na een per 100 persone en die inspeksies na een elke drie maande.

Ons het egeter die stelsel om weer maandeliks 'n kantoorinspeksie af te dwing, behou omdat daar in drie maande baie verkeerd kan gaan, veral met elektriese apparaat.

4. In die algemeen het die verbetering van die veiligheidsprogram nie soveel baat gevind nie want die mense sien op teen die baie papierwerk wat gedoen moet word. Dit kan egter nie weggeredeneer word nie want beheer moet uitgeoefen word met die uiteindelike doel om ongelukke te verminder deur middel van behoorlike ondersoektegnieke.
5. Wat die algemene veiligheid as sulks betref het die aanstelling van veiligheidsverteenwoordigers, veiligheidskomitees en Sentrale Veiligheidskomitee die besef van verantwoordelik by die werknemers aangewakker, wat op sy beurt weer minder ongelukke tot gevolg gehad by werksplekke en kantore.

**MNR A D DU PLESSIS: DEPARTEMENT: MANNEKRAG, PRETORIA**

Mnr die President, ek sal vir u sê wat ek gedoen het toe ek in 'n streek was. Ek het van die voorsieners gevra dat as hulle probleme het met 'n kontrakteur, dan moet hulle die rapporteer by hom, maar skryf onderaan die brief vir hom dat u 'n afskrif van daardie brief aan ons stuur. Ek het altyd daarop gereageer en van die kontrakteur 'n skriftelike verduideliking vereis en ek dink in 'n baie groot mate het dit gewerk. Ek het ook 'n afskrif van my antwoord aan die voorsiener gestuur, ek het 'n afskrif van my antwoord aan die kontrakteursvereniging gestuur en die persoon het geweet dat almal weet van sy

flaters. Ek het gevind dat dit het baie gehelp, so ons is baie bereid om saam met u die bal te speel. Ons wil graag hê dat die ding reg moet wees. Ek moet natuurlik aan die anderkant sê wat die kontrakteurs probleme het met die voorsieners, dit gebeur ook soms, het ons dieselfde paadjie gevolg, net in die teenoorgestelde rigting.

Julle het opgemerk dat daar meer vervolgings voorkom vir oortredings van regulasies van 'n administratiewe aard.

Inspekteurs lê klem op 'n oudit van die veiligheidsbestuurstelsel van 'n werkgewer en speel die administratiewe regulasies hier 'n kardinale rol, naamlik:

1. Nie aanmelding van voorvalle – die beseerde word die voorreg van die beskerming van die Wet weerhou as 'n voorval nie aangemeld word nie.
2. Nie aanstelling van veiligheidsverteenwoordigers.
3. Nie samestelling van veiligheidskomitees.
4. Nie aanstelling van aangewese persoon ingevolge Algemene Administratiewe Regulasie 4.
5. Nie ondersoek van voorvalle en eie rekordhouding.

Waar die veiligheidsbestuurstelsel van 'n werkgewer goed funksioneer en die bestuur en werknemers betrokke is, sal veiligheid seëvier.

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**V5. Vraag oor die registrasie van kontrakteurs – deur Mnr A H L Fortmann:**

Met betrekking tot individue in diens van 'n werkgewer wat privaat kontrakteurswerk wil verrig.

**VRAAG:**

Mag hulle:

6.1 Geregistreer word as 'n kontrakteur?
6.2 Geregistreer word as 'n permithouer?

**Q5. Question on the registration of contractors – by Mr A H L Fortmann:**

With regard to individuals working for an employer and wanting to do contracting work privately.

**QUESTION:**

Can they

6.1 Be registered as contractors?
6.2 Be registered as permit holders?

**MR A D DU PLESSIS: DEPARTMENT OF MANPOWER, PRETORIA**

Mr Chairman, yes, there are, first of all electrical contractors who have to qualify to be able to be registered and then we have permit holders who are virtually a temporary or special contractor. I'll deal with an electrical contractor first and there we will have to look at the definition of an electrical contractor. An electrical contractor is any person registered as a contractor in terms of this Act who undertakes to perform installation work on behalf of other persons. This excludes his own employees. So an electrical contractor is a person who undertakes work for somebody else. When he registers as a contractor you don't know where he is going to perform installation work. The contractor has to comply to certain aspects for registration purposes. There are two criteria:

First of all it can be any person including a juridical person who can apply for registration. Here such person must have a fixed address and a telephone listed in his name and secondly he must employ an installation electrician on a full time basis or he must be an installation electrician himself. Those are the qualifications necessary for registration. If a person has a fixed address, a telephone listed in his name, employs an installation electrician, he can be registered as a contractor. When he is a contractor, he must be able to exercise supervision on a full time bases over the installation work while it is in progress. This means he cannot dump a person at the premises and let him carry on and he proceeds to his normal 8 hour job and that afternoon he comes back and picks him up. He was not available to exercise supervision. Ofcourse the other part of his duties are to ensure that the work is done in a safe manner. He must inspect and test the completed work prior to making application for connection and this is one of the aspects that Mr Boshoff mentioned. It is obvious that the installation was not tested prior to making application and the annexure 1 completed. So we do have certain criteria for registration as a contractor and ofcourse his duties. Those are all part of being a contractor.

Being a permit holder is something different. We have to make provision for the person who can do his own work, who do not need a contractor to perform installation work on his premises. He has the expertise himself. It is not necessary for such a person to register as a contractor because being registered as a contractor means before he commences work he must notify the supplier. When the installation is completed he must test and inspect and notify the supplier. He may not connect without the permission of the supplier and the supplier must include these installations in part of the 70% of tests. We want to exclude a lot of unnecessary administrative work. So we want to register a person who can do his own work, who is an electrical installation electrician or who employs one on a full time basis to do his own work under terms that you can determine which should be more leniant than for contractors who are doing work for people where they have no ties with. It is not their own work, it is work that they do for somebody else. They do not have to use that specific machinery or installation. This is the difference. We would like to see suppliers make more use of permit holders for specifically the larger users of machinery, factories, people who have their own electricians. Let them work on a permit system. Don't hesitate to register a person who is an electrician who has a fixed address and a telephone number. The only thing is he must then work like a contractor, he must notify you of all work, he must test before an inspection. The supplier may call for a contractor to be present at each inspection, and I don't think you do inspections after hours, so you can determine the time and the date of the inspection and you can expect the contractor to be present at the inspection. If you have problems ofcourse you follow the second root of insisting that the installaion electrician himself is available. The one man contractors are normally the installation electrician himself so I think in that case, be strict on these people to ensure that the proper job is done. But I don't think we should completely eliminate them. We do have a place for them in industry as well.

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**V6. Vraag oor die inspeksie van installasie werk en elektriese installasies – deur Mnr J K von Ahlften:**

Volgens regulasie 5(1) van die elektriese installasie regulasies soos afgekondig in Staatskoerant kennisgewing R2270 van 11 Oktober 1985, en die Hoof Inspekteur se Kennisgewing R2272 van 11 Oktober 1985 moet verskaffers *ten minste* 70% van alle installasies wat in nuwe persele en in aanbouings of struktuurvergaderings geïnstalleer word, sal geïnspekteur en getoets word.

Gedurende die afgelope drie jaar na die wetgewing van bogenoemde bepaling deur die Hoof Inspekteur behoort dit reeds aanvaar te wees dat 30% van alle installasiewerk en elektriese installasies wat in die Republiek van Suid Afrika gedoen word, moontlik reeds deur elektriese kontrakteurs vir aansluiting in terme van uitklaringssertifikaat van hulle installasie elektrisiëns geïnspekteur en getoets word en nie deur die installasie inspekteure van munisipaliteite nie.

Die tyd is dus nou geleë dat daar terugvoering van die voorsieners verkry word oor die algemene standaard en veiligheid van die installasie werk wat nie deur plaaslike besture geinspekteer of getoets is nie en of daar enige ernstige probleme in hierdie verband deur die eienaars van sulke elektriese installasies ondervind was.

As veronderstel word dat van die 207 lid-ondernemings van die VMEO gemiddeld ongeveer 500 installasie inspekteurs teen 'n totale koste van R25 miljoen (1987 Begrotings) per jaar indiens moet hê en as 'n vermindering van 30% bereik kon word, moes daar 'n besparking van R8,5 miljoen tot voordeel van die munisipale belastingbetalers gewees het.

**VRAAG:**

Die vraag ontstaan dus of daar werklik 'n vermindering van 30% in die installasie inspeksies bereik was met 'n besparing in kostes vir munisipale elektrisiteitsvoorsieningondernemings sonder dat daar 'n ernstige verlaging in die standaard of veiligheid van installasie werk in die Republiek van Suid-Afrika ondervind is.

**Q6. Question on inspection of installation work and electrical installations – by Mr J K von Ahlften:**

In terms of regulation 5(1) of the electrical installation regulations published by Government Notice R 2270 of 11 October 1985, the Chief Inspector has determined by Notice R 22782 or 11 October 1985 that suppliers shall cause *at least* 70% of all installation work and electrical installations which are installed in new premises and in additions or structural affections to existing premises to be inspected and tested.

During the past three years since enactment of the above determination by the Chief Inspector it must therefore be apparent that at least 30% of all installation work and electrical installations in the Republic of South Africa could have been inspected an dtested by electrical contractors and authorised for connection in terms of the certificate of compliance of their installation electricians and not by municipal installation inspectors.

The time is therefore opportune to get some feedback from suppliers on the general standard and safety of the instalation work not tested and inspected by supply authorities and whether any serious problems ahve been encountered in this respect by the owners of such electrical installations.

If one assumes that the 207 member undertakings of the AMEU on average have to employ say at least 500 installation inspectors at a total cost of R25 m (1987 Estimates) per annum and that a reduction of 30% has in fact been achieved the saving would have been R8,5 m to the advantage of municipal ratepayers.

**QUESTION:**

The question therefore really is whether a reduction of 30% in installation inspections has in fact been achieved with an associated saving in costs to municipal electricity supply undertakings without a serious reduction in the *standard* and *safety* of installation work being performed in the Republic of South Africa.

**MR A H L FORTMANN: BOKSBURG**

On the question of whether problems have been encountered by owners of electrical installations that were permitted to be connected by contractors, the answer is that we in Boksburg have in fact not encountered any problems, because of the fact that care was taken to only grant permission to contractors who had proved themselves to deliver good workmanship, by virtue of the fact that they had done a number of installation work tests without having had to take a re-test.

On the second question of whether there has been a saving, the answer is that as there has been no reduction in staff, there has been no saving. It must however be pointed out that staff is engaged in educating and training of contractors in this regard.

On the third question of whether a reduction in the standard and safety of installation work has been experienced, the answer is that Boksburg has found that there is a severe escallation of illegal work and steps are being taken to control it.

At the moment it is difficult to achieve all installation work to be done legally and to prosecute offenders by existing legislation is almost impossible.

The safety of the illegal work that has been found to be connected is of a very low standard, most of the offences being the absence of earth conductors, undersize conductors, no earth leakage protection, over-rated protection etc.

In this regard I would like to ask other local authorities do to overcome this problem, assuming of course that others have had similar problems.

The consumers are mostly not aware that there is a problem with their electrical installation.

At present I have not got figures to substantiate my suspicion, but I am of the opinion that there has been an increase in domestic home fires and these could well have been caused by such illegal installation work.

Thank you Mr Chairman.

**MR C E ADAMS: PORT ELIZABETH**

Just one point of interest Mr Chairman relating to Mr Fortmann's question. We have found that we now have more time to devote to progress inspections. Only inspecting 70 percent of the work, means that our Inspectors have free time and instead of having to employ an extra Inspector to do all the installations we now use that free time to do progress inspections as the jobs are continuing. We find that this is contributing a tremendous amount to getting the installations properly installed in the first place.

**ATTIE VAN DEN BERG: KRUGERSDORP**

Alhoewel die wet voorsiening maak dat minstens 70% van alle installasies geëinspekteur moet word, is dit onrealisties om te verwag dat die uitgawes ook ooreenkomstig met 30% moet afneem. In die eerste plek mnr die President kan 'n onderneming nie met deeltydse inspekteurs bevredigende werk lewer nie. Vanweë die volgende faktore kan daar slegs ± 5% van die gewone uitgawes besnoei word:-

**Nuwe Aansluitings**

Sekere toetse kan slegs uitgevoer word nadat die toevoer aangeskakel is, byvoorbeeld lasrelê en aardlekeenheid.

Aannemers het nie sleutels vir mini-substasies nie.

Deposito moet betaal wees.

Voordat diensaansluitingkabel gekoppel word, moet die inspekteur seker maak dat die aannemer se kabel na die gebou installeer is.

Uit bogenoemde is dit duidelik dat alle nuwe geboue minstens twee keer deur 'n inspekteur besoek word voordat die toevoer aangeskakel kan word.

**Aanbouings en toevoegings tot bestaande installasies**

Toestemming om aan te skakel, word verleen, maar aangesien aannemers dikwels hulle nie bemoei met die toestand van die bestaande installasie nie, kan dit nie aanvaar word dat die installasie as geheel veilig is nie.

Al word die toevoeging tot die installasie nie inspekteer nie, word die ou installasie wel inspekteer.

On gebruik om te vra vir lasrelê's op geyserstroombane, ens. asook oorlasbeskerming op die hele installasie, die vele gevalle waar die meters nie toeganklik vir die meterlesers is nie, is maar enkele redes waarom daar in meeste gevalle inspeksies uitgevoer word.

Mnr die Preisent, ek stem saam met die Elektriese Kontrakteurs Vereniging dat hulle bedryf moontlik sodanig uitgebrei kan word om grootliks die werk van die Munisipale installasie inspekteur oor te neem. My grootste probleem bly egter dat 'n werker in die praktyk nie sy eie werk self as reg en korrek kan sertifiseer nie, tensy dit gewettig word.

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**V7. Vraag oor die gebruikskode vir die bedrading van persele (SABS 0142-1987) – deur Mnr Charles Adams:**

Die Gebruikskode was gedurende 1978 inwerking gestel en het die Standaard Regulasies vir die Bedrading van Persele, wat deur die SA Instituut van Elektriese Ingenieurs geadministreer was, vervang.

Die Gebruikskode is meer volledig as die Standaard Regulasies en van 'n suiwer tegniese oopunt is dit meer aanvaarbaar as 'n ingenieursdokument. Die Kode is ongelukkig op so 'n manier geskryf en opgestel dt dit nouliks vertolk kan word, bv. gereelde kruisverwysings, te min detail op plekke en die behoeftes vir spesifieke items is nie gerangskik nie en handel onder enkele opskrifte.

Dit moet in gedagte gehou word dat terwyl die Kode deur 'n breë spektrum van die elektriese ingenieurs bedryf gebruik word, is dit primêer bedoel vir gebruik deur installasie elektrisiëns, wie hoewel goed opgeleide vakmanne, hulle normaalweg nie 'n hoë vlak van akademiese opleiding het nie. In die praktyk vind gegradueerde ingenieurs in baie omstandighede dit moeilik om die vereistes van die Kode te vertolk. Die feit dat die Kode somtyds nie maklik verstaanbaar is nie, lei tot onenigheid tussen beide elektriese inspekteurs van plaaslike besture en elektriese kontrakteurs. 'n Ander nadeel ontstaan uit die presiese beskrywing van gedeeltes van die Kode, deur dat die verantwoordelike ingenieurs van verskeie plaaslike besture verskillende vertolkings huldig oor dieselfde regulasie, wat dan lei tot verdere verwarring tussen elektriese kontrakteurs.

Dis items en/of seksies wat die meeste verwarring veroorsaak, is:

**1. KONTAKSOK STROOMBANE**

1.1 Die behoeftes is nie gegroepeer onder een hoofopskrif nie.

1.2 'n Stroombaan word nie beperk tot die aantal kontaksokke nie, maar by die aantal kamers bedien – dit is verwarrend – byvoorbeeld tel 'n kombuis as twee kamers.

**2. BADKAMERS**

2.1 Hierdie seksie is hoogs gekompliseerd.

**3. SWEMBADDENS**

3.1 Hierdie seksie is hoogs gekompliseerd en baie van die behoeftes blyk te oorvleuel.

**4. GOEDKEURINGS SISTEEM**

4.1 Hierdie sisteem is kommerwekkend en tydrowend wat ontwikeling van nuwe materiale en toerusting benadeel.

4.2 Indien 'n stelsel ontstaan wat plaaslike kommitees insluit kan so 'n stelsel meer funksioneel wees.

**Q7. Question on the code of practice for the wiring of premises (SABS 0142-1987( – by Mr Charles Adams:**

This Code of Practice was introduced during 1978 and replaced the Standard Regulations for the Wiring of Premises which were administered by the South African Institute of Electrical Engineers.

The Code of Practice is more comprehensive than were the Standard Regulations and from a purely technical aspect is probably more presentable as an engineering document. However, the Code has unfortunately been written and arrangend in a manner which makes for difficult interpretation, i.e. constant cross references, too little detail in places and the requirements for specific items are not arranged and dealt with under single headings.

It must be borne in mind that while the Code is used by a wide cross-section of the electrical engineering industry, it is primarily intended for use by installation electricians who, although they may be well trained as artisans, do not generally acquire a high level of academic expertise. In practice even graduate engineers have difficulty in many instances with determining the exact requirements of the Code. The fact that the Code is at times difficult to interpret has caused confusion amongst both electrical inspectors of suppl authorities and electrical contractors. A further consequence of this difficulty in arriving at the exact meaning of parts of the Code, is that the responsible engineers for various supply authorities have at times arrived at different interpretations of the same regualtion which has led to even further confusion amongst electrical contractors.

The items and/or sections in the Code which have caused most controversy are:

**1. SOCKET OUTLET CIRCUITS**

1.1 The requirements are not grouped under one heading.

1.2 A circuit is not limited by the number of outlets supplied but rather by the number of rooms served – this is confusing i.e. a kitchen counts as two rooms.

**2. BATHROOMS**

2.1 This section is very complicated.

**3. SWIMMING POOLS**

3.1 This section is very complicated and many of the requirements seem to overlap.

**4. APPROVALS SYSTEM**

4.1 The system is very cumbersome and time consuming which discourages development of new materials and items of equipment.

