

① CRM
② CRL

PROCEEDINGS 1969

Volume 1

Forty-First Convention

16th to 19th JUNE, 1969

Umtali

The Association of Municipal Electricity
Undertakings of Southern Africa



VERRIGTINGS 1969

Deel 1

Een-en-Veertigste
Konvensie

16de tot 19de JUNIE 1969

Umtali

Die Vereniging van Munisipale Elektrisiteits-
ondernemings van Suidelike Afrika

**Vereniging van Munisipale
Elektrisiteitsondernemings
van Suidelike Afrika.**

**KENNISGEWING VAN DIE
41ste KONVENISIE**

Hierby word bekend gemaak dat die 41ste Konvensie van die Vereniging vanaf 16 tot 19 Junie 1969, albei datums inbegrepe, te Umtali gehou sal word, en wel op die plekke soos in die Sakelys en Program wat hierby uitgereik word, aangegee.

DAVIDSON EN EWING (EDMS.) BPK.
Per : R. G. Ewing.

1 April 1969. Sekretarisise.

SAKELYS EN PROGRAM.

MAANDAG, 16 Junie 1969.

- 10.00 vm. Kom byeen vir tee op die Queen's-saal terrein.
- 10.30 vm. Vergader in Queen's-saal.
- 10.45 vm. Openingsgebed.
Verwelkoming by die Konvensie deur die President.
Verwelkoming in Umtali deur Sy Agbare die Burgemeester van Umtali.
Amptelike Opening van die Konvensie deur die Eerste Minister, Sy Edele I. D. Smith.
Inhuldiging van President.
Presidentsrede.
- 12.30 nm. Verdaging vir middagete.
- 2.00 nm. Registrasie by die Konvensie se Vergaderplek — Courtauld-teater.
- 2.30 nm. Verkiesing van Aangewese President.
- (1) Voorgestelde aanvaarding van die Afrikaanse teks van die Grondwet soos in Volume 2 van die 1967 — verrigtinge gepubliseer.
- (2) Om oorweging te skenk aan die wysigings voorgestel deur:—
- (a) Mnr. P. J. Botes, soos hierby aangeheg;
- (b) Mnr. E. de C. Pretorius, soos hierby aangeheg.
- Die uitvoerende Raad sal aan die Konvensie verslag doen oor die voorgestelde wysigings, soos hierbo aangedui.
- Verkiesing van Uitvoerende Raad.
Verslag van die Sekretariaat.
- 4.00 nm. Verdaging en verversings.
- 7.15 nm. Burgelike Onthaal — Queen's-saal.

**The Association of Municipal
Electricity Undertakings
of Southern Africa.**

**NOTICE OF
41st CONVENTION**

Notice is hereby given that the 41st Convention of the Association will be held in Umtali at the venues set out in the Agenda and Programme issued herewith from 16th June to 19th June, 1969, both days inclusive.

DAVIDSON & EWING (PTY.) LTD.
per : R. G. Ewing,

1st April, 1969. Secretaries.

AGENDA AND PROGRAMME.

MONDAY, 16th June, 1969.

- 10.00 a.m. Assemble for tea in Queen's Hall Grounds.
- 10.30 a.m. Assemble in Queen's Hall.
- 10.45 a.m. Opening Prayer.
Welcome to Convention by the President.
Welcome to Umtali by His Worship the Mayor of Umtali.
Official Opening of the Convention by the Prime Minister the Honourable I. D. Smith.
- Induction of President.
Presidential Address.
- 12.30 p.m. Luncheon Adjournment.
- 2.00 p.m. Registration at Convention Venue — Courtauld Theatre.
- 2.30 p.m. Election of President Elect.
Constitution of the Association:
- (1) Proposed adoption of the Afrikaans text of the Constitution as published in the 1967 Proceedings Volume 2.
- (2) To consider amendments proposed —
- (a) by Mr. P. J. Botes as appended hereto;
- (b) by Mr. E. de C. Pretorius as appended hereto.
- The Executive Council will report to the Convention on the proposed amendments received as indicated above.
- Election of Executive Council.
Report of Secretaries.
- 4.00 p.m. Adjournment and Refreshment.
- 7.15 p.m. Civic Reception — Queen's Hall.

DINSDAG, 17 Junie 1969.

- 9.30 vm. Referaat : "Ontwikkeling van Elektrisiteit in Rhodesië — 'n Oorsig van Vooruitgang en Toekomstige Tendense" — D. R. Irvine, Rhodesiese E.V.K.
- 10.30 vm. Teepouse.
- 11.00 vm. Bespreking van referaat oor Rhodesiese E.V.K.
- 12.30 vm. Verdaging vir middagete.
- 2.00 nm. Referaat : "Reken-outomaat-ingenieurswese — J. D. N. van Wyk, W.N.N.R., Pretoria.
- 4.00 nm. Verdaging en Verversings.
- 7.30 nm. Aandete-vertoning — "Die Vrolike Neëntigerjare" — Queen's-saal.

TUESDAY, 17th June, 1969.

- 9.30 a.m. Paper : "Electricity Development in Rhodesia — Review of Progress and Future Trends" — D. R. Irvine, Rhodesian E.S.C.
- 10.30 a.m. Tea Interval.
- 11.00 a.m. Discussion on Rhodesian E.S.C. Paper.
- 12.30 p.m. Luncheon Adjournment.
- 2.00 p.m. Paper : "Computer Engineering" — J. D. N. van Wyk, C.S.I.R., Pretoria.
- 4.00 p.m. Adjournment and Refreshment.
- 7.30 p.m. "Gay Nineties Supper Show" — Queen's Hall.

WOENSDAG, 18 Junie 1969.

- 9.30 vm. Referaat : "Finansiële Outonomie" — Rowan Martin, Stadtesourier, Salisbury.
- 10.30 vm. Teepouse.
- 11.00 vm. Bespreking van referaat oor finansies.
- 12.30 nm. Verdaging vir middagete.
- 2.00 nm. Referaatjie : "Elektrise Standaarde in Sentraal-Afrika" — R. L. Richards, Sentraal-Afrikaanse Standaardvereniging.
- 2.45 nm. Bespreking van Verslae van Subkomitees en Verteenwoordigers.
- 4.00 nm. Verdaging en Verversings. Aand Vry.

WEDNESDAY, 18th June, 1969.

- 9.30 a.m. Paper : "Financial Autonomy" — Rowan Martin, City Treasurer, Salisbury.
- 10.30 a.m. Tea Interval.
- 11.00 a.m. Discussion on Finance Paper.
- 12.30 p.m. Luncheon Adjournment.
- 2.00 p.m. Paperette : "Electrical Standards in Central Africa" — R. L. Richards, C.A. Standards Association.
- 2.45 p.m. Discussion on Reports of Sub Committees and Representatives.
- 4.00 p.m. Adjournment and Refreshment. Free Evening.

DONDERDAG, 19 Junie 1969.

- 9.30 vm. Lede-forum.
- 10.30 vm. Teepouse.
- 11.00 vm. Lede-forum vervolg en bespreking van vorige referate.
- 11.30 vm. Referaatjie : "K.W.H.-kurwes en hul Beteekenis" — A. A. Middlecote, S.A.B.S., Pretoria.
- 12.30 nm. Verdaging vir middagete.
- 2.00 nm. Afskeidsgroet — Raadsheer J. Steer, Salisbury. Raadsheer J. Payne, Bulawayo.
- 3.30 nm. Teepouse.
- 4.00 nm. Erelidmaatskap en Oorhandiging van Ordetekens. Slotsitting.
- 5.30 nm. Vertrek na Vila da Manica, Mosambiek, vir Kontinentale Aand.

THURSDAY, 19th June, 1969.

- 9.30 a.m. Members' Forum.
- 10.30 a.m. Tea Interval.
- 11.00 a.m. Continuation of Members' Forum and discussion of previous papers.
- 11.30 a.m. Paperette : "Kwh Curves and their Significance" — A. A. Middlecote S.A.B.S., Pretoria.
- 12.30 a.m. Luncheon Adjournment.
- 2.00 p.m. Valediction — Alderman J. Steer, Salisbury Alderman J. Payne, Bulawayo
- 3.30 p.m. Tea Interval.
- 4.00 p.m. Honorary Membership and Presentation of Insignia. Closing Session.
- 5.30 p.m. Leave for Continental Evening at Villa da Manica, Mocambique.

PROGRAM VIR DAMES

LADIES PROGRAMME

MAANDAG, 16 Junie 1969.

- 10.00 vm. Vergader vir tee op die Queen's-saal-terrein.
10.30 vm. Vergader in Queen's-saal.
10.45 vm. Opening met gebed.
Verwelkoming by Konvensie deur die President.
Verwelkoming in Umtali deur Sy Agbare die Burgemeester van Umtali.
Amptelike Opening van die Konvensie deur die Eerste Minister, Sy Edele I. D. Smith.
Inhuldiging van President.
Presidentsrede.
12.30 nm. Verdaging vir middagete.
7.15 nm. Burgelike Onthaal — Queen's-saal.

DINSDAG, 17 Junie 1969.

- 9.45 vm. Vertrek vanaf Queen's-saal per bus na Vumba.
Oggendtee by die Herberg Die Wit Perd.
Besoek aan Vumba Nasionale Park en Tuine.
Middagete by Hotel Leopard Rock.
7.30 nm. Aandete-vertoning — "Die Vrolike Neëntigerjare" — Queen's-saal.

WOENSDAG, 18 Junie 1969.

- 10.00 vm. Modeparade en Filmvertoning — Reënboog-teater.
Tee op Queen's-saal-terrein.
12.30 nm. Middagete op Queen's-saal-terrein.
2.00 nm. Vry of besoek aan Aalwyntuine.
Aand Vry.

DONDERDAG, 19 Junie 1969.

- 10.00 vm. Vertrek per bus vanaf Queen's-saal na Kingsley Fairbridgedenkteken.
Oggendtee as gaste van die Burgemeesters-vrou by Hotel Christmas Pass.
12.30 nm. Middagete op Queen's-saal-terrein.
3.30 nm. Vergader by Queen's-saal vir Verversings en slotsitting.
5.30 nm. Vertrek na Vila da Manica, Mosambiek, vir Kontinentale Aand.

MONDAY, 16th June, 1969.

- 10.00 a.m. Assemble for tea in Queen's Hall Grounds.
10.30 a.m. Assemble in Queen's Hall.
10.45 a.m. Opening Prayer.
Welcome to Convention by the President.
Welcome to Umtali by His Worship the Mayor of Umtali.
Official Opening of the Convention by the Prime Minister the Honourable I. D. Smith.
Induction of President.
Presidential Address.
12.30 p.m. Luncheon Adjournment.
7.15 p.m. Civic Reception — Queen's Hall.

TUESDAY, 17th June, 1969.

- 9.45 a.m. Leave Queen's Hall by coach for Vumba.
Morning tea White Horse Inn.
Visit to Vumba National Park and Gardens.
Luncheon at Leopard Rock Hotel.
7.30 p.m. "Gay Nineties Supper Show" — Queen's Hall.

WEDNESDAY, 16th June, 1969.

- 10.00 a.m. Fashion and Film Show — Rainbow Theatre. Tea in Queen's Hall Grounds.
12.30 p.m. Lunch in Queen's Hall Grounds.
2.00 p.m. Free or Visit to Aloe Gardens.
Free evening.

THURSDAY, 19th June, 1969.

- 10.00 a.m. Leave Queen's Hall by Coach to Kingsley Fairbridge Memorial.
Morning tea at the Christmas Pass Hotel with the Mayoress.
12.30 p.m. Luncheon in Queen's Hall grounds.
3.30 p.m. Assemble at Queen's Hall Grounds for refreshments and Closing Session.
5.30 p.m. Leave for Continental evening at Villa da Manica, Mocambique.

WYSIGINGS AAN DIE GRONDWET, VOORGESTEL DEUR

1. Dat die woorde in subklousule (1)(iv) van klousule 14 geskrap en met die volgende vervang word:—

“nege-ingenieurlede (met uitsluiting van die reedsgenoemdes) deur die Konvensie verkies.”

2. Dat subklousule (2) van klousule 14 geskrap en met die volgende vervang word.

“(2) Die Raadslid-verteenwoordigers van lede-ondernemings wil ingenieurlede tot President en aangewese President verkies word, plus twee Raadslid-verteenwoordigers deur die Konvensie verkies is ook lede van die Uitvoerende Raad van die Vereniging.”

WYSIGINGS AAN DIE GRONDWET, VOORGESTEL DEUR

MNR. E. DE C. PRETORIUS.

1. Subklousule 4(v) :
Vervang “ondernemings” met “lede-ondernemings en lede.”
2. Subklousule 4(vi) :
Vervang “sodanige” met “derglike.”
3. Subklousule 6(4) :
Voeg in na “plaaslike owerheid” die woorde “in die Republiek van Suid-Afrika, Rhodesië en Suidwes-Afrika.”
4. Subklousule 7(1) :
Moet herformuleer word om voorsiening te maak vir ondernemings waar die pos van hoofingenieur tydelik vakant is.
5. Subklousule 7(2)(v) :
 - (a) Vervang “ingenieur,” waar dit die eerste keer voorkom, met “ingenieurs.”
 - (b) Vervang die (vae) “a ten volle gekwalifiseerde professionele ingenieur wees” met die woorde “wees en moet oor die onderverinding en kwalifikasies beskik wat vir die Uitvoerende Raad aanvaarbaar is.”
6. Subklousule 7(3) :
Skrap die woord “voortaan.”
7. Subklousule 9(3) :
 - (a) Vervang die woorde “per jaar” met die woorde “gedurende die finansiële jaar van die plaaslike bestuur wat die finansiële jaar van die Vereniging onmiddellik voorafgaan.”
 - (b) Die lidmaatskappelde is baie arbitrêr vasgestel en volg geen vaste patroon nie. Ek stel die volgende bydraes voor :

AMENDMENTS TO THE CONSTITUTION PROPOSED BY

MR. P. J. BOTES

1. That the words appearing in sub-clause (1)(iv) of clause 14 be deleted and the following substituted therefor:—

“nine engineer members (excluding those already mentioned) to be elected by the Convention.”

2. That sub-clause (2) of clause 14 be deleted and the following substituted therefor:—

“(2) The Councillor representatives of member undertakings whose Engineer members are elected as President and President Elect, plus two Councillor representatives of member undertakings, to be elected by the Convention, shall also be members of the Executive Council of the Association.”

AMENDMENTS TO THE CONSTITUTION PROPOSED BY

MR. E. DE C. PRETORIUS

1. Section 4(v) :
Substitute “member undertakings and members” for “undertakings.”
2. Section 4(vi) :
Substitute “suchlike” (Afrikaans: “derglike”) for “such.”
3. Section 6(4) :
Insert after “local authority” the words “in the Republic of south Africa, Rhodesia and South West Africa.”
4. Section 7(1) :
Should be re-phrased to provide for undertakings of which the position of chief engineer may be temporarily vacant.
5. Section 7(2)(v) :
 - (a) Substitute “engineers” for “engineer” where it appears the first time.
 - (b) Substitute “who has such experience and holds such qualifications as may be acceptable to the Executive Council” for the (vague) “be a fully qualified professional engineer.”
6. Section 7(3) :
Delete “henceforth.”
7. Section 9(3) :
 - (a) Substitute “during the financial year of the local authority immediately prior to the financial year of the Association” for “per annum.”
 - (b) The membership contributions are very much arbitrary; there is no fixed pattern. I propose the following contributions :

VERKOPE

BYDRAE

Tot	1 miljoen K.W.U.	—	—	—	R17
Oor	1 miljoen tot	4 miljoen K.W.U.	R25		
Oor	4 miljoen tot	16 miljoen K.W.U.	R33		
Oor	16 miljoen tot	64 miljoen K.W.U.	R41		
Oor	64 miljoen tot	256 miljoen K.W.U.	R49		
Oor	256 miljoen tot	1024 miljoen K.W.U.	R57		
Oor	1024 miljoen K.W.U.	—	—	—	R65

("256" en "1024" kan deur "250" en "1,000" vervang word).

8. Subklousule 6(4), (9(5), (6) en (7) :
"Geassosieerde onderneming" behoort onder die hoof "Woordomskrywing" omskryf te word.
9. Subklousule 10(1) :
Vervang die woorde "al om die tweede jaar" met die woord "jaarliks."
10. Subklousule 10(3) :
Skrap die voorbehoudsbepaling.
11. Subklousule 12(1) :
Vervang die woord "kan" met die woord "moet."
12. Subklousule 12(4) :
Voeg by: "Stembrieffies moet van 'n geheime merk voorsien word."
13. Subklousule 12(5) :
Herformuleer die eerste sin in die Engelse teks om te lees: "A representative of a member undertaking at Convention."
14. Subklousule 12(6) :
Vervang die woorde "word die voorstel verwerp" met die woorde "het die Voorzitter 'n beslissende stem."
15. Subklousule 12(7) :
Voeg in na die woorde "die pers word" die woorde "skriftelik deur die Uitvoerende Raad."
16. Subklousule 14(1)(iii) :
Skrap die woorde "as dan."
17. Bots subklousule 15(1) nie met subklousule 14(1)(iii) nie?
18. Subklousule 17(2) :
Voeg in na "lede" die woorde "van wie minstens vyf Ingenieurlede is."
19. Subklousule 19(1) :
Skrap die tweede sin. (Reeds gedek deur subklousule 16(f).)
20. Subklousule 22(1) :
(a) Vervang die woord "drie" in die eerste sin met die woord "tien."
(b) Vervang die woord "ondernemings" na die woord "watter" met die woord "lede-ondernemings."
21. Subklousule 22(2) :
Vervang die woorde "Uitvoerende Raad" met die woord "President." (Goedkeuring deur die U.R. kan baie tyd in beslag neem).

SALES

Contribution

Up to	1 million kWh	—	—	—	R17
Over	1 million to	4 million kWh	R25		
Over	4 million to	16 million kWh	R33		
Over	16 million to	64 million kWh	R41		
Over	64 million to	256 million kWh	R49		
Over	256 million to	1024 million kWh	R57		
Over	1024 million kWh	—	—	—	R65

("250" and "1000" could be substituted for "256" and "1024.")

8. Subsection 6(4), 9(5), (6) and (7) :
"Associate undertaking" should be defined under the heading "Definitions."
9. Subsection 10(1) :
Substitute "annual" for "bi-ennial."
10. Subsection 10(3) :
Delete the proviso.
11. Subsection 12(1) :
Substitute "shall" for "may" in the second sentence.
12. Subsection 12(4) :
Add the sentence "Ballot papers shall bear a secret mark."
13. Subsection 12(5) :
Re-phrase: "A representative of a member undertaking at Convention"
14. Subsection 12(6) :
Substitute "the Chairman shall have a casting vote" for "the motion shall be deemed to be lost."
15. Subsection 12(7) :
Insert after "the press shall be invited" the words "by the Executive Council in writing."
16. Subsection 14(1)(iii) :
Delete "for the time being."
17. Does subsection 15(1) not conflict with subsection 14(1)(iii)?
18. Subsection 17(2) :
Insert between "members" and "shall" the words "of which not less than five shall be Engineer Members."
19. Subsection 19(1) :
Delete the second sentence. (Already covered by subsection 16(f).)
20. Subsection 22(1) :
(a) Substitute "ten" for "three" in the first sentence.
(b) Insert between "what" and "undertakings" the word "member."
21. Subsection 22(2) :
Substitute "President" for "Executive Council." (Approval by the E. C. may take an unduly long time.)

22. Klousule 25 :

Vervang die woord "Convention" in die Engelse teks met die woord "Association." (Sien Afrikaanse teks).

Hy stel ook voor dat die subklousules van die Grondwet volgens 'n vaste patroon hernommer word en doen as 'n voorbeeld aan die hand —

(Klousule)	1.	
(Subklousules)	1(1)	(Primêr)
	1(1)(a)	(Sekondeêr)
	1(1)(a)(i)	(Tersier)

DIE VERENIGING VAN MUNISIPALE ELEKTRISITEITSONDERNEMINGS VAN SUIDELIKE AFRIKA.

Ledegede: Gebaseer op jongste beskikbare verkoopsyfers.

RAAD	Volgens mnr. E. Pretorius	
	Volgens huidige skaal.	se voorstel.
	R	R
Adelaide	25	25
Alberton	35	41
Aliwal Noord	30	33
Barberton	30	33
Beaufort Wes	30	33
Benoni	45	49
Bethlehem	35	41
Bloemfontein	45	57
Bloemhof	25	25
Boksburg	45	49
Brakpan	35	49
Brandfort	25	25
Bedfordview	30	41
Bethal	30	33
Bothaville	25	25
Bredasdorp	25	25
Brits	30	41
Buite-Stedelike Gebiede	30	33
Bulawayo	45	57
Burgersdorp	25	25
Carletonville	35	41
Carolina	25	25
Ceres	30	33
Cradock	30	33
De Aar	30	33
Dewetsdorp	21	17
Dundee	30	33
Durban	65	65
Edenvale	35	41
Empangeni	30	33
Ermelo	30	33
Eshowe	30	33
Estcourt	35	41
Fort Beaufort	25	25
Fort Victoria	30	33
George	30	41

22. Section 25 :

Substitute "Association" for "Convention."
(See Afrikaans text.)

He also proposes that the subsections of the Constitution be renumbered according to a fixed pattern and suggests for example,

(Section)	1.	
(Subsection)	1(1).	(Primary)
	1(1)(a)	(Secondary)
	1(1)(a)(i)	(Tertiary)

MUNICIPAL ELECTRICAL UNDERTAKINGS OF SOUTH AFRICA.

Subscriptions. Based on last available sales statistics.

COUNCIL	As per	
	As per present scale	proposal by Mr. E. de C. Pretorius
	R	R
Adelaide	25	25
Alberton	35	41
Aliwal North	30	33
Barberton	30	33
Beaufort West	30	33
Benoni	45	49
Bethlehem	35	41
Bloemfontein	45	57
Bloemhof	25	25
Boksburg	45	49
Brakpan	35	49
Brandfort	25	25
Bedfordview	30	41
Bethal	30	33
Bothaville	25	25
Brits	30	41
Bredasdorp	25	25
Bulawayo	45	57
Burgersdorp	25	25
Cape Town	65	65
Carletonville	35	41
Carolina	25	25
Ceres	30	33
Cradock	30	33
De Aar	30	33
Dewetsdorp	21	17
Dundee	30	33
Durban	65	65
East London	45	49
Edenvale	35	41
Empangeni	30	33
Ermelo	30	33
Eshowe	30	33
Estcourt	35	41
Fort Beaufort	25	25
Fort Victoria	30	33

RAAD	Volgens mnr. E. Volgens huidige de C. Pretorius skaal. se voorstel.		COUNCIL	As per present scale		As per proposal by Mr. E. de C. Pretorius	
	R	R		R	R		
Germiston	45	49	Germiston	45	49		
Gobabis	25	25	Gobabis	25	25		
Graaff-Reinet	30	33	Graaff-Reinet	30	33		
Grahamsstad	35	41	Grahamstown	35	41		
Greytown	30	33	Greytown	30	33		
Gwelo	35	49	Gwelo	35	49		
Harrismith	30	33	George	30	41		
Heidelberg	30	33	Harrismith	30	33		
Howick	25	25	Heidelberg	30	33		
Johannesburg	65	65	Howick	25	25		
Kaapstad	65	65	Johannesburg	65	65		
Kakamas	21	17	Kakamas	21	17		
Keetmanshoop	25	25	Keetmanshoop	25	25		
Kempton Park	35	41	Kempton Park	35	41		
Kenhardt	17	17	Kenhardt	17	17		
Kimberley	35	49	Kimberley	35	49		
Klerksdorp	35	49	Klerksdorp	35	49		
Knysna	30	33	Knysna	30	33		
Kokstad	25	33	Kokstad	25	33		
Komgha	21	17	Komgha	21	17		
Koppies	25	25	Koppies	25	25		
Kroonstad	30	41	Kroonstad	30	41		
Krugersdorp	35	49	Krugersdorp	35	49		
Ladybrand	25	25	Ladybrand	25	25		
Ladysmith	35	41	Ladysmith	35	41		
Louis Trichardt	30	33	Louis Trichardt	30	33		
Lydenburg	25	25	Lydenburg	25	25		
Mafeking	30	33	Mafeking	30	33		
Makwassie	21	17	Makwassie	21	17		
Matatiele	25	25	Matatiele	25	25		
Messina	25	25	Messina	25	25		
Meyerton	35	41	Meyerton	35	41		
Middelburg (K.P.)	25	25	Middelburg (C.P.)	25	25		
Middelburg (Tvl.)	30	41	Middelburg (Tvl.)	30	41		
Mossel Baai	30	33	Mossel Bay	30	33		
Nelspruit	30	41	Nelspruit	30	41		
Newcastle	30	30	Newcastle	30	30		
Nigel	35	41	Nigel	35	41		
Odendaalsrust	30	33	Odendaalsrust	30	33		
Oos Londen	45	49	Orkney	30	41		
Orkney	30	41	Oudtshoorn	30	41		
Oudtshoorn	30	41	Paarl	35	49		
Paarl	35	49	Parys	30	41		
Parys	30	41	Peri-Urban Areas	30	33		
Pietermaritzburg	45	49	Pietermaritzburg	45	49		
Pietersburg	35	49	Pietersburg	35	49		
Piet Retief	25	33	Piet Retief	25	33		
Potchefstroom	35	41	Potchefstroom	35	41		
Port Alfred	25	25	Port Alfred	25	25		
Port-Elizabeth	55	57	Port Elizabeth	55	57		
Port Shepstone	30	33	Port Shepstone	30	33		
Potgietersrust	30	41	Potgietersrust	30	41		
Postmasburg	25	25	Postmasburg	25	25		
Pretoria	65	65	Pretoria	65	65		
Queenstown	30	41	Queenstown	30	41		

RAAD	Volgens mnr. E. de C. Pretorius		COUNCIL	As per proposal by Mr. E. de C. Pretorius	
	Volgens huidige skaal.	de C. Pretorius se voorstel.		As per present scale	proposal by Mr. E. de C. Pretorius
	R	R		R	R
Randfontein	35	41	Randfontein	35	41
Riversdale	25	25	Riversdale	25	25
Robertson	30	41	Robertson	30	41
Rodepoort/Maraisburg	45	49	Rodepoort/Maraisburg	45	49
Rustenburg	35	41	Rustenburg	35	41
Salisbury	55	57	Salisbury	55	57
Somerset-Oos	30	33	Somerset East	30	33
Somerset-Wes	30	41	Somerset West	30	41
Springs	45	49	Springs	45	49
Standerton	35	41	Standerton	35	41
Stanger	30	41	Stanger	30	41
Stellenbosch	35	41	Stellenbosch	35	41
Strand	30	41	Strand	30	41
Saldanha Baai	25	25	Saldanha Bay	25	25
Sasolburg	35	41	Sasolburg	35	41
Stilfontein	35	41	Stilfontein	35	41
Tarkastad	17	17	Tarkastad	17	17
Thabazimbi	25	33	Thabazimbi	25	33
Tzaneen	30	41	Tzaneen	30	41
Uitenhage	35	49	Uitenhage	35	49
Umtata	30	41	Umtata	30	41
Umtali	35	41	Umtali	35	41
Vanderbijlpark	35	49	Vanderbijlpark	35	49
Ventersdorp	25	25	Ventersdorp	25	25
Vereeniging	35	49	Vereeniging	35	49
Viljoenskroon	25	33	Viljoenskroon	25	33
Virginia	35	41	Virginia	35	41
Vrede	25	25	Vrede	25	25
Vryburg	30	33	Vryburg	30	33
Vryheid	35	41	Vryheid	35	41
Walvisbaai	35	41	Walvis Bay	35	41
Warmbad	35	41	Warmbaths	35	41
Welkom	35	49	Welkom	35	49
Wellington	30	33	Wellington	30	33
Westonaria	30	33	Westonaria	30	33
Winburg	25	25	Winburg	25	25
windhoek	35	41	Windhoek	35	41
Witbank	35	41	Witbank	35	41
Witriver	25	25	White River	25	25
Wolmaransstad	25	25	Wolmaransstad	25	25
Worcester	35	41	Worcester	35	41
	<u>R4,253</u>	<u>R 4,897</u>		<u>R4,253</u>	<u>R 4,897</u>

VERSLAG VAN DIE SEKRETARIAAT.

Aan: Die President en Lede van die Vereniging.

Mnr. die President en here.

Dit verskaf my groot genoë om die verslag van u Vereniging vir die twee-jaar-tydperk wat op 28 Februarie 1969 geëindig het, aan u voor te lê.

DOODSBERIGTE.

Dit is met opregte leedwese dat ons die heengaan van die volgende persone gedurende die tydperk deur hierdie verslag gedek, te boek stel:—

J. C. Fraser, Erelid en Voormalige President van die Vereniging. "J. C.," sal nog lank deur baie lede van die Vereniging onthou word as 'n beminde en opregte vriend.

J. W. Ross, 'n Ingenieurslid van die Vereniging.

VEERTIGSTE KONVENSIE.

Die 40ste Konvensie van die Vereniging is vanaf Maandag, 15 Mei tot Vrydag, 18 Mei 1967 in Lourenco Marques gehou.

Die afgevaardigdes is deur die President van die Camara Municipal, Senor Humberto das Neves, in Lourenco Marques verwelkom en by die Konvensie deur Sy Agbare die Burgemeester van Vanderbijlpark, Raadslid H. C. van der Walt. Die amptelike opening van die Konvensie is waargeneem deur Sy Edele die Sekretaris van Openbare Werke, Vervoer en Kommunikasies van Mosambiek, Senor A. V. Subtil. Die Konsul-Generaal van die Republiek van Suid-Afrika in Mosambiek, Mnr. G. C. Nel, het ook die openingsitting van die Konvensie toegespeek.

In al vier hierdie toesprake is die fundamentele begeerte van die verskillende volke om met mekaar saam te werk, uitgespreek, en die tema van die Konvensie n.l. "Die Ingenieurswese ken geen grense nie" was inderdaad veelseggend.

Geen verslag omtrent hierdie gedenkwaardige Konvensie sal volledig wees nie sonder om melding te maak van die feit dat daar, binne die kort tydperk van minder as twee jaar sedert verteenwoordigers van plaaslike besture, openbare nutsmaatskappye, regeringsdepartemente en die elektrotegniese ingenieurswese vir die eerste keer by hierdie vergaderplek byeenkoms het, sulke verreikende ontwikkelings met betrekking tot die opwekking en verspreiding van elektrisiteit in die subkontinent plaasgevind het soos die begin van die bouwerk aan die Cabora Bassa-projek en die besluit van Evkom, Suid-Afrika, omkrag by grootmaat vanaf daardie projek te koop, sowel as die instemming van die betrokke regerings om die Kunene-

REPORT OF THE SECRETARIES.

To the President and Members of the Association.

Mr. President and Gentleman,

It gives me great pleasure to submit to you the Report of your Association for the two-year period ended 28th February, 1969.

OBITUARY.

It is with deep regret that we record the deaths of the following during the period covered by this Report:

J. C. Fraser, Honorary Member and Past President of the Association. "J. C." will long be remembered as a dear and sincere friend by many in the Association.

J. W. Ross, an Engineer Member of the Association.

FORTIETH CONVENTION.

The 40th Convention of the Association was held in Lourenco Marques from Monday, 15th May, to Friday, 18th May, 1967.

Delegates were welcomed by the President, Camara Municipal, Senor Humberto das Neves, and to the Association, by his Worship the Mayor of Vanderbijlpark, Councillor H. C. van der Walt. The official opening of the Convention was performed by the Honourable the Mocambique Secretary for Public Works, Transport and Communications, Senor A. V. Subtil. The Consul General for the Republic of South Africa in Mocambique, Mr. G. C. Nel, also addressed the opening session of the Convention. In all four speeches was expressed the fundamental desire of the various peoples of Southern Africa to co-operate, and the theme of the Convention "Engineering knows no Boundaries," was indeed significant.

Reference to this memorable Convention would be incomplete without mention of the fact that within the short period of under two years since representatives of Local Authorities, Public Utilities, Government Departments and the Electrical Engineering Industry met together at this time venue for the first time, there have been such far-reaching developments in relation to electrical generation and supply in the Sub-Continent as the commencement of construction of the Cabora Bassa project, and the decision of Escom, South Africa, to purchase power in bulk therefrom, as well as agreement by the Governments concerned for the development of

rivier vir Kragopwekkings- en ander doeleindes te ontwikkel.

Namens die President, lede van die Vereniging en die ander persone wat die Konvensie te Lourenco Marques bygewoon het, is dit vir my besonder aangenaam om ons hartlikste waardering teenoor die owerhede in Lourenco Marques te boek te stel vir hul uitstaande gasvryheid, wat nog lank onthou sal word deur almal wat die voorreg gehad het om dit te geniet. Almal wat die provinsie Mosambiek vir die eerste keer besoek het, het ongetwyfeld huis toe gegaan met 'n nuwe gevoel van waardering vir die vriendelikheid van die inwoners van hierdie gebied.

Dit is ook vir my aangenaam om melding te maak van alle betrokkenes se oprepte waardering van die hoogs doeltreffende wyse waarop die President die verrigtinge by die Konvensie gelei het, sowel as van die konsidereerde en bekwame wyse waarop hy dwarsdeur sy ampstermyn sy ampsepligte uitgevoer het. Ook aan Mev. Theron wil ons ons oprepte dank oordra vir haar ondersteuning en bystand.

Die eerste referaat wat aan die Konvensie voorgelê is, was getiteld "Hoogspanningsstroombrekers, soos in die Nasionale 400 KV-Transmissiestelsel gebruik" deur Mnr. D. R. Duffield. Mnr. Duffield se referaat in verband met sekere aspekte van die stroombrekers wat op die ultra-hoogspanningstelsel van Evkom in die Republiek gebruik word, vorm 'n waardevolle bydrae tot die Verrigtinge van die Vereniging.

Die volgende punt op die program van die Konvensie het oor "Blits-watervarmers" gehandel en het lewendige bespreking uitgelok.

Die referaat "Research into Electrical Power Engineering and Related Subjects at the C.S.I.R." deur Mnr. R. B. Anderson en J. D. V. van Wyk, was van besondere belang, aangesien dit die lede van die Vereniging 'n duideliker insig gegee het in die omvang van die navorsing wat tans in verband met die elektrotegniese ingenieurswese by die W.N.N.R. gedoen word, en waarvan almal waarskynlik nie voorheen bewus was nie.

Referaatjies is daarna gelewer oor "Die Gas-turbine-installasie by die Kragentrale van SONEF" en "Die erts-laai-installasie by Lourenco Marques." Ek wil graag in hierdie stadium ons dank en waardering aan Mnr. W. U. Snell van Rolls Royce Beperk oordra vir die moeite wat hy homself getroos het om na S.A. te kom en hom die Konvensie in te lig in verband met die opwekking van krag met behulp van die gas-turbine en die moontlikhede van hierdie metode.

Die tweede referaatjie, wat voorgedra is deur Mnr. J. R. Telles, bygestaan deur Mnr. E. Lopez, onder die opskrif "Elektriese Installasies by die erts-laai-installasie in die hawe van Lourenco Marques," was besonder interessant, aangesien dit 'n beskrywing gegee het van gesofistiseerde

the Kunene River for power generation and other purposes.

On behalf of the President, members of the Association and all others who attended the Lourenco Marques Convention, it is indeed a pleasure to record the sincerest appreciation to the authorities in Lourenco Marques for their outstanding hospitality which will long be remembered by all those privileged to enjoy it. Visitors to the province of Mocambique for the first time undoubtedly returned home with a new appreciation of the friendliness of the people of the territory.

I have much pleasure in placing on record the appreciation of all for the most effective Chairmanship of the Convention by the President, as well as the considerate and effective manner in which he has carried out duties throughout his term of office. To Mrs. Theron is also extended sincere thanks for her support and assistance.

The first Paper presented to the Convention was "High Voltage Circuit Breakers as applied to the National 400 K.V. Transmission System" by Mr. D. R. Duffield. Mr. Duffield's paper on the aspects of Circuit Breakers being utilised on the ultra-high tension system of Escom in the Republic constitutes a valuable contribution to the Proceedings of the Association.

The next item on the Convention Programme related to "Instantaneous Water Heaters," which evoked lively discussion.

The Paper "Research into Electrical Power Engineering and Related Subjects at the C.S.I.R." by Messrs. R. B. Anderson and J. D. V. van Wyk was of particular interest in giving, as it did, the members of the Association a clearer insight into the magnitude of research currently taking place at the C.S.I.R. in the field of Power Electrical Engineering, which was possibly not appreciated by all previously.

Paperettes were next presented on the "Gas Turbine Installation at the Power Station of SONEF," and "The Ore Loading Plant at Lourenco Marques." At this stage I would like to place on record our appreciation to Mr. W. U. Snell of Rolls Royce Ltd. for coming to South Africa, and for giving the Convention an insight into power generation utilising the gas turbine and its potential.

The second Paperette given by Mr. J. R. Telles, assisted by Mr. E. Lopez on the "Electrical Installations at the Lourenco Marques Harbour Ore Loading Plant" was particularly interesting, giving a description, as it did,

keerde toerusting wat hoofsaaklik in Mosambiek ontwerp en vervaardig is.

Die referaat oor "Enkele Aspekte van Straatverligting" deur Mnr. J. W. Smit, Hoofwetenskaplike van die Buro vir Standaarde, was 'n besonder nuttige voorsetting van soortgelyke stukke wat voorheen aan die Vereniging voorgelê is in verband met hierdie steeds belangriker wordende aspek van die elektrotegniese ingenieurswese, wat ook van algemene belang is.

Die lede-forum by hierdie geleentheid het 'n sitting ingesluit wat vir Raadslede van besondere belang was. Die probleem van administrasie en delegasie is op bekende wyse behandel in 'n referaat wat deur Raadslid H. G. Kipling voorgedra is, en die bespreking daarvan was hoogs insiggewend.

Ander punte wat in die forum bespreek is, het gehandel oor "Draagbare Toestelle wat vanaf kontakokke gevoer word" wat in 'n deeglike referaat deur Mnr. A. F. Turnbull voorgedra is, en "Aardlekbeskerming, soos in Bogronse Lyne en Huishoudelike Installasies toegepas," wat op ewe bekende wyse deur Mnr. H. P. Smith in 'n referaat behandel is.

TEGNEISE VERGADERING 1968.

Die Tegnieise Vergadering is vir die eerste keer oor 'n tydperk van twee dae gehou, en wel te Vanderbijlpark op 9 en 10 Mei 1968. Ons wil graag ons waardering teenoor Sy Agbare die Burgemeester en Raadslede van Vanderbijlpark te boek stel vir die gasvryheid wat aan die afgevaardigdes na die Tegnieise Vergadering betoon is. Die totale bywoning was bevredigend en, na die mening van die organiseerders, was die verlenging van die sitting na twee dae beslis geregtig.

Die tema van die vergadering was "Produktiwiteit in Munisipale Elektriesiteitsondernemings" en hierdie tema is op bekende wyse ingelê deur Mnr. A. C. T. Frantz in vorm van 'n referaat. Dit is opgevolg deur bydraes deur Mnr. C. Lombard oor "Die Gebruik van Halfgeskoolde Arbeid, Bystand vir Ambagsmanne en Meganisasie," "Die Instandhouding van Substasies" deur Mnr. W. W. Martin en A. S. Bridger, "Die Lees van Meters, Boekhouding en Insameling van Gelde" deur Mnr. L. S. Campbell en "Die Installasie en Werkverrigting van Aardlekrele's op Huishoudelike Installasies" deur Mnr. F. J. van der Merwe. Al hierdie praktiese bydraes is goed ontvang en het bespreking van hoogstaande gehalte tot gevolg gehad.

Die referaat van Mnr. S. J. Liebenberg oor "Die Elektriese van die Bantoetuislande" waarin daar ook verwys is na Bantoeedorpe wat as satelliete van munisipaliteite in die blanke gebiede van S.A. beskou kan word, was 'n waardevolle bydrae tot die Verrigtinge van die Vereniging en 'n interessante voorsetting van vorige besprekings oor hierdie onderwerp of vorige Konvensies.

Die referaat van Mnr. G. Masson onder die titel " 'n Oorsig van die gebruik van Ondergrondse Hoogspanning-

of sophisticated equipment designed and largely manufactured in Mocambique.

The paper on "Some Aspects of Street Lighting" by Mr. J. W. Smit, principle Scientist, S.A. Bureau of Standards, was a most useful follow-up to those previously submitted to the Association on this increasingly important aspect of electrical engineering, which is also of general interest.

The Members' Forum on this occasion included a session of particular interest to Councillors. The problem of administration and delegation were ably introduced in a Paper by Councillor H. G. Kipling. Discussion was most informative.

Other items discussed in the forum concerned "Portable Appliances fed from Socket Outlets," ably introduced in a Paper by Mr. A. F. Turnbull, and "Earth Leakage Protection applied to Overhead Lines and Domestic Installations" also ably introduced in a Paper by Mr. H. P. Smith.

1968 TECHNICAL MEETING.

The 1968 Technical Meeting of the Association was held for the first time over a period of two days on 9th and 10th May at Vanderbijlpark. Our appreciation is extended to His Worship the Mayor of Vanderbijlpark, and City Councillors for the hospitality shown to delegates to the Technical Meeting. The total attendance was considered satisfactory and justified, in the opinion of the Organisers, the extension of the meeting over a period of two days. Appreciation is expressed to his Worship the Mayor and Councillors of Vanderbijlpark for the hospitality extended to those attending the Meeting.

The theme of the meeting was "productivity in municipal electricity undertakings," and the topic was ably introduced in a Paper by Mr. A. C. T. Frantz followed up with contributions by Mr. C. Lombard "Use of Semi-skilled Labour, Assistance for Artisans and Mechanisation," "Substation Maintenance" by Mr. W. W. Martin and Mr. A. S. Bridger, "Meter Reading, Accounting and Collections" by Mr. L. S. Campbell, and "Installation and Performing of Earth Leakage Relays in Domestic Installations" by Mr. F. J. van der Merwe. All these practical contributions were well received and evoked discussion of a high standard.

The paper by Mr. S. J. Liebenberg "Electrification of the Bantu Homelands," which referred also to Bantu towns which are satellites of municipalities in the White areas of the Republic, was a valuable contribution to the Proceedings of the Association, and an interesting follow-up to previous discussion in Conventions on the same subject.

kabelnetwerk in Johannesburg" was eweneens 'n opvolging van 'n vroeëre hydrae tot die Verrigtinge van die Vereniging, en het 'n onderwerp van aktuele praktiese belang gedek.

Die lede-forum by die Tegnieëse Vergadering het 'n groot hoeveelheid konstruktiewe bespreking uitgelok, veral met betrekking tot die koördinerende van die elektrisiteitsvoering.

LIDMAATSKAP.

Die volgende nuwe lede is gedurende die twee jaar wat op 28 Februarie 1969 geëindig het, verkies:

Rade-lede:

- Die Munisipaliteit Ermelo.
- Die Munisipaliteit Howick.

Ingenieurslede:

- G. C. du Plessis (Adjunk-Elektrotegniese Stadsingenieur, Potchefstroom).
- A. P. van Schaalkwyk (Adjunk-Elektrotegniese Stadsingenieur, Bloemfontein).
- E. A. McWilliam (Elektrotegniese Stadsingenieur, Pretoria).
- J. W. S. Muir (Elektrotegniese Ingenieur, Knysna).
- D. S. van der Merwe (Elektrotegniese Ingenieur, Witbank).
- J. N. Jones (Elektrotegniese Stadsingenieur, Bulawayo).
- A. Gerber (Assistent-Elektrotegniese en Meganiese Ingenieur, Keetmanshoop).
- K. U. Psotta (Elektrotegniese Stadsingenieur, Keetmanshoop).
- W. Robertson (Elektrotegniese Ingenieur, Hermanus).
- H. Foden (Adjunk-Elektrotegniese Stadsingenieur, Salisbury).
- C. P. du Plessis (Elektrotegniese Ingenieur, De Aar).
- K. J. Murphy (Elektrotegniese Ingenieur, Cradock).
- K. G. Robson (Elektrotegniese Stadsingenieur, Oos-Londen).
- M. J. W. Chappel (Adjunk-Elektrotegniese Stadsingenieur, Port Elizabeth).

Geassosieerders:

- J. A. Munro, (Elektrotegniese Ingenieur, Bloemhof).
- C. J. Snyman, (Elektrotegniese Ingenieur, Ventersdorp).
- W. J. Dauth (Senior Elektrisiën, Postmasburg).
- A. Louw (Elektrotegniese Ingenieur, Kakamas).
- P. J. R. Pretorius (Elektrotegniese Ingenieur, Vryburg).

Tegniese Geassosieerdes.

- G. S. de Vries (Seksie-Ingenieur, Distribusie, Bloemfontein).
- H. J. Brink (Seksie-Ingenieur, Distribusie, Bloemfontein).

The paper by Mr. G. Masson "A Review of High Voltage Underground Cable Reticulation Practice in Johannesburg" was likewise a follow-up on an earlier contribution to the Association's Proceedings, and covered a subject of practical current interest.

Members forum at the Technical Meeting brought forth much constructive discussion, particularly in relation to co-ordination of electricity supply.

MEMBERSHIP.

The following new members were elected during the two years ended 28th February, 1969:

Councillor Members:

- Municipality of Ermelo.
- Municipality of Howick.

Engineer Members:

- G. C. du Plessis (Deputy Town Electrical Engineer, Potchefstroom).
- A. P. van Schaalkwyk (Deputy City Electrical Engineer, Bloemfontein).
- E. A. McWilliam (City Electrical Engineer, Pretoria).
- J. W. S. Muir (Electrical Engineer, Knysna).
- D. S. van der Merwe (Electro-Technical Engineer, Witbank).
- J. N. Jones (City Electrical Engineer, Bulawayo).
- A. Gerber (Assistant Electrical & Mechanical Engineer, Keetmanshoop).
- K. U. Psotta (Electro-Technical Engineer, Keetmanshoop).
- W. Robertson (Electrical Engineer, Hermanus).
- H. Foden (Deputy City Electrical Engineer, Salisbury).
- C. P. du Plessis (Electro-Technical Engineer, De Aar).
- K. J. Murphy (Municipal Electrical Engineer, Cradock).
- K. G. Robson (City Electrical Engineer, East London).
- M. J. W. Chappel (Deputy City Electrical Engineer, Port Elizabeth).

Associates:

- J. A. Muro (Town Electrical Engineer, Bloemhof).
- C. J. Snyman (Town Electrical Engineer, Ventersdorp).
- W. J. Dauth (Senior Electrician, Postmasburg).
- A. Louw (Town Electrical Engineer, Kakamas).
- P. J. R. Pretorius (Town Electrical Engineer, Vryburg).

Technical Associates:

- G. S. de Vries (Section Engineer, Distribution, Bloemfontein).
- H. J. Brink (Section Engineer, Generation, Bloemfontein).

D. B. Briers (Beplanningingenieur, Bloemfontein).
W. J. Reichert (Assistent-Elektrotegniese Ingenieur,
Stilfontein).

D. B. Briers (Planning Engineer, Bloemfontein).
W. J. Reichert (Asst. Electrical Engineer, Stilfontein).

Geaffilieerdes.

Tork Time Controls, Geink.
Keen's Electrical Distribution (Edms.) Bpk.
Marthinusen en Coutts (Edms.) Bpk.
G. S. Rogers (Edms.) Bpk.
S.A. Nasionale Komitee vir Verligting.
Belliss en Morcom Suidelike Afrika (Edms.) Bpk.
Kantley, Pempier, Loteryman en de Kroon.
Wardle en Simpson.
Eberhard-Martin (Edms.) Bpk.
Amalgamated Power Engineers S.A. (Edms.) Bpk.

Affiliates :

Tork Time Controls, Inc.
Keen's Electrical Distribution (Pty.) Ltd.
Marthinusen & Coutts (Pty.) Ltd.
G. S. Rogers (Pty.) Ltd.
S.A. National Committee in Illumination.
Belliss & Morcom Southern Africa (Pty.) Ltd.
Kantley, Templar, Loteryman & de Kroon.
Wardle & Simpson.
Eberhard-Martin (Pty.) Ltd.
Amalgamated Power Engineers S.A. (Pty.) Ltd.

Oorplasinge :

D. Murray-Nobbs vanaf Ingenieur-lid na Assosiaat-lid.
W. J. Reichert vanaf Ingenieur-lid na Tegnieise
Geassosieerde.
E. L. Smith vanaf Ingenieur-lid na Assosiaat-lid.
J. W. Phillips vanaf Ingenieur-lid na Afgetrede Lid.

Transfers :

D. Murray-Nobbs transferred from Engineer to
Associate Member.
W. J. Reichert transferred from Engineer to Technical
Associate.
E. L. Smith transferred from Engineer to Associate
Member.
J. W. Phillips transferred from Engineer to Retired
Member.

Die volgende bedankings is gedurende die tydperk
waaroor hierdie verslag handel, ontvang :

The following resignations took place during the
period under review :

Ingenieur-lede :

J. W. Hough — Brakpan.
P. A. Giles — Oos-Londen.
T. H. Baillie — Broken Hill.

Engineer Members :

J. W. Hough — Brakpan.
P. A. Giles — East London.
T. H. Baillie — Broken Hill.

Assosiaat-lede :

D. P. de Wet — Brakrivier.
T. de Wit — Brits.

Associate Members :

D. P. de Wet — Brakrivier.
T. de Wit — Brits.

Rade-lede :

Walmer, by sy amalgamasie met Port Elizabeth.
Stutterheim.
Que Que.
Broken Hill (Kabwe).
Mooirivier.
Morreesburg.

Councillar Members :

Walmer on amalgamation with Port Elizabeth.
Stutterheim.
Que Que
Broken Hill (Kabwe).
Mooi River.
Morreesburg.

Geaffilieerdes :

George Kent.
G. H. Langler en Kie. Bpk.
Rhotec Sales (Pvt.) Bpk.
S. Cohen Bpk.
Tork Time Controls Geink.
Minnesota Mining en Manufacturing Co. (S.A.)
(Edms.) Bpk.
G.E.C. Rhodesië (Pvt.) Bpk.
Copperbelt Power Company.
Samuel Osborne S.A. (Edms.) Bpk.

Affiliates :

George Kent.
G. H. Langler & Co. Ltd.
Rhotec Sales (Pvt.) Ltd.
S. Cohen Ltd.
Tork Time Controls Inc.
Minnesota Mining & Manufacturing Co. (S.A.) (Pty.)
Ltd.
G.E.C. Rhodesia (Pvt.) Ltd.
Copperbelt Power Company.
Samuel Osborne S.A. (Pty.) Ltd.

Afgestorwe lede :

J. W. Ross, Brits — Ingenieurlid.
J. C. Fraser, Johannesburg — Erelid.

Die vergelykende lidmaatskapsyfers is soos volg :

	Volgens vorige verslag	Insluitende tot 28.2.69 en met uitsluiting van daardie persone wie se huidige adresse onbekend is.
Erelede	16	18 (per abuis as 14 aangegee)
Afgetrede lede	3	5
Ondernemingslede	138	133
Ingenieurlede	125	136
Tegniese Geassosieerdes	1	5
Geassosieerdes	19	24
Assosiaal-lede	31	33
Geaffilieerdes	90	91

GELDSAKE.

Die Inkomste- en Uitgawe-rekenings vir die twee jaar wat deur hierdie verslag gedek word, tesame met die balansstate soos dit op 29 Februarie 1968 en 28 Februarie 1969 was, word hierby aan u voorgelê.

Die uitslag van die twee jaar se bedrywighede is 'n gekonsolideerde oorskot van R3,436. Die Konvensie te Lourenco Marques het besonder hoë uitgawes meegebring, dog, met die oog op die feit dat 'n volkskaalse Konvensie nou slegs elke tweede jaar gehou word, is dit nodig dat die Vereniging se geldsake in heroerweging geneem word, hoofsaaklik as gevolg van die steeds stygende produksiekoste van die Verrigtinge. Die twee volumes van die Verrigtinge wat nou elke jaar gepubliseer word, is aan 'n gestadige toename in die koste onderhewig, hoofsaaklik as gevolg van hoër drukkoste, dog dit moet daarby in gedagte gehou word dat die Verrigtinge tans, sover as prakties moontlik, in 'n heeltal tweetalige vorm uitgegee word. Dit het natuurlik 'n groot invloed uitgeoefen op die onkoste wat deur die Vereniging gedra moet word. Inkomste uit advertensies, sowel as die verkoop van bykomstige eksemplare van die Verrigtinge, kon nie op dieselfde peil gehandhaaf word nie, en dit was 'n bydraende faktor tot 'n groter verlies op die produksie van die Verrigtinge.

'n Voorstel ter verhoging van die ledegelede verskyn op die sakelyk van hierdie Konvensie, en die Uitvoerende Raad sal sy sienswyse daaromtrent aan die Konvensie voorlê. Vir die inligting van lede dien daar op gewys te word dat daar geen verhoging van die ledegelede van Rade sedert die algemene verhoging van Mei 1956 plaasgevind het nie, met die uitsondering van 'n baie geringe aan-

Members Deceased :

J. W. Ross, Brits — Engineer Member.
J. C. Fraser, Johannesburg — Honorary Member.

Comparative Membership figures are as follows :

	As per previous report	Including admissions up to 28.2.69 and excluding those individuals present whereabouts are unknown
Honorary Members	16 (shown in error as 14)	18
Retired Members	3	5
Undertaking Members	138	133
Engineer Members	125	136
Technical Associates	1	5
Associates	19	24
Associate Members	31	33
Affiliates	90	91

FINANCE.

The Income and Expenditure Accounts for the years under review, together with Balance Sheets, as at 29th February 1968 and 28th February 1969, are submitted herewith.

The results of the two years operation is a consolidated excess of Expenditure over Revenue of R3,436. The Lourenco Marques Convention was particularly costly, but on the basis of a full Convention being held only every second year, the finances of the Association now require reconsideration, principally as a result of the continued increase in cost of production of the Proceedings. The two volumes of the Proceedings now published annually have been subject to a steady rise in cost due to increase in printing charges, but in addition, it must be remembered that these are now produced as nearly as practical in completely bilingual form. This has naturally had a very great effect on the cost to be met by the Association. Advertising revenue, as well as sales of additional copies of Proceedings, have not been maintained, and this is another factor resulting in an increase loss on the Proceedings.

A proposal to increase subscriptions is contained in the Agenda for this Convention, and the Executive Council will submit its views thereon to the Convention. For the information of members, it is desired to point out that the subscription rate of Councils has not been increased,

passing in 1965 as gevolg van die oorskakeling van ponde en rande. Die verhoging van 1956 was daarop gemik om voorsiening te maak vir die betaling van reis- en verblyf-koste ten opsigte van die halfjaarlikse vergaderings van die Uitvoerende Raad en om die las van daardie plaaslike owerhede wie se verteenwoordigers op die Uitvoerende Raad gedien het, te verlig. Daar was baie min, indien enige, aanpassing om die algemene verhoging van die kostestruktuur en die verminderende koopkrag van geld die hoof te bied.

Ander fasiliteite soos klankreproduksie van hoë gehalte, met inbegrip van gelyktydige vertaaldienste, bring ook hoe uitgawes mee, en daar moet verder in gedagte gehou word dat, alhoewel 'n Tegniëse Vergadering ten opsigte van onthaalkoste (d.w.s. die hoof-sosiale funksie by die Konvensie) heelwat minder kos as 'n volkskaalse Konvensie, die ander uitgawes nie veel minder is nie.

Ek wil graag langs hierdie weg my dank oordra aan die lede van die Komitee vir geldsake, nl. Mnr. R. Leishman, die sameroeper, en Mnr. C. Lombard, vir hul bystand gedurende die afgelope twee jaar.

STREEKSTAKKE.

Daar is gedurende die tydperk wat deur hierdie verslag gedek word, geen nuwe streekstakke gestig nie.

HALFJAARLIKSE VERGADERINGS VAN DIE UITVOERENDE RAAD.