4.2 If some system incorporating local committees could be extablished the system might be more functional.

**5. INDUSTRIËLE AANWENDINGS**

5.1 Die Kode plaas nie genoeg klem op die vereistes van installasie werk in industriële situasies nie.

**VRAAG:**

Hoe voel die ander lede omtrent hierdie genoemde punte en moet die Gebruikskode nie dalk herskryf word nie?

**5. INDUSTRIAL APPLICATIONS**

5.1 The Code does not place enough emphasis on the requirements for work carried out in industrial situations.

**QUESTION:**

What do other members feel about these points, and should the Code of Practice be re-written?

**MR C E ADAMS: PORT ELIZABETH**

Mr Chairman, I can't add very much to what is written in the written question. I would just like to say that we are not questioning the technical content of this Code of Practice. What we are suggesting is that it could be re-written to make it more easily readable. My staff and in particular my Consumers Engineer and my Chief Installation Inspector spend an awful lot of time explaining to contractors what is in the code. And I think basically that this is because the code is not written in a form that a contractor can easily read. So what we are suggesting is that we re-write it in a more readable form and we wondered whether other municipalities had the same experience and whether they shared our thoughts. Thank you.

**MR J TOMS: SABS**

When I first read Mr Adam's points, I thought he didn't like the Bureau, but I spoke to him yesterday and he assured me that this wasn't the case. But if I can take the points he makes in the order they occur. In the start of his contribution, he talks about cross references and the numbers which exist. And there is a basic reason for this and that is because similar requirements relate to many situations. For example – the earthing requirements and the shielding of life parts occur many place in the Code and if these points were re-iterated in each occasion, it would make the code very volumenous. He made the point just a moment ago regarding interpretation and I'm rather sorry to hear that it has been a problem because when the Code is edited, every endeavour is made both by the editors and by the Wiring Code Committee to ensure the Code is simple to interpret. But here can I advise him that if he has a problem with interpretation, that he must either phone Mr Culhoon or myself at the Bureau and we are only too happy to give him an interpretation of any point which he finds to be difficult.

The third point he makes is about socket outlets. And I would accept the present method of dealing with socket outlets is unsatisfactory. There are forty references in the index and only sixteen of which refer to one sub-clause. This is an editorial matter which is being remedied and proposals for amendments will be submitted to the Wiring Code Committee.

Bathrooms – they are complicated and so are swimming pools. All I can do is plead the fifth amendment here and say that we followed IEC practice in the dimensional requirements for bathrooms and swimming pools. He mentions the approval system. I assume that Mr Adams is talking about authorisation. Is that what he means, because approval is vested in the supplier but authorisation is what I think he's talking about. Can he please indicate that that it is so? ... That is so. Right thank you. Well, as far as authorisation is concerned, it is a bit cumbersome the present system and because I felt this to be the case, I convened a small working group which met about a fortnight ago to consider the objectives and procedures for authorisation and that working group has formulated several proposals that will be put forward to the main Committee and will form the basis of amendments to make the whole procedure simpler and quicker to use. Mr Adams makes the point about industrial applications and says that he doesn't think that it deals with those situations. I'm surprised, I wasn't aware that it didn't deal with the situation, but let me emphasise that the Code is now subject to continuous amendment and by way of illustrating this, five amendments have been issued since the second revision of the code was gazetted on the 4th of September 1987, that is just a year and we've already had five amendments past by the Council and the sixth one is now in preparation and will be published shortly.

It is intended also that the Code will be re-published every five years. That is all the amendments will be collected together and another revision will be published each five years. To assist in his understanding it has been devided by type style into manditory and advisory parts in terms of the Electrical Installation Regulations of the Machinery and Occupational Safety Act and this will make it very clear to the reader which of the requirements are manditory and which are advisory. In conclusion I would emphasise that the Bureau does not write the Code. There seems to be a misconseption in some peoples minds that the Bureau writes the Code. This is not true. It provides the secretariat and the publishing facilities only. The Technical Committee that is appointed by the Bureau Council, writes the code and proposals for amendment may be submitted by any of you and will be circulated to the Technical Committee. If a consensus of agreement is reached, the amendment is published by the Bureau and takes effect when it is gazetted.

Those of you who wish can make arrangements with the SABS for the amendments to be sent to you when published. There is a fee for this service but it is very modest and it means that you would receive amendments as and when published without having to go through every copy of the Government Gazette. Thank you.

**MR M P P CLARKE: RANDBURG**

Mr Chairman, perhaps it would be of interest for the members to know that in the old days authorisation procedure was something like a supplier or designer or manufacturer of a new system sending the particular system to the Bureau having a series of tests done and then sending a sample of this lot complete with copies of the tests to the Recommendations Committee which is the AMEO plus various other members who then looked at the results and the equipment and then either made a recommendation directly to the Chief Inspector to say if this should be authorised or can be authorised alternatively send it back to the Bureau for more tests. Now the new Code SABS 0142 lay down a procedure where the article came first to the Committee and it was then the Committee's responsibility to decide on what tests should be carried out on that specific item or system or whatever it was. Then it was referred to the Bureau, then it came back to the next Committee meeting. In point of fact, this is what Mr Thoms is referring to as the small sub-committee that has been looking at a method of reviewing in streamlining this. When you study it, you'll realize there's a potential for delay. You can waste three months very easily with the way things are at the moment and three months means money, etc, etc, for manufactureres and suppliers. But it is being looked at and I,m sure we'll find a solution. Thank you.

**MR J J BOSHOFF: VANDERBIJLPARK**

Whilst I do not agree with everything said by Mr Adams, I do think that there is need for serious scrutiny of SABS 0142, and

especially the wording of the requirements, since there appear to be many contradictions between different regulations of the code and also between requirements of the code and of regulations under the Machinery and Occupational Safety Act.

From experience I know how easily this type of thing can happen, since a committee discusses a section of an existing document and decides on certain amendments to it without at that stage realising the possible effect of this on another section. Furthermore it can happen that, during the grammatical editing of a document, the intentions of the technical committee can be lost or misinterpreted.

I have previously submitted comments on various requirements of the code which I considered problematic to the Highveld branch and do not intend repeating them here but can add the following example to it:

In the AMEU bulletin No. 173, August 1988, it is stated that the Chief Inspector advised as follows:

Non-storage type instant water heaters are appliances in terms of SABS 0142.

Since these appliances can be installed as fixed appliances *shall* be installed as a fixed appliance which means that it may not be installed otherwise and therefore these two statements are contradictory.

I must add that both the Afrikaans and English texts of SABS 0142 are in agreement, while I only received an Afrikaans version of the bulletin which could possibly be a wrong translation from the English.

A further point that needs mentioning is that, in terms of the Electrical Installation Regulations promulgated under the M.O.S. Act, the installation work inter alia teminates at a point of outlet.

I might be wrong, but I have not seen any stipulation prohibiting circuits being wired in the conventional way with conduit, etc., providing this with a "plug top" and plugging it into socket outlets, claiming that these circuits do not constitute installation wordk.

Further a storage type water heater is also a appliance.

Does this suggest that it can be supplied from a socket outlet obviating the Council's load management systems? It seems as if the Electrical Installation Regulations might also need some amending.

It seems to me that many AMEU members find various sections of SABS 0142 confusing or feel that certain sections should be modified or deleted or that sections should be added. It is impossible for one representative from the AMEU to have the wisdom and experience to think of all members when attending meetings amending or drafting the code. On the other hand if every organisation had to be represented by a dozen different members the committee would be too clumsy to operate.

I would like to suggest that a working group of AMEU members be formed to whom all members can submit their queries, ideas and suggestions. This working group could then meet periodically, discuss the submissions, give a mandate to the member serving on the main committee and give feedback to individual members via the branches.

**MNR J LOUBSER: BENONI**

U is heeltemal korrek met wat u daar genoem het. Ek kan ook vir u sê dat mnr Boshoff en mnr Adams is die twee plaaslike besture van wie ons die meeste kommentare kry oor die kode en elke kommentaar wat hulle lewer het bestaansreg. Dit is wel nodig dat daar aandag gegee moet word aan hulle. Die voorbeeld wat mnr Boshoff genoem het van eenvoudig die hele sisteem inprop laat my dink aan jare gelede op 'n vorige dorp waar ek was, het die mense die huis oorspronklik vir 32V bedraad net vir ligte, en toe hulle nou Eskom krag daar gekry het het hulle eenvoudig 'n elektriese motor aangekoop en 'n generator aangedryf met die elektriese motor wat hulle ingeprop het. So die 32V sisteem was heeltemal uit die bedrading uitgesny.

**MR DENNIS KNEALE: ECA**

Mr Chairman I believe that there are many grey areas in the doce and the MOS Act as it stands at the moment with regard to the electrical installations, particularly when the terminals of a control panel feeding a fridge plant or tillar plant or high rise building or a building like this, are regarded as the final terminals in the wiring. After that, according to certain interpretations I have heard doesn't form part of the code, is not tested by anybody, is done by peopele who don't know what they are doing. I believe this is one of the areas that need cleaning up. I know Mr Fraser has written many letters to various parties in this concern. I believe all the wiring eminating from a control panel to the motor, the flow switches, to the pressure switches and so on, all that forms part of the wiring under the code, needs to be clearly defined as such. Thank you.

**MNR JAN LOUBSER: BENONI**

Mnr Boshoff het voorgestel dat die VMEO 'n subkomitee saamstel. Ek persoonlik is sterk ten gunste daarvan want ek kan nou vir u sê om al hierdie kommentare van al die lede te verwerk is 'n kolosale werk en so 'n subkomitee sal 'n baie goeie doel dien. Ek neem aan dit sal op die Uitvoerende Raad bespreek moet word.

**MR D FRASER: DURBAN**

Mr Chairman I don't have any particular observation to make, obviously there are areas, this is a living document, where amendments are necessary from time to time but I believe the machinery exists for the code to be kept upto date provided the effort is made by all the parties concerned with the use of the document to submit their views from their own experience. The AMEU should co-ordinate as far as the municipal supply authorities are concerned, co-ordinate all these points of view so that they can be channelled properly through to the Bureau. I'm sure the necessary action would follow from that. Thank you.

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## V8. Bespreking oor die VMEO se verslag oor 'n opname: Gebruik van aparte neutraal en aard geleiers in beskermende veelvoudige aardsisteme – deur Mnr Gordon Davies:

### 1. DOELWIT VAN OPNAME

By die VMEO-Konvensie in Kaapstad vanaf 28 - 30 September 1987 was 'n bespreking gehou aangaande die VMEO-Gebruikskode vir die "Application of Protective Multiple Earthing to Low Voltage Distribution Systems" waaruit dit geblyk het dat daar 'n

## Q8. Discussion on the AMEU report of a survey: Use of separate neutral and earth or protective multiple earth systems – by Mr Gordon Davies

### 1. PURPOSE OF SURVEY

At the AMEU Convention in Cape Town on 28 to 30 September 1987 a discussion tok place regarding the AMEU Code of Practice for the "Application of Protective Multiple Earthing to Low Voltage Distribution Systems" and it became apparent that

groot veskeidenheid van aardingsisteme in Suid Afrika in gebruik is.

Gedurende die konvensie is daar ooreengekom dat Mnr Gordon Davies 'n vraelys na VMEO Ingenieurslede sal omstuur, met die doel om 'n skedule vir aardingsmetodes vir die VMEO op te stel.

'n Vraelys was opgestel soos onder op die aangehegte bylae en na alle VMEO lede versprei, naamlik 150 en 12 ESKOM-streke waarvan slegs 91 beantwoord is.

**VRAAG:**

Kan Mnr Davies uitbrei op sy bevindings en moontlik 'n eenvormige sisteem voorstel indien dit as gewens beskou word.

there appeared to be a multiplicity of earthing systems in use in South Africa.

At the Concention it was agreed that Mr Gordon Davies circulate a questionnaire to AMEU Engineer Members in order that a schedule of earthing methods be produced by the AMEU.

A questionnaire was drafted accordingly as shown attached, and distributed to all AMEU members, numbering amount 150, and 12 ESKOM Regions, of which 91 replies in all were received.

**QUESTION:**

Can Mr Davies elucidate on his findings and possibly put forward a common system if this is deemed desirable.

**MR GORDON DAVIES: PIETERMARITZBURG**

Mr President, Gentlemen. At the Cape Town Convention we had certain proposals to make on updating the AMEU code of practice. Let me say now that we believe that the document is basically a very sound one, but there were some minor alterations and amendments which perhaps could have been made. But at that convention there was a lot of discussion on earthing and it became quite obvious that there were a number of different systems in use, and also that the designation of the system were not known to most of the delegates or a lot of the delegates. As a result of that, we were asked to go back and have a look at the code of practice, and again to circulate members to try to find out what systems of earthing they had. But if we look at the code of practise, one of the things that came up was that we should be looking at the IEE wiring regulations. Now, we did this, and we came to the conclusion that these regulations were far too complicated for us. Those regulations talk of the system TN-C. This system T- determines, or tells you that the system is earthed at the transformer and various other things.

Firstly we came to the conclusion that following that code of practice or wiring regulation, was not what we wanted to do, and it really wasn't the right thing to do, because we always have earthed systems, and we don't in fact provide for systems in the domestic or a factory which has a CNE wiring. Having said that we then circulated members and the replies which were very good, 91 out of 150 indicated that slightly over half actually still use the old SNE system. And of course that system is not what the code of practise was actually written for. The code of practise is for the application of protective multiple earthing. So we now have a situation where, from the survey if I can read from it, 51 percent in fact have SNE, and 49 percent have other types of earthing which must be CNE. If you then go down the system you find that of the CNE systems something over half in fact use a SNE service cable. So this system is completely mixed up., if you'd like to say that. As far as the momenture is concerned we believe that we should get rid of things like MEN because people can't understand them, so what we are proposing is that you have a two term description of this system. The first would be the reticulation upto the service connection and the second would be the service connection. Now that we think makes it quite simple. You've got an SNE SNE system or you've got am SNE CNE system or CNE SNE and that is what we propose to do. We do not believe the people understand what MEN is and we think that that is going to be simple. Having basically told you what the survey said we really have to move outside the scope of this document. Obviously if people wish to retain the old SNE system, they are perfectly entitled to do so, but one of the recommendations that we would make, its not obviously mandatory, is that we should go over the PME completely. And the reason that we do this, is that when we look at the cost of cable for instance, you are looking at a difference of something of the order of R500 in R2 000 per 100 meter. Now basically having said that we now have to look at what we are going to do with the service connection.

You then have 2 possibilities with the service connection. You have a CNE service connection and what the code of practise now says, is that if you use that service connection it is mandatory that you earth it at the consumers terminal. On the other hand if you have the SNE service connection, that earth is not mandatory. We recommend the SNE service connection. We believe that it is too much of a chance to infact accept that the contact on the black wire on the CNE would not in fact give you trouble, and we also believe that even if you make that earth mandatory its probably not going to work anyway. And the third reason that we are recommending this system is that you can get concentric cable which infact is cheaper than the concentric for the CNE, but you do have somewhat of a cost difference if you have overhead line, where you have to pull on an earth conductor. So the results of the survey are that 51 percent still go for the old system, about 49 go for multiple earthing. We believe that multiple earthing is the right way to go and we also believe that the service connection should be SNE. Thank you.

**MR GAUNT: AFFILIATE**

Mr Chairman I am very concerned at these sort of suggestions, because I believe that they are wasting us money. The British system of earthing or systems of earthing have been very carefully classified for many applications, and the simplicifations which are being made here, I do not believe are correct. For example in South Africa it is necessary to have insulated systems in certain instances, and the British code of practice allows for that, but the South African doesn't. This sort of thing is in a operating theatre in a hospital, is an insulated system. Now if we try and make too many simplifications we loose sight of what we are trying to achieve with the earthing. We have a situation on this side where the earth is shown as a seperate conductor, but in fact that isn't the only way of doing the earthing. In the British regulations or doces of practice, there are the two documents, the neutral can be earthed or a seperate earth can be supplied. If we're thinking of an overhead bundle system, where there isn't a seperate earth wire then you have a combined neutral and earth on the supply side of the consumer. If however you have a system where you lay earths in a trench with an underground cable, you have a seperate earth from the neutral. Now the British amenditure makes allowance for that. The British code of practice on earthing also makes a clear distinction between earthing systems where earth leakage protection is installed, and this is a fairly expensive system, except where high soil resistivities are concerned, and that is what we have in this country, and its one of the reasons why South Africa was so right in going to earth leakage protection. But if you have earth leakage protection, there are a whole lot of other earthing systems that can be used, because the sensitivity and the safety of the consumer is adequately catered for. What

concerns me is if we simplify this to such an extent that we have a belt and braces system with earthing and a seperate earth to the consumer and earth leakage that we will be throwing away a lot of money, and further I would actually disagree with Mr Davies, on the aspect of the cable connection for the consumer because the prices that we get form the suppliers, indicate the cable with just consentric neutral and the phase is about 30 percent cheaper than the concentric split cable. And therefore if we talking costs about systems, I believe that we can save nearly a quarter of the cost in som installations, if we use engineering acceptable systems. What concerns me is that if we take a code of practise of this kind and we enforce it as a regulation, that we are throwing away money needlessly. Thank you Mr Chairman.

**MR G DAVIES: PIETERMARITZBURG**
Yes, Mr Gaunt, I think you accept the fact that the code of practice or the wiring regulations in the UK are in fact wiring regulations, but they cover the whole system. Now they do make provision for systems which are unearthed etc etc. Now I do not believe that we should get involved in that sort of thing in a code of practice. That is my personal view. I don't believe that if we put that complication in we would be getting anywhere. The other point is that I believe the supply authorities need to be in a position where they are able if anything happens to say, that they have in fact provided a system which was relatively safe, and I believe that by using an SNE connected service, you can do that. If for instance you go on to the system of the CNE with that earth, at that point there, all you are really saying is if anything goes wrong in our system that has got to be good and it becomes a sort of backstop to you. I don't believe that that is the right thing to do. Now as far as cheapening the system is concerned, I just cannot accept the figures quoted by Mr Gaunt. I might say that we had correspondence on this matter, and we went to the trouble of getting the prices of these various cables, which I have here. The position is that our figures, and we have a cable factory which is right on our doorstep, indicated that the split concentric which is a standard cable, is in fact some R20 per hundred metres cheaper. Now I don't believe that we should be even if the cable which Mr Gaunt proposes was in fact cheaper, I don't think we should be looking at that sort of thing. I believe that the system envisaged there is a sound one, and that is what we would recommend. The point that Mr Gaunt put to me is, could he not use the CNE system, service cable without an earth electrode. I don't believe that that is good practise. I think that that is frankly pretty dangerous, because all that is going to happen, as if there is a connection fault on that neutral, the whole of the installation is going to be increased to a potential which will be dangerous. I think that I've answered most of the questions.