Die halfjaarlikse vergaderings van die Uitvoerende Raad wat in 1968 en 1969 gehou is, het albei in Johannesburg plaasgevind, en in beide gevalle het die Stadsraad van Vanderbijlpark as gasheer opgetree. Namens die President en die Uitvoerende Raad wil ek graag ons opregte dank oordra aan Sy Agbare die Burgemeester en die Stadsraadslede van Vanderbijlpark vir die gasvryheid wat hulle aan die Uitvoerende Raad betoon het, nie alleen by hierdie geleentheid nie, maar ook tydens sy vergadering wat met die Tegniëse Vergadering saamgeval het.

SUBKOMITEES EN VERTEENWOORDIGERS.

Dit is weereens my voorreg om die dank en waardering van alle betrokkenes oor te dra aan die lede van die tegniëse subkomitees van die Vereniging, sowel as aan diegene wat ons belange in ander organisasies verteenwoordig. Hulle taak word elke jaar meer belangrik, en al die lede van die Vereniging is veel dank aan hulle verskuldig.

R. G. Ewing,
namens Davidson en Ewing (Edms.) Bpk.
Sekretaris.

apart from a slight adjustment in 1965 arising from the conversion from pounds to rands, since a general increase in May 1956. On that occasion the purpose was to make provision for the payment of the costs of travelling and accommodation in respect of the mid-year Executive meetings, and to remove the burden therefore from the local authorities whose representatives served on the Executive. There was little or no adjustment to meet the general growth in cost structure and decreased purchasing power of currency.

Other facilities such as high quality sound reproduction, including simultaneous translation, are also costly, and it must further be remembered that whilst a Technical Meeting is far less costly than a Convention in respect of entertainment expenses, i.e. the major social function at a Convention, other costs are not appreciably lower.

I wish to convey sincere thanks to the members of the Finance Committee, Mr. R. Leishman, Convenor, and Mr. C. Lombard, for their assistance in the past two years.

REGIONAL BRANCHES.

No new Regional Branches have been established during the period under review.

MID-YEAR EXECUTIVE MEETINGS.

The Mid-year Executive Meetings held in 1967 and 1968 both took place in Johannesburg, and the host was the Municipality of Vanderbijlpark. On behalf of the President and Executive Council sincere appreciation is conveyed to His Worship the Mayor and Councillors of Vanderbijlpark for their hospitality extended to the Executive on these occasions, as also to the Executive Council when it met at the time of the 1968 Technical Meeting.

SUB-KOMITEES AND REPRESENTATIVES.

Once again, it is my privilege to convey the appreciation of all concerned to the members of the technical sub-committees in the Association, as well as those who represent our interests on other organisations. Year by year their task is becoming more important, and the entire membership owes them a debt of gratitude.

R. G. EWING,
for Davidson & Ewing (Pty.) Ltd.
Secretaries.

10 April 1969.

10th April, 1969.

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA.
 VERENIGING VAN MUNISIPALE ELEKTRISITEITSONDERNEMINGS VAN SUIDELIKE AFRIKA.

BALANCE SHEET — 28th FEBRUARY, 1969
 BALANSSTAAT — 28 FEBRUARIE 1969

1968			1968			
R.		R. R.	R.		R. R.	
4,214	ACCUMULATED FUNDS/ OPGEHOOPTE FONDS		3,947	2	PRESIDENTIAL BADGE/ PRESIDENTS KENTEKEN	2
7,383	Balance at 1st March, 1968/ Balans soos op 1 Maart 1968	4,214		47	FURNITURE AND FITTINGS/ MEUBELS EN TOEBEHORE	42
3,169	Less Excess of Expenditure over Income for the year/ Min Oorskot van Uitgawe oor Inkomste vir die jaar	267			At cost less Depreciation/ Teen Kosprys min waarde- vermindering	
2,032	CURRENT LIABILITIES/ BEDRYFSLASTE		5,534	3,500	INVESTMENTS/ BELEGGINGS	2,000
2,032	Sundry Creditors/ Diverse Krediteure	1,474			Indefinite Period Shares with Building Societies/ Onbepaalde termyn aandele by Bouverenigings	
—	Hotel and Air Deposits received in advance/ Hotel en Lug Depositos ontvang betalings 1969 Convention/Konvensie	4,060		2,697	CURRENT ASSETS/ BEDRYFSBATES	7,437
				1,553	Sundry Debtors/ Diverse Debiteure	1,147
				150	Payments in Advance/ Vooruitbetalings — 1969 Convention/Konvensie	563
				80	Savings Account/ Spaarrekening	1,104
				20	Deposit/ Deposito	20
				894	Cash at Bank/ Kontant by Bank	4,603
<u>R6,246</u>			<u>R9,481</u>			
				<u>R6,246</u>		<u>R9,481</u>

G. C. THERON, President.

DAVIDSON EN EWING (EIENDOMS) BEPERK
 DAVIDSON & EWING (PROPRIETARY) LIMITED
 per : R. G. EWING
 Secretaries/Sekretaris

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA.
 VERENIGING VAN MUNISIPALE ELEKTRISITEITSONDERNEMINGS VAN SUIDELIKE AFRIKA.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 28TH FEBRUARY, 1969
 INKOMSTE- EN UITGAWE REKENING VIR DIE JAAR GEËINDIG 28 FEBRUARIE 1969

1968			1968		
R.		R.	R.		R.
100	Audit Fees/Ouditgelde 1968	100	306	Income from Investments/ Inkomste uit Beleggings	245
40	Bank Charges / Bankkoste	52		Interest Received/ Rente Ontvang	
3,152	Convention and Technical Meeting Expenses/ Konvensie en Tegniiese Ver- gaderingskoste	374	6,026	Subscription and Attendance Fees/ Subskripsie en Bywoningsgelde	6,044
	Vanderbijl Park —	374		Excess of Expenditure over Income/ Oorskot van Uitgawe oor Inkomste	267
	Technical Meeting Cost Tegniiese Vergaderingskoste			Transferred to Accumulated Funds/ Oorgedra na Opgehoopde Fonds	
3,152	Lourenco Marques — Net Cost	—	3,169		
5	Depreciation — Furniture and Fittings/ Waardevermindering — Meubels en Toebehore	5			
501	Executive Council Expenses/ Uitvoerende Raadkoste	692			
	— Mid-year Meeting/ Mid-jaar vergadering				
5	Insurance/ Assuransie	30			
2,273	Loss on Production of Pro- ceedings/ Verlies met Produksie van Ver- rigtinge	1,618			
98	Postages and Telegrams (General)/ Posgeld en Telegramme (Algemeen)	174			
541	Printing & Stationery (General) / Drukwerk en Skryfbehoeftes (Algemeen)	384			
1,950	Secretarial Fees/ Sekretarielegelde	2,160			
21	Subscriptions/ Subskripsies	61			
97	Sundry Expenses/ Diverse Uitgawe	10			
199	Telephones/ Telefoon	206			
257	Translation Fee/ Vertalinggelde	383			
262	Travelling Expenses (General)/ Reiskoste (Algemeen)	307			
<u>R9,501</u>		<u>R6,556</u>	<u>R9,501</u>		<u>R6,556</u>

REPORT OF THE AUDITORS TO THE MEMBERS OF THE
OUDITEURSVERSLAG AAN DIE LEDE VAN DIE

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA.
VERENIGING VAN MUNISIPALE ELEKTRISITEITSONDERNEMINGS VAN SUIDELIKE AFRIKA.

We have audited the books of Account and examined the Securities
Ons het die rekeningboeke en die sekuriteite van die Vereniging
of the Association. We have obtained all the information and explanations
geouditeer en nagegaan. Ons het al die inligting en verduidelikings gekry
which to the best of our knowledge and belief were necessary for the
wat, na die beste van ons wete en kennis, vir die doeleindes van ons
purpose of our audit. In our opinion proper books of account have been
oudit nodig was. Na ons mening is behoorlike rekeningboeke gehou vir
kept as far as appears from examination of those books and we certify
sover dit uit ons ondersoek van daardie boeke blyk, en ons sertifiseer
that the attached Balance Sheet and Income and Expenditure Account are
dat die aangehegte Balansstaat en Inkomste- en Uitgawerekening met die
in agreement with the books of account. We further certify that the
rekeningboeke ooreenstem. Ons sertifiseer verder dat die Balansstaat
Balance Sheet gives a true and fair view of the state of the Association
'n juiste en redelike oorsig verstrek van die toestand van die Vereniging
as at the 28th February, 1969, and the Income and Expenditure Account
se sake soos op 28 Februarie 1969, en dat die Inkomste- en Uitgawerekening
gives a true and fair view of the results ended on that date.
'n juiste en redelike oorsig verstrek van die resultate vir die jaar wat op
daardie datum geëindig het.

EAST LONDON.
11th April, 1969.
OOS-LONDEN.
11 April 1969.

LAZARUS BROTHERS & BARR
LAZARUS BROERS EN BARR
Chartered Accountants (S.A.)
Geoktrooieerde Rekenmeesters (S.A.)
Auditors/Ouditeure.

DIE ELEKTRISITEITSVOORSIENINGSKOMMISSIE VAN RHODESIE.

'n Oorsig van vooruitgang en van Toekomstige Tendense.
deur

D. R. IRVINE, B.Sc.(Ing.) Siv. Ing., L.L.E.I. L.L.I. (Rhod.)
Hoof- Handelingsingenieur.

1. GESKIEDKUNDIGE AGTERGROND.

Een van die grondliggende redes vir Rhodes se planne om die gebied wat tans as Rhodesië bekend staan, te okkupeer, is ontgetwyfeld te vinde in die berigte en gerugte wat indertyd in omloop was dat 'n tweede Witwatersrand op ontdekking gewag het in die bosryke streek tussen die Limpopo- en Zambesiriviere. Die gevolg was dat, sodra die okkupasie 'n voldoende feit geword het, die belangrikste bedrywighede buite die dorpies en gehuggies wat ontstaan het, op die mynbedryf toegespits was.

In die vroeë dae het die myne wat tot stand gekom het, hulle krag gekry van masjiene wat eers deur stoom en later deur suigas aangedryf is, en wat vir hul brandstofvoorraad op die inheemse bosse aangewese was. Teen die dertigerjare het hout egter begin skaars word en die mynwerkers het hulself na ru-olie-enjins begin wend. Hierdie enjins was op hulle beurt egter duur om aan te koop en aan die loop te hou, maar ook om in stand te hou, veral onder die afgesonderde plaaslike omstandighede.

As gevolg hiervan het die Bernheimmyn in die Mazoe-district in Oktober 1933 aansoek om die verskaffing van elektrisiteit vanaf die Munisipaliteit Salisbury, wat sowat 20 myl na die Suide geleë is. Die Munisipaliteit het op sy beurt by die Regering aangeklop om finansiële hulp ter verkryging van die kapitaal wat vir die bou van die lyn nodig was.

Die destydse Minister van Mynwese, wyle Kaptein W. S. Senior, was van mening dat daar alle rede bestaan het om die beoogde ontwikkeling aan te moedig. Deur krag vanaf sentraal-geleë kragentrales te verskaf, sou daar plaaslike steenkool in plaas van ingevoerde ru-olie gebruik word, wat weer die betalingsbalans sou verbeter, terwyl die land se natuurlike hulpbronne beter bewaar sou kon word deur die hoeveelheid hout wat die inheemse bosse onttrek word, te verminder. Die werker sou op sy beurt 'n betroubare bron van krag bekom, en die taryke, duur brekasies van kragbronne sou iets van die verlede wees. Ook sou hy, soos by dieper die aardkors indring op soek na lonende etensierslae, nie meer die las ondervind wat deur die voortdurende tekort aan krag meegebring is nie.

'n Maand ná die Bernheim-aansoek het die Munisipaliteit Gatooma die Regering versoek om oorweging te skenk aan 'n skema ingevolge waarvan krag vanaf die munisipale kragentrale aan nabygeleë plase en myne verskaf sou kon word. In hierdie stadium het die Minister besluit dat 'n meer algemene ondersoek nodig was en het opdrag gegee dat 'n verslag insake die verskaffing van elektrisi-

THE RHODESIA ELECTRICITY SUPPLY COMMISSION.

A Review of Progress and of Future Trends.
by

D. R. IRVINE, B.Sc.(Eng.) C.Eng. M.I.E.E. M. Rhod. I.E.
Chief Commercial Engineer

1. HISTORICAL BACKGROUND

One of the fundamental reasons behind Rhodes's plans for occupying what is now Rhodesia undoubtedly lay in the reports and rumors which were prevalent at the time that a second Witwatersrand was waiting to be discovered in the wooded lands that lay between the Limpopo and Zambesi rivers. Accordingly once occupation was an accomplished fact, the main centre of activity, outside the villages and hamlets that were established, was in the mining industry.

In the early days, the mines that were established obtained their power from plant driven first by steam and then by suction gas, each of which relied on the indigenous forests for fuel. By the 1930's, however, timber was becoming scarce and the miners were turning to crude oil engines. These however were in turn costly not only to acquire and to run but also to maintain, especially under the local isolated conditions.

As a result, in October 1933 the Bernheim Mine in the Mazoe District, applied for a supply of power from Salisbury Municipality, which was some 20 miles to the south. The Municipality in turn approached the Government for financial assistance in finding the capital for the line.

The Minister of Mines at the time, the late Capt. W. S. Senior, decided there was every reason to encourage the development proposed. By supplying power from central electricity power stations, local coal would be used instead of imported crude oil and the balance of payments would be improved, while, by reducing still further the inroads being made into the indigenous timber, the country's natural resources would be conserved. The miner, for his part, would receive a reliable source of power and the frequent and costly breakdowns of prime movers would be a thing of the past. Also as he went deeper into the earth in search of payable ore he would no longer be plagued with the continual problem of shortage of power.

A month after the Bernheim application, Gatooma Municipality requested the Government to consider a scheme under which power from the municipal power station would be supplied to adjacent farms and mines. At this stage the Minister decided a more general investigation was required and called for a report on the supply

teit aan myne in Rhodesië, met spesiale verwysing na die Gatooma-gebied, aan hom voorgelê moet word.

As gevolg van hierdie verslag en van latere, meer gedetailleerde opnames van die belastingspotensiaal van die vernaamste myngebiede, het die Regering in Januarie 1935 besluit om 'n wetsontwerp in te dien, ingevolge waarvan daar 'n Elektrisiteitsvoorsieningskommissie in die lewe geroep sou word, en die Wet op Elektrisiteitsvoorsiening is, met inwerkingtreed op 1 Julie 1936, afgekondig. In die tussentyd is 'n ooreenkoms aangegaan tussen die Regering, die Munisipaliteit Umtali en die Mynvereniging van Penhalonga aangegaan, ingevolge waarvan die Regering die finansies verskaf het vir 'n lyn van 22 KV vanaf die munisipale kragentrale na Penhalonga. Soortgelyke reëlings is getref tussen die Regering, die Munisipaliteit Gwelo en die Vereniging van Myn-eienaars van Selukwe vir 'n lyn van 33 KV vanaf Gwelo na Selukwe.

2. DIE ONTWIKKELING VAN DIE KOMMISSIE.

Die Kommissie se eerste stappe was om in 1937 die munisipale kragcentrales te Umtali, Gatooma en Gwelo, tesame met die halfvoltoeide Umtali-Penhalonga- en Gwelo-Selukwe-kraglyne, aan te koop. Bykomend hier toe is bestellings geplaas vir die oprigting van nuwe kragcentrales by Gwanda, Shabani en Umniati en daar is begin met die bou van die transmissie- en verspreidingsstelsels wat vanaf hierdie kragcentrales uitgestraal het.

Ten einde die gebiede rondom Salisbury en Bulawayo te dek, het die Kommissie gereël om krag by grootmaat van die kragcentrales in hierdie twee stede aan te koop, en verder kraglyne is gebou om elektrisiteit na die omliggende plase en myne te versprei.

Teen die tyd dat die oorlog uitbreek het, dit wil sê toe die Kommissie skaars drie jaar lank bestaan het, was daar reeds 640 myl kraglyn in werking en is dertig miljoen eenhede verkoop, waarvan 80% aan myne.

Ten spyte van die ses jare van oorlog wat hierop gevolg het (gedurende welke tydperk 'n groot hoeveelheid materiaal en toerusting wat nie meer ingevoer kon word nie, in die verskillende werksinkels van die Kommissie vervaardig is) het die mylafstand van kraglyne, toe die vrede gesluit is, meer as verdubbel, terwyl die verkope vervierdubbel het tot 120 miljoen eenhede, van welke hoeveelheid die myne sowat 93 miljoen eenhede verbruik het, wat nog amper 80% van die totaal uitgemaak het. Die installasies in die sewe kragcentrales by Gatooma, Gwanda, Gwelo, Rusape, Shabani, Umniati en Umtali het 'n totale vermoë van 37 M.W. gehad, terwyl daar bykomstig sowat 5 M.W. krag van die Munisipaliteite Bulawayo en Salisbury aangekoop is.

In die na-oorlogse tydperk is daar 'n begin gemaak met die oprigting van die Kommissie se hoof-kragcentrale, nl. Umniati B. Dit is oorspronklik as 'n sentrale van 140 M.W. ontwerp, maar met die oog op die vooruitsig om krag vanaf Kariba te kry, is die bouwerk in 1957 gestaak, toe daar reeds 120 M.W. geïnstalleer was. In die tussentyd is daar ook toevoegings gemaak tot die kragcentrales by Umtali, Shabani en Gwanda, terwyl daar met dié by Gatooma, Gwelo en Rusape weggedoen is. In Umtali is die bouwerk aan die kragcentrale egter ook gestaak, en

of electricity to mines in Rhodesia, with special reference to the Gatooma area.

As a result of this report and of subsequent more detailed surveys of the load potential of the principal mining areas, the Government decided, in January, 1935, to introduce a Bill creating an Electricity Supply Commission, and the Electricity Supply Act was promulgated with effect from the 1st July 1936. In the meantime, an agreement had been entered into between the Government, the Umtali Municipality and the Penhalonga Miners Association whereby the Government financed the erection of a 22kV line from the municipal power station to Penhalonga. Similar arrangements were entered into between the Government, the Gwelo Municipality and the Selukwe Mine Owners' Association for a 33kV line from Gwelo to Selukwe.

2. THE DEVELOPMENT OF THE COMMISSION.

The Commission's first steps in 1937 were the purchase of the municipal power stations at Umtali, Gatooma and Gwelo and of the partly completed Umtali-Penhalonga and Gwelo-Selukwe power lines. In addition new power stations were ordered for erection at Gwanda, Shabani and Umniati, and work was started on the transmission and distribution systems radiating from all these stations.

To cover the areas around Salisbury and Bulawayo, the Commission arranged to purchase power in bulk from the municipal power stations in these two cities, and further power lines were constructed to distribute electricity to the adjacent mines and farms.

By the out-break of the War, after just over three years of existence, 640 miles of power lines were in operation and thirty million units were being sold, 80% of them to mines.

In spite of the subsequent six years of war (during which a considerable quantity of training material, as well as equipment which could no longer be imported, was manufactured in the Commission's various workshops), by the time peace came again, the mileage of power lines had more than doubled while sales had quadrupled to 120 million units a year, of which amount mines consumed 93 million units, still not much less than 80% of the total. Plant installed in seven power stations at Gatooma, Gwanda, Gwelo, Rusape, Shabani, Umniati and Umtali totalled 37 MW and in addition about 5 MW of power was purchased from Bulawayo and Salisbury Municipalities.

In the post-war period the erection of the Commission's major power station, Umniati B, was commenced. This was scheduled as a 140 MW power station but owing to the advent of Kariba power, construction was brought to a halt in 1957 when 120 MW had been installed. In the meantime additions were also made to the Umtali, Shabani and Gwanda power stations while those at Gatooma,

wel in 1956, aangesien onderhandelinge met die Portugese owerhede aangeknoop is om die Kommissie in staat te stel om sy kragvoorrade vir die Oostelike Distrikte vanaf die stelsel wat deur die Sociedade Hidro-Elctrica do Revue op die Revue-ivier ontwikkel is, aan te koop. Hierdie aankope het op 14 Julie 1957 begin en, afgesien van twee typerke van ernstige droogte, het die krag-sentrale vir Umtali sedertdien slegs op 'n gereedheids-grondslag gefunksioneer.

Toe krag vanaf die Karibakrag-sentrale in 1960 en 1961 beskikbaar gestel is, het die Kommissie sy benodig-hede vir Mashonaland by Norton, vir die Middellande by Sherwood en vir Matabeleland by Bulawayo aangekoop. Die posisie met betrekking tot geïnstalleerde masjinerie by die verskillende krag-sentrales van die Kommissie was in hierdie stadium soos volg:—

Umtali	120	M.W.
Shabani	31.25	M.W.
Umtali	16.50	M.W.
Gwanda	12.50	M.W.
Chipinga (diesel)	0.37	M.W.
Totaal	180.62	M.W.

Umtali	120	MW
Shabani	31.25	MW
Umtali	16.5	MW
Gwanda	12.5	MW
Chipinga (diesel)	0.37	MW
Total	180.62	MW

Sedertdien is geen groot uitbreidings aan die opwek-vermoë aangebring nie. Die enigste toevoegings was 'n klein verhoging tot 445 K.W. by Chipinga, wat gekoppel is aan 'n klein hidro-elektriese skema van 400 K.W. op die nabylegde Lusiturië-ivier, en 'n dieselsel van 125 K.W. vir gereedheidsdiens by die Victoria-waterval.

Die krag-sentrale vir Umtali is as 'n tussengekoppelde krag-sentrale geklassifiseer en as sodanig het sy kragpro-duksie onder die beheer van die Kariba-owerhede geresorteer. Boonop is ongewaarborgde voorrade langs be-staande kraglyne van die Kommissie beskikbaar gestel ten einde die gedeeltelike afsluiting van die Shabani- en Gwanda-krag-sentrales moontlik te maak, dog dit alles het geheel-en-al onder die Kommissie se beheer gebly.

Om tot die verkope van elektrisiteit terug te keer: die tabel wat as figuur 1 hieronder aangegee word, toon die aantal eenhede wat aan die verskillende klasse van verbruikers verkoop is sedert die totstandkoming van die Kommissie. Tot 1954 is dit gebaseer op die jare wat op 31 Maart eindig, terwyl daar vanaf 1955 van die jare wat op 30 Junie eindig, gebruik gemaak is.

Die syfers toon aan dat dit die land drie jaar geneem het om na die oorlog weer op dreef te kom, dog, toe dit eers gebeur het, was die groei-koers van die belasting fenomenaal. Gedurende hierdie tydperk was die jaarlikse toename 21.7%, en verkope het meer as verdriedubbel.

Oor die algemeen was die agt finansiële jare wat gedurende die tydperk van Federasie geval het, vanuit die oogpunt van kragverkope gesien, nie besonder gunstig vir dié gedeelte van die land wat deur die Kommissie van krag voorsien word nie. Op geen tydstop gedurende die onderhawige tydperk het die jaarlikse presentasie-toe-name dubbele syfers bereik nie, terwyl dit by twee geleenthede so laag as 2.4% was.

Gwelo and Rusape were disposed of. In Umtali however, power station construction was also suspended, this time in 1956, as negotiations had been opened with the Portuguese authorities for the Commission to purchase its power requirements for the Eastern Districts from the system being developed by the Sociedade Hidro-Elctrica do Revue on the Revue river. Purchases commenced on the 14th July 1957 and, apart from two severe periods of drought, the Umtali power station has been on standby ever since.

When power from Kariba power station became available in 1960 and 1961, the Commission purchased its requirements for Mashonaland at Norton, for the Midlands at Sherwood and for Matabeleland at Bulawayo. The plant position at the various Commission power stations at this stage was as follows:—

Since then no further major extensions to the generating capacity have been made, the only additions being a minor increase to 445 kW at Chipinga, coupled with a small 400 kW hydro-electric run-of-river scheme on the adjacent Lusitu river, and a 125 kW standby diesel set installed at Victoria Falls.

Umtali power station was designated an inter-connected power station and as such its output came under the control of the Kariba authority. In addition non-firm supplies were made available over existing Commission power lines to allow partial shutting-down of Shabani and Gwanda power stations, but these remained completely under Commission control.

Turning again to sales of electricity, the table given as Figure 1 below details the units sold to the various classes of consumer since the inception of the Commission. Until 1954 it is based on years ending on the 31st March while, since 1955, years ending on the 30th June have been used.

The figures show that it took three years for the country to get into its stride again after the war, but, once this was accomplished, for the next six years the load growth was phenomenal. During this period the average annual increase was 21.7%, and sales more than trebled.

In general, from the aspect of sales of power, the eight complete financial years which occurred during the period of Federation were not particularly kind to that portion of the country supplied by the Commission, and on no occasion did the annual percentage increase reach double figures, while on two occasions it was as low as 2.4%.

DISTRIBUTION OF UNITS SOLD TO VARIOUS CLASSES OF CONSUMER
SINCE THE INCEPTION OF THE COMMISSION
(MILLIONS)

VERSPREIDING VAN EENHEDE AAN VERSKILLENDE KLASSE VERBRUIKERS
VERKOOP SEDERT DIE TOTSTANDKOMING VAN DIE KOMMISSIE.
(MILJOENE)

Year	Mining	Industrial	Municipal	Farming	Domestic and other Users	Annual Totals	% Increase
Jaar	Mynwese	Nywerhede	Munisipaal	Boerdery	Huishoudelik en ander Verbruikers	Jaarlikse Totale	Toename
1936/37	—	—	0.142	—	—	0.142	—
1937/38	6.146	0.073	4.381	—	0.008	10.608	—
1938/39	23.715	0.645	5.337	—	0.186	29.882	181.7
1939/40	52.956	0.688	5.941	—	0.454	60.039	100.9
1940/41	78.109	2.587	6.504	—	0.652	87.851	46.3
1941/42	87.090	5.692	10.239	—	0.916	103.937	18.3
1942/43	90.989	8.236	11.885	—	1.092	112.202	7.9
1943/44	88.498	9.634	12.715	—	1.395	112.241	0.0
1944/45	92.753	10.761	14.113	—	2.046	119.675	6.6
1945/46	102.168	11.442	13.126	—	2.895	129.631	8.3
1946/47	107.177	12.304	14.899	—	4.080	138.459	6.8
1947/48	107.013	13.431	17.944	2.408	—	143.780	3.8
1948/49	123.403	16.523	25.494	3.555	—	172.846	20.2
1949/50	143.796	30.950	33.455	4.976	—	219.159	26.8
1950/51	157.523	43.725	41.227	7.596	—	259.737	18.5
1951/52	190.192	51.407	89.434	10.728	—	354.799	36.6
1952/53	222.979	63.793	92.724	14.569	—	411.184	15.9
1953/54	231.895	95.509	99.333	18.960	—	467.132	13.6
Apl./June							
1954	61.288	31.680	25.036	5.495	6.030	129.528	—
1954/55	256.130	130.384	85.733	24.961	26.498	523.707	—
1955/56	272.545	149.691	78.856	30.757	31.578	563.427	7.6
1956/57	285.325	168.165	95.247	35.412	35.093	619.243	9.9
1957/58	313.850	174.859	109.481	41.634	37.548	677.372	9.4
1958/59	330.760	166.194	115.986	50.000	43.965	706.904	4.4
1959/60	321.814	177.663	125.394	54.368	44.422	723.661	2.4
1960/61	338.749	188.094	128.496	55.724	47.900	758.963	4.9
1961/62	335.546	197.332	136.247	61.934	54.756	785.816	3.5
1962/63	328.305	212.032	142.445	64.622	57.356	804.760	2.4
1963/64	343.676	286.570	150.596	71.456	60.507	912.804	13.4
1964/65	366.659	322.193	180.707	74.002	64.227	1,007.788	10.4
1965/66	397.863	360.633	170.851	84.730	73.147	1,087.225	7.9
1966/67	415.592	363.892	138.441	89.150	88.390	1,095.465	0.76
1967/68	424.939	591.940	146.325	111.586	96.973	1,371.762	25.2

Figure 1.

Figuur 1.

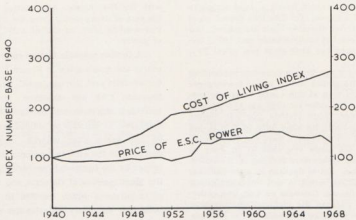


FIGURE 2

Die vyf jaar ná Federasie was jare van wisselende voorspoed, te wyte aan politieke oorwegings wat die normale ekonomiese faktore beïnvloed het. Die gemiddelde groeiakoers gedurende hierdie jare was egter 11.3%, terwyl verlede jaar se syfer 'n skouspelagtige 25.2% was.

The five post-Federation years have been ones of varying fortunes due to political considerations affecting the normal economic factors. The average growth during these years however has been 11.3%, while last year's figure was a spectacular 25.2%, due mainly to a 63%

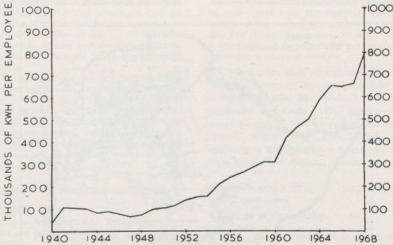


FIGURE 3

Dit is hoofsaaklik te danke aan 'n vermeerdering van 63% nywerheidsverbruik, wat vir die eerste keer dié van die mynnywerheid verbygesteek het. Dat hierdie toenames nie ten koste van die verbruiker plaasgevind het nie, word bewys deur die grafiek in Figuur 2, wat die gemiddelde

increase in industrial consumption, which for the first time exceeded that of the mining industry. That these increases have not taken place at the expense of the consumer is illustrated by the graph in Figure 2 which shows the average price paid in pence per unit compared

prys in pennies wat per eenheid betaal is, soos vergeleke by die prys van 1940, aantoon. Op dieselfde grafiek word die lewenskoste-indeks op dieselfde basis aangetoon. Oor die tydperk van 28 jaar het laasgenoemde met 169% toegeneem, terwyl die prys van krag slegs met sowat 29% vermeerder het.

'n Verdere kenmerk van kragverkope wat vermelding verdien, word deur die grafiek wat in figuur 3 weergegee word, geïllustreer. Dit toon nl. die aantal verkoopte eenhede per werknemer. Die syfer vir 1940 was 41.5 duisend K.W.H. per werknemer. Teen verlede jaar het hierdie syfer byna vertwintigvoudig tot 809.3 duisend K.W.H. per werknemer. Daar sal ook opgemerk word dat die hoeveelheid krag wat teen die einde van 1964/65 en weer ná 1965/66 aan munisipale verbruikers verkoop is, 'n aansienlike afname getoon het. Dit is daaraan te wyte dat daar in 1965 en 1966 finaliteit bereik is met onderhandelinge met die Munisipaliteite van Gatooma en Que Que onderskeidelik, as gevolg waarvan die elektrisiteitsondernemings van albei hierdie plaaslike owerhede by die Kommissie se organisasie ingeskakel is.

Verdere aspekte van die Kommissie se werksaamhede wat van belang mag wees, staan in verband met die myl-afstande van die kraglyne wat reeds opgerig is, die aantal verbruikers wat bedien word en die totale vraag waarin diestelsel moet voorsien.

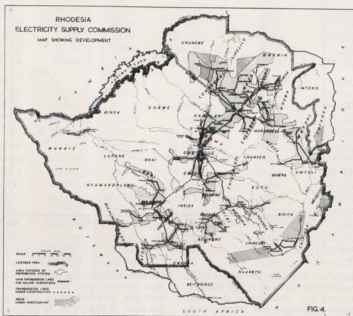
In verband met eersgenoemde blyk dit dat daar aan die einde van 1968 feitlik 10,000 myl transmissie- en verspreidingslyne in werking was, wat soos volg tussen die verskillende spanningskategorieë verdeel was:—

with the 1940 figure. Also plotted on the same basis is the cost of living index. Over the 28 year period the later increased by 169% as against a 29% increase in the price of power.

A further notable feature concerning sales is brought out by the graph given as Figure 3. This shows the number of units sold per employee. The 1940 figure was 41.5 thousand kWh per employee. By last year this had increased nearly twenty-fold to 809.3 thousand kWh per employee. It will also be noticed that, at the end of 1964/65 and again after 1965/66, there were considerable decreases in the sales to municipal consumers. These were caused by the successful conclusion in 1965 and 1966, with the Municipalities of Gatooma and Que Que respectively, of negotiations which resulted in the amalgamation of both their electricity undertakings with the Commission's organisation.

Further aspects of the Commission's activities which may be of interest concern the mileages of power line erected, the number of consumers served, and the overall system demand.

In respect of the first, at the end of 1968 there were virtually 10,000 miles of transmission and distribution line in service, split under the following voltage categories:—



88 en 110 K.V.	620
66 K.V.	130
33 K.V.	1,294
11 K.V.	7,357
Laagspanning	594
	<hr/>
	9995

88 and 110 kV	620
66 kV	130
33 kV	1,294
11 kV	7,357
L.T.	594
	<hr/>
	9,995

Die kaart wat in figuur 4 verskyn, toon die hoof-transmissielyste, sowel as die gebied wat deur die verspreidingsstelsel gedek word. In hierdie stadium is krag aan 12,529 verbruikers verskaf, wat volgens klasse soos volg verdeel is:—

Mynwese	314
Nywerhede	495
Munisipaal	3
Boerdery	4,370
Huishoudelik en ander	8,247
	<hr/>
	12,529

The map which is given as Figure 4, shows the main transmission lines as well as the area covered by the distribution system. At this stage, power was being supplied to 12,529 consumers, which number was subdivided by class as follows:—

Mining	314
Industrial	495
Municipal	3
Farming	3,470
Domestic and Others	8,247
	<hr/>
	12,529

Hierdie totaal lyk miskien laag as mens die totale aantal verkoopte eenhede in ag neem. Daar moet egter onthou word dat, in die groter stadsgebiede soos Salisbury, Bulawayo, Umtali en Gwelo, die Kommissie nie aan individuele verbruikers krag lewer nie. Eersgenoemde twee koop hul kragbehoeftes direk in grootmaat van die owerhede wat oor die Karibastelsel beheer uitoefen — die Sentraal-Afrikaanse Kragkorporasie — terwyl laasgenoemde twee owerhede, tesame met die kleiner Munisipaliteit Fort Victoria, hul voorrade by grootmaat vanaf die Kommissie verkry.

Laastens het die hoogste belasting van die Kommissie se stelsel (na inagneming van die verskeidenheidsfaktor) aan die einde van 1968 232 M.W. beloop. Van hierdie hoeveelheid is meer as 80% vanaf Kariba verkry, terwyl die res gedeeltelik (14%) in die Kommissie se nie-tussen-geskakelde kragsentrales opgewek en gedeeltelik aangekoop is, óf vanaf die portugese hidro-elektriese owerheid in Mosambiek, óf, in die geval van kleinere voorrade, vanaf die naaste private kragsentrales.

This total may seem low considering the number of units sold. It should be remembered however that in the major urban areas of Salisbury, Bulawayo, Umtali and Gwelo, the Commission does not supply individual consumers. The first two purchase their power requirements in bulk direct from the authority operating the Kariba system — the Central African Power Corporation — while the two latter authorities, together with the smaller Municipality of Fort Victoria, are supplied in bulk by the Commission.

Finally, the peak after-diversity demand of the Commission's system at the end of 1968 was 232 MW. Of this amount over 80% was obtained from Kariba while the remainder was partly (14%) generated in the Commission's non-inter-connected power stations and partly purchased, either from the Portuguese hydro-electric authority in Mocambique or, in the case of minor supplies, from the nearest available privately owned power station.

3. DIE KOMMISSIE SE TRANSMISSIESTELSEL

3.1. Soorte Konstruksie.

Die Kommissie se wydverspreide transmissiestelsel van bogronde lyne wat teen spannings van 110, 88, 66 en 33K.V. werk, beloop in sy geheel 'n afstand van net meer as 2000 roete-myle.

Tot onlangs het die Kommissie op uitgebreide skaal gebruik gemaak van 'H'-maste van buisvormige staal vir alle permanente transmissielyste van 110 en 88 K.V., en hierdie lyne het uitstekende diens gelewer in die belastingstoestande wat in hierdie deel van die land ondervind word. Waar dit, weens die golwende landskap of ander redes, nodig was dat die maste hoër moet wees, is aan

3. THE COMMISSION'S TRANSMISSION SYSTEM.

3.1. Types of Construction.

The Commission's widespread overhead-line transmission system operating at voltages of 110, 88, 66 and 33kV collectively totals just over 2,000 route miles.

Until recently the Commission has made extensive use of tubular steel 'H' masts for all permanent 110 and 88kV transmission lines and these have given excellent service under the loading conditions experienced in this country. Where additional mast height was necessary,

hierdie vereistes voldoen deur gebruik te maak van verlengingsstukke wat so ontwerp is dat hulle in die boonste gedeeltes van standaardpale ingepas het.

In verskeie transmissielyste van 88 K.V. wat tans in aanbou is, word gebruik gemaak vervaardigde trallemaste met smal voetstukke en grondfondamente vir hangdoel-eindes en viervoetige maste met wye voetstukke, wat in beton gegiet is, vir trek- en hoekpunte. As 'n geheel gesien, is daar 'n marginale vermindering van die koste per myl ten opsigte van lyne met die vervaardigde maste, wat plaaslik vervaardig word, soos vergelyk by dié waar-in ingevoerde H-maste van buisvormige staal gebruik word. In figure 5 en 6 word die twee basiese tipes hang-

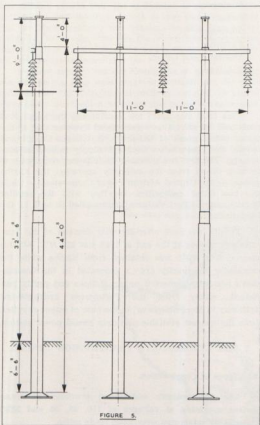


FIGURE 5.

stutte wat gebruik word, aangetoon. Hieruit blyk dat, deur 'n driehoekige geleirformasie op maslyne te gebruik 'n enkele aardedraad genoegsame beskerming teen moontlike weerligskade bied, terwyl daar by die 'H'-maste twee aarde-drade nodig is.

due to undulating ground or other requirements, this was provided by using tubular steel extension pieces designed to fit into the top of standard poles.

Various 88kV transmission lines at present under construction are making use of narrow-base fabricated lattice type towers having earth footings for suspension positions and four-footed wide-base towers set in concrete for tension and angle points. On balance, there is a marginal reduction in cost per mile for lines with the fabricated towers which are manufactured locally, compared with those using imported tubular 'H' masts. Figures 5 and 6 illustrate the two basic types of suspen-

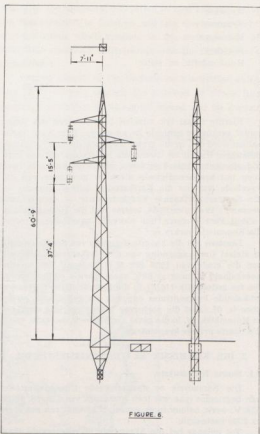


FIGURE 6.

sion supports used from which it will be seen that by using a triangular conductor formation on tower lines, a single earth wire provides adequate protective screening against possible lightning damage whereas two earth wires are required for the 'H' masts.

Dit is miskien van belang om daarop te let dat dit uit die ondervinding wat met die 'H'-tipe hangmaste opgedoen is, blyk dat, ten spyte van die feit dat hierdie maste min langsterke het en geneig is om op grondvlak te beweeg wanneer daar, (soos wat baie selde gebeur), 'n geleier breek, weer regop geplaas kan word en dat dit dus moontlik is om die kragtoevoer te herstel binne die kort tyd wat nodig is om die geleiers en/of die aardedrade te herstel.

In die ontwerp van vervaardigde hangmaste is daar 'n swak skakel ingebou, gewoonlik tussen die romp van die mas en elke kruisarm. Hierdie swak skakel is ingebou ten einde die mas teen ernstige skade te vrywaar indien daar 'n geleier sou breek.

Die ontwerp van 33 K.V.-lyne word in twee hoof-groepe verdeel :-

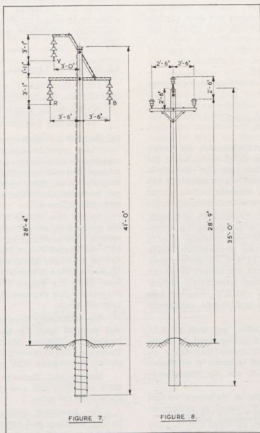
- (a) hooflyne met geleiers van middelmatige grootte wat gestut word deur hangende isolators in 'n driehoekige formasie op 'n "wensbeen" — kruisarm van staal,

It may be of interest to note that from experience gained with 'H' type suspension masts, despite their providing little longitudinal strength and the fact that they are likely to move at ground level in the rare occurrence of broken conductor conditions, it is possible to straighten up the mast and so restore supply within the short time required to implement conductor and earth wire repairs.

The design of fabricated suspension towers incorporates a weak link, usually between the tower body and each crossarm. This feature is introduced to avoid serious damage to the tower under broken conductor conditions.

The 33kV line designs fall into two main groups —

- (a) main lines with medium sized conductors supported by suspension insulators in triangular formation on a steel 'wish-bone' crossarm with an over-



met 'n bogronde aardedraad vir beskerming. Behandelde houtpale of pale van buisvormige staal word gebruik. Hierdie tipe konstruksie vorm die ruggraat van die 33 K.V.-stelsel.

- (b) sekondêre lyne met kleiner geleiers wat deur pen-insulators op 'n horisontale kruisarm van hout gestut word, sonder die dekking van 'n aarde-draad. Behandelde houtpale word gebruik. Hierdie tipe lyn het uit die Kommissie se standaard-ontwerp vir die platteland (11 K.V.) ontwikkel en word hoofsaaklik gebruik om plattelandse stelsels te versterk en uit te bou.

Die twee tipes 33 K.V.-lyn word in figuur 7 en 8 geïllustreer. Dit is duidelik dat die tweede tipe lyn van 'n uiters ekonomiese konstruksie is, welke feit dit vir 'n groot aantal dunbevolkte gebiede moontlik gemaak het om elektriese krag te bekom.

Daar is baie jare lank al in alle lyne van aluminium-geleiers met staalkerns gebruik gemaak, terwyl isolators van sowel glas as porselein in gebruik is. Daar word egter aan laasgenoemde voorkeur gegee, veral op spanningspunte, waar dit moeilik is om isolators wat deur vandale beskadig word (en wat meer dikwels met glas as met porselein gebou) te vervang.

3.2. Die Uitleg van Substasies.

Die Kommissie se hoof-substasies word basies in twee groepe verdeel, nl.:—

- (a) Ontvangsstasies
(b) Primêre Verspreidingssubstasies.
(a) Ontvangsstasies.

Hierdie stasies vorm die ontvangspunte vir groot-maatkragvoorrade vanaf primêre produsente, soos die Sentraal-Afrikaanse Kragkorporasie en die Sociedade Hidro-Electrica do Revue. Hulle werk teen spannings van 110 of 88 K.V. en is hoofsaaklik oorskakelingsstasies vir die ontvangs en verspreiding van grootmaatkrags.

In die geval van die 110 K.V.-ontvangsstasie by Umtali, bestaan die huidige uitleg uit 'n inlaatpunt vanaf die Revuestelsel, met voorsiening vir verdubbeling, plus 'n tussen-koppeling met die Umtalise kragentrale, asook verlagingsperiewe tot 33 K.V. en 11 K.V. vir die verspreiding van krag na die Munisipaliteit van Umtali en na die Oostelike Distrikte. Voorts is daar voorsiening gemaak vir toekomstige voerleidings van 110 K.V., waarvan een tans onder konstruksie is, om die Middel-Sabi- en Laeveld-gebiede te voorsien.

Die oorblywende ontvangsstasies, wat teen 88 K.V. werk en vanaf die Kariba-netwerk gevoer word, is strategies geleë te Norton, Sherwood (naby Que Que) en Bulawayo. Die stasie by Sherwood is basies 'n oorskakelingsseenheid om krag teen 88 K.V. aan die Middellande te verskaf.

Die ontvangsstasies by Norton en Bulawayo verskaf oorskakelingsperiewe teen 88 K.V., sowel as verlagingsperiewe vir die onmiddellik aangrensende gebiede.

Die ontvangsstasies bestaan gewoonlik uit duplikaat-

head screening earth wire. Treated wood or tubular steel poles are used. This type of construction forms the backbone of the 33kV system.

(b) secondary lines with smaller sized conductors supported by pin insulators on a horizontal wooden crossarm without earth wire coverage. Treated wood poles are used. This type of line was developed from the Commission's standard rural 11kV design and is mostly used to reinforce and develop rural systems.

Figures 7 and 8 illustrate the two types of 33kV line. It will be appreciated that the second type of line is of a most economical form of construction, which fact has enabled a large number of low-density areas to be electrified.

Steel cored aluminium conductors have been universally employed on all lines for many years, while both porcelain and glass insulators are in service. The former however are preferred, particularly at strain positions, where replacement after vandalism damage, which is more frequently experienced with glass than porcelain, can be difficult.

3.2. Substation Layouts.

The Commission's major substations are divided basically into two types:—

- (a) Receiving Stations.
(b) Primary Distribution Substations.
(a) Receiving Stations.

These provide the intake points for bulk power supplies from primary producers, such as the Central African Power Corporation and the Sociedade Hidro-Electrica do Revue. They operate at voltages of 110 or 88kV and are mainly switching stations for receiving and distributing bulk power.

In the case of the Umtali 110kV Receiving Station, the present layout comprises an intake from the Revue system, with provision for duplication, an interconnection with the Umtali Power Station, and also step-down facilities to 33kV and 11kV, for distribution to Umtali Municipality and the Eastern Districts. Further provision has been made for future 110kV feeders, one of which is presently being engineered, to supply the Middle Sabi and Lowveld areas.

The remaining Receiving Stations, operated at 88kV and supplied from the Kariba network are strategically located at Norton, Sherwood (near Que Que) and Bulawayo. The Sherwood Station is essentially a switching station distributing 88kV power to the Midlands.

Norton and Bulawayo Receiving Stations provide 88kV switching and also step-down facilities for immediately adjacent areas.

The Receiving Stations generally afford duplicate busbar facilities, and bus-coupling, with small oil-volume switchgear on all circuits.

geleisamgeriewe en stamkoppeling, sowel as skakeltoeg met klein olievolume op alle stroombane.

Waar gedupliseerde stroombane bestaan, is 'n skakelstelsel van geleisamselektering ingestel, wat dit moontlik maak om 'n hele stroombaan vir instandhoudingsdoelendes te isoleer.

Waar die stroombane nie gedupliseer is nie, word daar van 'n hoof- en 'n omloop-skakelstelsel gebruik gemaak sodat die olie-stroombreker, wat gereed is instandhouding nodig het, geïsoleer kan word, terwyl die stroombaan nog steeds van krag voorsien kan word. Hierdie twee alternatiewe stelsel word in figuur 9 geïllustreer.

(b) Primêre Distribusie-substasies.

By hierdie stasies word verlagingsfasiliteite verskaf om die primêre spanning van 88 K.V. te verlaag na 33 K.V. en 11 K.V., vir distribusie of vir direkte verskaffing aan die verbruiker.

Substasies met transformators van laer as 10 MVA word gewoonlik voorsien met 'n inkomende olie-stroombreker van die klein-olievolume-tipe en al hierdie verlagingstransformators se toevoer geskied deur middel van lugbreek-skakelaars wat outomaties opmaak en waarvan die uitklinking vanaf die transformator se beskermingsstelsel in werking gestel word. Vir vermoëns bokant 10 MVA of waar die stelsel sodanig is dat outomatiese skakelaars nie gebruik kan word nie, word olie-stroombrekers ingespan om die transformators te isoleer en te beskerm.

Waar 'n enkele oliestroombreker en outomatiese skakelaars vir 'n substasie gebruik word, word daar voorsiening vir tussenklinking van die inkomende olie-stroombreker en die skakelaars gemaak, as gevolg waarvan die vinniger opmakende stroombreker die hele substasie isoleer, terwyl die stadiger-werkende outomatiese skakelaar die foutiewe transformator onder ongelaaide toestand isoleer. Ná 'n sekere tydperk maak die olie-stroombreker weer outomaties toe en hervat die kragvoorsiening na die gesonde dele van die substasie. Onopsetlike hertoemaking van die inkomende olie-stroombreker voordat die fout herstel is, word uitgeskakel deur hierdie stroombrekerelektries met die transformator se skakeltoeg te verbind. 'n Tipiese samestelling word in figuur 10 geïllustreer.

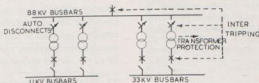


FIGURE 10

Op sekere 88/33 K.V.-transformators van kleiner vermoë word die 33 K.V.-stroombrekers wat in figuur 10 aangetoon word, vervang met outomatiese skakelaars van

Where duplicated circuits exist, a bus selection switching system has been adopted, enabling an entire circuit to be isolated for maintenance.

Where non-duplicated circuits occur, a main and by-pass switching system is employed, enabling the O.C.B., which requires regular maintenance, to be isolated, while still maintaining continuity of supply to the circuit. These two alternative systems are illustrated in Figure 9.

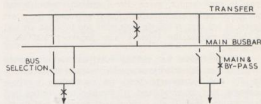


FIGURE 9

(b) Primary Distribution Substations.

These stations provide step-down facilities for transforming from the primary voltage of 88kV to 33kV and 11kV, for distribution or for direct consumer utilization.

Substations with transformers below 10 MVA are generally provided with an incoming substation O.C.B. of the small-oil-volume type, and all such step-down transformers are supplied through automatic-opening, air-break disconnecting switches, the tripping of which is activated from the transformer protection system. For capacities above 10 MVA or where the system conditions do not permit the use of auto-disconnects, O.C.B.'s are employed for transformer isolation and protection.

Where a single substation O.C.B. and transformer auto-disconnects are used, intertripping of the incoming O.C.B. and disconnects is provided, whereby the more rapidly opening O.C.B. isolates the entire substation, while the slower auto-disconnect isolates the faulty transformer under "dead" conditions. After a suitable time-lag, the O.C.B. re-closes automatically, restoring supply to the healthy elements of the substation. Inadvertent reclosing of the incoming O.C.B. onto an uncleared fault is avoided by interlocking this O.C.B. electrically with the transformer switchgear. A typical arrangement is illustrated in Figure 10.

On certain smaller capacity 88/33kV transformers the 33kV circuit breakers shown in the above figure are replaced by 33kV auto-disconnects fitted with load-break

33 K.V. wat van vragbreek-kontakte voorsien en aan die verbonde transformatorbeskerming gekoppel is.

3.3. Beskerming en Kommunikasie.

Die veiligheid van die toevoer onder fout-toestande hang af van die selektiwiteit en stabiliteit van beskerming-toestelle, sowel as van die betroubare regstelling van foute deur die skakeltuig. Ten einde dit op sy hoof-transmissie-lyne te verwezenlik, maak die Kommissie gebruik van hoë-spoed, outomaties-hersluitende olie-stroombrekers wat gestel is om met 'n enkele slag weer toe te maak en met 'n totale ongelaaiide tydperk van ongeveer 400 millisekondes.

Stroombrekers wat radiale voerlyne beskerm, word toegevoer met enkelstadium-impedansie-afstandbeskerming, en dié wat tussenverbindings en ewewydige voerlyne beskerm, met draer/afstand- of fashoekbeskerming met draerstrom, insluitende oorstroom-steunrelê's met omgekeerde vertraging tot 'n bepaalde minimum.

Transformatorbeskerming word verskaf deur hoogspannings- en laagspanningstransformatorstroombrekers, met tussenklinking deur middel van totale gebalanseerde beveiliging in die geval van eenhede met 'n vermoë van 20 MVA en meer, deur hoogspanningstroom- en hoog- en laagspanningsbeskerming met beperkte aardfoutvermoë vir eenhede met 'n vermoë tot by 10 MVA, sowel as deur Buchholz- en temperatuurbeskerming, wat aan alle transformators gekoppel is. Soos hierbo aangetoon, word die transformatorstroombrekers by sommige transformators vervang met outomatiese afskakelaars, maar die stelsel van beveiliging bly basies dieselfde.

Alle groot stasies op die hooftransmissiestelsel word verbind deur middel van enkelstroombaan-draerverbindings met selektiewe oproepvermoë, en hierdie stelsel word in die eerste plek vir doeleindes van stelselbeheer gebruik. Behalwe sy funksie as 'n verbindingsmiddel, verskaf hierdie toerusting ook geriewe vir die telemeting van die vrag en vir die bespoeding van die tussenklinking van die terminale olie-stroombrekers wat in die verspreidingsstelsel gebruik word. Vier BHF-radiobasisstasies met vier mobiele stasies, is in 1954 in diens geneem. Die waarde van hierdie toerusting vir doeleindes van stelselbeheer en -instandhouding het baie gou duidelik geblyk en 'n program is in werking gestel waarvolgens elke depot van 'n basisstasie en 'n genoegsame aantal mobiele stasies voorsien sou word.

Hierdie netwerk, wat nou een van die grootste in die land is, bestaan uit 29 basis- en 67 mobiele en verskaf algehele dekking van die Kommissie se hele voorsieningsgebied vir instandhoudingsdoeleindes. Daarby vorm dit 'n waardevolle reserwe vir die draerstelsel vir beheerdoeleindes.

3.4. 88kV-seriekapasitor.

Voor die invoering van elektriese krag vanaf Kariba, is die Kommissie se stelsels, sowel Noordelik as Sentraal, vanaf 'n enkele termiese sentrale by Umniati voorsien. Vragvoorspellings het aangedui dat die las wat op die

contacts and coupled to the associated transformer protection.

3.3. Protection and Communication.

Security of supply under fault conditions depends on selectivity and stability of protective devices, and reliable fault clearance by switchgear. To achieve this on its main transmission system the Commission employs high speed auto-reclosing oil circuit breakers arranged for single shot reclosure with a total dead time of approximately 400 milliseconds.

Breakers protecting radial feeders are fitted with single stage impedance-distance protection, and those protecting interconnectors and parallel feeders, by carrier/distance or phase comparison carrier current protection, with back-up overcurrent I.D.M.T.L. relays.

Transformer protection is provided by means of H.V. and L.V. transformer breakers intertripped by overall differential protection in the case of units of 20 MVA and above in capacity, by H.V. overcurrent and H.V. and L.V. restricted earth fault protection for units of up to 10 MVA in capacity, and by Buchholz and Temperature protection which is fitted to all transformers. As indicated above, the transformer circuit breakers are replaced by auto-disconnects on some transformers, but the system of protection remains the same.

Single circuit line carrier communication, with selective calling, links all major stations on the main transmission system and is utilised primarily for system control purposes. Apart from its function as a communication link, this equipment also provides facilities for load telemetering and accelerated inter-tripping of the terminal oil circuit breakers employed on the transmission system. Four V.H.F. base stations and four mobiles were placed in service during 1954. The value of this equipment for system control and maintenance purposes very soon became apparent, and a programme was embarked upon to equip each depot with one base station, and the appropriate number of mobiles. This network which is now one of the largest in the country, comprises 29 base stations and 67 mobiles, and provides complete coverage of the Commission's area of supply for maintenance purposes, and is in addition a valuable standby to the carrier system for control purposes.

3.4. 88kV Series Capacitor.

Prior to the injection of Kariba Power both the Commission's Northern and Central systems were supplied from a single thermal station at Umniati. Load forecasts in 1955 indicated that the load centred upon Norton would

Norton-stasie rus, teen 1959/60 'n totaal van 25 MW sou bereik. Aangesien hierdie vrag langs 'n 90 myl lange 88 KV-lyn van 0.2 vk. dm. aluminium met staalkern wat aan koper gelykstaan, vervoer sou moes word teen 'n lasfaktor van .85, sou dit 'n spanningsverlies van naby aan 25% meebring. Die maksimum-spanning wat by die 88 KV-geleestamme by Umniati beskikbaar was, was 5% bokant die nominale waarde, met die gevolg dat Norton 'n volvragspanning van sowat 20% onder die nominale vermoë sou ondervind.