**MR GAUNT: AFFILIATE**
Mr Chairman, I'm not sure whether I've misunderstood Mr Davies, and I would like to clarify something. Is he of the opinion that the British Code of practice on earthing provides for unsafe situations, because I don't believe it does.

**MR G DAVIES: PIETERMARITZBURG**
Mr Gaunt that is a leading question. In fact I believe it does, in certain instances. Particularly with the earthing conditions that we have in this country.

**MR K VAN ALPHEN: SABS**
Mr Chairman, I refer again to what has already been said on previous occasions, is that while it is very good that the AMEU produces a code of practice, I think it should be welcomed. We have come to a stage where the Department Manpower has started using this code of practise, in circumstances that are not warranted. We already have cases even miniature substations, for suddenly some Inspectors demand an extra earthing bar. Now I think what we have to bear in mind is that we have reached discussions with the Department of Manpower. The Department of Manpower is looking at deregulation and actually impose upon the bureau now to take a more afirmative step, and produce a code of practice. In other words they will say, what we deregulate provided that it is a National accepted code of practise. Now I think that while this puts across a whole broad field we shouldn't therefore perhaps also look at your Executive Council as to the next step. The bureau today are quite happy to just take a code of practise produced by anybody and if it has sufficient backing from a national basis to produce that, just as a code of practise. I think then to meet Mr Gaunt's objection, not only Mr Gaunt we have also heard other bodies protesting against the implication of the AMEU code of practise. It is typical for the AMEU, but not necessary typical for other installations, that we should then perhaps if we would produce such a code of practice, put there a note of caution to say, this is a particular system, other systems do also exist. I think that at that moment it is not clear in the minds of the Department of Manpower and I would certainly like to see your work, which is very worthwhile being given a national status with then a note to say there are other systems also existing, and they must be just on their merit seperately.

**MR G DAVIES: PIETERMARITZBURG**
Yes, Mr Chairman. I would go along with that. I think that this is a code of practise for supply authorities. That is the way it was drawn up. If somebody want to run a factory, and do something completely different with a unearthed system. OK maybe we should mention this in the code of practise, but as I've said before the IEE code covers the whole spectrum from the transformer right into the factory and into anything else. So I still believe that this code of practise is one which we as supply authorities should use and operate on, and use it basically as a standard, and if you like put a note that there are other systems, that can be used if you wish to. Or other circumstances.

**MR D FRASER: DURBAN**
Mr Chairman, I think if we can arrive at a common code of practise, that will be very desirable. It just seems to me that we should be able to resolve this sort of difference of opinion that exists here. I am not familiar with the details of the difference of opinions. I would support Mr Davies's suggestion that the service cable should be retained as a seperate neutral and earth, because we've got a lot of existing systems which are seperate neutral and earthed on the mains, and if we retain the seperate neutral and earth service connection, then we've got one common type of service connection. Quite frankly I don't believe that there is a tremendous cost saving, in doing away with the insulated neutral on the SNE service cable, because it is not only the cost of the cable that makes up the cost of the provision of the service. The trenching is a very significant part of the cost of the service connection. So the saving in dropping out that neutral conductor or the earth conductor in the service, I don't think would make a tremendous difference in the cost. The big saving in the cost is the use of the consentric neutral and earth main cable. This is where the saving lies in my opinion.

**MR GERNANDT: NYLSTROOM**
Mr Chairman I would like to ask a question please? Is it acceptable on the SNE system to use tha armouring of the cable connected to your neutral on the council's side and at the consumer's side, use an earth spike, and also connect the armouring to the earth spike etc. Is it advisable to worki that system?

**MR G DAVIES: PIETERMARITZBURG**

Mr Chairman, I believe that that system is quite acceptable. People ask for earth spikes. Some systems for instance Durban, on a seperate neutral and earth, also ask for earth spikes but we believe that that is an expensive luxury which isn't really necessary. But I would say that the system that you propose is quite acceptable.

Perhaps if I could just pass onto what Mr Fraser said. The question of cost on the service cable. I don't believe its relevant as he says. All you in fact are doing is replacing one conductor in a cable which in fact is usually there anyway, by a mandatory earth connection, which he might get a decent earth connection, and you might not. If you in shale like Pietermaritzburg, you are not going to get it anyway. The cost of putting that earth in is probably about the same as the cost of the other conductor in the cable, which is if it is a concentric cable, it doesn't really cost you anymore. Thank you.

**MR V RAYNAL: AFFILIATE**

I want to mention something that Mr Davies has probably overlooked. About 10 years ago the South African Institute of Electrical Engineers ran a workshop on the earthing of the neutral. This was held at the CSIR, and a point that was raised was that in the CNE system, combined neutral earth system, where the earth is earth electrode they found that earth leakage devises on the premises were shunted, because the current was swamped and it was recommended that the SNE system with the earth electrode was the one recommended. I would like to bring this one up. Also I find that there is confusion in the minds of a lot of people because on the premises one is not allowed to earth a neutral. The neutral can only be earthed on the distribution side, and the code of practise points out that you cannot earth a neutral otherwise you are going to defeat your earth leakage. That is what causes a lot of confusion in people's mind.

**MR LEON WESSELS: AFFILIATE**

Thank you Mr Chairman for the opportunity given to me for discussing various aspects of the research I am doing on behalf of the National Energy Council. As many of the delegates know at this stage, its about the Analysis of Distribution Line Outages.

For the research project to be successful we need the assistance of the supply authorities especially municipalities, who ar prepared to monitor suitable lines for the survey. Unfortunately, the response to our first and reminder letters were very poor, as the delegates can see from the figures before them. However, after extensive canvassing the picture has changed dramatically over the last 2 months.

From the 233 supply authorities contacted, 113 are willing to support this survey.

As ons vinnig kyk na die lyne wat gemonitor word, kan ons sien dat daaroor 118 lyne reeds data ingevorder is. Dit is van 60 elektrisiteitsowerhede verder is daar nog 53 munisipaliteite wat of elektrisiteitsowerhede wat wat nog data moet instuur. Van daardie elektrisiteistowerhede verwag ons ongeveer nog 'n 80 lyne. Dit gaan die total lyne op basies 200 te staan bring, en dit is meer as wat ons in die begin verwag het, en dit lyk asof ons 'n positiewe resultate aan die einde van die projek gaan hê.

Dit is interessant om op te merk dat ongeveer meer as 50% van die lyne minder as 10 kilometer lank is. Ons kort egter lyne in die 22kV en 33kV groep. Ek sal dit waardeer indien daar van die munisipaliteite is wat van die lyne het, en wat nog nie deelneem nie of wat wel deelneem maar nie lyne aangebied het vir monitor nie, om asseblief dit vir ons te kan doen.

Hierdie grafiek is net 'n uiteensetting van die munisipaliteite wat nie deelneem aan die navorsing nie. 20 Persent van hulle het glad noe oorhoofse lyne nie, so hulle kan uit van die aard nie deelneem nie. Daar is dan ongeveer 13 persent van die munisipaliteite het geen rede verskaf hoekom hulle nie deelneem nie. 14 Persent het gesê, hulle het kort lyne, maar dit is nie belangrik vir ons of dit 'n kort of 'n lang lyn is nie. Wat vir ons belangrik is is dat daar 'n lyn in 'n omgewing gemonitor word. Hetsy of dit in Noort Kaap, hetsy dit in Natal is, en daardie lyn is 2 kilometer lank. Dit is vir ons belangrik, want ons kyk nie net na die lengte van die ly nie, ons kyk ook na die eksterne faktore wat die beïnvloed. Wat die werking van daardie ly beïnvloed. Voëls in daardie omgewing, weerlig veral in die hoërveld, Transvaal streke en veral in die Vrystaat ook. Ek moet baie dankie sê vir die Vrystaat munisipaliteite. Ons het 'n goeie groep van hulle mooi versprei daar. Wat ons wel baie bekommered maak is die groep van ongeveer 22 – 23 persent van die munisipaliteite wat 'n tekort aan personeel het wat 'n groot werkslas het en wat nie hulle weg oopsien om aan hierdie navorsing deel te neem nie. Dus, persoonlik voel ek dat op die ou einde die werking en die beskikbaarheid van die elektrisiteitstoevoer na die verbruiker kan beïnvloed.

Op hierdie punt, dink ek dit is van pas, as ons 'n paar vrae stel aan die munisipaliteite.

Hoe word 'n geskiedenis van die onderhoud en werking van die lyne opgebou, indien geen verslae oor kragonderbrekings gehou word nie?

Hoe werk munisipaliteite begrotings uit, vir onderhoud en werking van hulle lyne?

To what standard do municipalities design lines?

How do municipalities evaluate the performance of their lines?

What do the consumers think of the quality of the available supply?

Have the municipalities answers to these questions? Thank you Mr Chairman.

**MNR K VAN ALPHEN: SABS**

Vriende baie van ons het nie gereageer op hierdie vraelyste nie en die eintlike doel, as ek dit reg het, hoekom mnr Wessels hier is vandag, is dat hy wil hê ons moet asseblief reageer.

**DR R ANDERSON: HONORARY MEMBER**

I'm very glad to talk about this one, because its not only lightning, that we're really concerned with, the whole project which the National Energy Council is funding, and I am the one looking after it for the moment. Its being funded because the project leaders, that is Trevor Gaunt and Mr Lous Wessels, is one in which they want to examine the various causes of damage to 11kV, to distribution lines up to 33 or 66kV from which one can learn where to put one's money virtually in further research. So I would also like to join his appeal to ask members of the AMEU to support this particular project. In particular because we would like to fund it again next year, and one of the things about funding it for another year is that it is going to be of value to the organisation and if the AMEU puts its back against this project it will certainly be funded. So I merely then join with them in saying that I think this is a very important project. I think municipalities will learn a lot from it. They will learn where the majority of people are really having trouble on their system and this will of course lead to correct measures which can be taken. So I think it is in everybodies advantage to assist. Thank you.

## AMEU QUESTIONNAIRE

### USE OF SNE OR PME on LV SYSTEMS (380 V)

**SEPARATE NEUTRAL & EARTH (SNE) SYSTEM**

1(a)

Do you use a SNE System with neutral earthed at source only? (as indicated in fig. 1) YES/NO

1(b)
Is it mandatory for the consumer to provide an independent earth electrode? YES/NO

**PROTECTIVE MULTIPLE EARTH (PME) SYSTEM**

2(a)
Do you use a PME System with a Combined Neutral & Earth (CNE) service connection or an SNE service connection? (as indicated in figs 2a and 2b) CNE/SNE

2(b)
Is it mandatory for the consumer to provide an independent earth electrode? YES/NO

2(c)
Do you use Combined Neutral and Earth (CNE) cable on your system YES/NO

2(d)
Do you join CNE onto existing SNE systems? YES/NO
If so, at what points do you earth the SNE/CNE cables? (fig. 3 indicates recommended practice)

Explanatory diagrams were submitted with the above questionnaire to assist in the completion thereof, of which a copy is attached.

# AMEU REPORT

## SURVEY: USE OF SEPARATE NEUTRAL AND EARTH OR PROTECTIVE MULTIPLE EARTH

### 1. SCHEDULE OF EARTHING METHODS

The replies were analysed and summarised in Schedule 'A' Parts 1 and 2, and is intended merely as an indication as to which authorities use which of the two earthing systems.

A percentage analysis of the replies to each question is tabled below:-

**PART 1:**
**SEPARATE NEUTRAL AND EARTH (SNE) SYSTEM**

| | | YES% | NO% |
|---|---|---|---|
| a) | Using a SNE system with neutral earthed at source only. (ref. figure 1) | 49 | 51 |
| b) | Mandatory for consumers to provide an independent earth electrode. | 54 | 46 |

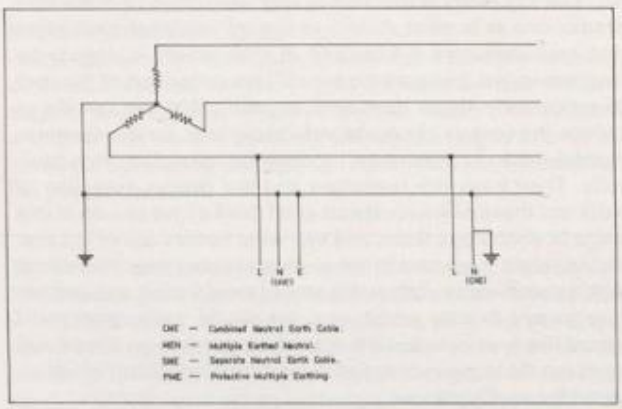
**PART 2:**
**PROTECTIVE MULTIPLE EARTH (PME) SYSTEMS**

| | | CNE | SNE | CNE/SNE | N/A |
|---|---|---|---|---|---|
| a) | PME System with a Combined Neutral & Earth (CNE) service connection or an (SNE) service connection. (ref. figure 2a, b) | 35% | 36% | 4% | 25% |

| | | YES% | NO% |
|---|---|---|---|
| b) | Mandatory for consumer to provide an independent earth electrode. | 60 | 40 |
| c) | Use of Combined Neutral and Earth (CNE) cable within the system | 39 | 61 |
| dii) | Joining CNE on to existing SNE Systems (ref. figure 3) | 26 | 74 |

| | | RECOMMENDED PRACTICE | OTHERS |
|---|---|---|---|
| dii) | Earthing points adopted with SNE/CNE cables when joining CNE onto existing SNE systems. (ref. figure 3) | 50% | 50% |

NB: The results indicated under d(ii) were deduced from replies to Question 2d of the questionnaire.

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**V9. Transformator en miniatuursubstasies vir retikulasiesisteme – deur Mnr Bob Wallis, Kommersieële bestuurder, G.E.C. Distribution Transformer Company:**

Gedurende 'n aantal onlangse opnames wat gedurende die afgelope 12 maande uitgevoer is, was dit duidelik dat die veiligheid van die sisteme en die personeel se veiligheid die belangrikste was. By die SAIEI Werkswinkel waar die onderwerp van die Koste Retikulasie bespreek is, was 'n aantal alternatiewe voorgestel, waar almal tot 'n groot mate tot 'n vergelyk gekom het tussen koste en veiligheid.

'n Aantal onlangse installasies is met miniatuursubstasies en transformators, waarin 'n paar van die ondergenoemde voorstelle geinkorporeer is, geinstalleer:

1. Oplas inprop van verbindinge.
2. Geen las hoogspanningskakelaars
3. Paal gemonteerde transformators met "OP LAS" skei skakelaars en laagspanning verspreidingspanele.

Vandag se vervaardigers is onder voortdurende druk om lae koste toerusting, wat aan gedurende spesifikasie veranderings moet voldoen, te ontwikkel en te produseer.

**Q9. Transformer and miniature substations for reticulation systems by Mr Bob Wallis, Commercial Manager, G.E.C. Distribution Transformer Company:**

During a number of recent surveys carried out over the last 12 months it was apparent that security of the system and personnel safety was of prime importance. At the SAIEE Workshop where the subject of Low Cost Reticulation was discussed a number of alternatives were suggested, all resulting in a compromise between cost and safety to varying degrees.

Recently a number of installations have been equipped with miniature substance and transformers incorporating some of these suggestions:

1. On load plug conncectors.
2. Off load high voltage switches.
3. Pole mounted transformers incorporating "ON LOAD" sectionalising switches and LV distribution panels.

Manufacturers today are under continual pressure to develop and produce low cost equipment to varying specifications.

Wat is die antwoord?
Kan die VMEO die vervaardigers leiding in hierdie verband gee?

What is the answer?
Can the AMEU offer the manufacturers direction in this regard?

**MR R WALLIS: AFFILIATE**
The low cost innovations referred to in the discussion topic, are presently installed in high density housing schemes. I believe it is reasonable to assume that these developments will grow into towns and cities with their own Electrical Engineers and departments, ultimately becoming members of the AMEU. It is with this in mind that I raised this discussion as I believe the design of these new systems and products are of great interest to this association. Thank you.

**MR DENIS ACKERMAN: ESKOM**
I think Fred Daniel will be able to help us out here, because there is an electrical supplier's liasion committee being established and we are all looking at this sort of transformer standardising on miniature substations. Maybe he would like to comment.

**MR F DANIEL: CAPE TOWN**
Mr President, I'll take this and put it off to somebody else actually. I think it is Charles Adams from Port Elizabeth who's gôt the duty of preparing that specification. Am I not right Charles?

**MR CHARLES ADAMS: PORT ELIZABETH**
All I can say really is that this is very early days to make firm predictions as to what should go in a mini-sub. I think the fact that manufacturers are looking at alternatives is only to be recommended, because we are all very conscious of the cost of reticulation these days and anything that we can do to reduce the cost, is of course very important. So the developmental work, I think, must be done by manufacturers basically. They have the resources and the design expertise to work out these new inovations and I think all we can do at this stage is encourage them and see what comes out of it. Later on we might incorporate one or two of these new inovations in this specification, but at this stage I would say it was premature to say exactly which one we would encourage and I would like to encourage the manufactureres to go ahead and work out these new ideas and try and reduce the cost of reticulation for us. Thank you.

**MR JANSEN: SABS**
Yes Mr Chairman, we share the sentiments of Mr Charles Adams in that we are looking forward to new developments in this field. We have seen the application of onload plug connectors and we do like the principle of these machines. We believe that they can be very useful in certain applications. We are not particularly keen on on-load high voltage switches that are not mentioned here. Off-load high voltage switches could be very useful. We have seen some of these on-load devices. We have reservations about on-load switching in the transformer oil. I am not aware of on-load sectionalising switches in all the distribution panels, but whatever the industry has to offer should be considered in the light of fitness for purpose and the purpose has to be defined by the users and by the audience of this particular meeting. Thank you.

**CLR F VAN DER VELDE: CAPE TOWN**
What worries me, the comment has been made, that when we are talking about townships we are trying to save money and we are trying to look for cost effectiveness and so often we incorporate sophisticated equipment that we might use once every 5 years or 10 years. How often do we actually switch rings in a township? How necessary is it that we need to switch those rings on load? Does the domestic user have to have such a reliable supply that can't be switched off off-load in order to break a link? We saw the effect yesterday of the cost of the HV-switchgear and the HV-minisubs which is a high percentage of the cost per erf of reticulation. Perhaps we are specifying to high, you know, our townships, and perhaps we can deal with a simple plug-out ringmain unit rather than a sophisticated one which we might operate very infrequently.

**MNR PIET BOTES: ROODEPOORT**
In Roodepoort het ons die noodsaaklikheid gevind om veral miniatuursubstasies, so gou as moontlik wanneer jy 'n kabelfout het, te ontkoppel. In die verlede het ons die kabel van die een kant af op dieselfde terminaal en alles so vasgebind. Nou wanneer jy 'n fout het in die middel van die nag, en jy moet daardie ontkoppeling doen, is dit dan 'n bietjie ongemaklik vir die manne wat daar werk en gevolglik het ons probeer om allerhande soorte van ontkoppeling te doen en ons het baie probleme gevind orals, veral met hierdie epoksie "resin" tipe van vrag en sondervrag afskakelingtoerusting maar dit lewer probleme op. Een of ander tyd gee hierdie tipe van goed probleme af en die jongste ene is hierdie "plug in" metodes wat hier buite gedemonstreer word maar ek dink hulle is almal in die beginstadium. Ek dink ons kan nie sê op hierdie stadium dat hulle alreeds beproef is en dat ons hulle wil hê nie. Ek dink dit is 'n stadium van evolusie, ons wil nog eers kyk wat ons in die toekoms gaan doen en hoe dinge gaan vorder, maar op hierdie stadium kan ons geen vaste reëlings tref nie, maar die feit bly staan dat ons dinge nodig het om af te skakel so gou en sonder gevaar vir die operateur. Ek dink dit is baie belangrik. Maar op hierdie stadium kan ons nie nog sê waarheen dit gaan nie; ek dink baie van hierdie goed is in die eksperimenteer-stadium. Dankie meneer.

**MNR JAN LOUBSER: BENONI**
U weet daar in ons dorp doen ons presies wat raadslid Van der Velde sê. Ons gebruik ook miniatuursubstasies wat ons van vrag af kan haal, maar ek het in die laaste tyd begin probleme optel met mense wat intensief op die aandelebeurs werk. Hulle gebruik hierdie Beltelsisteem en as ek 'n oomblik 'n kragonderbreking daar veroorsaak, dan is hull kniediep in die moeilikheid en dan kry ek dit in die nek.Hulle hanteer dit van hulle gewone huise af. So daardie tipe van moeilikheid kan ons nog optel.

**MR A H L FORTMANN: BOKSBURG**
Mr Chairman, I would support Mr Botes and I would plead that we must not go overboard with too primitive a method of isolation. I slows down, it delays power restoration, consumers get annoyed, it is dangerous. We've had experience ourselves in Boksburg where we use systems where we had back to back end boxes with solid links connected. I can assure you, if you had to do any work on a ring on fault conditions, you have a mammoth task on your hands. So I don't think we must revert to too primitive a method. A good form of isolation I think is desirable and ideal. Thank you Mr Chairman.

**MNR VELDSMAN: KPA GEMEENSKAPSDIENSTE**
Ons het ernstig gekyk hoe ons in swart woongebiede die koste van retikulasie op die hoogspanningkant kan verminder en veral na minisubstasies. Nou, ons het eers gekyk na hierdie inpropsisteme. Een van daardie voorbeelde staan hier buitekant en ons het ook gekyk na die inpropsisteem. Op beide sisteme is vandag in konstruksie en is so pas begin gebruik maar ek dink op hierdie stadium loop dit baie goed. Dit is baie vroeg om te sê hoe dit op die lang tyd gaan verloop en of ons enige

probleme met die bedryf daarvan gaan hê. Vir ons is dit baie belangrik dat die bedryf reg moet verloop, veral jou bedryfspersoneel moet werklik goed opgelei wees om hierdie tipe van goed te hanteer. Dis al wat ek op hierdie stadium kan sê. Dankie mnr die Voorsitter.

**MR T GAUNT: AFFILIATE**

There seem to be two categories of supply authorities where many who have large established networks, large stores, well trained operators and making a high income from trading electricity to subsidise the rates. For them it is unimportant to make savings on material and equipment and those sort of authorities are not asking manufacturers to make changes. The manufacturers themselves can't be expected to make changes which are not user requirements. It will be an investment in researching and development on which they will get no return. I hope there is another group of supply authorities, and those are those that are marginal profit undertakings. They have troubled piloting their new tariffs through their electricity control board because their tariffs seem to be a bit high. Where they have consumers that can't afford any extra's and I believe that these, who often don't have large stores commitments, they don't have large groups of operators who are well trained and know their systems, these supply authorities many of whom are possibly not even represented here, are the one's who are in a very difficult capital investment situation, and I believe it's to those that the manufacturers are looking for guidance on development and unfortunately very often there is not a forum for them to bring that forward, because the more established authorities actually say no, that is not good practice.

**MR L HUNT: WHITERIVER**

Recently I had to budget on a scheme for a new Township Development, and I found that the cost of the ring man units worked out at no more than 1% of the total cost of the scheme, bearing in mind that as you have already heard, the importance of continuity of supply, is becoming increasingly important to a wide variety of consumers. I feel that the ring main unit with the fused tee off, for my purpose at least, is absolutely essential. Thank you.

**MNR GERNANDT: NYLSTROOM**

Mnr die Voorsitter, baie dankie vir die geleentheid en ek wil net sê dat ek verteenwoordig daardie sektor waarna mnr Gaunt verwys het. Een van hulle (die sektor wat nie so baie geld het nie), mnr die Voorsitter. Ek wil spesifiek praat oor minisubstasies en spesifiek oor die laagspanning kompartement. Ek dink as 'n mens nie 'n hoofskakelaar daar installeer nie, en net een koperstaaf, dan kan mens omtrent 'n besparing bewerkstellig van ongeveer R2 000.

Dit het my nog altyd te bowe gegaan waarom daar tweekopers langs mekaar is. Die een is neutraal, die een is die aardstaf en hulle word verbind. Dit gee net aanleiding tot 2 ekstra plekke wat los aansluitings kan veroorsaak en die hoofskakelaar, daar is addisionele 9 konneksiepunte wat ook los aansluitings kan veroorsaak. Indien mens wil krag afskakel, die isolator sit mos net langsaan in die hoogspanningskompartement, so ek vra graag die lede wat hulle dink van my gedagte.

**MNR DE VILLIERS: ALBERTON**

Mnr die President, ek wil net by die vorige spreker aansluit. Ons gebruik in Alberton baie jare reeds die stelsel van geen hooskakelaar op die laagspanning vir die minisubstasie nie met baie goeie sukses. Ek kan dit definitief aanbeveel.

**MR K VAN ALPHEN: SABS**

I think that what Mr Gaunt said is very true. There are certainly different needs for different types of communities. We are eagerly awaiting the results of Charles Adam's Committee and after that we will certainly take up the reigns and try to fomulate something perhaps for next years presentation at the next convention.

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## CIGRÉ HIGHLIGHT
## a case of collaborative work between ESKOM – CSIR – SABS

**BY MR J C VAN ALPHEN: SABS**

PHASE-TO-PHASE TESTING

Both ESKOM and CSIR are working together in close collaboration with CIGRÉ in an international research project, determining phase-to-phase clearances in order to establish design parameters for compact line constructions.

Mr President, at this very moment Prof Jan Reynders, Bryant le Roux and Hendri Geldenhuis of the CSIR Energy Technology Division are overseas to present their results to the CIGRÉ working group and Prof Reynders asked me in his absence to report to you briefly on the subject.

Phase-to-phase testing involves the use of two impulse generators fired simultaneously, generating two impulses of opposite polarity. These impulses are used to determine the dielectric strength between two phase conductors in a compact line design where the phase-to-phase clearance is smaller than the phase-to-ground clearance.

Because of the large space required and the need for two synchronized impulse generators, each worth R1-3 million, the project could only be carried out at the National Electrical Test Facility: Apollo (NETFA) of the SABS. In order to meet an international challenge it became a case of fruitful cooperation between two institutions, the CSIR and the SABS, highlighting their complimentary rôles in South African technology.

The SABS provided the facility at NETFA where the indoor 3,2 MV impulse generator was moved outside and synchronized with the outdoor 4,4 MV impulse generator. On the large spece available and with the aid of the Bureau's mechanical handling facilities, two experimental test gaps as decided upon in CIGRÉ were set up, namely a 4 m rod gap, and a 4 m parallel conductor gap, each suspended 8 m above ground.

The CSIR provided the high tech measuring and data capturing facilities housed in their mobile screened Faraday cage which made it possible to compute the results in a meaningful way, simultaneously recording the ambient conditions prevailing at the time of testing.

As a further refinement, the CSIR placed an in-house designed charge measuring deviuce in the conductor in order to measure the space charge in the gap. A fibre-optics measuring system brought the information to ground level so that the results could be monitored in the CSIR cage.

This experiment was an event of national importance and as South Africans we should be proud of it. The prestigious international research body CIGRÉ chose to ask three countries to participate in this work. They are Italy, South Africa and Mexico, each representing a particular altitude above sea level. From the first news received it would appear that the South African results have been very well received.

This was made possible by virtue of the complementary nature of the two national bodies, the CSIR and the SABS. The experiments were carried out in an excellent team spirit, each party putting in every bit of innovative engineering skill in order to surmount the difficulties with which one is faced when entering the field of the unknown.

**AFSLUITING SESSIE – CLOSING SESSION:**

**MR A H L FORTMANN: PRESIDENT**

Ek is bly om te sien dat die dames weer by ons aangesluit het.

Ladies and Gentlemen, Councillor Frank van der Velde of Cape Town would like to address you.

Mr v d Velde will you please come to the rostrum to address us.

**COUNCILLOR FRANK VAN DER VELDE – CITY OF CAPE TOWN**

Mr President, Mr Mayor, ladies and gentlemen I do not wish to cap the enthusiastic sales pitch of the Mayor of this beautiful Transvaal town. Nor do I wish to compare Cape Town with Potchefstroom. But rather I sought to find similarities or links between the two parts of our most wonderful country.

The most obvious link that came to mind is at this very moment creaking and groaning its way from the mother city via Potch to Pretoria – and I refer of course to the reenactment of the Great Trek of a century and a half ago. You know it was said that those that stayed behind from that First Great Trek did so because they failed the medical. That might be so Mr Mayor, but those of us, or rather those of our ancestors who remained at the beautiful Cape of Good Hope did not remain idle. They for example planted some vines. And herein Mr Mayor I found the second link between Potchefstroom and Cape Town. And that is the fruit of the vine. Which was grown and pressed and bottled in the Cape, but it was labelled and matured here in Potchefstroom.

I might add that last night it was drunk here as well. En daar is natuurlik die kwessie van die rugby. En voordat ek daarmee begin of voordat ek al die Vaalies uitnooi om jou osse te begin inspan vir die groot trek Kaap toe volgende jaar, moet ek eers die toekoms van daardie Currie Beker bespreek.

My Raad, mnr die President, mnr die Burgemeester, saam met die ander plaaslike besture van die Wes Kaap het 'n besluit geneem om die besoek daar van die goue beker hier in die Transvaal tot 'n einde te bring. Ons opdrag is oorgedra aan die manne met die blou strepe en of Naas Botha of dan nie, sal Nuweland op 2 Oktober 1988 weer in besit van daardie goue beker wees.

Yesterday Mr President Jules van Ahlften boasted of the fact that he had been retained as a consultant for the forthcoming wedding of Stoffel Stoffberg. And it reminded me of the problem a farmer friend of mine once had a number of years ago, and that was with an over population of cats ...

On Tuesday 30 September my Council, passed a special resolution noting the nomination of our City Electrical Engineer Mr Fred Daniel as President Elect and that resolution instructed me to invite you and the AMEU to hold your 51st National Convention in Cape Town in 1989.

It is therefore with great pleasure Mr President that I invite you and the members of the AMEU to the first City of South Africa. Die Moederstad. The fairest Cape in all the land, and I hope the microphones will work there.

**MR A H L FORTMANN: PRESIDENT**

Thank you Mr van der Velde for your kind invitation, I am sure we are all looking forward to holding our 1989 Convention in Cape Town.

Geëerde gaste, dames en here, ons het nou aan die einde gekom van hierdie 12de VMEO Tegniese Vergadering. Ek hoop en vertrou dat u die verrigtinge interessant en waardevol gevind het. Ons moet natuurlik ook nie vergeet nie dat benewens die formele referate en besprekings wat plaasgevind het, so 'n nasionale byeenkoms grootliks daartoe bydra dat informele gedagtes gewissel kan word en dat vriendeskapsbande versterk word. Na so 'n paar dae van byeen wees is dit dus met 'n mate van weemoed dat ons uitmekaar moet gaan.

Om van so 'n vergadering 'n sukses te maak behels baie harde werk deur baie mense en is ek seker u almal met my sal saamstem dat die afgelope twee dae se reëlings besonder goed verloop het. Dit is derhalwe van pas dat ons ons dank teenoor die wat so hard gewerk het om die Tegniese Vergadering vlot te laat verloop het, uitspreek.

Eerstens wil ek, namens die VMEO, my dank uitspreek aan die Burgemeester, Raadsheer Johan Oosthuizen en sy Raad, wat ons uitgenooi het om in hierdie pragtige dorp, wat in hierdie jaar 150 jaar oud is, ons Tegniese Vergadering te hou.

Ons dank ook aan die Burgemeestersvrou, mev Oosthuizen, wat so mooi bygedra het om die dames se program 'n pragtige sukses te maak.

Ek glo nie ek is verkeerd as ek sê dat die grootste werk hier op die skouers van mnr Fanie Steyn, die Elektrotegniese Stadsingenieur van Potchefstroom gerus het, en ons hartelike dank aan hom vir wat hy en ook sy vrou Annamarie, en sy personeel gedoen het om ons Tegniese Vergadering so suksesvol te laat verloop.

Hier dink ek ook aan die busvervoer hier plaaslik en tussen Potchefstroom en Jan Smuts lughawe. Hierdie diens weet ek was 'n reuse taak vir mnr Fanie Steyn.

Hendrick Visser vir die klanktoerusting.
Johan Nigrini en Pieter Myburg vir die neem van fotos.
Nick Cilliers: Vervoer vanaf die lughawe.
Kerneels Smit: Hoof kroegman.

Dan die dames:

Die wat met registrasie gehelp het en saam met die dames gegaan het:-

Desiré Louw, Adrie Gerber, Marthie Nortjé, Pikkie Swart en Ralie van der Walt.

Verder sê ons ook dankie aan die tiksters – Lezyda Bezuidenhout, Ria Naudé, Tilla Steyn, Annetjie Botha, Ansie Pretorius en Ria van Huyssteen.

Petro Botha – bandopnames en Jenny van Rensburg, Sally van Heerden en Karen van Jaarsveld – inligting.

Op hierdie tydstip is dit my voorreg om klein aandenkings aan hierdie persone te oorhandig en vra hulle nou om dit te ontvang.

The morning and afternoon teas were kindly sponsored by the Town Council of Potchefstroom and to them a hearty thanks for providing us with the refreshments. Thank you to Potchefstroom for these.

Die damesprogram was eintlik deur mnr Fanie Steyn gereël en daarmee wil ons hom ook gelukwens. Baie dankie Fanie.

To the authors of the various papers and all the contributors a sincere thank you for your contributions. Without the delegates you cannot have a meeting and your attendance, together with your wives is much appreciated.

Vir die pragtige blomme wat hierdie saal so mooi versier het sê ons ook 'n hartlike dank aan mnr James Neuper en sy personeel van die Departement Parke vir hulle bydrae in hierdie opsig.

To the sponsors of the luncheons, our Affiliate Members, whose unfailing loyalty and assistance we are extremely grateful for and on behalf of the AMEU, I would like to express a special word of thanks for your wonderful support in this regard. Thank you Mr Brian Madeley, your committee and all your members.

I did thank the Affiliates for the sporting activities they arranged last Sunday afternoon and the cocktail party that followed, but I would like to repeat our gratitude and thanks for a lovely day enjoyed by all.

I believe that the Ladies had a most interesting programme

and were entertained in a most enjoyable manner.

The following persons, seated here in front, were responsible for various tasks in connection with this convention and I would like to mention them.

Hulle is:-

Mnr Fanie Steyn – plaaslike organiseerder (ek het sy naam reeds genoem).

Sy helpers: Eerstens die mans:

Mnre Johan van den Berg (Assistent Elektrotegniese Stadsingenieur en
Hannes Marais – Hulpsekretaris
Hennie Coetzee, Stefan Steyn en Gawie Marais
Nico Nortjé vir die vervoerreëlings en damesprogram.
Johan Bamberger
Herbie Smith
Daan van der Merwe
Sias van Staden
Piet Knoetze en
Jack Nel – vir die tafels, stoele, ens. in die saal.

Mr Fanie Steyn was responsible for obtaining sponsors to enable him to finance various aspects of the Technical Meeting as well as certain articles – I think here in particular of the attaché cases from Messrs Trek Petroleum, the cuff links from the Town Council of Potchefstroom and the name tags.

Thank you Fanie for all your hard work in this regard.

Aan ons Sekretaris, Mnr Bennie van der Walt wil ek graag my dank en waardering vir sy hulp en leiding uitspreek. Bennie is al so vertroud met VMEO-sake dat hy eintlik onmisbaar geword het. Bennie, baie dankie vir jou bystand.