Hierdie bestek was buite die vermoë van die outomatiese belaste tapwisselende transformators wat geïnstalleer was, en enige toename in hierdie reguleringsetode kon, ingeval van 'n kragonderbreking, spanningstoenames tot gevolg hê wat ernstige verleentheid kon veroorsaak.

Ten einde die volle voordeel uit omtakkapasitors te trek, sou hulle oor 'n groot aantal vragsetra, wat oor 'n uitgestrekte gebied en hoofsaaklik in onbemande sub-stasies geïnstalleer is, versprei moes word, en die aanvanklike uitgawes, sowel as die latere instandhoudings-koste van die beheertoerusting, sou baie hoog wees. Vanweë hierdie oorwegings en die feit dat die serie-kapasi-tor die kenmerkende eienskap van feitlik onmiddellike regulering het, is daar besluit om hierdie tipe spannings-regulerende toerusting in die 88 KV-lyn te gebruik, en dit is gedurende 1956 in werking gestel.

Die totale stroombaan-reaktansie van die lyn, met inbegrip van die transformators, was ongeveer 100 ohms. Weens (a) 'n kompromie tussen hoë kompensasië (met 'n moontlikheid van resonansië-invloede) en genoegsame aanjaging om die belaste tapwisselende transformators doeltreffend te laat werk; en (b) die noodsaaklikheid daarvan om te verseker dat daar, met die afstandpendansiëbeskerming wat op hierdie lyn gebruik word, geen nie-werkende sones ontstaan nie, is daar besluit op 'n kapasitor-reaktansie van 50 ohms, wat, teen 'n maksimum-stroomaanslag van 200 ampere, 'n kapasitor-werkspanning van 10 KV en 'n KVAR-aanslag van 2,000 per fase gee, d.w.s. 'n driefasige eenheid van 6 MVAR. Die bevestiging was van die hooggapig- en kortsluitingsstroombreker-tipe.

reach 25MW by 1959/60. Since this load would be supplied by a 90 route mile 0.2 sq. in. copper equivalent S.C.A. 88kV line at a load power factor of about .85, this would result in a voltage drop approaching 25%. The maximum voltage available on the 88kV busbars at Umniati was 5% above the nominal value so that Norton would have experienced a full load voltage some 20% below nominal rating.

This range was outside the capacity of the automatic on-load tap-changing transformers installed and any increase in this method of regulation could cause embarrassing voltage rises in the event of a supply failure.

In order to gain full advantage from shunt capacitors they would be required to be distributed over a large number of load centres covering an extensive area mainly in unattended substations, and the cost and subsequent maintenance of the control equipment would be high. Because of these considerations and the fact that the series capacitor has the characteristic feature of automatic and virtually instantaneous regulation, it was decided to employ this type of voltage-regulating equipment for the 88kV line and the installation was commissioned in 1956.

The total circuit reactance of the line including transformers was about 100 ohms. However, due to (a) a compromise between high compensation, with a possibility of resonant effects, and sufficient boost to permit on-load tap-changing transformers to operate efficiently, and (b) the necessity to avoid non-operating zones with the distance impedance protection employed on this line, a capacitor reactance of 50 ohms was chosen, which at a maximum current rating of 200 amps gives a capacitor operating voltage of 10 kV and kVAR rating of 2,000 per phase, i.e. a 6 MVAR 3 phase unit. The protection was of the arc-gap and short circuiting breaker type.

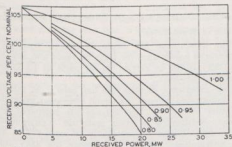


Fig. 11 Umniati-Norton line voltage performance without series capacitors.

In figure 11 en 12 kan die bevredigende werking van hierdie seriekapasi-tor duidelik gesien word.

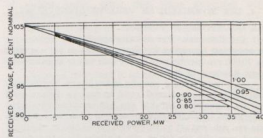


Fig. 12 Umniati-Norton line voltage performance with series capacitors of 50 ohms per phase.

Figures 11 and 12 indicate the satisfactory performance of this series capacitor.

Ná die invoering van krag vanaf Kariba in die Sherwood- (naby Umniati) en Norton ontvangsstasies, het hierdie kapasitor as 'n deursendingseenheid teen 'n verminderde vrag gewerk, behalwe in noodtoestande. Dit het in alle opsigte bevredigend gewerk en sal na 'n ander plek oorgeplaas word wanneer die geleentheid hom voordoet.

3.5. Beplanning van die Stelsel.

Almal wat deur ons land reis, word getref deur die wydverspreide elektrisiteitsverspreidingsstelsel wat uitgestrekte gebiede met 'n lae potensieële verbruikerstal bedien. Plase is dikwels baie groot, die dorpie klein en ver van mekaar geleë, en die land se minerale hulpbronne is so wydverspreid en van so 'n groot verskeidenheid dat die myne, behalwe dat hulle in baie gevalle betreklik klein is, ook talryk en oor 'n wye gebied versprei is.

So 'n situasie vereis besonder versigtige beplanning ten einde kapitaal uitgawes tot 'n minimum te beperk en ook om verliese en spanningsverminderinge binne ekonomiese en praktiese perke te hou, wat sal aanpas by die ontwikkeling van die aanvraag en die doeltreffendheid van die werking van die stelsel.

Hierby is baie lang lyn-afstande betrokke, wat dit nodig gemaak het om bogronde lyne teen 'n baie lae koste per myl te ontwikkel, soos vroeër reeds verduidelik, tesame met substasies wat eenvoudig en tog streng funksioneel ontwerp is. Om die spanning op so 'n stelsel behoorlik te reguleer, is 'n baie wesentlike probleem en dit word binne die statutêre perke beheer deur die oordeelkundige gebruik van outomatiese belaste tapwiel-selende transformators en spanningsreguleerders. Dit help natuurlik ook as die kragfaktor van die stelsel hoog gehou word, wat meestal in Rhodesië die geval is, hoofsaaklik vanweë die feit dat alle verbruikers met 'n maksimum-aanvraag van meer as 100 KVA teen 'n tweeledige KVA-tarief van krag voorsien word. Aangesien die verbruikerstariewe ook aan die KVA-aanvraag gekoppel is, word dit uiters selde gevind dat verbruikers op hierdie tariewe nie die een of ander toestel installeer om hul kragfaktor baie hoog te hou nie.

4. DIE KOMMISSIE SE VERSPREIDINGSTELSEL.

4.1. Die gebruik van Houtpale.

Die Kommissie het die afgelope 30 jaar behandelde houtpale vir bogronde kraglyne gebruik, en het nou meer as 70,000 van hierdie pale in alle dele van sy stelsel dwarsdeur Rhodesië in diens.

Ons ondervinding van die gebruik van hierdie pale was besonder bevredigend, veral as daar ag geslaan word op die ekonomiese aspekte van hul oorspronklike oprigtingskoste en gemiddelde lewensduur, soos vergeleke by dié van pale wat uit ander stowwe vervaardig is. Houtpale word gevolglik vir feitlik alle plattelandse verspreidingsstelsels van 11 KV en laagspanning gebruik, sowel as vir 33 KV-lyne met 'n kort lewensduur. (Waar nodig word pale van buisvormige staal by trek- en swaar hoekpunte gebruik).

Rhodesië is nou feitlik self-onderhoudend sover dit sy

Subsequent to the injection of Kariba power into Sherwood (close to Umniati) and Norton Receiving Stations this capacitor has operated on a reduced load through-put except under emergency conditions. It has operated satisfactorily in all respects, and will, when the occasion arises, be transferred elsewhere.

3.5. System Planning.

To all travel within our country, the widespread electricity reticulation serving considerable areas with low potential consumer density is most noticeable. Farms are often very large, villages small and widely separated, and the country's mineral resources are so extensive and varied that mines, in addition in many cases to being relatively small, are numerous and scattered.

Such a situation requires exceptional care in planning to minimise capital expenditure and also to confine losses and voltage drops within economic and practical limits consistent with load development and operating efficiency.

Very long lengths of line are involved which has necessitated the development of overhead lines with a very low cost per mile, as previously described, and sub-stations of simple but distinctly functional designs. The regulation of voltage on such a system is a very real problem and is controlled within statutory limits by the judicious use of automatic on load tap changing transformers and voltage regulators. It also of course helps if the system power factor is kept high, which generally is the case in Rhodesia due largely to the fact that all consumers with the maximum demands over 100 kVA are supplied on two part kVA tariffs. As in addition the consumption charges are also tied to the kVA demand, it is extremely rare for consumers on these tariffs not to install some means or other to keep their power factor very high.

4. THE COMMISSION'S DISTRIBUTION SYSTEM.

4.1. Use of Wood Poles.

The Commission has employed treated wood poles for overhead power lines for some 30 years, and now has more than 70,000 in service on all parts of its system throughout Rhodesia.

Our experience of their use has been most satisfactory, taking into account the sound economics associated with their initial cost and average life compared with supports constructed in other materials. Consequently, wood poles are used for practically all rural 11kVA and L.V. distribution, and for the shorter life 33kV lines (where necessary, tubular steel poles are employed at tension and heavy angle points).

Rhodesia is now virtually self supporting in wood pole requirements, the majority being of the Eucalyptus saligna species which are produced in the favourable

behoefte aan houtpale betref. Die grootste van hierdie pale is van die spesie *Eucalyptus Saligna*, wat in die gunstige groeitoestande van die Oostelike Distrikte geproduseer word. Die uitsoek, afkap, behoorlike veroudering, behandeling en uiteindelijke versending na die werkerrein kan so lank soos twee jaar duur en gevolglik moet die beraming van werklike behoeftes noukeurig gedoen word lank voordat die pale werklik op die werkerrein afgelewer word.

Die *Eucalyptus Saligna*, wat vinnig groei, het 'n betreklik oop grein en teen 'n vog-inhoud van 12% is die gemiddelde breukmodule daarvan ongeveer 10,000 pond per vierkante duim, wat voldoende is vir die belastingsvereistes wat hiertelende ondervind word.

Daar is 'n aantal faktore wat meehelp om hout te vernietig, en, in rangorde van belangrikheid, is hulle die volgende: Termiete en houtboorders, verrotting, weerlig, plus bos- en grasbrande. Al hierdie faktore is 'n voortdurende bron van moeilikhede vir sowel die kweker as die gebruiker, en positiewe stappe is nodig om hulle teë te werk indien daar van die pale verwag word om lank te hou. Die tydperk tussen inspeksies, soos deur die wet vir ons land voorgeskryf, is ses jaar, maar in die Kommissie se diens word hierdie inspeksies, vir sover dit moontlik is, met korter tussenposes uitgevoer.

'n Ontleding van inspeksievlae toon dat beskadiging deur termiete die mees algemene oorsaak van verswakking is, en wel in die geval van ongeveer 4% van alle geïnstalleerde pale, terwyl verrotting by sowat 1.9% voorkom.

In Rhodesië, met sy weerligpeil van ongeveer 80 dae per jaar waarop donderstorms voorkom, is dit nie verbasend nie dat, gedurende die afgelope 20 jaar dat ongeaarde plattelandse en standaard 11 KV-lyne in werking is, weerlig vir sowat 20% van alle houtpale wat vir welke in werking is, weerlig vir sowat 20% van alle houtpale wat vir welke rede ookal beskadig is, verantwoordelik was.

Indien dit egter vergelyk word met die totale aantal pale wat opgerig is, is hierdie syfer besonder laag, nl. in die omgewing van 1.7 persent. Alhoewel bos- en grasbrande geensins sulke ernstige gevaar as weerlig inhoud nie, word daar tog elke jaar 'n redelike groot aantal pale hierduer beskadig. Weens die hoë intensiteit en die duur van die gelokaliseerde hitte wat opgewek word, hou bosbrande die ernstigste gevaar in. Terwyl daar min gedoen kan word om weerligskade te verhoed, kan daar tog gepoeg word om die brandgevaar te verminder deur die oop vertikale barste in die hout, sover dit grootte en lengte betref, te beperk, aangesien hierdie barste gewoonlik los vesels bevat en dieselfde uitwerking as 'n skoorsteen kan hê. Deurgangsstroke word natuurlik gereël van bosse skoongemaak, maar dit is nie moontlik om die gras rondom al die pale, behalwe dié wat transmissielyle dra, te verwyder nie.

Die ouderdom van die paal, die doeltreffendheid van die oorspronklike behandeling en die mate van voorkomende instandhouding wat in die verlede uitgevoer is,

growing conditions of the Eastern Districts. The selection, felling, adequate seasoning, treatment and eventual despatch to site can take up to two years and therefore requirements must be accurately assessed well ahead of actual delivery to site.

The *Eucalyptus saligna*, being fast growing, has a relatively open grain and at 12% moisture content the average modulus of rupture is approximately 10,500 pounds per square inch, which is adequate for loading condition requirements in this country.

There are a number of timber destroying agents, such as, in order of importance, termites and wood borers, rot, lightning, plus both bush and grass fires. All are a constant source of trouble to both grower and user and positive steps must be taken to counteract them if poles are to be long lasting. The statutory period between inspections in this country is six years, but within the Commission, whenever possible these inspections are carried out at intervals even shorter than this.

An analysis of inspection reports shows that damage by termites is the commonest cause of deterioration, about 4% of all poles installed being affected, while rot accounts for 1.9%.

With an average isoceraunic level in Rhodesia of 80 thunder-storm days per annum, it is not surprising that during the past twenty years of unearthed rural and standard 11kV line operation, lightning has been responsible for some 20% of all wood poles damaged through various causes; however, when compared with the total number erected, this figure is singularly small, being of the order of 1.7 per cent. Although by no means as serious as lightning damage, bush and grass fires do cause a fair number to be destroyed each year, the former being the more serious due to the high intensity and period of localized heat generated. Whilst little can be done to prevent lightning damage, the restriction in size and length of open vertical cracks in the timber, which generally contain loose fibres and can provide a chimney effect, does help to reduce losses due to fire. Bush cleaning of wayleave strips is of course carried out regularly, but it is not possible to remove grass from the surrounds of wooden poles, other than those associated with transmission lines.

The age of the pole, efficiency of initial treatment and the amount of preventive maintenance carried out in the past are the main factors determining the incidence of damage by termites and rot.

Optimum treatment is attained by adequate reduction in moisture content followed by correct and thorough preservation applied by one of the established recognised processes. This Commission has standardised over the years in using high temperature creosote mixed with 20% by volume of diesel fuel oil added to which P.C.P. (Pentachlorophenol) is now introduced in the ratio of 2% by weight.

Superficial methods of treatment such as brushing, spraying and dipping have been found totally inadequate for long life timber use and impregnation either by

is die hoof-faktore wat die mate van beskadiging deur termiete en verrotting bepaal.

Die optimumgraad van behandeling wat verkyr kan word, word verkyr deur die genoegsame vermindering van die vog-inhoud, gevolg deur korrekte en deeglike behandeling volgens een van die gevestigde en erkende prosesse. Na jare se ondervinding het die Kommissie as Standaard aanvaar die gebruik van kreesoot teen 'n hoë temperatuur, gemeng met 20% dieselbrandstof by volume, waarby tans PCP (pentachlorophenol) in die verhouding van 2% by gewig gevoeg word.

Oppervlakkige behandelingsmetodes soos kwas-aanwending, spreï en onderdempeling het totaal ontoereikend geblyk te wees om 'n lang lewensduur aan hout te besorg, en deurtrekking volgens 'n drukbehandeling of die warm-en-koud ooptenk-metode word algemeen gebruik. Laasgenoemde metode word deur die Kommissie verkies.

Die aanvanklike koste van die ooptenk-installasie is ongeveer eenderde van die van 'n ekwiwalente drukstelsel en die produksie daarvan is voldoende om in die behoeftes van die Kommissie te voorsien. Voorts kan volledige behandeling met die ooptenkmetode verseker word, aangesien dit betreklik eenvoudig is om te werk en dit nie geskoolde toesig nodig het nie. Weens die baie groter produksie wat van 'n vakuum/druk-installasie verkyr kan word, is laasgenoemde egter die ideale stelsel vir die groter handelsprodusent, ten spyte van die hoër aanvanklike kapitaalkoste daaraan verbonde.

'n Ontleding van die inligting wat van die pale se kenplaatjies verkyr is, toon dat, nadat 'n lyn sowat 20 jaar in diens was, daar verwag kan word dat die breektempo van pale tot omtrent 15% sal styg, dog daar word in die vooruitsig gestel dat hierdie tempo in die toekoms sal afneem weens die verbeterde behandelingsmetodes van sowel die pale as die omliggend grond, wat die voorkoming van aanvalle deur termiete ten doel het.

4.2. Hersluitapparaat en Verdeel-skakelaars.

Die Kommissie se 11 KV-distribusiestelsel is hoofsaaklik bogronds en die hoë weerligvorms in meeste dele van Rhodesië het tot gevolg dat 90% van alle foute van 'n verbygaande aard is, wat deur geskikte skakeltoeg herstel kan word, met slegs 'n kortstondige onderbreking van die toevoer. Hersluiters word gevolglik op sorgvuldig uitgesoekte plekke langs die hooftoevoerlyne geïnstalleer, en hulle maak voorsiening vir twee vinnige en twee vertraagde hersluitings voor uiteindelijke uitsluiting. Elke hersluiters word noukeurig met sy steunhersluiters ingestel ten einde te verseker dat die foutiewe seksie behoorlik onderskei word. Tak-voerlyne word gewoonlik vanaf die hooflyn beskerm deur middel van outomatiese verdeel-skakelaars wat só ontwerp is dat hulle die kere wat die steun-hersluiters werk, kan "tel" en die stroombaan ná 'n voorafbepaalde aantal kere kan opmaak gedurende die tydperk wat die hersluiters ook oop is.

Daar word dus nie van hulle verwag om foutstroom te onderbreek nie. Indien 'n fout herstel word voordat die verdeel-skakelaar opmaak, word sowel die tel-meganisme as die meganisme van die hersluiters outomaties heringe-

pressure treatment or the open tank, hot and cold, methods are generally used, the latter being preferred by the Commission.

The initial cost of the open tank plant is about one third of that for an equivalent pressure system and the output is adequate for the requirements of this Commission. Furthermore, treatment to rejection with the open tank method can be assured as it is relatively simple to operate and does not require skilled supervision. However the very much greater output obtainable from a vacuum/pressure plant makes this the ideal system for the larger commercial supplier in spite of its higher initial capital cost.

An analysis of information from pole tags shows that after a line has been in service some 20 years the pole failure rate can be expected to rise to about 15%, but it is anticipated that this will be reduced in the future by improved methods of treatment in the field of both pole and the surrounding ground, to prevent termite attack.

4.2. Auto-reclosers and Sectionalisers.

The Commission's 11kV distribution system is predominantly overhead and the high isoceraunic level in most areas of Rhodesia results in at least 90% of all faults being of a transient nature and therefore capable of being cleared by suitable switchgear involving only a momentary break in continuity of supply. Reclosers are accordingly installed at carefully selected points along the main feeders and provide two fast and two retarded reclosures before lockout. Each recloser is accurately graded in with its back-up recloser to ensure proper discrimination of the faulty section. Branch feeders are usually protected from the main line by automatic sectionalisers which are designed to 'count' operations of the back-up recloser and open the circuit after a pre-determined number of operations, during an interval when the recloser is also open. They are not therefore required to interrupt fault currents. If a fault clears before the sectionaliser opens, the counting mechanism automatically resets, as does the recloser's mechanism, and both devices are thus ready for another cycle of operations if a new fault occurs.

A further protective system was developed by the

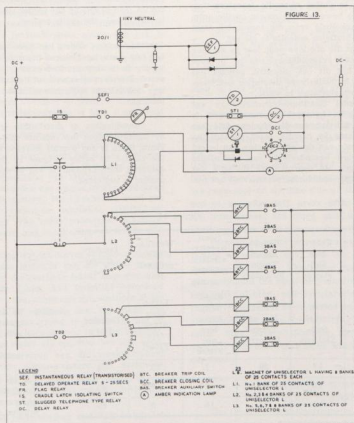
stel, en albei toestelle is dan weer gereed vir 'n nuwe reeks operasies indien 'n nuwe fout hom sou voordoen.

'n Verdere beskermingstelsel is in 1955 deur die Kommissie se ingenieurs ontwikkel om voorsiening te maak vir hoë-weerstand-aardfoute wat nie 'n genoegsame foutstroom opwek om die normale beskermingstelsels in werking te stel nie. Hierdie sensitiewe aardfout-beskerming, wat terloops die belangstelling van ingenieurs by ander voorsieningsowerhede gewek het, maak gebruik van 'n getransistoriseerde aanvoelings- en soek-apparaat, dit die toevoer na die verbruikers langs die gesonde toewat die foutieve stroombaan opspoor en uitsluit, terwyl voerlyne in stand hou. Hierdie skema is by alle substasies wat die 11 KV-verspreidingstelsel voorsien, geïnstalleer en het slegs 'n enkelstroom-transformator in die gemeenskaplike neutrale geleiding van die transformator nodig om dit in werking te stel.

Hierdie apparaat het, gedurende die baie jare wat dit in diens is, hoogs betroubaar en sonder foute gewerk, en 'n skematiese diagram van 'n tipiese stroombaan word in

Commission's engineers in 1955 to cater for high resistance earth faults which would not produce sufficient fault current to operate the normal protection. This sensitive earth fault protection, which incidentally has been of some interest to engineers in other supply authorities, employs a transistorised sensing and searching device which locates and locks out the faulty circuit whilst maintaining supply to the consumers on all the healthy feeders. This scheme is installed at all substations which supply the 11kV reticulation and requires only a single current transformer installed in the common neutral of the transformer to actuate it.

This device has proved very reliable and trouble free during the many years it has been in service and a schematic diagram of a typical circuit can be seen in Figure 13.



figuur 13 weergegee. In die Amerikaanse tipe hersluiters, wat heeltemal uitsluit ná 'n ontakklank, is 'n spesiale hersluitingsapparaat, wat met 'n vallende gewig werk, ontwerp, en hierdie apparaat lewer besonder bevredigende diens.

4.3. Sekerings en Aflieers in Substasies.

Tot ongeveer 1965 was dit die gebruik by die Kommissie om weerligafleiers en uitskei-sekerings te voorsien as beskerming van die transformators in elke distribusie-substasie.

Oor 'n tydperk van meer as 25 jaar het die rekords egter aangetoon dat, veral in die geval van verbruikers op die ongeaarde plattelandse stelsels, die oorgrote meerderheid van kragonderbrekings veroorsaak is deur sekerings wt as gevolg van weerligfoute van verbyggaande aard gesmelt het. Gesien daar in feitlik alle gevalle geen permanente skade aan enige neder toerusting berokken is nie, is daar besluit om sekerings in meeste van die individuele verbruikerssubstasies wat aan ongeaarde plattelandse lyne gekoppel is, uit te skakel waar die transformatorvermoë nie 50 KVA te bowe het nie, en om op die outomatiese hersluitingskakeltoeg van die toevoerlyn staat te maak om slegs die foutiewe gedeelte te isoleer.

Hierdie beleid, wat die afgelope paar jaar in werking gestel is, het die aantal kragonderbrekings in 'n groot mate verminder, en het dit ook moontlik gemaak om sonder weerligafleiers by onderlyne substasies met booghorings op die transformatorbusse te werk.

Wanneer die aantal distribusietransformators wat deur weerlig beskadig is, in oënskyn geneem word, is daar geen aanduiding dat daar oor die afgelope drie jaar enige algemene toename in hierdie soort beskadiging voorgekom het as gevolg van die verandering van beleid nie. In figuur 14 word besonderhede van beskadigde transformators aangegee, en daaruit blyk duidelik dat daar geen merkwaardige verandering plaasgevind het nie.

13. On American type auto-reclosers, which look out following a shunt trip, a special reclosing arrangement employing a falling weight has been devised and operates very satisfactorily.

4.3. Fuses and Arresters in Substations.

Until about 1965 it was the Commission's practice to provide lightning arresters and drop-out type fuses to protect the transformers in each distribution substation.

Over a period of more than twenty-five years however, records showed that, particularly with consumers supplied on the unearthed rural type system, the majority of interruptions to supply were caused by fuses blowing as a result of transient lightning faults. As in virtually all cases there was no permanent damage to other equipment, it was decided to eliminate fuses in most of those individual consumer substations connected to unearthed rural lines, where the transformer capacity did not exceed 50kVA, and to rely on the feeder auto-reclosing switchgear to isolate only the faulty section.

This policy, which has been implemented over the last few years, has reduced the number of interruptions of supply to a very marked extent, and has also made it practicable to operate without lightning arresters at under-line substations with arcing horns on the transformer bushings.

Consideration of distribution transformers damaged by lightning does not indicate that, over the last three years, there is any overall increase in damage because of the change in policy. Figure 14 shows some details of damaged transformers. It will be seen that no significant change is indicated.

Figure 14.

Jaar	Onderlyne Substasies	Terminale Substasies	Totale aantal Transformators	Geen weerligafleiers geïnstalleer nie	Weerligafleiers geïnstalleer	Donderstorm dae
Year	Underline Sub-Stations	Terminal Sub-Stations	Total No. of Transformers	Lightning Arresters not Fitted	Lightning Arresters Fitted	Thunder-Days
1965/66	12	17	29	7	22	74
1966/67	23	12	35	18	17	85
1967/68	11	12	23	14	9	55

NOTE: To date, nearly 4,000 distribution transformers with capacities of 50 KVA or lower have been installed.

N.B. Tot op datum is byna 4,000 distribusie - transformators met vermoëns van 50 KVA of minder geïnstalleer.

Figuur 14.

4.4. Voorsiening aan Besproeiingskemas met Hoë Digtheid.

Die ontwikkeling van uitgebreide besproeiingsprojekte in die Laeveld het 'n nuwe benadering deur die Kommissie tot hierdie besonder probleem van elektrisiteitsverspreiding nodig gemaak. Kleinhoewes wissel van 150 tot 240 akker en lê weerskante van betongevoerde kanale, met pompe wat deur twee-polige, driefasige elektriese motors van 80 tot 120 pk. aangedryf word.

Individuele pompe lewer water in permanente stygende hoofgeleidings vir die besproeiing van die lande op elke kleinhoewe, en die algemene topografie van die lande bepaal dat die bogronde distribusienetwerk so uitgelê moet word dat dit, waar moontlik, die rigting van die kanale kan volg. Dit veroorsaak dat tipiese voerlyne van tot so lank as ses myl gebou moet word (afhagende van die uitleg van die besproeiingstelsel) en dat hierdie lyne elke 800 tree tot soveel as 200 KVA moet kan dra.

Die aanvanklike koste van die installasie, spanningsverliesoorewegings, die wenslikheid daarvan om 'n ligte geleier te gebruik sodat die kanaalroete makliker gevolg kan word, gepaard met maklike beheer en die regstreekse aansluiting van die pompmotore, het tot gevolg gehad dat daar op 'n distribusiespanning van 33000 volts besluit is.

Die vorm wat die lynkonstruksie aangeneem het, is in die voorafgaande gedeelte van hierdie referaat beskryf en in figuur 8 geïllustreer. Die ondervinding wat tot dusver met die werking van hierdie konstruksievorm in die Laeveld opgedoen is, was hoogs bevredigend en is deels te danke aan die feit dat weerlig in hierdie deel van Rhodesië minder dikwels voorkom — trouens, die gemiddelde voorkoms van donderstormdae is hier slegs sowat 40 per jaar.

Substasies word toegerus met uitskei-sekeringsstuig wat die primêre windsels van die distribusie-transformators beheer, terwyl lug-stroombrekers die nodige beskerming aan die laagspanningskant verskaf. Standaard buitens-huise distribusietransformators van 33000/380 volts word gebruik, met ontwerpwaardes wat aanpas by die perdekrag van die aangekoppelde motore. Weerligafleiers word aan die lynkant van alle terminale substasies geïnstalleer, sowel as aan ongeveer elke vyfde onderlyse substasie. Alle transformators word met booghorings op hul 33 KV-buste toegerus.