In Boksburg was daar ook 'n paar persone behulpsaam met die reëlings vir hierdie Vergadering en in besonder was dit my eie Sekretaresse, mev Salomé Goosen wat reuse werk verrig met tikwerk, korrespondensie ens., asook mnr Roelof van Wyk, wat ook diep betrokke was met verskeie pligte. Vir beide sê ek baie dankie vir wat julle gedoen het.

To my wife Joy, thank you for your moral support during this time and the time leading up to the Technical Meeting.

To representatives of other organisations, such as the ESKOM, SABS, Department of Manpower, Provincial Administrations, Departement Handel en Nywerheid, die Brandweer Instituut, Department Openbare Werke, tersiêre inrigtings and The Electrical Contractors Association.

I would like to say that we appreciate your presence by adding colour to our meeting.

I would like to thank our new President-Elect, Mr Fred Daniel, who has assisted me during this Technical Meeting, but Ladies and Gentlemen I can assure you that I have already had him help me prior to the Technical Meeting, when I knew that he was to become the new President-Elect. Thank you Fred, I appreciate your assistance.

Voordat ek nou finaal afsluit, verstaan ek dat mnr Fred Daniel eers 'n paar woorde wil se: Mnr Fred Daniel.

**MR FRED DANIEL: PRESIDENT–ELECT**

Thank you Mr President for this opportunity. During the past two days you Mr President have been doing all the thanking and I think it would only be appropriate at this stage to reverse the order and for us to say thank you on behalf of all the delegates and the ladies, for your exceptionally successful and interesting 12th Technical Meeting.

Die wyse waarop u die verrigtinge gelei het dra bewys van u langasem en uithoe vermoë wat u seker by die Comrades opgedoen het. U het alles letterlik aan die draf gehou wat weereens bewys hoekom u die President van die Vereeniging is.

Nogmals baie dankie Alwin en Joy vir 'n Tegniese Vergadering wat lank onthou sal word en mag die komende jaar, vir julle uiters suksesvol wees.

Ladies and gentlemen let us show our sincere appreciation of our President and Joys great leadership by giving them a big hand.

**MNR A H L FORTMANN: PRESIDENT**

Baie dankie Fred vir die mooi woorde.

Dames en here dit bring ons nou aan die einde van hierdie vergadering en ek wens u almal God se rykste seën toe en 'n veilige reis terug huistoe.

Ladies and Gentlemen I wish you all God's richest blessings and a pleasant and safe journey home and now formally declare this 12th Technical Meeting of the AMEU closed.

# AMEU ENGINEER MEMBERS / INGENIEURSLEDE VMEO

| | | |
|---|---|---|
| **A** | | |
| ADAMS CE | City Electrical Engineer, P O Box 369, PORT ELIZABETH | 6000 |
| ALGERA JD | Elektrotegniese Stadsingenieur, Posbus 16, RUSTENBURG | 0300 |
| ANDREWS KI | Elektrotegniese Stadsingenieur, Posbus 86, Walvisbaai | 9190 |
| **B** | | |
| BADENHORST H | Elektrotegniese Ingenieur, Posbus 21, KNYSNA | 6570 |
| BAKER AB | Electrical Engineer, P O Box 20, SWELLENDAM | 6740 |
| BARTHOLOMEW WG | Municipal Engineer, P O Box 47 KOFFIEFONTEIN | 9986 |
| BARRATT MEO | Electrical Engineer, P O Box 13, PORT ALFRED | 6170 |
| BECK HD | City Electrical Engineer, P O Box 529, EAST LONDON | 5201 |
| BEESLEY W | Borough Electrical Engineer, P O Box 5, HOWICK | 3290 |
| BEKKER MJ | Elektrotegniese Ingenieur, Posbus 96, LOUIS TRICHARDT | 0920 |
| BEUKES HG | Hoof Tegniesebeampte, Posbus 3, BULTFONTEIN | 9760 |
| BEZUIDENHOUT TJ | Elektrotegniese Ingenieur, Posbus 3, BETHAL | 2310 |
| BLOM DS | Hoof Elektrisiën Posbus 44, MARQUARD | 9610 |
| BOOYSENS L | Elektrotegniese Ingenieur, Posbus 155, VREDE | 2455 |
| BOSCH LA | Elektrotegniese Superintendent, Posbus 13, BURGERSDORP | 5520 |
| BOSHOFF HO | Direkteur, Elektrotegniese Dienste, Posbus 2, BELLVILLE | 7535 |
| BOSHOFF JJ | Elektrotegniese Stadsingenieur, Posbus 3, VANDERBIJLPARK | 1900 |
| BOTES PJJ | Elektrotegniese Stadsingenieur, Posbus 15, GROOTBRAKRIVIER | 6525 |
| BOTES PJ | Elektrotegniese Stadsingenieur, Privaatsak X30, ROODEPOORT | 1725 |
| BOTHA HG | Elektrotegniese Stadsingenieur, Posbus 61, LYDENBURG | 1120 |
| BOTHA JN | Hoof Tegniese Dienste, Posbus 1, FOCHVILLE | 2515 |
| BOTHA JJ | Direkteur Ingenieursdienste, Posbus 708, WELKOM | 9460 |
| BOTHA WA | Hoof Elektrotegniese Afd. Posbus 34, POTGIETERSRUS | 0600 |
| BOTH A | Hoof Elektrotegniese Ingenieur, Posbus 136, ELLISRAS | 0555 |
| BOTHMA O | Elektrotegniese Stadsingenieur, Posbus 25, MOSSELBAAI | 6500 |
| BOZYCZKO W | Electrical Engineer, P O Box 56, LADYSMITH | 3370 |
| BRIERS DB | Elektrotegniese Stadsingenieur, Posbus 302, KROONSTAD | 9500 |
| BRINK PSJ | Town Electrical Engineer, P O Box 2, HERMANUS | 7200 |
| BRONKHORST JL | Elektriese Ingenieur, Posbus 35, BRACKENFELL | 7560 |
| BULL FW | Town Electrical Engineer, P O Box 8, KOKSTAD | 4420 |
| BUPÉ WR | Town Electrical Engineer, BEACON BAY | |
| **C** | | |
| CLARKE MMP | City Electrical Engineer, P/Bag 1, RANDBURG | 2125 |
| CLOETE DJ | Elektrotegniese Stadsingenieur, P/Sak X7, VIRGINIA | 9430 |
| CLOETE RH | Dorpsingenieur, Posbus 20 SENEKAL | 9600 |
| CREEDY M | Town Electrical Engineer, P O Box 12, WELLINGTON | 7655 |
| CUNNINGHAM T | Head Electrical Department, P O Box 45, HEILBRON | 9560 |
| **D** | | |
| DAMON L | Elektrotegniese Ingenieur, Posbus 23, NIGEL | 1490 |
| DANIEL FLU | City Electrical Engineer, P O Box 82, CAPE TOWN | 8000 |
| DAVIES EG | City Electrical Engineer, P O Box 399, PIETERMARITZBURG | 3200 |
| DAUTH WJ | Chief Electrical Engineer, P/Bag X9011, VOLKSRUST | 2740 |
| DAWSON JD | Town Electrical Engineer, P O Box 45, UITENHAGE | 6230 |
| DE BRUYN CD | Elektrotegniese Ingenieur, Posbus 10, CARNARVON | 7060 |
| DEKENAH KC | TOWN AND ELECTRICAL ENGINEER, P O Box 33, BABERTON | 1300 |
| DE KOCK FP | Posbus 156, VIRGINIA | 9430 |
| DE VILLIERS JD | Elektrotegniese Ingenieur, Posbus 4, ALBERTON | 1450 |
| DE VRIES DJ | Stadselektrotegniese Ingenieru, Posbus 19, GEORGE | 6530 |
| DE VRIES JM | Hoof Tegniesebeampte, P/Sak X12, VREDENBURG | 7300 |
| DREYER HJ | Elektrotegniese Ingenieur, Posbus 21, JEFFREYSBAAI | 6330 |
| DU PLESSIS CP | Elektrotegniese Stadsingenieur, P/Sak X304 WORCESTER | 6850 |
| DU TOIT E | Elektrotegniese Stadsingenieur, Posbus 106, BRITS | 0250 |
| DU TOIT FH | Elektrisiteitsuperintendent, Posbus 24, CALEDON | 7230 |
| DU TOIT PL | Hoof Elektrotegniese Dienste, Posbus 34, ORKNEY | 2620 |
| DU TOIT RE | City Electrical Engineer, P/Bag X10, KWA-XUMA | 1868 |
| **E** | | |
| EHRICH JA | Town Electrical Engineer, P O Box 66, STANDERTON | 2430 |
| ELBOURNE RJ | Chief Technical Officer, P O Box 50, KINROSS | 2270 |
| ERASMUS PR | Elektrotegniese Ingenieur, Posbus 2, SECUNDA | 2303 |
| ESTERHUYSEN AC | Elektrotegniese Stadsingenieur, Posbus X02, VILJOENSKROON | 9520 |

**F**

| | | |
|---|---|---|
| FENTHUM LB | Electrician, P O Box 22, THABA NCHU | 9780 |
| FORTMANN AHL | Town Electrical Engineer, P O Box 215, BOKSBURG | 1460 |
| FOURIE L | Elektrotegniese Stadsingenieur, Posbus 45, NELSPRUIT | 1200 |
| FOURIE de V JJ | Elektrotegniese Stadsingenieur, P/Sak X1017, EVANDER | 2880 |
| FOURIE JHJ | Hoof Tegniese Dienste, Posbus 13, BRANDFORT | 9400 |
| FRASER DH | City Electrical Engineer, P O Box 147, DURBAN | 4000 |

**G**

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|---|---|---|
| GERNANDT A | Hoof: Elektrotegniese Dienste, P/Sak X1008, NYLSTROOM | 0510 |
| GOUSSARD PJ | Hoofelektrisiën, Posbus 14, KOPPIES | 9540 |
| GREYLING JPJ | Posbus 23, PIET RETIEF | 2380 |
| GROBLER J | Elektrotegniese Stadsingenieur, Posbus 551, BETHLEHEM | 9700 |
| GROVE CR | Hoof-Elektrotegniese Ingenieur, Posbus 43, HARRISMITH | 9880 |
| GROTIUS RJ | Posbus 13, DEWETSDORP | 9940 |

**H**

| | | |
|---|---|---|
| HALLIDAY KWJ | Municipal Electrical Engineer, P O Box 5, PORT ELIZABETH | 4240 |
| HAMERSCHLAG SN | Town Electrical Engineer, P O Box 3, BEDFORDVIEW | 2008 |
| HARPESTAD P | Acting Borough Electrical Engineer, P O Box 33, KING WILLIAMS TOWN | 5600 |
| HATTINGH JJ | Elektrotegniese Stadsingenieur, P/Sak X1004, RICHARDSBAAI | 3900 |
| HEYDENRYCH JE | Elektrotegniese Ingenieur, Posbus 14, MIDDELBURG | 1050 |
| HILL T | Elektrotegniese Ingenieur, P/Sak X5030, KIMBERLEY | 8300 |
| HOOD JS | Borough Engineer, P O Box 71, GREYTOWN | 3500 |
| HUGO AHW | Town Electrical Engineer, P O Box 78001, SANDTON | 2146 |
| HUGO JG | Electrical Engineer, P O Box 51, BREDASDORP | 7280 |
| HUMAN MJ | Elektrotegniese Stadsingenieur, Posbus 15, BRAKPAN | 1540 |
| HUNT LE | Town Electrical Engineer, P O Box 2, WHITE RIVER | 1240 |

**J**

| | | |
|---|---|---|
| JANTZEN GH | Elektrotegniese Stadsingenieur, Posbus 29, HENNENMAN | 9445 |
| JELLIMAN CE | P O Box 36, FORT BEAUFORT | 5720 |
| JORDAAN DJP | Posbus 35, VEREENIGING | 1930 |
| JORDAAN PW | Hoof-Elektrotegniese Afd., Posbus 34, POTGIETERSRUS | 0600 |

**K**

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|---|---|---|
| KLOPPER LF | Munisipale Elektriese Ingenieur, Posbus 72, STANGER | 4450 |
| KOEGELENBERG FJC | Hoof Tegniesebeampte, Posbus 18, FRANSCHOEK | 7690 |
| KOK JA | Elektrotegniese Ingenieur, Posbus 55, MIDDELBURG | 5900 |
| KREBS WF | Stadselektrotegniese Ingenieur, P/Sak X2009, OTJIWARONGO | 9210 |
| KRIEK JJ | Stadselektriese Ingenieur, Posbus 115, EMPANGENI | 3880 |
| KRIGE WA | Elektrotegniese Ingenieur, Posbus 14103, VEWRWOERDBURG | 1040 |
| KROMHOUT RR | Borough Electrical Engineer, P O Box 47, MOOI RIVIER | 3300 |

**L**

| | | |
|---|---|---|
| LAAS CP | Elektrotegniese Ingenieur, Posbus 15, KENHARDT | 8900 |
| LEIGH RA | City Electrical Engineer, P O Box 699, JOHANNESBURG | 2000 |
| LE ROUX DE | Electrical Engineer, P O Box 2, STUTTERHEIM | 4930 |
| LE ROUX EC | Elektrotegniese Ingenieur, De Wetstraat 66, Reitz Park, WELKOM | 9460 |
| LEWIS L | Town Electrical Engineer, P O Box 5011, WINDHOEK | 9100 |
| LIEBENBERG HDG | Elektrotegniese Ingenieur, Posbus 64, LADYBRAND | 6745 |
| LINDE AP | Hoof Elektrisiën, Posbus 2, FRANKFORT | 9830 |
| LOCHNER J VAN S | Elektrotegniese Stadsingenieur, Posbus 111, PIETERSBURG | 0700 |
| LOTTER GA | Elektrotegniese Ingenieur, Posbus 34, POTGIETERSRUS | 0600 |
| LOUBSER DPVP | Posbus 27, DOUGLAS | 8730 |
| LOUBSER JA | Elektrotegniese Ingenieur, P/Sak X014, BENONI | 1500 |
| LOUW HAL | Elektrotegniese Ingenieur, Posbus 12, PAARL | 7620 |
| LOUW L | Elektrotegniese Ingenieur, Posbus 16, PRIESKA | 5940 |

**M**

| | | |
|---|---|---|
| MACLACHLAN AC | Town Electrical Engineer, Private Bag X20, VREDENBURG | 7380 |
| MALAN JG | Elektriese/Meganiese Ingenieur, Posbus 13, KEMPTON PARK | 1620 |
| MALLINSON RJ | Elektrotegniese Stadsingenieur, Posbus 21, SOMERSET-OOS | 7140 |
| MARAIS CHA | Elektrisiteits Meganiese Ingenieur, Posbus 30, PARYS | 9585 |
| McNAMARA AB | Electrical Engineer, P O Box 21, KOMGA | 4950 |
| MEYER A | Elektrotegniese Ingenieur, Posbus 52, MALMESBURY | 7300 |
| MILLARD RC | Town Electrical Engineer, P O Box 255, OUDTSHOORN | 6620 |

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| MONTGOMERY JA | Town Electrical Engineer, P O Box 25, EDENVALE | 1610 |
| MOSTERT JN | Elektrotegniese Ingenieur, Posbus 52, ROBERTSON | 6705 |
| MOSTERT AH | Stadselektrotegniese Ingenieur, Posbus 53, SWAKOPMUND | 9180 |
| MULDER JAC | Elektriese Ingenieur, Posbus 60, PIKETBERG | 7320 |
| MURPHY KJ | Town Electrical Engineer, P O Box 19, SOMERSET WEST | 7130 |
| MYBURGH G | Elektrotegniese Ingenieur, Posbus 4, KURUMAN | 8460 |
| MYBURG PA | Assistent Direkteur, P/Sak X11280 NELSPRUIT | 1200 |
| **N** | | |
| NAUDE B | Hoof Elektriese Distribusie, Posbus 17, STELLENBOSCH | 7600 |
| NAUDE E | Elektrotegniese Stadsingenieur, Posbus 725, CARLETONVILLE | 2500 |
| NIEUWORDT JGH | Elektrotegniese en Dorpswater Ingenieur, Posbus 24, MONTAGU | 6720 |
| NORTJE GJ | Elektrotegniese Stadsingenieur, Posbus 145, GERMISTON | 1400 |
| NORTJE JJ | Elektrotegniese Stadsingenieur, Posbus 10, WARRENTON | 8530 |
| **O** | | |
| OPPERMAN DJ | Elektrotegniese Stadsingenieur, Posbus 45, SPRINGS | 1560 |
| **P** | | |
| PAGEL PVE | Elektrotegniese Ingenieur, Posbus 26, PLETTENBERGBAAI | 6600 |
| PEENS JG | Elektrotegniese Ingenieur, Posbus 6, WESSELSBRON | 9680 |
| PELSER WH | Elektrotegniese Ingenieur, Posbus 31, COLIGNY | 2725 |
| PERRYER HO | Town Electrical Engineer, P O Box 113, QUEENSTOWN | 5320 |
| PETERS AG | Town Electrical Engineer, P O Box 278, GWELO, HARARE, ZIMBABWE | 5320 |
| PIENAAR JF | Elektrotegniese Ingenieur, Posbus 10, GLENCOE | 2930 |
| PIKE E | P O Box 57, VRYHEID | 3100 |
| POLLOCK T | Electrical Engineer, P O Box 3, GORDONS BAY | 7150 |
| PRITCHARD MR | Elektrotegniese Stadsingenieur, Posbus 708, WELKOM | 9460 |
| **R** | | |
| RAUTENBACH GF | Elektrotegniese Ingenieur, Posbus 99, KLERKSDORP | 2570 |
| ROHRBECK WD | Posbus 39, HOOPSTAD | 2670 |
| ROODT MJG | Hoof Elektrisiën, P/Sak X1011, ALIWAL-NOORD | 5530 |
| ROODT JSG | Hoof Elektriese Departement, Posbus 26, REITZ | 9810 |
| ROSSOUW GT | Posbus 241, JAN KEMPDORP | 8550 |
| ROSSOUW JN | Elektrotegniese Stadsingenieur, Posbus 42, MAFIKENG | 8670 |
| ROSSOUW N | Hoof Elektrisiteitsbeampte, Posbus 60, PIKETBERG | 7320 |
| **S** | | |
| SCHERMAN CJ | Stadselektrotegniese Ingenieur, Posbus 423, PRETORIA | 0001 |
| SIMPSON AC | Town Electrical Engineer, P O Box 42, DESPATCH | 6220 |
| SMALL CTR | Town Electrical Engineer, P O Box 9, BEAUFORT WEST | 6970 |
| SMIT AH | Elektrotegniese Ingenieur, Posbus 33, BABERTON | 1300 |
| SMIT JJ | Elektrotegniese Stadsingenieur, Posbus 2729, WITBANK | 1035 |
| SPENCER JI | Electrical Engineer, P.O. Box 15, ESTCOURT | 3310 |
| STAPLETON R | Borough & Electrical Engineer, P O Box 37, ESHOWE | 3815 |
| STEYN JN | Hoof Tegniese Beampte, Posbus 83, HARTSWATER | 8570 |
| STEYN JS | Elektrotegniese Stadsingenieur, Posbus 113, POTCHEFSTROOM | 2520 |
| STRAUSS JC | Bestuurder Tegniese Dienste, Posbus 60, SASOLBURG | 9570 |
| STRICKLAND MRC | Electrical Engineer, P O Box 1073, CAPE TOWN | 8000 |
| SWART JCP | Elektrotegniese Ingenieur, Posbus 29, VELDDRIF | 7365 |
| SWART JPE | Elektrotegniese Ingenieur, Posbus 201, HEIDELBERG | 2400 |
| SWART LM | Elektrisiën in Beheer, Posbus 73, ALEXANDRIA | 6185 |
| SWART TL | Elektrotegniese Ingenieur Posbus 10, GLENCOE | 2930 |
| **T** | | |
| TENCATE JI | Elektrotegniese Stadsingenieur, Posbus 67, PHALABORWA | 1390 |
| THERON TA | Elektrotegniese Stadsingenieur, Posbus 48, ERMELO | 2350 |
| **U** | | |
| UYS PJJ | Hoof Tegniese Beampte, Posbus 90, THABAZIMBI | 0380 |
| **V** | | |
| VAN DER BERG J | Elektrotegniese stadsingenieur, Posbus 20, STILFONTEIN | 2550 |
| VAN DEN BERG AJ | Elektrotegniese Ingenieur, Posbus 94, KRUGERSDORP | 1740 |
| VAN DEN BERG RJ | Town Electrical Engineer, P/Bag X20, HALFWAY HOUSE | 1685 |

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|---|---|---|
| VAN DER LINDE JL | Elektrotegniese Stadsingenieur, Posbus 21, ODENDAALSRUS | 9400 |
| VAN DER MERWE AJ | Elektrotegniese Stadsingenieur, Posbus 3704, BLOEMFONTEIN | 9300 |
| VAN DER MERWE DS | Elektrotegniese Ingenieur, Posbus 3, WITBANK | 1035 |
| VAN DER MERWE G | Posbus 96, LOUIS TRICHARDT | 0920 |
| VAN DER MERWE PJ | Elektrotegniese Stadsingenieur, Posbus 20, STILFONTEIN | 2550 |
| VAN DER WALT FSP | Assistent Direkteur, P/Sak X5005, KIMBERLEY | 8300 |
| VAN DER WALT PS | Posbus 3, BULTFONTEIN | 9670 |
| VAN DER WALT BG | Town Electrical Engineer, P O Box 44, CERES | 6835 |
| VAN ROOYEN HE | Dorps- Waterwerke en Elektroteg- niese Ingenieur, Posbus 47, KIRKWOOD | 6120 |
| VAN WYK F | Posbus 6306, RIEBEECKSTAD | 9469 |
| VAN ZYL J | Hoof: Elektrisiteit/Waterwese, Posbus 116, FICKSBURG | 9730 |
| VAN STADEN PC | Tegniese Assistent Elektries, Posbus 12, BOTHAVILLE | 9660 |
| VENTER J | Elektrotegniese Hoofbeampte, P/Sak X340, NABOOMSPRUIT | 0560 |
| VENTER GA | Elektrotegniese Ingenieur, Posbus 9, MEYERTON | 1960 |
| VELDSMAN DE | Elektrotegniese Ingenieur, P/Sak X7, GOODWOOD | 7460 |
| VOSLOO C | Elektrotegniese Ingenieur, Posbus 1341, PRETORIA | 0001 |
| VON BARDELEBEN FP | Electrical Engineer, P O Box 33, TONGAAT | 4400 |
| **W** | | |
| WHEELER DJ | Elektrotegniese Ingenieur, Posbus 13, BURGERSDORP | 5520 |

# ASSOCIATE MEMBERS – ASSOSIAATLEDE

| | | |
|---|---|---|
| **B** | | |
| BASSON FJC | INGENIEURSASSISTENT, POSBUS 22 ASHTON | 6715 |
| BOSHOFF MHL | SENIOR ELECTRICAL ENGINEER, 20 BRADLEY ROAD, SUMMERSTRAND, PORT ELIZABETH | 6001 |
| **C** | | |
| CLOETE DJ | POSBUS 99, KLERKSDORP | 2570 |
| COETZEE CJF | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, P/SAK X30, ROODEPOORT | 1725 |
| COOPER-CHADWICK L | P O BOX 57, GERMISTON | 1400 |
| **D** | | |
| DE BEER WM | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, POSBUS 48, WARMBAD | 0480 |
| DE WET LDM | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, POSBUS 215, BOKSBURG | 1460 |
| DIBB KG | DEPUTY CITY ELECTRICAL ENGINEER, P O BOX 147, DURBAN | 4000 |
| DREYER JJG | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, POSBUS 4, ALBERTON | 1450 |
| DU PLESSIS CJ | POSBUS 868, KEMPTON PARK | 1620 |
| DU PLESSIS GC | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, POSBUS 94, KRUGERSDORP | 1740 |
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| GREENFIELD JW | P.O. BOX 20 GONUBIE | 5256 |
| **H** | | |
| HATTING CJP | GEELHOUTLAAN 6, KINGSHILL, HARRISMITH | |
| HOBBS IL | DEPUTY ELECTRICAL ENGINEER, P O BOX 45, UITENHAGE | 6230 |
| **J** | | |
| JOUBERT JN | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, POSBUS 45, NELSPRUIT | 1200 |
| **L** | | |
| LABUSCHAGNE PHJ | ADJUNK DIREKTEUR, TEGNIESE DIENSTE, ATHERSTONESTR 19, VANDERBIJLPARK | 1900 |
| LAMPRECHT BC | P/SAK X015, BENONI | 1500 |
| LOOTS MF | ASSISTENT ELEKTROTEGNIESE INGENIEUR, POSBUS 136, ELLISRAS | 0555 |
| **M** | | |
| MATTHEWS GS | DEPUTY ELECTRICAL ENGINEER, P/BAG X014, BENONI | 1500 |
| MYBURG G | MUNISIPALE ELEKTROTEGNIESE INGENIEUR, POSBUS 4, KURUMAN | 8460 |
| **O** | | |
| OLIVIER J | POSBUS 60, SASOLBURG | 9570 |

| | | |
|---|---|---|
| **P** | | |
| PRETORIUS JW | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR. POSBUS 23, NIGEL | 1490 |
| **R** | | |
| ROOS JJ | ASSISTENT ELEKTROTEGNIESE INGENIEUR, POSBUS 25, EDENVALE | 1620 |
| **S** | | |
| SMIT RC | POSBUS 3, BULTFONTEIN | 9670 |
| SMITH AH | POSBUS 33, BARBERTON | 1300 |
| SURTHEES EH | DEPUTY TOWN ENGINEER, P O BOX 215, BOKSBURG | 1460 |
| **T** | | |
| THIRION CL | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, POSBUS 42, DE AAR | 7000 |
| **V** | | |
| VAN DER WALT CJ | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, P/SAK X014, BENONI | 1500 |
| VAN NIEKERK PJS | DEPUTY ELECTRICAL ENGINEER, P/BAG X1 RANDBURG | 2125 |
| VAN ROOYEN PJ | ADJUNK-ELEKTROTEGNIESE INGENIEUR, POSBUS 6736, BLOEMFONTEIN | 9300 |
| **W** | | |
| WHITEHEAD HR | DEPUTY ELECTRICAL ENGINEER, P O BOX 147, DURBAN | 4000 |
| WILLE J | ASSISTENT ELEKTROTEGNIESE INGENIEUR, POSBUS 7, LICHTENBURG | 2740 |
| WILLIAMS HGN | ADJUNK-ELEKTROTEGNIESE STADSINGENIEUR, POSBUS 99, KLERKSDORP | 2570 |

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PROVINSIALE DIENSTE,, OOS-KAAP, Posbus 14025, Sidwell 6061
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VRYBURG MUNISIPALITEIT, Posbus 35, Vryburg, 4600
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ZASTRON MUNISIPALITEIT, Zastron, 9950

# AMEU AFFILIATE MEMBERS / VMEO GEAFILIEERDE LEDE

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| Clinkscales, Maughan, Brown & Part. | Managing Director | P O Box 196, Port Elizabeth | 6000. |
| Clinkscales, Maughan Brown & Part | B R Hadfield | P O Box 570, Cape Town 8000 | (021) 24-4133 |
| Connesco CC | BF Boombes | P O Box 12468, Benoryn 1504 | (011) 917-2730 |
| Conradie D J J & Partners | Managing Director | P O Box 17031, Groenkloof 0027. | |
| Conradie D J R & Venter | C L Meintjes | P O Box 1009, Bloemfontein 9300 | (051) 47-1636 |
| Cu Al Engineering | M E Walsh | P O Box 18228, Dalbridge 4014. | |
| Cullinan Electrical | Dave Smith | P/Bag 18, Olifantsfontein 1665 | (012) 61-2551 |
| C C G Systems (Pty) Ltd | Frans Lackinger | P O Box 192, Kempton Park 1620 | (011) 394-2020 |
| Crabtree J A (Pty) Ltd | B Rodgers | P O Box 413, Springs 1560 | |
| Crompton Parkinson | RSH Wiseman | P O Box 4236, Johannesburg 2000 | (011) 680-3400 |
| Cutler-Hammer (SA) Ltd | Managing Director | P O Box 14089, Wadeville 1422. | |
| De Villiers & Moore | Abe de Villiers | P O Box 472, Durbanville 7550. | |
| Decalight | T J P Wilson | P O Box 258, Paarden Eiland 7420 | (021) 51-7076 |
| Development Bank of SA | WS Naudé | P O Box 784433, Sandton 2146 | (011) 445-2447 |
| Digital Data System OC | | P O Box 35872, Northcliff 2115 | |
| Distribution Components cc | Chris Nash | P O Box 1396, Randburg 2125 | (011) 792-2705 |
| Drewett Hubble & Pokorny Inc | R Everatt | P O Box 47270, Parklands 2121 | |
| Du Toit C A & Vennote | Mnr M L Loest | Posbus 4256, Pretoria 0001. | |
| Du Toit C A & Partners | Henk Turkstra | P O Box 2509, Cape Town 8000 | (021) 23-7220 |
| Du Toit & Van der Vyver | D C U du Toit | Posbus 2917, Kaapstad 8000. | (021) 24-8137/8 |
| Duncansby (Pty) Ltd | John T Grundy | P O Box 10508, Strubenvale 1570 | (011) 56-8385 |
| Eberhardt-Martin (Pty) Ltd | Roger Martin | P O Box 85027, Emmarentia 2029. | (011) 673-2036 |
| Electrical Contractors Ass. of SA (EAC) | Dennis Kneale | P O Box 5327, Johannesburg 2000 | (011) 614-1112 |
| Electrical Moulded Components | Managing Director | P O Box 872, Honeydew 2040 | |
| Electrical Protection Co. (Pty) Ltd | A C Barnes | P O Box 14633, Wadeville 1422 | (011) 827-5912 |

| | | | |
|---|---|---|---|
| Electro Network (Pty) Ltd | D Jackson | P O Box 57458, Springfield 2137. | |
| Elen Elect. Enclosures (Pty) Ltd | J M Kapral | Unit B3, P O Box 716, Florida 1710 | (011) 674-1277 |
| Erenco SA (Pty) Ltd | L J Ward | P O Box 32012, Braamfontein 2017 | (011) 403-5941 |
| Everitt & Germishuizen Inc. | J C Germishuizen | P O Box 1369, Randburg 2125 | (011) 789-2313 |
| Fainsinger & Associates | H Weitzel | P O Box 2142, Windhoek, SWA 9000 | (061) 3-5165 |
| Farad (Pty) Ltd | Managing Director | P O Box 31220, Braamfontein 2017 | |
| Ferreira & Vennote | Cloete Delport | P O Box 28985, Sunnyside 0132 | (012) 26-0803 |
| Fuchs Electrical Industr. | Managing Director | P O Box 3758, Alrode 1451. | |
| Gardner & Carpenter | D Gardner | 278 Oxford Street, East London 5200 | |
| GEC Cables Co. | B D Scott-Hayward | P O Box 13004, Knights 1413 | (011) 826-6647 |
| GEC Measurements | R Dismore | P O Box 39146, Bramley 2018. | |
| GEC Power Distribution Ltd | P M Elder | P O Box 13024, Knights 1413 | (011) 826-6647 |
| GEC Projects Co. | S A Keightley | P/Bag 1, Bramley 2018 | (011) 887-1800 |
| Genwest Industries (Pty) Ltd | Hilton Murphy | P O Box 5031, Benoni South 1502 | (011) 52-8111 |
| Golnix CC | C J Vermaak | P O Box 342, Bellville 7530. | |
| Grasslin Controls SA (Pty) Ltd | S W A Raabe | P O Box 303, Lonehill 2062 | |
| H V Test & Power Control cc | B A Madeley | P O Box 651287, Benmore 2010 | (011) 883-2149 |
| Hawker-Siddeley Africa (Switchgear) | Frank Goulding | P O Box 417, Roodepoort 1725 | (011) 764-2566 |
| Hawker-Siddeley Africa | Managing Director | P O Box 14359, Wadeville 1422. | |
| Hill Kaplan Scott Inc. | Trevor Gaunt | P O Box 3965, Cape Town 8000 | (021) 23-7050 |
| Huletts Aluminium Ltd | F C Montgomery | P O Box 25, Olifantsfontein 1665 | (012) 61-2641 |
| Interswitch (Pty) Ltd | Dieter Korner | P O Box 11048, Johannesburg 2000 | (011) 678-1193 |
| Insulator Industries cc | Managing Director | P O Box 258, Benoni 1500. | |
| J J Anderson Raadgewende Ingenieurs | Managing Director | P O Box 1197, Cape Town 8000. | |
| James Croswell & Associates | V A Raynal | P O Box 480, Rivonia 2128 | (011) 726-2328 |
| John L Kenyon Suppliers | Managing Director | P O Box 11101, Dorpspruit, Pietermaritzburg 3206. | |
| Karl Pfisterer (SA) Pty Ltd | Richard Jones | P O Box 6530, Dunswart 1508. | |
| Kennedy & Donkin Africa (Pty) Ltd | R J Moon | P O Box 4358, Randburg 2125 | (011) 883-4680 |
| Kilpatrick SA (Pty) Ltd | B Gilbert | P O Box 6869, Johannesburg 2000. | |
| Klockner-Moeler (SA) Pty Ltd | Ray Hudson | P O Box 100, Kempton Park 1620 | (011) 975-3937 |
| Kwandebele Nat Dev Corp Ltd | A J van Wyk | P O Box 1300, Bronkhorstspruit 1020 | (012121) 3421 |
| Kwazulu Finance & Investment Corporation Ltd | Managing Director | P O Box 681, Ladysmith 3370. | |
| Kwikot Ltd | Peter Nash | P O Box 389, Benoni 1500 | (011) 892-2030 |
| Larry Barnett International (Pty) Ltd | Larry Barnett | P O Box 166, Johannesburg 2000 | (011) 824-1210 |
| Liebenberg & Stander: Mechanical & Electrical | K Garner | P O Box 2618, Cape Town 8000 | (021) 23-5101 |
| Lumex (Pty) Ltd | Managing Director | P O Box 39045, Bramley, 2018. | |
| Marais G H & Vennote | W Seymour | Posbus 1789, Pretoria 0001 | (012) 325-3980 |
| Merlin Gerin Electric (Pty) Ltd | L Duvenhage | P O Box 6090, Dunswart 1508 | (011) 892-1001 |
| Merlin Gerin (Pty) Ltd | Managing Director | P O Box 869, Isando 1600 | |
| Merz & Mclellan (SA) | Angus McFarlane | P O Box 31012, Braamfontein 2017 | (011) 339-5754 |
| Middelburg Steel & Alloys | Managing Director | P O Box 781815, Sandton 2146. | |
| Midland Equipment (Pty) Ltd | Managing Director | P O Box 440, Kempton Park 1620. | |
| Netplan Raadgewende Elektries Ing | LJ du Preez | Hamiltonstraat 23, Harrismith 9880 | |
| Nel C L | Best. Direkteur | Posbus 1815, Welkom 9460 | |
| Nienaber en van der Walt | | Posbus 1639, Rivonia 2128 | (011) 803-1355 |
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| Norman Cornish | Les Brown | P O Box 82552, Southadale 2135 | (011) 680-5541 |
| North & Robertson | Managing Director | P O Box 309, East London 5200 | |
| Oak Industries (SA) (Pty) Ltd | Managing Director | P O Box 1172, Pietermaritzburg 3200. | |
| Ogatin (Pty) Ltd | Managing Director | P O Box 514, Roodepoort 1725. | |
| Olen & Foster | M S Foster | 710 Nedbank Centre Strand Street Cape 8001 | (012)24-0020 |
| Oscar Computers Technologies (Pty) Ltd | A Nortje | P O Box 725, Randburg 2125 | (011) 789-1203 |
| Ove Arup & Partners | Managing Director | P O Box 52285, Saxonwold 2132. | |
| Pelser W J | Managing Director | P O Box 5372, Mmabatho 8681. | |
| Plantech Associate Inc. | Hein Schuld | P O Box 20206, Alkantrant 0005 | (012) 348-8643 |
| Power Engineers (Pty) Ltd | Jim Lappin | P O Box 44, Eppindust 7475 | (021) 54-2681 |
| Power Installations Pty Ltd | S W Freeborn | P O Box 11655, Randhart 1457 | (011) 864-1692 |
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| Performed Line Products | D Kambouris | P O Box 958, Pietermaritzburg 3200 | (0331) 7-1520 |
| Programming Skills (Pty) Ltd | Managing Director | P O Box 4137, Randburg 2125. | |
| Protective Switchgear | Managing Director | P O Box 8738, Johannesburg 2000. | |
| Pirelli General Cables | Managing Director | P O Box 11158, Bloubergrant 7443. | |