Uit die ondervinding wat tot dusver opgedoen is, blyk dit dat die maandelikse lasfaktor van die stelsel tussen 60% en 70% is, terwyl die jaarlikse faktor ongeveer 40% behoort. Laasgenoemde faktor kan grootliks beïnvloed word wanneer dit min reën, aangesien dit, wanneer al die hoewes klaar beplant is, nodig is om, ten einde die verlangde voggehalte in die grond te handhaaf, min of meer gelyktydig op al die hoewes weer te begin besproei, en wel sowat vyf dae nadat dit opgehou het met reën. Hierduer word die uitwerking van die verskeidenheid tussen die verskillende hoewe-eienaars wat andersins verwag sou kon word, tot 'n groot hoogte uitgeskakel.

5. ELEKTRISITEITSVOORSIENING AAN BANTOEDORPE.

Die Kommissie se ondervinding met betrekking tot die voorsiening van elektrisiteit aan Bantoe dorpe is in 'n

4.4. Supply to High Density Irrigation Schemes.

The development of extensive irrigation projects in the Lowveld has required a different approach by the Commission to this particular problem of electricity distribution. Plots vary in size from 150 to 240 acres and are situated either side of concrete lined canals with pumps driven by two pole 3-phase electric motors of from 80 to 120 h.p.

Individual pumps deliver water into permanent rising mains for spraying onto the lands of each plot, and the general configuration of the lands dictates a layout of the overhead distribution reticulation which follows the line of the canals wherever possible. This results in typical feeders as much as six miles in length which, depending upon the irrigation layout, may be loaded at up to 200 kVA every 800 yards.

The initial cost of the reticulation, voltage drop considerations, the desirability of employing a light conductor so enabling the canal route to be followed easily, added to simplicity of control and straight forward starting of the pump motors led to the adoption of a distribution voltage of 33,000.

The form of line construction adopted is that described in the previous section of this paper and illustrated in Figure 8. Operational experience with this form of construction in the Lowveld to date has been very satisfactory, which no doubt is assisted by the fact that lightning is less frequent in this area of Rhodesia with an average annual isoceraunic level of approximately 40.

Substations are equipped with drop-out fusegear controlling the primary windings of the distribution transformers whilst air circuit breakers provide protection on the L.V. side. Standard 33,000/380 volt outdoor distribution transformers are employed with ratings appropriate to the connected motor horsepower. Lightning arresters are connected on the line side of all terminal substations and at approximately every fifth underline substation. All transformers are fitted with arcing horns on their 33kV bushings.

Experience so far has indicated monthly system load factors of between 60% and 70% and annual ones of approximately 40%. This latter figure can be influenced greatly should the rains be poor, since, once all the plots are fully planted, soil moisture considerations dictate that irrigation must be re-started on all plots more or less simultaneously, some five days after the cessation of good rains. This largely eliminates the effects of diversity between individual plot loads which otherwise could be expected.

5. ELECTRICITY SUPPLIES TO AFRICAN TOWNSHIPS.

The Commission's experience in the field of electricity supplies to African townships has been rather limited due

taamlike mate beperk deur die gebrek aan bedrade persele in meeste van hierdi dorpe wat binne die Kommissie se gelisensteerde voorsieningsgebied geleë is.

Behalwe 'n paar wat deur die Regering gebou is, val al die ander Bantoe dorpe onder die beheer van óf 'n Munisipaliteit of 'n Stadsraad, en hulle hoof-oorweging is natuurlik die noodsaaklikheid daarvan om voldoende behuisingseriewe daar te stel.

Die bedrading van die huise vir elektrisiteit word ongelukkig as 'n biote gerief beskou, en tot tyd en wyl daar genoegsame fondse beskikbaar is om die agterstand wat behuising betref, in te haal, wou dit voorkom asof daar beslis min, indien enige, pogings aangewend gaan word om die huise te bedraad, tensy daar óf 'n beleidsverandering plaasvind óf die gelde wat vir die daarstelling van geriewe opgesig is, vir die bedrading van huise vrygestel word.

Boonop word die verskaffing van elektrisiteit aan 'n gemeenskap van halfgeskoolde of ongeskoolde werkers ernstig in die wiele gery deur baie probleme wat hulle oorsprong het in die basiese probleme wat uit 'n laer lewensstandaard voortspruit of wat die gevolg is van onkunde en vooroordeel wat aan ou gevestigde stamgewoontes te wyte is. As gevolg hiervan, sowel as van die feit dat daar aan die gemiddelde werker gewoonlik 'n huis toegeken word wat van 'n hout- of koolstof toegerus is, met die gevolg dat die bewoner gewoonlik slegs krag vir verligtingsdoeleindes plus sulke huishoudelike toebehore soos 'n strykyster en moontlik 'n ketel nodig het, is daar by ondervinding gevind dat die "kontrakaanvraag" of vraagbeperkingsmetode van voorsiening die mees bevredigende is wat tot dusver aangebied kon word.

Met verwysing na spesifikasie Bantoe dorpe waaraan krag voorsien word, was die eerste een wat deur die Kommissie geretikuleer is, 'n Regeringsdorp wat in 1963 naby Umtali gebou is. Dit het bestaan uit 303 huise, waarvan almal bedraad en van dienste voorsien is. Die diens is aangebied op die basis van óf 'n beperkte vraagvoorsiening van 1 ampere, 2 ampere, 5 ampere en 7½ ampere met die toepaslike gelde maandeliks vooruitbetaalbaar, óf die standaard huishoudelike tarief. Soos verwag kon word, was daar vir laasgenoemde geen aanvraag nie, maar dit was 'n saak van ernstige teleurstelling dat selfs diegene wat die beperkte vraagtoevoer aangeva het, nooit veel meer as 40% van die totaal uitgemaak het nie. In 'n poging om sowel die aantal aansluitings as die gebruik wat van die toevoer gemaak word, te bevorder, is 'n Bantoe-kliek vir 'n proeftydperk van 5 maande in die dorp geplaas om verkoopsbewordingwerk in die algemeen te doen, dog met weinig welslae. Meer onlangs is daar gevind dat, deur die 1-ampere-toevoer op 'n weeklike vooruitbetaalde basis aan te bied, die aantal aansluitings tot 'n gemiddelde van 60% gestyg het, met 'n rekordspits van 75% by een geleentheid.

In 'n dorp wat aangrensend aan Que Que geleë is en waarvoor die Kommissie in 1966 verantwoordelikheid aanvaar het, word daar, vir sover dit die woonkwaatere betref wat van dienste voorsien is, deur 'n soortgelyke gemiddelde presentasie van die inwoners van dié diens

to the lack of wired premises in the majority of those townships which are situated within the Commission's licensed area of supply.

Apart from a few that are Government built, all other African townships fall under the authority of either a Municipality or a Town Council and, of course, their prime concern is the essential one of providing adequate housing. The wiring of the houses for electricity is unfortunately considered purely an amenity and therefore until such time as sufficient finance is available to eliminate the back-log of housing, it appears certain that there will be little or no attempt made to wire the houses, unless there is either a change of policy or alternatively monies available for the provision of amenities are released for the wiring of houses.

In addition, supplying an electricity service to semi-skilled or unskilled workers is beset with many difficulties which in the main all either stem from the basic problems coupled with a lower standard of living, or result from ignorance and prejudice due to old-established tribal customs. Because of the above, coupled with the fact that the average wage earner is generally allocated a house which is provided with a wood or coal stove and accordingly only requires power for lighting plus such domestic appliances as an iron and possibly a kettle, experience gained so far indicates that the "contract demand" or load limiter method of supply is the most suitable that can be offered.

Turning now to specific African townships in which supplies are provided, the first one reticulated by the Commission was a Government township which was built adjacent to Umtali in 1963. It included 303 houses all of which were wired and serviced. The terms offered were either a load limited supply from the following range — 1 ampere, 2 amperes, 5 amperes and 7½ amperes — with the appropriate charge paid monthly in advance, or the standard domestic tariff. Not unexpectedly, there were no requests for the latter, but there was considerable disappointment that on average even the number that took a load limited supply was never much more than 40% of the total. With a view to encouraging both the number of connections and the use made of the supply, for a trial period of five months an African clerk was employed in the township on sales development work generally; but with little success. More recently, it has been found that, by offering the 1 ampere supply on a weekly pre-payment basis, the number of connections has increased to an average of 60% with an all-time peak of 75% on one occasion.

Supply is taken by a similar average percentage of the serviced quarters in a township which is situated adjacent to Que Que, and for which the Commission assumed responsibility in July 1966. In this township however there is not quite the almost universal demand for the one ampere load limiter that is experienced in the Umtali

gebruik maak. In hierdie dorp is daar egter nie die feitlik universele aanvraag vir die 1-ampere-vraagbeperker wat in die dorp by Umtali ondervind word nie, met die gevolg dat die gemiddelde maandelikse inkomste sowat 65% hoër is. Dit is moontlik daaraan toe te skryf dat die dorp by Umtali naby die olieraffinadery, wat nou tydelik gesluit is, geleë is, en daar word vertrou dat daar mettertyd beter resultate verkry sal kan word.

Op 'n soortgelyke wyse het die Kommissie in Julie 1965 verantwoordelikheid aanvaar vir die voorsiening van elektrisiteit binne 'n Munisipale Bantoeedorp te Gatooma. In hierdie geval het alle toevoer egter geskied teen die standaard huishoudelike tarief van die Munisipaliteit, met dié uitsondering dat die minimum maandelikse vordering vanaf die normale tarief van een pond tot 'n bedrag van tien sjielings verminder is. Elektrisiteit is deur die munisipale elektrisiteitsdepartement teen 'n grootmaat-tarief aan die Departement Bantoeadminstrasie verskaf, wat op sy beurt weer die individuele rekenings ingevorder en enige surpluse wat daar was, gebruik het om die bedrading van huise te finansier. Hierdie beleid is deur die verskaffing van 'n meter, die lees daarvan, die uitsuur wat aangegaan is om die oorspronklike huise te bedraad, afbetaal is en dit onlangs moontlik gevind is om verdere uitbreidings aan die skema aan te bring. Oor die algemeen gesproke, is die gebruik van die standaard huishoudelike tarief egter nie 'n ongekwalifiseerde sukses nie, aangesien sowat 40% van die verbruikers hul meters baie fyn dop-hou en nooit die minimum van tien sjielings oorskry nie. Dit is beslis nie hoog genoeg om die koste verbonde aan die verskaffing van 'n meter, die lees daarvan, die uitsuur van 'n rekening en die invordering van die geld te dek en boonop nog die 20 eenhede elektrisiteit wat in die minimum-vordering ingesluit is, te verskaf nie.

Met die beperking van die toevoervraag en die vooruitbetaling van die vorderings, word die koste van sowel die installasie as die werking daarvan, tot 'n minimum beperk. Sels met hierdie metode is daar aanduidings dat die winsgrens afneem soos die omvang van die toevoer toeneem, en daar word tans kontrole meters geïnstalleer ten einde te bepaal of daar werklik op hierdie basis met 'n toevoer van 7½ ampere voortgegaan kan word. Die alternatief is natuurlik om toevoere van hierdie kaliber as gewone huishoudelike verbruik te klassifiseer, wat teen standaardtariewe met normale minimum-vorderings voorsien word.

Ten slotte kan daar, oor die algemeen gesproke, gése word dat, alhoewel die potensiële vraag in die Bantoeedorpe hoog is, die toename in die verbruik tot dieselfde peil as die gemiddelde vir die hele land, 'n stadige proses is en dat dit nie teen 'n vinniger tempo sal plaasvind as dié van die algemene ekonomiese ontwikkeling van die dorpe en hul inwoners nie.

6. DIE TOEKOMS.

6.1. 6.1. Organisasie en Beleid.

Bo en behalwe sy klaarbyklike funksies om elektrisiteit op te wek, te verkry en te voorsien, is die Elektrisiteitsvoorsieningskommissie, ingevolge die Wet op Elek-

township and as a result the average monthly revenue is some 65% higher. This possibly is due to the Umtali township being sited near the Oil Refinery, now temporarily closed, and it is hoped that better results will be obtained in due course.

Similarly, the Commission became responsible for the electricity supplies within a Gatooma municipal township in July 1965. In this case, however, all supplies had been provided on the standard municipal domestic tariff, with the one exception that the minimum monthly charge was reduced from the normal figure of one pound to a sum of ten shillings. Electricity was supplied by the municipal electricity department at a bulk rate to its African administration counterpart, which in turn collected the individual accounts and used whatever surpluses there were to finance the wiring of houses. This policy has been continued by the Commission and, as a result, the loan provided to wire the initial houses has been met and it has recently been possible to make further extensions to the scheme. Generally speaking, however, the use of the standard domestic tariff has not been an unqualified success, as some 40% of the consumers watch their meters very closely and never exceed the minimum charge of ten shillings. This is definitely not sufficiently high to cover the costs of providing a meter, reading it, sending an account, receiving payment, all in addition to the 20 units of electricity which are included in the minimum account.

With the load limited supply and the charge paid in advance, both the installation and the operating costs are kept to a minimum. However, even with this method, indications are that the surplus margin decreases as the size of the supply increases and check meters are being installed to find out whether or not a 7½ ampere supply can really continue on this basis. The alternative of course is to classify supplies of this calibre as ordinary domestic supplies to be provided on standard tariffs with normal minimum charges.

In conclusion, it can be said that, generally speaking, while the potential load in the African townships is large, the increase in consumption to the national average will be a slow process, and will not take place at a rate any faster than that of the general economic development of the townships and their inhabitants.

6. THE FUTURE.

6.1. Organisation and Policy.

In addition to the obvious functions of generating, acquiring and supplying electricity, the Electricity Supply Commission is, in terms of the Electricity Act, charged

tristiteit, verantwoordelik vir die ondersoek van nuwe of bykomstige geriewe vir die verskaffing van elektrisiteit en vir die koördinasie en samewerking van bestaande ondernemings, waar dit ookal nodig mag wees.

In die uitvoering van laasgenoemde aspekte van sy funksies, het die Kommissie tot die vaste oortuiging gekom dat, indien die koste van elektriese krag op die laags moontlike vlak gehou moet word, dit noodsaaklik is dat die toekomstige van die elektrisiteitsvoorsieningsbedryf in Rhodesië in die hande van een geïntegreerde streeksowerheid geplaas moet word, wie se verantwoordelikheid die hele veld moet dek, vanaf die aanvanklike opwekking, deur die daaropvolgende stadia van transmissie en verspreiding, tot by die finale verskaffing van die krag aan die individuele verbruiker.

Toe hy tot hierdie gevolgtrekkings geraak het, is die Kommissie deur die volgende faktore beïnvloed, wat almal, vanuit 'n nasionale oogpunt gesien, van oorwegende belang is:—

- (1) Elektrisiteit het 'n noodsaaklike openbare diens geword;
- (2) As sodanig moet dit 'n integrale faktor van die nasionale beplanningpatroon vorm.
- (3) Die toekomstige van hierdie bedryf moet ten nouste verbonde wees aan dié van die nywerheid in die algemeen en van nywerheidsproduktiwiteit in die besonder.
- (4) Dit is 'n sleutfaktor in die ontwikkeling van Stad en platteland.
- (5) Dit moet dus op die breë grondslag van nasionale ontwikkeling beskou word en moet bokant plaaslike wedywering en private belange uitstyg.
- (6) Positiewe ontwikkeling, selfs vinniger as die aanvraag, moet bevorder word deur middel van aktiewe navorsing, gekoppel aan hoër doeltreffendheid en 'n beter lasfaktor.
- (7) Ten einde dit te bereik, moet daar, in die nasionale belang, 'n omvattende plan wees vir:—
 - (a) Die plasing van nuwe sentrales.
 - (b) Ontwikkeling van die stelsel.
 - (c) Die opleiding van personeel.
 - (d) Die bestuur van die nywerheid om dit gelykfasig te hou, en
 - (e) Behoorlike inskakeling by nasionale ekonomiese oorwegings.

'n Verdere punt wat vir hierdie land van besondere belang is, is dat dit, vir die ontwikkeling van Rhodesië, noodsaaklik is dat soveel van die prosessering van sy grondstowwe as moontlik binne sy grense moet plaasvind. Ten einde krag te voorsien teen tariewe wat dit sal moontlik maak, is dit nodig dat die maksimum gebruik gemaak moet word van die buitespitstoevoer wat vir die hele land beskikbaar is. Dit is slegs werklik moontlik indien daar van 'n omvattende verspreidingsstelsel gebruik gemaak kan word.

Verdere voordele is te vinde in die beter aanwending van beperkte kapitale fondse deur die duplikasie van

with investigating new or additional facilities for the supply of electricity and for the co-ordination and co-operation of existing undertakings where required.

In applying itself to these latter facets of its duties, the Commission has very firmly come to the conclusion that, if the cost of power is to be kept to the lowest possible level, in Rhodesia the future of the electricity supply industry should be in the hands of one integrated territorial authority whose responsibilities should range from initial generation, through the sequential fields of transmission and distribution, to the final supply to the individual consumer.

In coming to these conclusions the Commission has been influenced by the following factors, all of which are of considerable importance from the national viewpoint.

- (1) Electricity has become an essential public service.
- (2) As such it must be an integral factor in national planning.
- (3) Its future must be closely associated with that of industry in general and industrial productivity in particular.
- (4) It is a key factor in town and country development.
- (5) It must therefore be considered on the broadest basis of national development transcending local rivalries and private interests.
- (6) Positive development, even ahead of demand must be fostered by active research, interplay with higher efficiency and better load factor.
- (7) To achieve this there must, in the national interest, be an overall plan for:—
 - (a) Siting of new stations.
 - (b) Development of the system.
 - (c) Training of personnel.
 - (d) Management of the industry to keep it in phase, and
 - (e) Interweaving with national economic considerations.

A further point of particular importance to this country is that it is essential to the development of Rhodesia that as much as possible of the processing of its raw materials takes place within its boundaries. To provide power at costs which allow this to be done, it is necessary that the maximum use be made of the off-peak supplies which are available to the country as a whole. This is only really possible with a unitary distribution system.

Other advantages lie in better use of limited capital

verspreidings- en ander dienste te vermy, sowel as deur winste in hul geheel binne die nywerheid te behou. Vanuit die steeds belangrike personeel-oogpunt gesien, is daar ook verskeie voordele, soos byvoorbeeld:—

- (i) 'n enkele beheerliggaam kan bekostig om aan elektrotegniese ingenieurs, wat kronies skaars is, die salarisse te betaal wat nodig is om nuwe personeel te trek, sonder om die koste verbonde aan die verskaffing van ander dienste te versteur;
- (ii) so 'n liggaam kan die beste gebruik maak van die professionele, bestuurs-, tegniese en ambagspersoneel wat wel beskikbaar is;
- (iii) vir die personeel self, moet amalgamasie tot gevolg hê dat beter vooruitsigte op bevordering geskep word en dat minder mense die diens verlaat om by groter organisasies in ander lande aan te sluit;
- (iv) beter opleidingskemas vir die personeel kan ingestel word.

Al hierdie dinge het daartoe gelei dat mense tot die slotsom gekom het dat alle bestaande kragte in één gebiedsowerheid saamgesmelt behoort te word.

6.2. Groter Toekomstige Vrae.

Vanuit die oogpunt van toekomstige belasting gesien, afgesien van normale toenames en vir sover daar op die oomblik vooruitgesien kan word, sal die hoof-bydraes tot die voortgesette uitbreiding van verkope in die elektrisiteitsvoorsieningsnywerheid in die toekoms deur die volgende bepaal word:

- (1) Die stikstof-kunsmisfabriek.
- (2) Die ystersmeltbedryf.
- (3) Die bedryf vir die ontginning, smelt en raffinering van nikkel.

Eersgenoemde beloof om die grootste te wees, weens die feit dat die benodigde waterstof by wyse van elektrolyse verkry sal word. Daar kan klaarblyklik slegs van hierdie proses gebruik gemaak word indien goedkoop krag beskikbaar is. Dit is gelukkig moontlik, aangesien 'n aansienlike gedeelte van die krag wat benodig word, buite spitstye vanaf 'n hidro-elektriese bron beskikbaar gestel kan word.

Die Ystersmeltbedryf het ook goedkoop krag nodig, dog, waar die kunsmisfabriek daaglik krag buite die spitstyd sal neem, kan die smelters 'n bydrae lewer tot die verhoging van die jaarlikse lasfaktor deur hul aanvraag tydens die spitstyd in die winter te verminder.

Deur hierdie stappe, n.l. die verkoop van krag buite spitstye en die vermindering van die aanvraag gedurende die winter, behoort die Kommissie se globale lasfaktor, wat reeds prakties 75% is, die 80%-merk te oorskry en kan dit moontlik binne die volgende vier of vyf jaar selfs tot 85% styg. Daar is egter prakties perke waarbo die lasfaktor nie opgestoot kan word nie, en, indien die verhogingsproses moet voortgaan, sal daar 'n bykomstige vraag na buitenspitstyd-krag gevind moet word.

Die ontginning en prosessering van nikkel het so pas begin. Selfs dié vrae wat nou aangesluit is, behoort

funds both by the avoidance of duplication of distribution and of services, and by the retention of surpluses wholly within the industry. From the very important staff aspect, there are also several advantages, such as:—

- (i) a single authority can afford to pay electrical engineers, who are chronically in short supply, the salaries which are now required to attract new staff, without disturbing the costs of providing other services.
- (ii) it can make the best use of what professional, managerial, technician and artisan staff is available.
- (iii) for the staff themselves, amalgamation must result in increased opportunities for advancement and accordingly fewer are lost to larger organisations in other countries.
- (iv) better staff training schemes can be introduced.

All these have led thinking to the conclusion that amalgamation into one territorial authority must be effected.

6.2. Future Large Loads.

From the point of view of future loadings, apart from normal increases and as far as can be foreseen at the present, the major contributions to the future continued growth of sales in the electricity supply industry will be in three fields:—

- (1) The nitrogenous fertiliser factory.
- (2) The ferro-smelting industry.
- (3) The nickel mining, smelting and refining industry.

The first of these promises to be the largest by virtue of the fact that the necessary hydrogen will be obtained by electrolysis. This process can obviously only be utilised if cheap power is available and fortunately, as a considerable portion of the power required can be supplied off-peak from a hydro-electric source, it has been possible to provide this.

The ferro-smelting industry also requires cheap power, but whereas the fertiliser plant will take daily off-peak power, the smelters are able to assist in increasing the annual load factor by reducing their demands over the winter peak.

By these means of selling daily off-peak power and load shedding over the winter peak, the Commission's overall load factor which is already virtually 75% should exceed 80% and may possibly even rise to 85% within the next four to five years. There is however a practical limit to which the load factor can be encouraged to rise, and for the process to continue, additional off-peak power must be found.

Nickel mining and processing have just started. Even those loads now connected however should ensure that this branch of Rhodesia's mining activities will, from the

egter te verseker dat hierdie vertakking van Rhodesië se mynbredryghede, vanuit die oospunt van elektrisiteitsverkope gesien, al gou beide die huidige leiers op hierdie gebied, nl. asbes en goud, in die skadu sal stel!

6.3. Toekomstige Kragbronne.

Diegene wat nog die lang argumente oor Kariba vs. Kafue gedurende die eerste tien jaar ná die oorlog kan onthou, sal saamstem dat dié besprekings basies oor die kwessie van voorkeur gegaan het. Vandag is dit nog hierdie selfde kwessie van voorkeur waarmee Rhodesië opgesaal sit, aangesien die land 'n aansienlike aantal moontlikhede het wat ontwikkel kan word.

Die mees belangrike hiervan is uitbreidings aan die Kariba-skema. Die maksimum vaste lewering van die bestaande dam is op 8,500 miljoen eenhede bereken en die bestaande installasie is in die praktyk nie in staat om veel meer as die helfte van hierdie hoeveelheid krag te lewer nie. Sowel 'n nuwe kragentrale op die noordelike oewer as uitbreidings aan die bestaande een op die suidelikeoewer is ondersoek, en dit staan vas dat daar met ten minste een hiervan, en moontlik met albei, voortgegaan sal word.

Dit is duidelik dat daar geen besluit om 'n nuwe kragentrale in Rhodesië te bou, geneem sal word sonder om deeglike ondersoek in te stel na die politieke, tegniese en ekonomiese implikasies van die aankoop van krag vanaf Cabora Bassa nie, en samesprekings met ons Portugese bure is steeds aan die gang.

In Rhodesië is daar ten minste drie steenkoolvelde (nl. te Wankie, Mkushwe in die Laeveld, en Buby, sowat 50 myl oos van Beitbrug) wat 'n termiese kragentrale van 250—300 M.W. wat laegraadse steenkool teen 'n lae globale koste verbruik, aan die gang kan hou.

Ten laaste is daar 'n aansienlike hoeveelheid krag wat op die Zambesirivier waar dit Rhodesië se gemeenskaplike grens met Zambië vorm, ontgin kan word. By die Victoria-waterval self kan daar sekerlik tot soveel as 100 M.W. geïnstalleer word, alhoewel die vaste lewering van 'n gewone lopende-rivier-skema ingevolge die bestaande waterregulasies slegs sowat 40 M.W. sal wees. Met opberging te Katambora, waar grond in vier lande oorstroom sal word, sal die vaste lewering tot oor die 300 M.W. styg.

Tussen die Victoria-waterval en die noordelike punt van die Kariba-dam is daar nog twee groot ravyns wat geëkspliteer kan word. Dit is die Batoka-ravyn (450 voet) en Dulwelsravyn (350 voet). Met opberging te Katambora kan hierdie twee skemas sowat 450 M.W. en 350 M.W. onderskeidelik tot Rhodesië se kragbenodighede bydra.

Die laaste moonlike skema op die Zambesi is by die Mpata-ravyn, wat stroom-af van Kariba af geleë is en sowat 20 myl stroom-op vanaf die punt waar die Zambesi Mosambiek binnevoel en dus ophou om die grens tussen Zambië en Rhodesië te vorm. Hierdie perseel is geskik vir 'n dam van omtrent 200 voet hoog en Rhodesië kan sowat 370 M.W. krag hiervandaan kry.

Hierdie skemas op die Zambesi kan 'n totaal van ongeveer 1500 M.W. krag aan Rhodesië (en natuurlik ook

point of view of sales of electricity, soon take precedence over both the present leaders, asbestos and gold.

6.3. Future Sources of Power.

Those who remember the long arguments over Kariba versus Kafue which took place over the first ten years after the war, will appreciate that basically the discussions were concerned with priority. Today it is still this question of priority which concerns Rhodesia as the country has a considerable number of possibilities open to it.

The first of these must be extensions to Kariba. The maximum firm output from the existing dam has been computed at 8,500 million units and the existing plant is, in practice, not capable of producing much more than half of this amount of power. Both a new power station on the North Bank and extensions to the existing one on the South Bank have been investigated. Certainly one and possibly both will be proceeded with.

Obviously no decision to build a new power station within Rhodesia will be taken without a thorough appraisal being made of the political, technical and economic implications of purchasing power from Cabora Bassa, and discussions with our Portuguese neighbours are continuing.

Within Rhodesia, there are at least three coal-fields at Wankie, Mkushwe (in the Lowveld) and Buby (some 50 miles east of Beitbridge) which could support a 250—300 MW thermal station burning low-grade coal at a low overall cost.

Finally, there is still a considerable amount of power to be exploited on the Zambesi river where it forms Rhodesia's common boundary with Zambia. At the Victoria Falls itself, certainly up to 100MW could be installed although, in accordance with the existing water regulations, the firm output for a run-of-river scheme would be only about 40MW. With storage at Katambora (land in four countries would be flooded) the firm output would rise to over 300 MW.

Between the Victoria Falls and the northern end of Kariba Dam, there are two further major gorges which could be exploited. They are Batoka Gorge (450 feet) and Devils Gorge (350 feet). With storage at Katambora, these could contribute some 450 MW and 350 MW to Rhodesian power requirements.

The last prospect on the Zambesi is at Mpata Gorge which is downstream of Kariba and some twenty miles upstream of the point where the Zambesi enters Mocambique ceasing to be the boundary between Zambia and Rhodesia. The site is suitable for a dam about 200 feet high and from this Rhodesia could obtain some 370 MW of power.