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| Raychem (Pty) Ltd | Managing Director | P O Box 134, Olifantsfontein 1665 | |
| Raymond Theron, Bouwer & Viljoen | Best. Direkteur | Posbus 1155, Upington 8800. | |
| Republic Power & Communication Co (Pty) Ltd | Managing Director | P O Box 2357, Halfway House 1685. | |
| Reyrolle Switchgear Ltd | W Tindle | P O Box 8080, Elandsfontein 1406 | (011) 974-2866 |
| Robertson F H & Associates | F H Robertson | P O Box 542, George 6530 | (0441) 74-2144 |
| Rocla (Pty) Ltd | Mr Armstrong | P O Box 92, Roodepoort 1725 | |
| Ron Slatem & Associates | R R Slatem | P O Box 67452, Bryanston 2021 | (011) 706-2737 |
| SA PVC Cables | K McArthur | P O Box 5093, Johannesburg 2000 | (011) 618-3900 |
| S A B C | P Fraser | P O Box 8606, Johannesburg 2000. | |
| Scottiish Cables | Managing Director | P O Box 188, Pietermaritzburg 3200. | |
| Shepstone-Krause C.C. | N Shepstone | 76 Valleyview Road, Morningside, Durban 4001. | |
| Siemens SA (Pty) Ltd | R van Ark | P O Box 4583, Johannesburg 2000 | (011) 715-9111 |
| Sigmaform SA (Pty) Ltd | Raymond Foxcroft | P O Box 32, Maraisburg 1700. | |
| Sprecher & Schuh (Pty) Ltd | P Smith | P O Box 61506, Marshalltown 2107 | (011)493-5022 |
| Steyn van Rensburg, Frigeni | Managing Director | P O Box 28727, Sunnyside 0132. | |
| Switchboard Manufacturers | Managing Director | P O Box 40086, Red Hill 4071. | |
| Technikon Pretoria | Skool vir Elektriese Ingenieurswese | | |
| | D F Bisschoff | Kerkstraat-Oos 420 Pretoria 0002 | (012) 318-5121 |
| The Fibre Glass Shop | Hilton Dalbock | P O Box 7166, East London 5200 | (0431) 46-1287 |
| Thermotek Development (Pty) Ltd | L Gill | P O Box 451, Silverton 0127. | |
| Thorn Lighting SA Pty Ltd | Managing Director | P O Box 43075, Industria 2042 | |
| Tinning & Galvanising Indust | Eben Henning | P O Box 3779, Alrode 1451 | (011) 864-2680 |
| Tubewrights (Pty) Ltd | Frik Liebenberg | P O Box 2358, Vereeniging 1930 | (016) 4-5133 |
| Unie Staalkorporasie SA Bpk | Peet de Villiers | Posbus 48, Vereeniging 1930 | (016) 4-5122 |
| Uniplan (Pty) Ltd | Managing Director | P O Box 7259, Johannesburg 2000. | |
| Vaalcor cc | Terry Young | P O Box 920, Edenvale 1610 | (011) 452-3240 |
| Van Niekerk J D & Vennote | Dirk van Niekerk | Posbus 50645, Randburg 2125 | (011) 782-6493 |
| Van Niekerk Kleyn & Edwards | B K Frow | P O Box 72927, Lynnwood Ridge 0040. | |
| Vector | David Gilbert | P O Box 1884, Johannesburg 2000 | (011) 835-2221 |
| Vorster vd Westhuizen en Vennote | Johan Venter | Posbus 398, Loevenstein, Bellville 7530 | (021) 953-2080 |
| Waco Disbributors | Ken Buckton | P O Box 461, Johannesburg 2000 | (011) 933-1657 |
| Watson, Edwards & vd Spuy | A E Sharpe | P O Box 783569, Sandton 2146 | |
| Weyers Botha & Hubee | Koos Weyers | P O Box 7100, Hennopsmeer 0046 | (012) 667-1021 |
| Yelland Engineering (Pty) Ltd | H J Yelland | P O Box 10993 Johannesburg 2000 | (011) 832-2061 |
| York Fibreglass Pressing (SA) (Pty) Ltd | Managing Director | P O Box 1361, Pientown 3600 | |
| Yorkshire Switchgear (SA) (Pty) Ltd | Managing Director | P O Box 157, Pinetown 3600. | |
| Zumtobel-Barlite (Pty) Ltd | P A Davies | P O Box 2421, Alberton 1450 | (011) 907-1640 |

# HONORARY MEMBERS / ERELEDE

**1915-1936**
DR. H J VAN DER BIJL - Electricity supply commission
J ROBERTS - Durban
E POOLE - Secretary/Sekretaris

**1938**
L L HORRELL - Pretoria

**1944**
G H SWINGER - Cape Town

**1945**
A T RODWELL - Johannesburg

**1950**
DR J H DOBSON - Johannesburg

**1951**
H A EASTMAN - Cape Town

**1955**
W BELLAD-ELLIS - East London
J C FRASER - Johannesburg
C KINGMAN - Durban

**1956**
W H MILTON - Electricity Supply Commission
A MORTON JAFFRAY - Salisbury
Major S G REDMAN - Merz & McLellan, Johannesburg
Clr. C E K YOUNG - Pietermaritzburg

**1957**
D A BRADLEY - Port Elizabeth

**1958**
Col. E G EWER - Pietermaritzburg
A FODEN - East London
C R HALLE - Pietermaritzburg

**1960**
Clr. F J CASTELYN -Bloemfontein
Clr. L P DAVIES - Springs

**1962**
S R SIMPSON - Bulawayo
J L VAN DER WALT - Vereeniging

**1963**
C G DOWNIE - Cape Town

J C DOWNEY - Springs
R L KANE - Johannesburg

**1965**
G J MULLER - Bloemfontein

**1967**
Clr. J D MARAIS - Johannesburg
J R TELLES - Lourenco Marques

**1969**
W. BEESLEY - Estcourt
P A GILES - East London
D MURRAY-HOBBS - Port Elizabeth
E L SMITH -Boksburg

**1971**
D HUGO - Pretoria
ACT FRANTZ - Cape Town
H T TURNER - Umlati
R LEISHMAN - Johannesburg
R M O SIMPSON - Durban
W ROSSLER - Pretoria
F STEVENS - Durban
J F LATEGAN - Stellenbosch

**1973**
R G EWING - Past Secretary

**1975**
Clr. H G KIPLING - East London
C LOMBARD - Germiston
D C PLOWDEN - Johannesburg
J G WANNENBURG - Chief Inspector of Factories

**1977**
Dr. R L STRASZACKER - Electricity Supply Commission
AA MIDDLECOTE - Fish Hoek
G C THERON - Vanderbijlpark
A C WADDY - Pietermaritzburg

**1979**
R W BARTON - Welkom
Clr. H J HUGO - Roodepoort

**1981**
J D VAN WYK - CSIR
Dr. R B ANDERSON - CSIR
JOHAN MORRISON - Affiliate

**1983**
T C MARSH - Affiliate
J K VON AHLFTEN - Springs

**1985**
A A WEICH - Chief Inspector Occupational Safety
K G ROBSON - East London
COUNCILLOR R L DE LANGE - East London
E DE C PRETORIUS - Potchefstroom
W BARNARD - Johannesburg

**1987**
A P BURGER - Pretoria
J D DAWSON - Uitenhage
D H FRASER - Durban
D C PALSER - Cape Town

## HONORARY MEMBERSHIP / ERELEDE

| | |
|---|---|
| ANDERSON RB | Thatchers Field 262, Lynnwood 0081 |
| BARNARD W | 3 Central Street, Houghton 2198 |
| BEESLEY W | P O Box 5, Howick 3290 |
| BARTON RW | P O Box 75830, Gardenview 2047 |
| BURGER AP | Posbus 29058, Sunnyside, Pretoria 0132 |
| DAWSON JD | P O Box 45, Uitenhage 6230 |
| DE LANGE RL | 4 Latamer Street, Berea, East London 5200 |
| DOWNEY JC | 10 Jessop Road, Selection Park 1560 |
| DOWNIE CG | Rectory Gardens, Broadwater, Worthing, Sussex, England |
| EWING RG | P O Box 779, East London 5200 |
| FRANTZ ACT | 7 New Way, Pinelands, Cape Town 7405 |
| FRASER DH | P O Box 147, Durban 4000 |
| HALLE CR | 22 Connaught Road, Pietermaritzburg 3201 |
| HUGO HJ | Maudstraat 110, Florida 1710 |
| LEISHMAN R | 66 Tana Road, Emmarentia Ext. Johannesburg 2095 |
| LOMBARD C | Posbus 4181, Germiston-Suid 1411 |
| MARSCH TC | 20 Bella Street, Lakefield, Benoni 1500 |
| MIDDLECOTE AA | 20 Tenth Ave, Fish Hoek 7975 |
| MORRISON JA | P O Box 792, River Club 2149 |
| MULLE GJ | Wilcockweg 35, Bloemfontein 9301 |
| PALSER DC | 110 Rathfelder Ave, Constantia 7800 |
| PRETORIUS E DE C | Barnardstraat 6, Potchefstroom 2520 |
| ROBSON KG | Cloud Rise, 61 Vincent Gardens, East London 5247 |
| SIMPSON RMO | 71 Hunters Way, Umgeni Park 4051 |
| SMITH EL | Langverwag 202, Morkelstraat, Unie Park, Stellenbosch 7600 |
| STEVENS F | 3 Caister Lodge, 264 Musgrave Road, Berea, Durban 4001 |
| STRASZACKER RL Dr | 240 Smith Street, Muckleneuk, Pretoria 0002 |
| TELLES JR | Predioi 1 Janeiro / GAB. 1-3 Andar, Avenida Samora Machel 285 Maputo, Republica Popular de Mosambique |

| | |
|---|---|
| THERON GC | Beethovenstraat 7, Vanderbijlpark 1900 |
| TURNER HT | 33Heaton Nicholls Road, Kloof 3600 |
| VAN WYK Dr JDN | Roosstraat 195, Meyerspark 0184 |
| VON AHLFTEN JK | 204 Little Killarney W/S, Newmontweg Selcourt, Springs 1560 |
| WADDY JC | 27 Marshall Road, Athlone, Pietermaritzburg 3201 |

## PAST PRESIDENTS - VOORMALIGE PRESIDENTE

| | | |
|---|---|---|
| 1915-17 | *JH Dobson | Johannesburg |
| 1917-19 | *J Roberts | Durban |
| 1919-20 | *B Sankey | Port Elizabeth |
| 1920-22 | *TCW Dodd | Pretoria |
| 1922-24 | *GH Swingler | Cape Town |
| 1924-26 | *J Roberts | Durban |
| 1926-27 | *B Sankey | Johannesburg |
| 1927-29 | *JM Lambo | East London |
| 1929-31 | *R Macauley | Bloemfontein |
| 1931-33 | *LL Horell | Pretoria |
| 1933-34 | *LF Bickell | Port Elizabeth |
| 1935-36 | *GG Ewer | Pietermaritzburg |
| 1936-37 | *A Rodwell | Johannesburg |
| 1937-38 | *JH Gyles | Durban |
| 1938-39 | *HA Eastman | Cape Town |
| 1939-44 | *IJ Nicholas | Umtata |
| 1944-45 | *A Rodwell | Johannesburg |
| 1945-46 | JS Clinton | Zimbabwe (Harare) |
| | *JW Phillips | Zimbabwe (Bulawayo) |
| 1946-47 | GJ Muller | Bloemfontein |
| 1947-48 | C Kinsman | Durban |
| 1948-49 | *A Foden | East London |
| 1949-50 | DA Bradley | Port Elizabeth |
| 1950-51 | CR Hallé | Pietermaritzburg |
| 1951-52 | JC Downey | Springs |
| 1952-53 | *AR Slbson | Zimbabwe (Bulawayo) |
| 1953-54 | *JC Fraser | Johannesburg |
| 1954-55 | GJ Muller | Bloemfontein |
| 1955-56 | *DJ Hugo | Pretoria |
| 1956-57 | *JE Mitchell | Zimbabwe (Harare) |
| 1957-58 | *JL van der Walt | Krugersdorp |
| 1958-59 | CG Downie | Cape Town |
| 1959-60 | *RW Kane | Johannesburg |
| 1960-61 | RMO Simpson | Durban |
| 1961-62 | C Lombard | Germiston |
| 1962-63 | *PA Giles | East London |
| 1963-64 | JC Downey | Springs |
| 1964-65 | RW Barton | Welkom |
| 1965-67 | *D Murray-Nobbs | Port Elizabeth |
| 1967-69 | GC Theron | Vanderbijlpark |
| 1969-71 | HT Turner | Umtali |
| 1971-73 | JK von Ahlften | Springs |
| 1973-75 | JC Waddy | Pietermaritzburg |
| 1975-77 | E de C Pretorius | Potchefstroom |
| 1977-79 | KG Robson | East London |
| 1979-81 | PJ Botes | Roodepoort |
| 1981-83 | DH Fraser | Durban |
| 1983-85 | W Barnard | Johannesburg |
| 1985-87 | JA Loubser | Benoni |
| 1987-89 | AHL Fortmann | Boksburg |

* Deceased/Oorlede

# PAST MEMBERS / VOORMALIGE LEDE

| | |
|---|---|
| ATTRIDGE WH | P O Box 369, Port Elizabeth 6000 |
| BARRIE JJ | 82 First Avenue, Dunvegan, Edenvale 1610 |
| BOBEK KH | 63 Westville Road, Westville 3630 |
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| BURTON CR | 54 Memorial Road, Kimberley 8301 |
| CAMPBELL AR | P O Box 3, Impendhele 4545 |
| CLINTON JS | P O Box 4648, Johannesburg 2000 |
| CONRADIE DJR | Posbus 1009, Bloemfontein 9300 |
| CRONJE W J | Weningstraat 37, Groenkloof, Pretoria 0181 |
| DAWSON C | Electricity Supply Commission, P O Box 2408, Durban 4000 |
| DE VILLIERS AP | P O Box 603, Hermanus 7200 |
| DE VILLIERS EE | Impalapark 16, Impalapark, Irene 1675 |
| DREYER MC | Kommissarisstraat 107, Welgemoed 7530 |
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| McGIBBON J | P O Box 47, Doonside, Nata 2500 |
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| POTGIETER NA | Webbstraat 1211, Queenswood, Pretoria 0186 |
| PSOTTA KU | Malherbestraat 9, Upington 8800 |
| RATTEY WP | 50 Neethling Street, Strand 7140 |
| REICHERT WJ | P/a Universiteitsingenieur, Universiteit van Kaapstad, Privaatsak, Rondebosch 7700 |
| ROSSLER A | 53 Azalea Gardens, 391 Alexandra Road Pietermaritzburg 3201 |
| SCHREUDER TP | P O Box 591, Vredendal 8160 |
| SCHOLES EH | 20 Gavin Avenue, Pine Park 5194 |
| VAN DER MERWE FJ | Posbus 1111, Carletonville 2500 |
| WILLIAMS JT | P O Box 1617, Pretoria 0001 |
| WEAKLY SL | 41 Hospital Street, Cradock 5880 |
| WYLIE RJS | P O Box 217, Germiston 1400 |

# H.V. TEST cc.

Register No. CK 85/01218/23

75 Maude St., Sandown 2196, P.O. Box 651287, Benmore 2010, South Africa Tel. (011) 883-2148/9, Fax:(011) 884-2606


*Typical vehicle mounting arrangement of BAUR Syscompact cable fault location and test equipment.*

## PRODUCT RANGE

Cable Fault Locating Equipment
Cable Tracing Equipment
Dielectric Voltage Test Instruments 0–300 Kv
Partial Discharge
H.V. Substation Portable Test Voltage and Frequency Injection Set
Rotating Machinery Test Instruments

- Location of short-circuits, cable cuts, low-resistive, high-resistive as well as intermittent cable faults
- Application of the classic impulse reflection method with most modern memory technology (singe core measurement, comparison measurement, differential measurement)
- Stepless testing up to32 kV DC
- Burn-down procedure up to 160 mA (200 mA)
- Pre-location according to the Secondary Impulse Method SIM (with surge of DC test voltage)
- Location of sheath faults according to the step-voltage method
- Thumping for accurate pin-pointing by measuring the time difference between magnetic and acoustic signal, using the delay time differential method (solution for problems with cables in ducts)

Vaalcor

# VaalCor

## LOCALLY DEVELOPED COMPUTER CONTROL SYSTEMS FOR:-

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- BUILDING MANAGEMENT
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**FOR ENQUIRIES CONTACT:**

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P.O. Box 920
Edenvale 1610

28 Mopedi Road
SEBENZA 1610

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Telex: 42-5469
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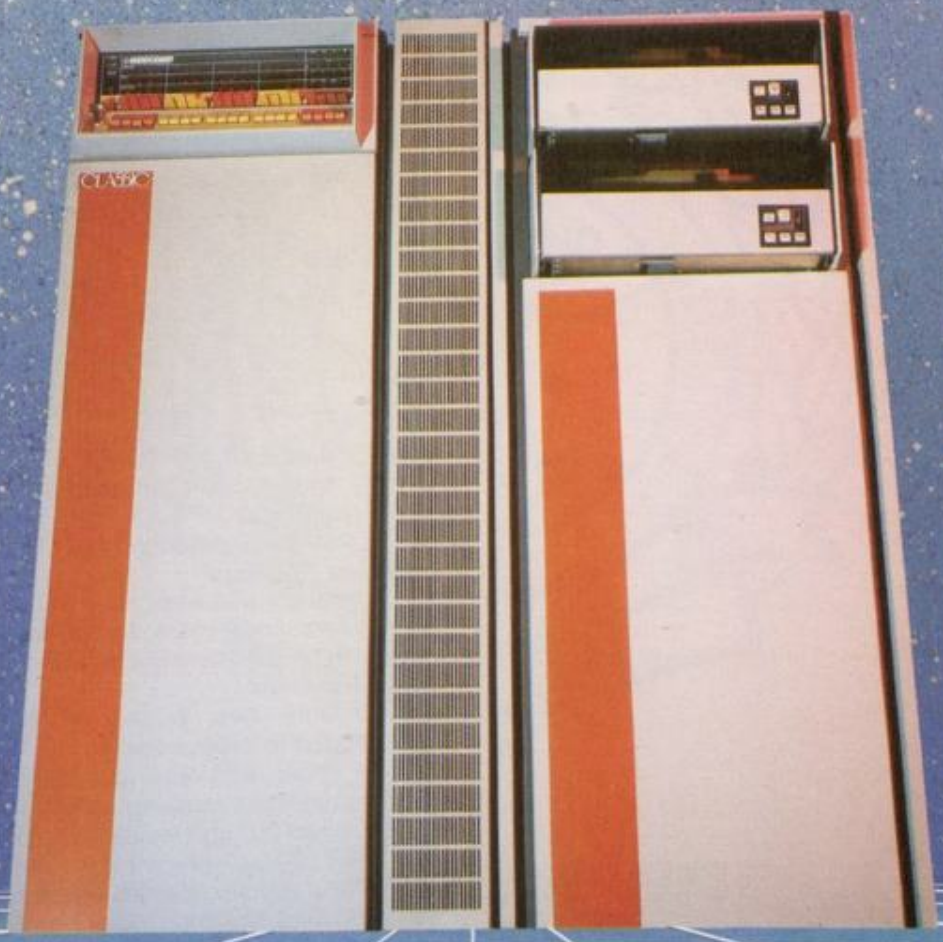
# Meet Oscar*, the genius who keeps our electricity account down to R12 million a month



The production of aluminium requires vast quantities of electricity. In fact Alusaf uses more electricity than the entire cities of Port Elizabeth and East London combined!