In aggregate these schemes on the Zambesi could provide about 1,500 MW of power to Rhodesia (and of

aan Zambië) verskaf, terwyl die totaal van al die krag-skemas in Rhodesië wat ondersoek is, plus dit wat van buite aangekoop kan word, verskeie duisende megawatt beloop. Soos in die eerste paragraaf van hierdie afdeling genoem, is die vernaamste taak nou om 'n voorkeurlys op te stel, met inagneming van die ekonomiese, tegniese en ongelukkig ook die politieke aspekte wat betrokke is.

7. DANKBETUIGING.

Die skrywer wil graag sy dank aan die Algemene Bestuurder van die Rhodesiese Elektrisiteitsvoorsienings-kommissie te boek stel vir sy toestemming om hierdie referaat te publiseer. Hy is ook veel dank verskuldig aan sy mede-ingenieurs wat afdelings 3 en 4 van die referaat bygedra het.

course to Zambia), while in total the various power sources investigated within and available by purchase outside Rhodesia amount to several thousand megawatts. As mentioned in the opening paragraph of this section, the main task is the evaluation of a priority list, taking into account the economic, engineering and, unfortunately, the political aspects involved.

7. ACKNOWLEDGEMENTS.

The author wishes to thank the General Manager of the Rhodesia Electricity Supply Commission for permission to publish this paper. He is also deeply indebted to those of his fellow-engineers who contributed Sections 3 and 4 of this paper.

COMPUTER ENGINEERING

by

J. D. N. van Wyk *

INTRODUCTION

Lord Kelvin, the famous physicist, once said: "When you can measure what you are speaking about and express it in numbers, you know something about it." This desire and necessity for expressing values in terms of numbers, have significantly changed man's ability to understand and control his environment; it was the basis which made computer science and engineering possible and has already influenced the lives of almost every individual in the civilized world today.

It is strange to think that few hundred years ago the art of computation was neither commonly understood nor widely practised. In his book "Faster than thought," Lord Bowden¹ refers to Pepsys, who in 1662, when he was in charge of contracts for the admiralty, found it necessary to rise by candlelight at 4.00 in the morning in order to learn his multiplication tables. He had been to Cambridge and was, by the standards of his time, a well-educated man, who in later life became the president of the Royal Society and a friend of Newton. Barlow², in his book, published in 1814, remarked that "Calculation is laborious and unremunerative," and continued, "a moderate skill in computation and persevering industry are not precisely the qualities a mathematician is most anxious to be thought to possess."

The introduction of logarithms by Napier and Briggs revolutionised ordinary computing and this was probably one of the greatest factors in developing navigation, surveying and astronomy. The amount of labour which went into the production of the first tables of logarithms and of trigonometrical functions took lifetimes of many of the people, who devoted their energies to this. Briggs was one person, who devoted his complete lifework to computing the logarithms which Napier invented. It was to be expected that shamelessly copying one another's results occurred frequently amongst these early workers. It was found that for example thirty individual errors which were first made in a table published in Europe in 1603, were found in a set of tables printed in Chinese two hundred years later. Even until recently, it was custom for an author to leave one or two deliberate mistakes in the least significant place in his set of tables as a trap for would-be plagiarists.

In man's attempt to invent machines to relieve him of the drudgery of calculation, two distinct types have been evolved. The first is typified in its simplest form by the slide rule or in its more modern form by the analogue

computer. These machines represent the magnitude of a number in some such physical quantity as length or a voltage. These machines can be used only where limited accuracy is required and computations will seldom exceed an accuracy of one part in a thousand. The other type which was developed worked with numbers or in other words in discrete quantities. The Abacus or Counting Frame was invented many thousands of years ago, and is still used today in the Far East for everyday calculations. The use of roman numerals which were the first introduced in Europe did not do much to stimulate the art of computation, but with the introduction of arabic numerals the necessary incentive was found.

In 1642 the first simple digital calculating machine was built by Blaise Pascal who was then only 19 years of age. He had hoped that it would be of assistance to his father who was a customs officer in Rouen. Leibnitz designed his machine in about 1673 and in 1878 the Swedish engineer, Odhner, invented his pinwheel method of adding numbers from 1 to 9. His patents were taken up in Germany and have been incorporated in the well known calculating machine, the Brunsviga.

The first suggestion that a machine could be made to automatically do the calculations came more than a hundred years ago from the mathematician Charles Babbage. Today when we look back at the suggestions and the detailed design that went into Babbage's machine, we can realise that he was almost a century ahead of his time. His efforts were largely defeated because of the primitive state of technology at his time, even that of metal working. Babbage had his ideas for his Difference Engine in 1812. He constructed a small working model which he demonstrated in 1822 and although Government support was given him, it was withdrawn in 1842. Babbage remarked "the commissioners were better qualified to judge on furniture for defeat than on furniture for the head." However, a model of the Difference Engine was built in 1859 and was used in 1863 for calculating the life tables from which insurance companies computed their premiums for many years. Parts of these machines are to be found in several museums in the United Kingdom.

In 1833 Babbage conceived the idea of his Analytical Engine which he realised would be far more versatile than the Difference Engine. It embodied the first ideas about a universal digital computer as we understand it today. Of this machine only parts were ever built. Most of Babbage's time was spent on improving lathes and gear cutting tools in order to manufacture the components for his computer. Babbage died a disappointed man in 1871, never having had the opportunity to realise what a profound step towards changing man's life had been taken by him.

PIONEERING COMPUTING MACHINES

We will not dwell on the development of the punch card machines which played such an important role in the process of familiarising people with the idea of

* Assistant Director responsible for Electrical Engineering Research, National Research Institute for Mathematical Sciences, Council for Scientific and Industrial Research.

mechanisation of calculations and the pioneers such as Dr. Hollerith and Mr. Powers, but advance to the development of the electronic calculating machine which really was the start of the revolution.

The first purely electronic calculating machine to be put into operation was the ENIAC which was built by the Moore School of Electrical Engineering at the University of Pennsylvania and completed in February, 1946. Although this machine was very successful, it was already possible to prove theoretically that electronic calculating machines of much greater power could be built, using less equipment. New ideas were ably presented in a report drafted by Dr. J. von Neumann on behalf of the group associated with the Moore School and by the end of 1946 work was already starting in a number of places on the construction of machines of the new kind.

Pioneering work was also done in Britain where as early as 1936 Dr. A. M. Turing read a paper before the London Mathematical Society which formulated the basic concepts and abstract principles of computation by machine. Further work was delayed in Britain due to the war, but in 1945 examination of the problems was made at the National Physical Laboratory by J. R. Wormsly and in 1947 the preliminary planning was sufficiently advanced to warrant the establishment of a special group for the development of the first digital computer at the National Physical Laboratory. This was called ACE for Automatic Computing Engine. At the Mathematical Laboratory of the University of Cambridge work began on the Edsac early in 1947; the machine performed its first fully automatic calculation in May, 1949. At the University of Manchester, following on early work at the Telecommunication Research Establishment during the war, Prof. Williams pursued the cathode ray tube storage system and in 1947 had a cathode ray tube store containing 1,024 digits going for a period of hours. This set the main line of the design of the machine which later became known as Madam and led to a whole series of machines which were developed in conjunction with the Ferranti company and offered commercially. Various other machines were developed by the Birbeck College Computation Laboratory of the University of London, under the direction of Dr. Booth.

In the United States the first digital calculator which preceded the electronic machine ENIAC was built by Prof. Aiken of Harvard University. His design had begun in 1939 and it was put in service in 1944. It made use of relays for performing its logical functions and was called the Harvard Mark I. I.B.M. developed its first machine which was put into operation in 1948, a very large machine which contained 23,000 relays and 13,000 valves. It was more than a hundred times as fast as the Harvard Mark I machine. At the Institute for Advanced Studies in Princeton, Prof. J. von Neumann included in his report already mentioned, in 1945 the proposals for the design of a machine which became known as the ADVAC — Electronic Discrete Variable Automatic Computer. In 1947 Burkes, Goldstein and von Neumann published another

report which outlined the design of another type of machine. This was the first suggestion for a parallel machine, which was then thought to be very fast doing some 25,000 operations per second. The von Neumann machine at Princeton was completed in 1952 and was popularly known as Maniac. The design of the machine inspired half a dozen other machines which have been built and which were affectionately known as Jhonnias. MIT, the Massachusetts Institute of Technology, built a computer called the Whirlwind which was the first machine sufficiently fast to be used for solving problems in real time. Another pioneering machine was the Univac built and designed by Eckard and Mauchly who built the Eniac during the war. This led to a whole series of machines built by the Remington Rand Corporation.

ARITHMETIC SYSTEMS

Most modern arithmetics are founded upon a system for representing the positive integers in terms of systematic symbols involving the concept of carry-over and it is really dependent upon a systematic representation of the counting process.³⁾ These arithmetics are the basis of all automatic computing operations now used.

Decimal	Binary	Octal
0	0	0
1	1	1
2	10	2
3	11	3
4	100	4
5	101	5
6	110	6
7	111	7
8	1000	10
9	1001	11
10	1010	12
11	1011	13
12	1100	14
13	1101	15
14	1110	16
15	1111	17
16	10000	20
17	10001	21
18	10010	22
19	10011	23
20	10100	24

Table — Some decimal numbers and their equivalent in binary and octal.

The recording of counted numbers in the system to be studied is by means of an infinite ordered sequence of marks of which the first will be considered to be at the right hand end and the others to proceed in order to the left. In each position the mark zero or a mark with an equivalent meaning will be admissible as a mark and usually one or more other marks will be admissible. For example in the decimal system the marks admissible in each position are the marks 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. The binary number system admits the marks zero and one at each position and no others. The binary system occurs frequently in consideration of automatic computers since many of the basic circuits such as the flip-flop naturally assumes two stable states and are therefore convenient to use with binary numbers.

A system which also occurs frequently in computing machines is the octal system where any one of eight different marks is admissible at each position, for example 0, 1, 2, 3, 4, 5, 6 and 7 or their binary equivalents of these namely 0 0 0, 0 0 1, 0 1 0, 0 1 1, 1 0 0, 1 0 1, 1 1 0, 1 1 1. Table 1 gives a comparison between decimal, binary and octal numbers for decimal numbers up to 20. Table 2 gives the rules for binary addition and table 3 rules for binary multiplication. Using these rules it can be illustrated how binary multiplication and binary division are achieved.

RULES FOR BINARY ADDITION

Augend	0	1	0	1
Addend	0	0	1	1
Sum	0	1	1	0
Carry	0	0	0	1

Table 2 — Rules for binary addition.

RULES FOR BINARY MULTIPLICATION

Multiplicand	0	1	0	1
Multiplier	0	0	1	1
Product	0	0	0	1

Table 3 — Rules for binary multiplication.

As an example of binary multiplication, we multiply 11100110 by 10001001, i.e. the binary numbers for 230 and 137.

$$\begin{array}{r}
 11100110 \\
 10001001 \\
 \hline
 11100110 \\
 00000000 \\
 00000000 \\
 11100110 \\
 00000000 \\
 00000000 \\
 00000000 \\
 11100110 \\
 \hline
 111101100010110
 \end{array}$$

In the example of binary multiplication, the two numbers are written down in the same way as would be decimal numbers and the multiplication is started the usual way, multiplying each digit in the multiplier with the multiplicand. Finally the addition is carried out in the usual manner although in binary addition it is often more convenient to add two non-zero rows together at a time simply to avoid confusion. The reader can check that the result is equivalent to the decimal number 31510.

Binary division is performed in much the same way as ordinary decimal long division.

$$\begin{array}{r}
 B \\
 1101 \\
 1010 \overline{) 10001001} \\
 \underline{A 1010} \\
 C 1110 \\
 1010 \\
 \underline{10001} \\
 1010 \\
 \underline{111}
 \end{array}$$

In the example we are dividing the binary equivalent of decimal 137 by the binary equivalent of decimal 10. As shown, the divisor is placed outside of the long division sign and the dividend is placed inside. By a series of successive subtractions the quotient is formed above the long division sign. The first step in the process is to place a divider beneath the dividend in a position as far to the left as positive difference will allow. This is shown on line A. The first digit, 1, of the quotient is placed at B in the same column as the lowest order digit of the divisor. The first digit 1 of the divider signifies that only one subtraction can be performed before the negative difference is encountered for this division of the divider. The divider is then subtracted from the dividend to produce the positive difference line C. The next digit in the dividend is brought down to the difference obtained on line C. If the new number on line C is larger than the divider the divider is then placed under this number and the subtraction process repeated. If the new number is less than the divider, 0 is placed in the quotient in the

same column as the lowest order digit of the divider in this position. The next digit of the dividend is then brought down to the difference, the divider shifted one place to the right and the subtraction process is continued until the quotient is completed to the radical point. Any remainder of the last subtraction is treated in the same manner as in ordinary long division. In the example shown above, the quotient is 1101 with a remainder of 111 divided by 1010. This corresponds to the decimal number 13 and $7/10$.

LOGICAL CIRCUITRY FOR HANDLING NUMBERS

The rapid development of computers came from a realization of the advantages of operating in a binary

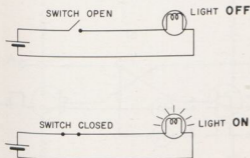


Figure 1 — Single switch controlling ON-OFF function.

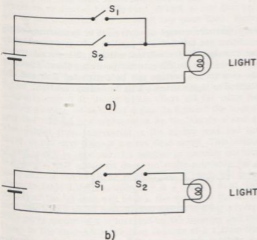


Figure 2 — Double switches showing AND and OR functions.

mode and equally important the development of circuits which operated in a binary fashion.

An electric current switch and a light bulb are good examples of binary devices. The switch has two states namely open or closed and similarly the light bulb has the two states off or on. The circuit connections in figure 1 are such that if the switch is open, the bulb is OFF and if the switch is closed, then the bulb is ON. The seemingly trivial relationship demonstrated in figure 1 has, when its full range of validity is recognised, led to a profound new way of thinking on automatic computing machines. Refer to the circuit shown in figure 2. The bulb in figure 2(a) will be ON if S1 or S2 is closed, whilst in the circuit shown in figure 2(b) the bulb will be ON if S1 and S2 are both closed. The former circuit is in everyday use in today's motor cars in which the cabin light comes on if any of the doors are open. The important point to note about the two circuits shown above, is that the bulbs light up only if certain defined conditions are satisfied and furthermore these conditions can be expressed in binary form. Thus in figure 2(b) the light is ON if switch S1 is closed and switch S2 is closed.

The relationships illustrated above can be studied abstractly completely independent of circuit devices like switches and light bulbs. The mathematician George Boole (1815 — 1864) first studied these relationships, and in 1854 published his work entitled "An Investigation of the Laws of Thought, on which Are Founded the Mathematical Theories of Logics and Probabilities." Today we refer to his mathematical theory as Boolean Logic. The application of Boolean Logic to circuits formed from switches were first studied by Claude Shannon in 1934. The further development of this theory and the development of new circuit techniques finally lead to the electronic digital computer as we know it today.

To appreciate the role which the theory, referred to above, played in the development of computers, refer to the desk calculator, with which most of us are familiar. The desk calculator has a console containing keys for entering numbers and a further set of keys for the common arithmetic operations of addition, subtraction, multiplication and division. In order to carry out a calculation, one must perform certain steps in a clearly defined sequence. For example, a sequence to add the numbers 2 and 3 may be as follows:

- Clear the register
- Enter 2 on the keyboard
- Depress "+" key
- Enter 3 on the keyboard
- Depress "+" key

Such a sequence of steps is known as a programme. When using a desk calculator, the human operator stores the programme in his brain, and recalls the steps in the sequence in which they are required. Looked upon in this way, the desk calculator is merely a mechanical aid which saves the operator the trouble of writing down everything on paper. In the digital computer, the steps of the programme is "remembered" by storing it inside the com-

puter together with the numbers to be used in the computation.

Looked at more closely "remembering" the sequence of steps means that the computer must activate the correct "keys" at the right time. The activation of a particular key is in itself a binary operation. At any given moment of time the key is in one of the two states designated by ACTIVE and NON-ACTIVE. In order for a key to become ACTIVE, a definite set of conditions must be satisfied. For example, the previous step must have been completed. If these conditions are satisfied, the control circuit of the key receives an activating signal. The circuit which decides whether the predefined condition is satisfied, is known in computer parlance as a "gate." The origin of this term is quite obvious: if the gate is "open," the activating signal can pass through; if the gate is "closed" the signal is prohibited to pass.

All possible types of gates can be built from the interconnection of three components, namely the AND-gate, the OR-gate and the Inverter. Figure 3 shows the usual symbols used for these elements.

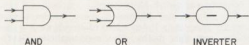


Figure 3 — Symbols used for indicating the AND-gates and the OR-gates and the INVERTER.

Each gate has two or more input lines and one output line. The AND-gate is open only if **all** the binary conditions represented by the input lines are satisfied; whilst the OR-gate is open if **one or more** of the binary conditions represented by the input lines are satisfied. The Inverter has one input and one output line only. If its input represents a **satisfied** condition, its output will represent the **unsatisfied** state of that condition, and vice versa. The inversion operation in everyday traffic control language corresponds to statements like: "If you **don't** see a red light, carry on," or equivalently, "If you see a red light, **don't** carry on." An Inverter is thus generally used in conjunction with a gate to **inhibit** operations.

The switches in the circuit shown in figure 2(a) represents an OR-gate, since the lamp will light up if S1 or S2 is closed and figure 2(b) represents an AND-gate, since the lamp will light only if S1 and S2 are closed. Working from this principle, the earliest computing machines were built using telephone selectors and relays. It was soon evident that the speed of operation of such a computer was not adequate in relation to the computational requirements of the time. Furthermore these mechanical devices proved to be unreliable. The maximum speed attainable was of the order of 100 elemental steps per second, in comparison the present day run-of-the-mill transistor equivalent of a binary switch can be tog-

* A diode is an electronic device which conducts current in one direction only.

gled at a rate of 10,000,000 operations per second, and may run for a year or more at this rate without failure.

Figure 4(a) shows the diode* OR-gate. Let A and B represent the input, and C the output. If A and B are both at ground potential, then the output C will also be at ground potential, assuming that ideal diodes are used. If a positive voltage is put on either A or B, the voltage at C will become positive. If we make the logic assign-

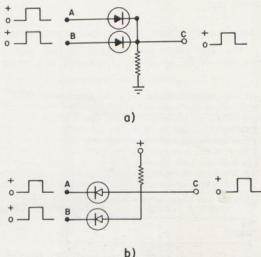


Figure 4 — (a) A two-input diode OR-gate for positive pulses.

(b) A two-input diode AND-gate for positive pulses.

ment that zero voltage is equivalent to the corresponding condition **not satisfied** and positive voltage equivalent to the corresponding condition **satisfied**, the circuit shown will operate as an OR-gate for positive pulses. Similarly the zero or low voltage can be designated a 0 and the positive or high voltage a 1 in the binary notation.

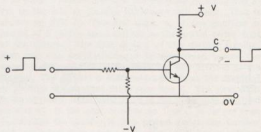


Figure 5 — Inverter circuit.

An AND-gate can be constructed in a similar manner as is shown in figure 4(b). Note that any input which is at ground potential will short-circuit the point C to ground, through the diode. The voltage at C will become positive only if both A and B are positive.

An inverter is realised by means of a transistor amplifier circuit, as shown in figure 5. The output at C of the inverter is of the opposite polarity to the input voltage at A and this is the opposite logical significance and is referred to as not A or \bar{A} .

Finally, in order to complete the basic elements for logical circuits, a device which stores binary information is required. Such a device is the flip-flop, the circuit of which is shown in figure 6. It basically consists of two

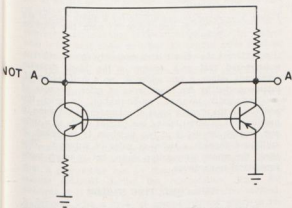
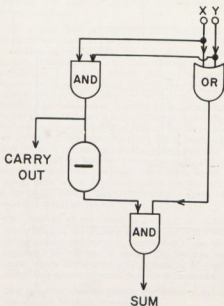


Figure 6 — Basic flip-flop circuit.

inverters connected back-to-back in such a way that only one of the transistors can be on at any given time. Hence if the one output is high (A), the other is low (\bar{A}), and vice versa.

Using these basic units described above and referring to the rules for binary addition in table 2, simple circuits can be constructed to obey the rules for addition⁴⁾. In figure 7, using the logical symbols described in figure 3, a simple circuit is shown which obeys all the rules for adding a single set of binary digits. In figure 7 the augend and the addend are represented by the inputs x and y. The output from the circuit is the binary sum and the carry to the next stage if a carry does occur. This simple circuit which is only one of a number of possible circuits, is called a half adder (it does not make provision for a carry-in). It can easily be verified that it obeys the rules given in table 3, for example, if x is a 1 and y is a 1, the output of the OR-gate will be a 1, the output of the AND-gate will be a 1 which immediately results in 1 for a carry. This carry output of 1 is inverted by the inverter and the input to the final AND-gate then consists of a 1 from the OR-gate and a 0 from the inverter, which inhibits an output on the sum-line and sum is therefore 0. Similarly



HALF ADDER

Figure 7 — Half adder circuit for a single binary stage.

the reader can check that all the other combinations are taken care of.

In order to achieve a useful adder, one has to deal with more than one digit in a number and a carry may occur in a lower order addition to be taken care of in higher order additions. The total possibility of combinations are given in table 4.

Figure 8 shows a possible logical circuit for a full adder which is one which takes care of carry inputs as

Augend	0	0	1	1	0	0	1	1
Addend	0	0	0	0	1	1	1	1
Carry In	0	1	0	1	0	1	0	1
Sum	0	1	1	0	1	0	0	1
Carry Out	0	0	0	1	0	1	1	1

Table 4 — Rules for binary addition with carry.

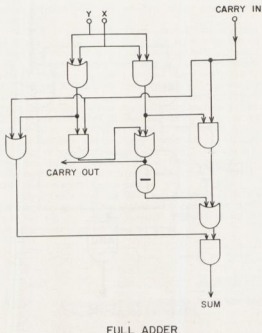


Figure 8 — Full adder circuit for a single binary stage

well as producing the sum and the carry output for each order in the binary number. Again by similar reasoning to above, the reader can follow through a few of the combinations given in table 4 and satisfy himself that the output sum digit and the carry digit will obey the rules given in the table. A complete adder would therefore be built up of a number of these units strung together according to the length of the binary number involved.

Multiplying is a more complex operation. It can be done by successive addition, but this is a time consuming operation. It is possible to construct a simultaneous parallel multiplying circuit, a device in which steady state signals representing the multiplicand and the multiplier are simultaneously applied to the input lines and after transients have died down, signals representing the product appear at the output lines. The product remains as long as the input signals are maintained. In practice, the inputs are usually pulses and the output will appear for the duration of the pulse. The time it takes to multiply two binary numbers together in this type of circuit, is usually determined by the propagation time of the carries through all the stages, which is equivalent to waiting for all the transients to die down and for the circuit to take up a stable state. Figure 9 shows a diagram of one form of such a multiplier for four digits. The

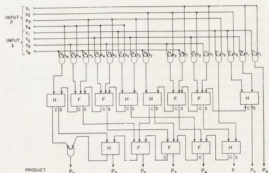


Figure 9 — A parallel multiplier for 4 digits. Inputs are X_1 to X_4 and Y_1 to Y_4 , with the product P_1 to P_8 .

complexity of the circuit is immediately obvious if it is remembered that each square in the block diagram represents either a full adder F, or a half adder H, interconnected by the usual types of gates. Because of the complexity involved, multiplication or even the addition in the cheaper types of computer, is not done in parallel, but in serial taking one pair of digits at a time and feeding the digits of two numbers to be added or multiplied through a series of gates in sequence. This slows the whole computation down, but is much more economical in hardware.

THE COMPUTING SYSTEM

It has been shown in the foregoing that it is possible to perform arithmetic operations using simple on-off circuitry. These circuits form the basis of the complete computing system. It is, however, necessary to connect

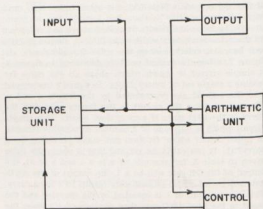


Figure 10 — General computer layout.

these circuits together in a suitable fashion to feed the series of pulses which represent the numbers to these circuits and to remove the results from the circuits to be presented to the human operator. Figure 10 shows in block diagram form the general lay-out of the computer systems. In the diagram the arithmetic unit is the unit in which the actual processing of the numbers take place. It is essential that these numbers be stored somewhere before and after manipulation and this is the function of the storage unit. To get information into the computer, an input unit is necessary and to convey the computed results to the outside world, an output unit is used. The reason why numbers cannot be taken straight from the input and processed and then presented to the output, is that the input-output devices are usually electro-mechanical of nature and are too slow to keep pace with the rate at which the arithmetic unit is working. The storage unit is a device which can absorb and produce numbers at a rate comparable to that of the arithmetic unit. The control unit is the unit which switches the various gates to allow the flow of digits through the circuits as is required.

The reason why the digital computer is such a powerful tool, is the fact that the control is a unit which operates with the same type of binary circuits as is used in the arithmetic unit. The control unit is switched by using instructions which can also be stored in exactly the same manner as the numbers in the storage unit. This means that these instructions can be modified if necessary by manipulating them exactly as one would do with the numbers. This is a powerful facility because it means that a programme can be changed according to actual results obtained during the computation. Thus for example it is possible, when using an iterative method, to proceed with a cycle of approximations which is repeated automatically until the end result does not change between successive operations. At such a stage the

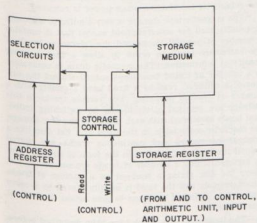


Figure 11 — Organisation of control and information channels in a typical storage system.

programme can then be diverted to proceed with a different operation.

The storage unit of a general purpose digital computer therefore stores both the instructions which control the machine operation and the data which are to be processed. The information is then referred to as words. The principle parts of a typical storage unit are: the address register, the selection circuits, the storage medium itself, the storage register or buffer and the storage control⁵⁾. The information transfer paths between these parts are shown in figure 11. A register is a storage unit which can store one word at a time. This may be made up of a string of flip-flops which are set to represent the 1's and 0's as it is contained in the word involved. They are used as buffers because the speed with which the arithmetic unit works is usually very much faster than the speed with which the information can be extracted from the larger storage media. Referring to figure 11, the operation of a typical storage unit is as follows:

1. The address of the word to be read or written is transferred to the address register and if the word is to be written, the word is transferred to the storage register. By address is meant the position in the store, which can contain a large number of words, to which this particular word is to be transferred.
2. The selection circuits decode the address and select the storage location involved.
3. Storage control is informed by the central control of the computer when to begin the reading or the writing process.

If reading, the word is then transferred from the storage medium to the storage register. If writing, the word is transferred from the storage register to the storage medium.

For use in storage, there is usually a hierarchy of different storage media within a single machine. The advantages of each type of storage in the overall machine function may then be utilized, for example it is necessary to have a fast storage medium available for direct communication with the arithmetic unit. In this case registers made up of flip-flops are often used, but because they are expensive, they are limited to the essential minimum required. To feed these, the conventional immediate

Type of storage	Typical unit size in 1000's of words	Typical read speed in microseconds per word	Typical cost in cents/bit
Flip-Flop Register	0.1	0.1	70
Ferrite Core	8	1.0	7
Magnetic Drum	1000,000	8	.25
Magnetic Tape	400,000	80	.0002
Magnetic Disc	24,000,000	40	.0006

Table 5 — Types of storage commonly used typical size, speed and cost.

access store is the magnetic core. Again one finds that the amount of core storage is limited by economics and usually a back-up store made up of either a magnetic drum or a disc file, or even magnetic tape units are used.

Table 5 shows typical speeds, size and cost for the various types of store.

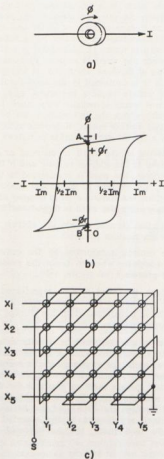


Figure 12 — (a) Individual core, typically 30 thousands of an inch outside diameter.

(b) Square hysteresis curve for storage cores.

(c) Single plane of co-incident storage.