Without Oscar we could not manage our energy consumption effectively. Oscar constantly keeps his finger on the Alusaf production pulse.

Using our locally developed software, he measures 5 400 data values every minute in our 524 reduction cells. This information is then used to maximise metal quality and output with minimum energy input.

But Oscar is only one element which optimises efficiency at Alusaf.

Supported by other sophisticated computerised systems for production, commercial and financial control, Alusaf's staff remain dedicated to a common goal:

To uphold our reputation as one of the most effective primary aluminium producers in the world.

- **Committed to the local market**
- **Competitive on international markets**

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PO Box 284, Empangeni, 3880
Tel (0351) 51111

ALUSAF

Aluminium reduction plant, Richards Bay

* *Our Process Control Computer for the optimisation, stabilisation and control of Aluminium Reduction.*

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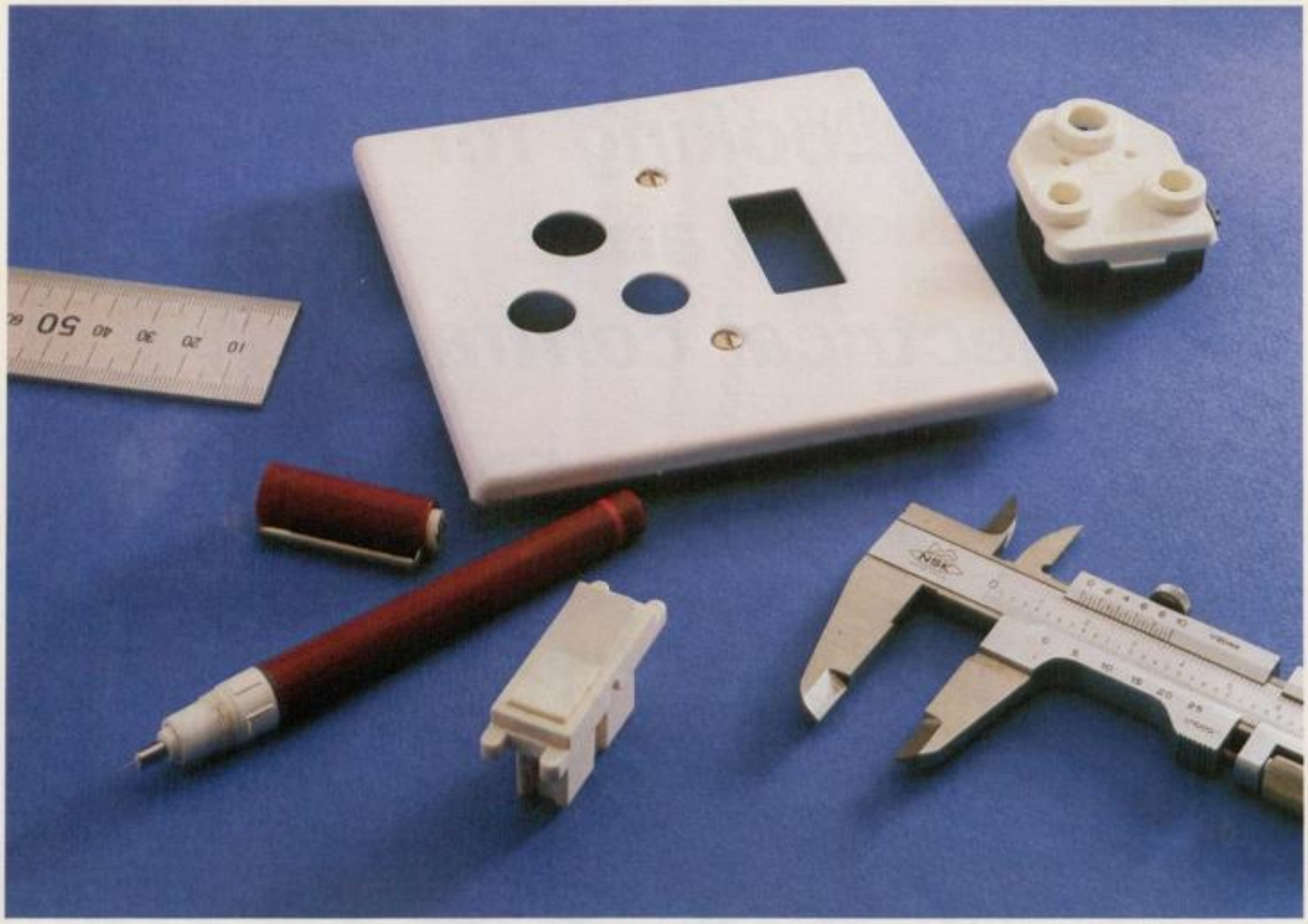

# Designed by Experts Manufactured by Litemaster

**Once again Litemaster introduces a whole new concept in electrical accessories.**

## DESIGNER RANGE

The Designer Range offers the user a whole new range of products which are technologically advanced and easy to install.

**Modular Design**
All the components, the switches and plug sockets are modular. They can be installed separately.

**In-Line Wiring**
The components have been designed to allow in-line wiring. No looping means that installation is faster.

**Extra Earth Terminal**
The yoke strap has an extra terminal for maximum safety.

**Silver Cadmium Contacts**
Under overload conditions, the contacts will not weld together because they are manufactured from silver cadmium.

**Cover Plates**
The Designer Range has been designed to fit standard Masterlite cover plates.

**Components**
Components snap fit to the yoke strap, from the back. They cannot be pushed through the front of the yoke strap.

**15 mm Depth**
The Designer Range has a low profile, which is only 15 mm deep. The product is ideal for plaster depth applications. As usual all our products are manufactured to the highest standards of quality and safety.

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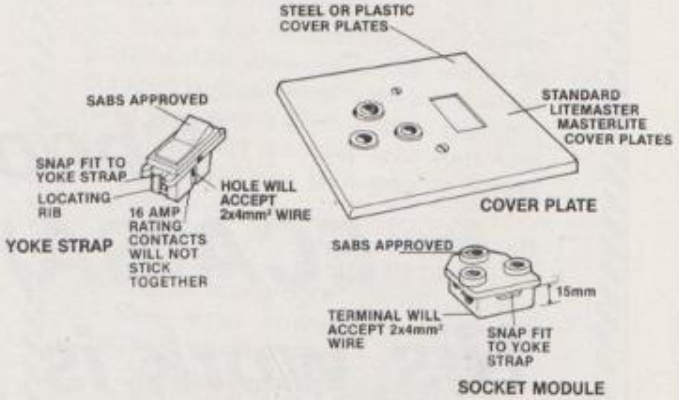


Post to: The Sales Director, Litemaster, P.O. Box 14040, Wadeville 1422.
Please send me my FREE copy of the Designer Range catalogue.

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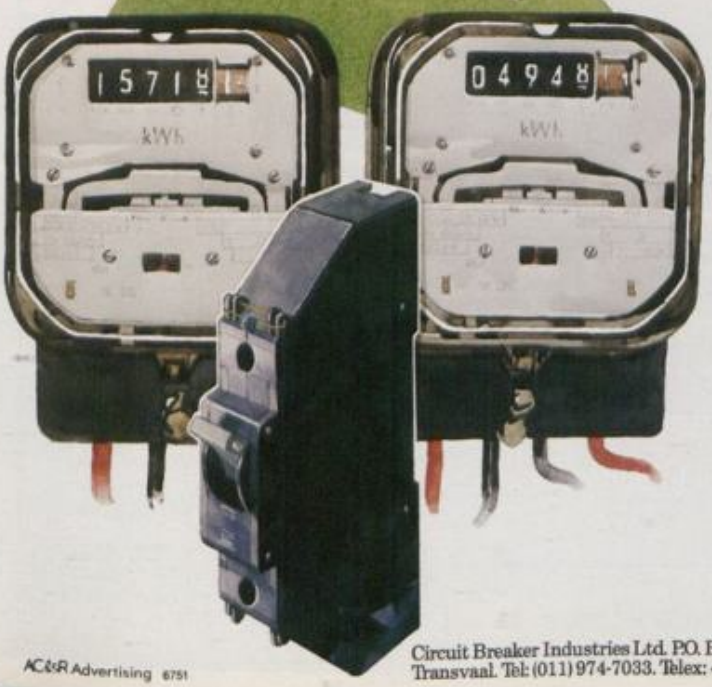

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- Tough thermoplastic shroud clips onto breaker (no screws).
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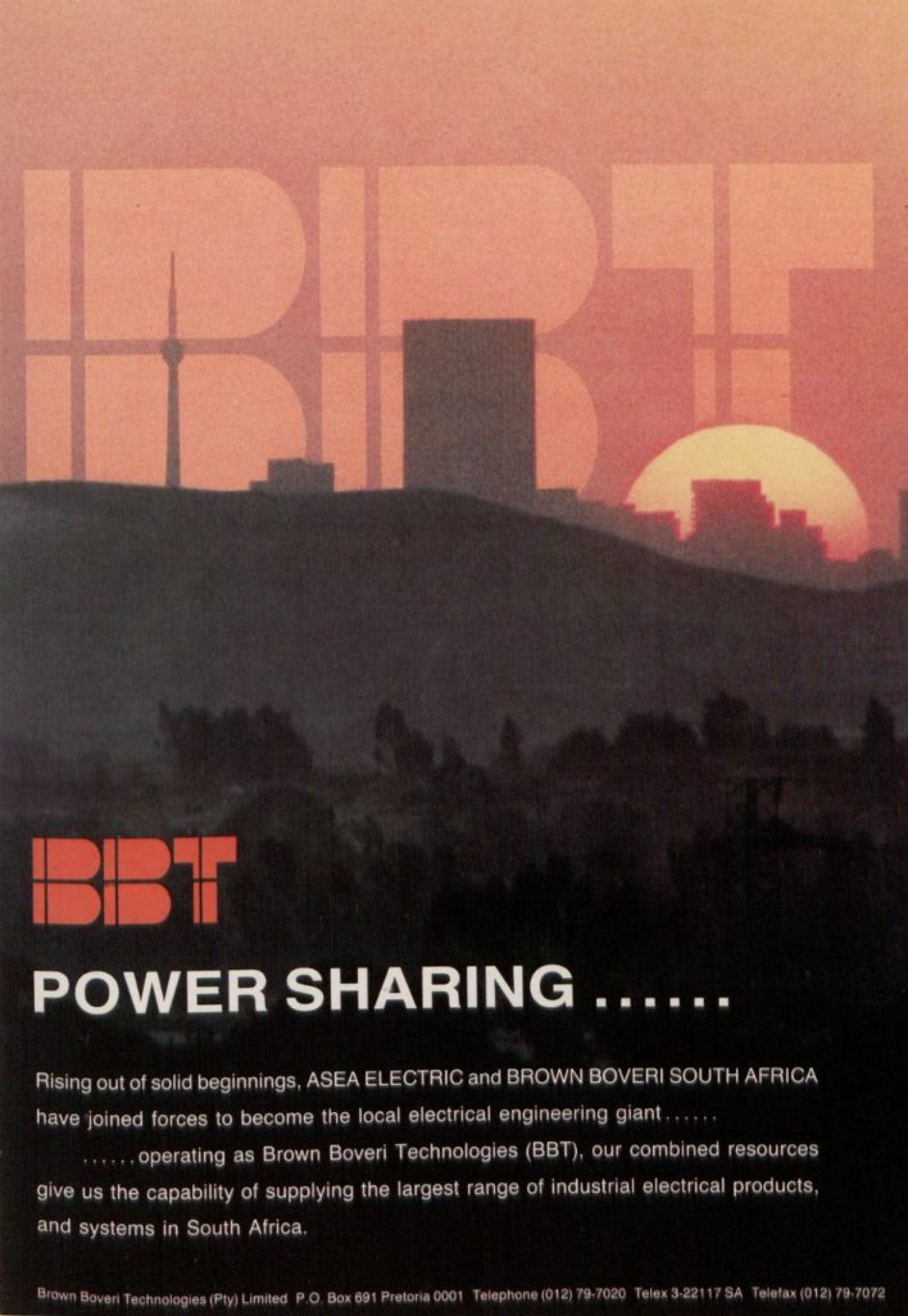


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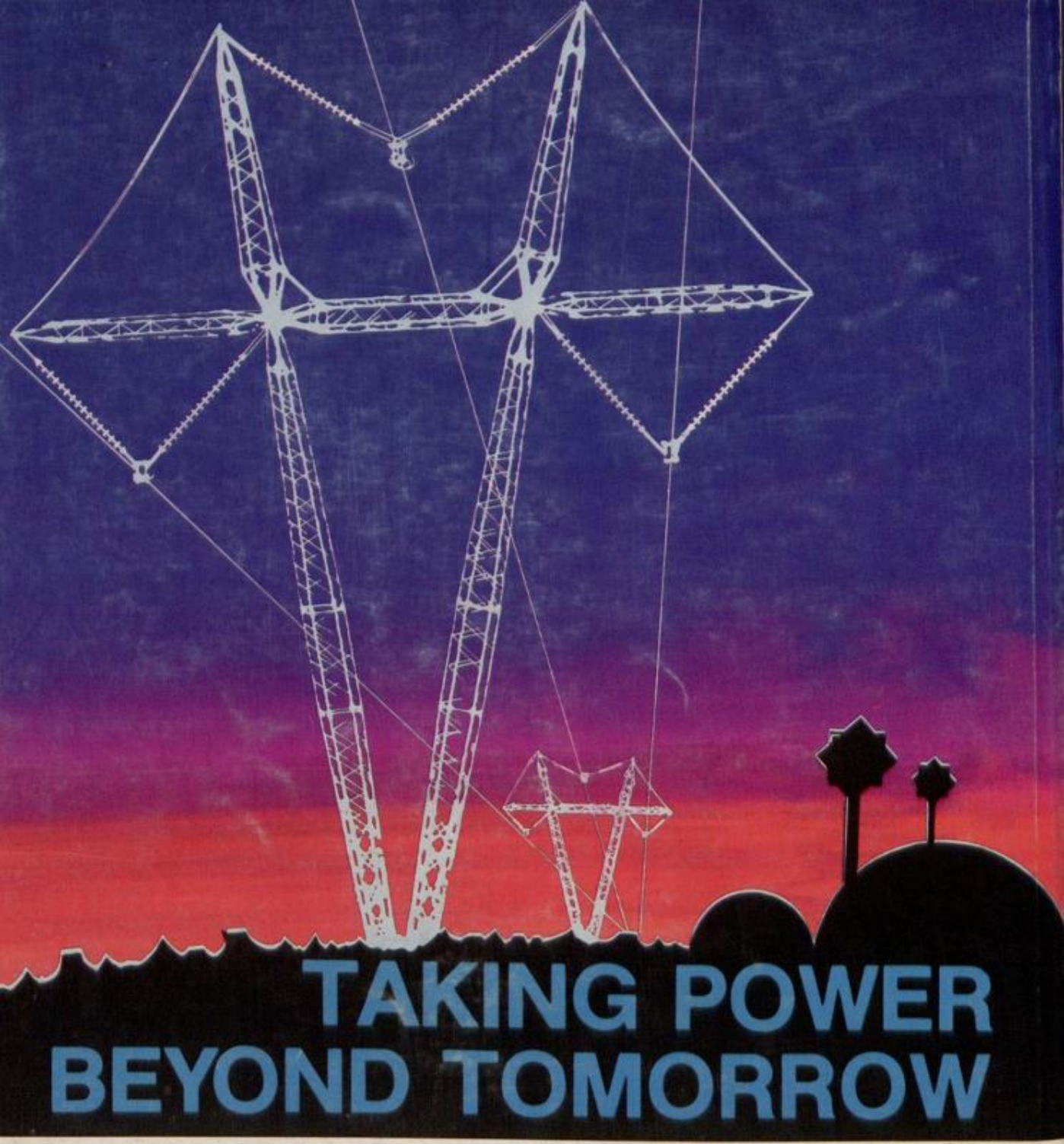


**Cullinan Electrical is committed single-mindedly to the supply of equipment, experience and expertise to the transmission, control and measurement of electrical energy.**

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