Figure 12 shows diagrammatically how the individual ferrite cores are strung together in a matrix to form storage units. Figure 12(a) indicates the individual core which can be magnetised in a clockwise or anti-clockwise direction representing a 1 or a 0. Figure 12(b) shows the hysteresis curve of such a core if magnetized by passing

a current I through a wire passing through its centre. It can be seen that if a current of plus I reaching a level of about Im has been passed through the core and is then removed, the remanent magnetism in the core will fall back to position A on the vertical axis, conversely if the current had been in the negative direction, the remanent position will be B. It is easy to designate the one state as 1 and other as a 0. The way in which these cores are used, is shown in figure 12(c).

The cores are suspended on a matrix of wires consisting of three wires passing through each core. A set of x-wires, a set of y-wires and one continuous wire, 5, which forms a sensing-wire. If for instance, a 1 is to be stored in the core marked A, two co-incident currents of a $+\frac{1}{2} Im$ each are passed through wires X₁ and Y₁ simultaneously. The core is then switched into the state shown in figure 12(b) which represents a 1. If this information is to be read again, two co-incident currents of $-\frac{1}{2} Im$ each are passed along X₁ and Y₁ and the core is then switched from its state at A to its state at B. In doing so, there is a flux change from $+(I)r$ to $-(I)r$ and this flux change induces a signal in the sense-wire. All the other cores except the one at the co-incident point between X₁ and Y₁ receive either $+\frac{1}{2} Im$ in the writing cycle or $-\frac{1}{2} Im$ in the reading cycle. This is not sufficient to switch them from their remanent position of $+(I)r$ to $-(I)r$ or vice versa. In practice, for a parallel store, a plane such as shown in figure 12 will be used for one digit in the word and a number of planes will be stacked one upon the other to give the various digits required to complete the full word. The total number of words is then determined by the number of cores per plane and the wordlength by the number of planes. The disadvantage of the ferrite core store is that the read-out is destructive as can be seen and the information has to be rewritten into the core if it is to be retained. Its advantage is that it is still the most economical high speed store presently available and retains its information when power is removed.

The magnetic tape storage is very similar to the usual tape units used for entertainment except that it contains a number of parallel tracks and the tolerances involved are extremely small in order to allow a high packing density of information. The magnetic drum is equivalent to a number of closed tape loops spread around the surface of a cylinder, read by a fixed head assembly with a number of reading positions. The various tracks in this instance are selected electronically by switching individual heads associated with each track. In the disc storage, the magnetic material is in the form of a flat disc like a gramophone record and continuous tracks are spaced around the centre of rotation in the form of circles. Here an arm containing a number of heads are suspended just above the disc giving a read-out on a number of tracks simultaneously and the head is usually moved by a servo system into different positions to give access to different sets of tracks.

The basic elements which have been described before, are really all that is needed to construct a computer. For communication with the outside world and for feeding

information into the computer, one or more input-output units are used. Input units are either punched card readers or punched paper tape readers with perhaps a tele-typewriter as a keyboard input. As output, line printers, tele-printers, card punches and paper tape punches are used.

PROGRAMMING

In order to make the computer perform a calculation, it is, however, necessary to write the instructions for it. This means that first of all the problem has to be analysed in detail and all the necessary calculations broken down into its simplest numerical steps. A detailed set of instructions has then to be written which tells the computer step by step how to proceed with the calculation, very much in the same detail and order as one would depress the keys on a desk calculator. These series of instructions, when written down, has to be coded in terms of the word configurations which the control in the computer can use for controlling the operations. In the earlier computers, it was necessary to code the instructions in the exact format in which it is used in the control unit. This was known as writing in machine language and it was a laborious time consuming procedure. In the modern computer, the instructions are written in almost everyday language. Inside the computer is stored a programme which has previously been written in machine language. This programme can understand the common language instructions and perform the translation inside the computer, decoding into a machine language version of the programme. This machine language version of the programme can be immediately run on the computer that

is executed, or it can be output again for future use by the programmer.

The development of these general purpose languages or software as it is commonly known, has become a major undertaking in the computer industry. It is true to say that today, the greatest single factor which is threatening to retard the application of computers, is not the limitations of the hardware or the electronics, but the software namely the lack of sufficient general purpose programmes which are available. The computer therefore only really becomes useful together with an extensive library of programmes which can be used for the general type of computations required and which only requires the input of the new data when problems have to be solved.

MODERN COMPUTING SYSTEMS

Because of the large speed discrepancy which exists between the central processor or the arithmetic circuits and the input-output devices, it is customary in large systems today to run the system in what is called a multi-programme mode. This means that the computer has stored in his memory several problems on which it operates "simultaneously." These programmes are given priorities and the central processor will tackle the problems with priority No. 1 first and operate on this until such time as it has to wait for information to be transferred either from the memory or from an input-output device. At such a stage, in stead of waiting for the transfer to take place, it would switch to the problem with priority No. 2 and carry on with this until such stage as a delay occurs in information here. It would then switch

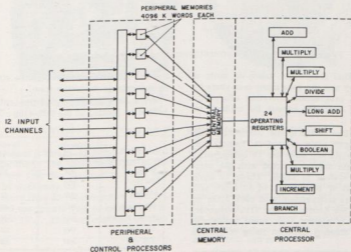


Figure 13 — Schematic of a modern large scale computer having 10 peripheral computers connected via a large scale central memory to the central processor.

to problem No. 3 if problem No. 1 has not yet completed its transfer. In this way the internal arithmetic units can be used to very high efficiency and the total increase in time taken per individual task is only marginally increased beyond what it would have taken if it was run alone on the computer.

The internal housekeeping inside the computer is largely done by a very sophisticated programme called the Operating System. This programme which together with some hardware circuits in the machine, schedules the switching between problems, looking several steps ahead to see where bottlenecks are due to occur and to speed up the operation by readying the information in

is the large central memory of 131,072 words of 60 bits. In the course of the solution of a problem, one or more peripheral and control processors are used for high speed information transfer in and out of the systems and to provide operator control. If the problem requires significant arithmetic speed, the central processor may be called on by a peripheral and control processor. A number of problems may operate concurrently with time sharing of the central processor.

The central processor has 10 independent arithmetic and logical units which operate concurrently in the solution of a problem. Similarly the central memory is organised in 32 logically independent banks of 4096 words.

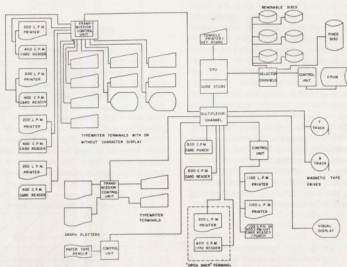


Figure 14 — The CSIR's present computing system when fully expanded.

time for processing. This programme takes up quite a large portion of memory and can take many man-years to develop. Without this programme operating efficiently, the hardware of the computer cannot be utilized to maximum effect.

It is interesting to look at the system configuration of one of the modern large scale computers, namely the Control Data 6600. Within the 6600 are 11 independent computers. Ten of these are constructed with the peripheral and operating system in mind. These 10 have separate memories each of 4096 words of 12 bits*, and can execute programmes independently of each other or the central processor. See figure 13. The 11th computer, the central processor, is a very high speed arithmetic device. The common element between these computers

Several banks may be in operation simultaneously; thereby minimising execution time.

The computing speed of the central processor can be judged by looking at the following: The minimum access

Computer	Year first installed	Normalized Computing Power	Normalized ratio computing power/cost
ENIAC	1946	.025	-
IBM 704	1955	1	1
IBM 7094	1962	12	3
IBM Stretch	1961	20	
Ferranti ICT Atlas	1962	50	
CDC 6600	1964	125	20-50
CDC 6800	1967	500	50-80

Table 6 — Increase in computer speed and economy over 2 decades.

* A bit is a binary digit.

time, i.e. the time to extract a selected word, of the central memory is 500 nano-seconds*. A full read-write cycle takes 1,000 nano-seconds or 1 micro-second. Long addition of two 60 bit words occupies 300 nano-seconds and floating point addition 400 nano-seconds. Multiplication of two 60 bit words (floating point) 1,000 nano-seconds. This means that the computer can theoretically add three million numbers of the equivalent of 18 decimal digits each in one second. In practice this will not be achieved, because the transfer of the information to and from the adder also takes time.

The rapid development of computers is making their use more economical and attractive. Table 6 shows the development of the computing power starting with the IBM 704 in 1955 to one of the fastest computers commercially available today. The ENIAC is included for the sake of interest. The figure should be taken as an indication of trends only, since it is virtually impossible to compare two systems with one another on an absolute basis; it depends to a very large extent on the configuration used and the type of problem considered. It is noteworthy, however, that the economics have improved by almost two orders of magnitude during this period.

Figure 14 shows diagrammatically the configuration of a reasonably large computing system viz. the present

control computers which are used for on-line application where the growth rate is nearer 40% per annum. In America alone it is estimated that by 1980, 20% of the gross national product will be in computing machines of one type or another. In South Africa, the computing load has steadily increased, and by the end of 1968 some 255 computers were installed and another 100 on order.

FUTURE DEVELOPMENTS

The first computers constructed using relays were slow, unreliable and bulky. The use of valves in the first electronic machine gave more than a 1000-fold increase in speed. The reliability, although increased, was still not adequate and large cooling systems were used to carry away the heat mainly generated by the thermionic heaters in the valves. A fairly large system such as the IBM 704 used by CSIR until 1967, generated some 100Kw of heat.

The invention of the transistor in 1948 by Schockley, Brittain and Bardeen, introduced an entirely new technology, creating a device which could be used as a current amplifier or as a switch requiring no heating element. The electrical current is conducted through semiconductor materials by means of electrons, or the absence of electrons called holes, and the current flow is controlled by voltages applied to junctions of the various layers of

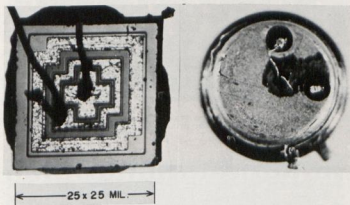


Figure 15 — Transistor chip before and after mounting.

CSIR IBM 360/65 system as it will be when fully expanded to its planned configuration. The computing load at the CSIR had doubled every year for the past 10 years and there is still no sign of slackening off.

Today there are more than 40,000 computers installed in the U.S.A. alone and the growth rate of capital investment is something like 15%. This excludes the process

the semiconducting materials. Transistors were soon improved to the extent that reliability of a very high standard was achieved and computers with mean-time between failures of many thousands of hours could be built. These devices were extremely small compared to their valve counterparts and very compact circuits could be built, using printed circuit wiring for interconnecting the transistors and diodes with discrete components such as resistors and condensers.

Figure 15 shows a transistor in "chip" form and when mounted on a suitable holder for protection, hand-

* 1,000 nano-seconds are equal to 1 micro-second. A micro-second is a millionth of a second.

ling and soldering into the circuit. The "chip" referred to here is usually a small piece of mono-crystalline silicon or germanium material into which various impurities are diffused to form the different layers of semiconducting material which constitutes the transistor or the diode.

The next stage in the development followed very quickly and by 1960 the first Integrated Circuit was announced. In this circuit all the transistors and the diodes used in a flip-flop for example, was manufactured on a single chip and in addition by the same process

resistors and condensers were also formed. Thus a complete circuit was now available in the same container that previously contained only one transistor or diode. Figure 16 shows some flip-flops in conventional form built on a printed circuit board and below the 5 cans containing the same circuits in intergrated form.

The present state of development is entering an entirely new era namely that of Large Scale Integration or LSI where large numbers of components are now placed on a single slightly larger chip. For example

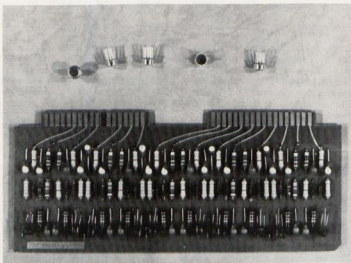


Figure 16 — The 5 cans at the bottom containing integrated circuits, can perform the same function as the printed board circuit above.

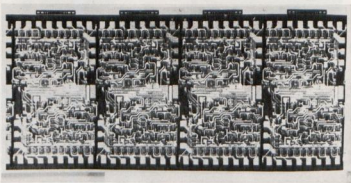


Figure 17 — Large scale integrated circuit adder for two 8-bit numbers. Adding time 10 nano-seconds. Physical size 53 × 119 thou.

Figure 17 shows an 8 bit adder which can add two 8 bit numbers plus a carry-in, together in 10 nano-seconds. This circuit is 53 thousands of an inch wide by 119 thousands of an inch long. The individual switching elements within the array switches at less than 1 nano-second⁶).

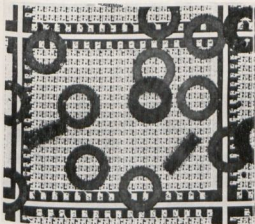


Figure 18 — Large scale integration storage unit. Compare size of each cell with superimposed ferrite cores of outside diameter of 30 thou.

In the field of fast storage elements the same techniques make possible extremely compact and fast stores. Figure 18 shows a 256 bit storage chip having individual cells for storing 1's or 0's of 6×8 thousands of an inch⁷). Compare the individual cores having an outside diameter of about 30 thousands of an inch. For this cell, the read-out is non-destructive and the response speed of each flip-flop is about 5 nano-seconds with a power dissipation of about 5 milliwatt per bit.

These arrays are not yet commercially available and manufacturing yield will have to be improved before they can compete economically with magnetic cores for example. One manufacturer, however, is confident that by 1971 they will be selling semiconductor memories for just over 2 cents per bit.

It is interesting to note that computers are used to design the intricate lay-out patterns used in the complex LSI-circuits referred to above!

With these technological advances already leaving the laboratory, it is interesting to speculate on what will happen by the year two thousand. In a recent publication of the IFIP: LAG⁸) a survey by the firm Parsons & Williams Inc., made at the occasion of the Seminar File 68, gave the following speculations as to the development and applications of computers up to this time.

"The rapid development of advanced computer applications is expected to continue to the year 2000

and result in much more influence on society than today. The expected widespread automation might create a new form of democracy in the future. However, strong emphasis has been made that events outside that of the Electronic Data Processing area, such as local and general political conflicts, can reduce the reliability of the forecast made.

A 50% reduction in the labour force in the present industries is expected in the late 1980's. The reduction will be partially compensated for by shorter working hours, together with new industries to absorb the labourers, but the problem of unemployment is expected to be much more serious in the future than it is today.

In the year 2000, all major industries will be controlled by computers. Small industries will not be automated to the same extent, but it is anticipated that not many of these will exist by then.

The money and cheque system of today will, to a large extent, be taken over by a network of terminals and computers by the early 1990's. Around 1985, a majority of employers will have terminals where income is recorded and automatically transferred to tax authorities (if the direct tax system exists by that date).

Large urban traffic flow will be controlled by computers from 1973, and policing of individual vehicles by combined radar detection and computer record of violation will be normal between 1980 and 1986. In the late 1990's, there will be a widespread use of automobile autopilots.

The influence on the medical profession by electronic data processing is expected to be extensive. Around 1975, patients in major hospitals will be controlled by computers, and in the beginning of the 1980's, a majority of doctors will have electronic data processing terminals for consultation. Computers will, at that time, give reliable diagnosis when the physician inputs the patients' symptoms.

Medicine, as well as other sciences, will, by 1983, have a well-established recording system so that scientific and other advances can be constantly updated and retrieved from large central files. Also, automation of libraries and an extensive use of Computer Aided Instruction are foreseen.

At the turn of the century, it is expected that computers will be just as common as telephones or television sets in private homes.

Up to the year 2000, electronic data processing systems will be based on networks of terminals connected to some large computers. Electronic data processing machines will be based on technologies other than today. It is expected that laser memories will be available between 1976 and 1983. The computers will also be smaller and faster. Even pocket size computers are expected.

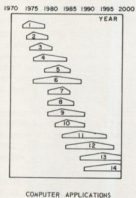
Oral input to computers in practice will be possible by 1979. Cards and paper tapes will be outdated at

that time as communication medium and transmission of data by laser signals will be usual by 1981.

The future software will, to a large extent, be built into the hardware by late 1990's and computers learning from their own experience will exist before 1989.

In spite of the advanced technology, the computer price is expected to decrease by a factor of 100 by the end of the 1980's."

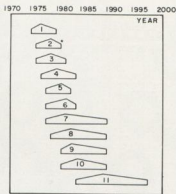
Figures 19 and 20 summarise these speculations in graphical form. No doubt some of these may appear far-fetched, but one has only to consider the tremendous development that has taken place during the past 20



- 1) Direction of large urban traffic flow by computer
- 2) Control of patients in major hospitals by computer
- 3) Widespread use of Computer Aided Instruction (CAI) in schools
- 4) Computer controlled commercial airplanes including takeoffs and landings
- 5) Recording of scientific and other advances so that constantly updated status is maintained in central files
- 6) Computer as diagnostician (giving reliable results)
- 7) Policing of individual vehicles by combined radar detection and computer record of violation (license number, excessive speed, etc.)
- 8) Majority of doctors having a terminal for consultation
- 9) 50% reduction of labor force in major industries because of EDP automation
- 10) Recording of all income by majority of employers on terminals and automatic transfer of this information to various tax authorities
- 11) Instruction at home through computers
- 12) Obsolescence of book libraries as known today for general factual information
- 13) Widespread use of automobile outplants
- 14) Computers as common as telephone or television in private homes

Figure 19 — Forecast of computer applications up to the year 2000.

years since computers were first introduced. No matter what we may think, computers have come to stay and have revolutionised our way of life already and will do so even more in the future.



- 1) Flexible internal storage, i.e. easily increased or decreased in size with use of plug-in units
- 2) Majority of software replaced by built-in hardware, i.e. small packages of integrated circuits to be attached to the computer
- 3) Briefcase computers ("advanced slide rules" with large memory)
- 4) Oral input to the computer
- 5) Laser memory
- 6) Transmission of data by laser signals
- 7) Cards and paper tapes no longer used as a communication medium
- 8) One million byte memory small enough to be included in an independent desk computer
- 9) Pocket size computers ("advanced slide rules" with large memory)
- 10) Computers learning from their experience
- 11) Computer price decreased with a factor of 100

Figure 20 — Forecast of development in computer technology up to the year 2000.

ACKNOWLEDGEMENT

The author wishes to acknowledge the assistance of several of his colleagues in helping him to gather data for this paper.

REFERENCES:

- (1) B. V. Bowden, *Faster than Thought*. Publisher Sir Isaac Pitman, 1953.
- (2) Barlows Tables of Squares etc. 1814.

- (3) High Speed Computing Devices. Engineering Research Associates, McGraw-Hill.
- (4) R. K. Richards. Arithmetic Operations in Digital Computers. D. von Nostrand.
- (5) Grabbe, Ramo, Wooldridge. Handbook of Automation, Computation and Control. Vol. 2. Wiley.

O P S O M M I N G

'n Kort historiese oorsig oor die ontwikkeling van die eerste syferrekenaars word gegee. Rekenkundige metodes en die belangrikheid van die binêre getalstelsel word behandel. Stroombane vir gebruik in numeriese berekeninge word beskryf. Die algemene samestelling van syferrekenaars, asook die rol van die verskillende onderdele en die programmering word gegee. Die logiese konstruksie van 'n moderne syferrekenaar word behandel en die samestelling van 'n groot rekenstelsel gegee. Enkele nuwe ontwikkelings in rekenaarkomponente word beskryf en verwagte nuwe toepassings van rekenaars aangetoon.

- (6) M. R. Byrd, W. H. Julitz, P. M. Lee, C. D. Phillips. The Fastest Logic Yet. Motorola Monitor, Vol. 6 No. 3.
- (7) W. Raisanen. Memories are made of this. Motorola Monitor, Vol. 6. No. 3.
- (8) IFIP: IAG-Communications 6/1968.

S U M M A R Y

A brief historical review of the development of the first digital computers is given. Arithmetic systems and the importance of the binary number system are outlined and circuits described which can perform numerical calculations. The general lay-out of digital computers is described and the role which various sub-units play, are outlined, as well as the importance of the programmes used. The logical construction of a modern computer is briefly described and the elements used in a large computing system are given. Finally some recent developments in the component field are described and future application of computers is outlined.

FINANSIËLE OUTONOMIE

deur

ROWAN MARTIN,

O.B.E., B. Com., F.I.M.T.A., A.C.W.A., F.C.I.S.,
Stadtesourier, Salisbury, Rhodesië.

"Die beskaafde nasie, algemeen gesproke, bestaan uit gepeupel, geldinsamelingsmasjien en kapitalis; en wanneer die gepeupel op een of ander iets geld wil uitgee, dan gebruik hulle die geldinsamelingsmasjien om die nodige geld van die kapitalis te leen, en dié leen dit aan die gepeupel, geslag na geslag, mits hy hulle kan belas."

(Ruskin)

1. Toe ek goedgegunstig genader is om hierdie Vergadering toe te spreek, het ek nie die uitnodiging gretig aangeneem nie. Suspiseus van die dag dat ek gebore is, het ek myself afgevera hoekom ek nou eintlik my kop vrywilliglik in 'n byenes moet insteek. Persoonlike ydelheid het egter al gou persoonlike suspisie ondergekry, en daarna het ek lank geloop en wik en weeg oor 'n moontlike onderwerp. Ek het gewanhoop, maar op die randjie daarvan het die glinsterende simbool van Onafhanklikheid uit die skemerwêreld opgeduik.

2. Laat ek nie versuim om die versekering te gee dat ek hier nie met politieke onafhanklikheid gemeoid is nie. En as 'n veteraan met drie-en-dertig jaar lank ondervinding in plaaslike bestuur, is ek ook nie van plan om u goeie guns te probeer wen deur dit vir die onafhanklikheid op bestuursvlak van elektrisiteitsondernemings binne die bestek van die plaaslike owerheid op te neem nie. Nee, die onafhanklikheid waaroor ek die stryd wil aanbind, is finansiële onafhanklikheid vir elektrisiteitsondernemings — 'n uiters reële outonomie by die verskaffing van kapitale finansiering vir uitbreiding en ontwikkeling.

DIE PROBLEEM

3. Dit is niks ongewoons nie, eintlik is dit die gewone loop van sake, om by die onderontwikkelde lande van die wêreld, en hierby sluit ek die Donker Vasteland in, te vind dat terwyl daar 'n dringende en toenemende behoefte aan uitbouing van kragfasiliteite bestaan, die omvang van die beskikbare kapitaal in 'n omgekeerde verhouding tot die behoefte staan.

In die beskaafder lande kan daar van die kapitaalmarkfasiliteite gebruik gemaak word om finansiering te bekom, maar waar hierdie fasiliteite ontbreek, is dit gewoonlik die Staat van wie daar verwag word om uitbreiding op nywerheidsgebied te finansier. Waar dit die geval is, en omdat noodsaaklike dienste van uiteenlopende aard soos skole, hospitale, openbare dienste en reservoires op die Staatsbegroting aangewys is, is dit onwaarskynlik dat daar aan die vereistes van die kragnywerheid voldoen sal word

FINANCIAL AUTONOMY

by

ROWAN MARTIN,

O.B.E., B. Com., F.I.M.T.A., A.C.W.A., F.C.I.S.,
City Treasurer, City of Salisbury, Rhodesia

"The civilised nation consists broadly of mob, money-collecting machine, and capitalist; and when the mob wishes to spend money for any purpose, it sets its money-collecting machine to borrow the money it needs from the capitalist; who lends it on condition of taxing the mob generation after generation."

(Ruskin)

1. When I received a gracious invitation to address this Convention, I did not accept with alacrity. Suspicious from birth onwards, I asked myself precisely why I should voluntarily stick my head into the lion's den. However, personal vanity soon overpowered personal suspicion and thereafter 'I wandered lonely as a cloud' in search of subject matter. My well of despair knew no depths and I was going under for the third and last time when out of the murky gloom emerged the shining symbol of Independence.

2. Let me assure you immediately that I am not concerned with a political independence. Nor, as a veteran with thirty-three year's service in local government, am I going to curry your favour by crusading for the executive independence of electricity undertakings within the perimeters of local government. No, the independence for which I campaign is a financial independence for electricity undertakings — a very real autonomy in the provision of capital finance for expansion and development.

THE PROBLEM

3. It is not unusual, in fact it is most usual, to find in the lesser-developed countries of the world, and I include the Dark Continent, that whilst there is an urgent and ever-increasing need for the expansion of power facilities, the available volume of capital finance is in inverse proportion to that need. In more civilised countries capital markets provide the facility for obtaining finance but, in the absence of such facilities, then it is usually the Government of the country which is expected to provide finance for industrial expansion. In such circumstances, and because the State's budget has to accommodate a host of essential demands, such as schools, hospitals, public offices and reservoires, it is most unlikely that the requirements of the power industry will be satisfied to the extent recommended by responsible engineers and consultants.

in die mate waarin verantwoordelike ingenieurs en konsultante dit aanbeveel.

Hierdie onewigtige toestand neig om selfs meer akkuut te word in daardie omstandighede waarin die regering die geldening aanvanklik vir eie rekening aangaan en dan daarna 'n toekening aan die Ministerie van Plaaslike Bestuur maak wat op sy beurt hierdie fonds op 'n behoeftegrondslag onder plaaslike besture onder sy vleuels verdeel. Nadat die plaaslike bestuur sy toekenings aan die verskillende departemente van die Korporasie gemaak het, is die gevolglike toekening aan die Elektrisiteitsdepartement gewoonlik te min om in die ware behoeftes te voorsien.

4. Maar selfs al sou voldoende geldenings vryelik beskikbaar wees vir elektrisiteitsondernemings via die kanaal van 'n gesofistikeerde geldmark, is daar baie ander goeie redes waarom 'n Voorsieningsowerheid moet probeer om homself selfonderhoudend te maak in die voorsiening van kapitaalgeld.

DIE DOELWIT

5. Die primêre doelwit van hierdie referaat is om nadruk te lê op die behoefte om 'n ordelike plan aan te pak vir die voorsiening van die grootste deel van ontwikkelingsgeld vanuit die bronne van die onderneming self.

HUIDIGE GEDAGTES

6. 'n Mens hoef nie ver te soek om voortreflike steun vir my pleidooi te vind nie. In 1959 het mnr. Eugene R. Black, President van die Internasionale Bank vir Rekonstruksie en Ontwikkeling, die volgende pertinente opmerkings gemaak :

„N Gestadige uitbreidende voorsiening van noodsaaklike openbare utiliteitsdienste is vandag 'n vereiste vir ekonomiese groei in alle onderontwikkelde lande. In die volgende dekade sal baie duisende dollar in kapitaal vir hierdie dienste gevind moet word. Daar is eenvoudig geen praktiese manier om hierdie geld te vind tensy 'n groot hoeveelheid daarvan deur die utiliteitsdienste self verkry word nie deur verbruikers voldoende tariewe te vra vir dienste wat aan hul gelewer word.

„Die Bank het hierdie standpunt al geruime tyd gehuldig. Ons het gesê dat dit gevaarlik is vir 'n ontwikkelende land om sentimenteel te wees oor of politieke oorgewings voorkeur te gee in aangeleenthede soos spoorweë en elektriese kraginstallasies; dat beleide wat op hierdie beskouings gegrond is, net die reserwes, wat die lewensbloed van elke land se toekomstige welvaart is, ondraaglik uitput. Ons het gesê dat voldoende utiliteits-tariewe veral belangrik is in 'n land waar daar geen georganiseerde kapitale mark is nie.”

„Met voldoende tariewe het ons tariewe bedoel wat utiliteite nie net in staat stel om die ware koste

This state of imbalance tends to become even more acute in those circumstances where initially the Government raises the loan finance for its own account and then makes a subsequent allocation to the Ministry of Local Government which, in turn, apportions these funds on a need basis to the local authorities coming under its wing. After the local authority has settled its own allocations for the several departments of the Corporation, the resultant allotment to the Electricity Department usually falls short of its real needs.

4. But even if adequate loan finance was to be freely available for electricity undertakings via the agency of a sophisticated money market, there are many other sound reasons why a Supply Authority should seek to make itself self-sufficient in the supply of capital finance.

THE OBJECTIVE

5. The primary objective of this essay is to urge the need to embark upon an orderly plan for providing the major part of development finance from within the resources of the undertaking itself.

CURRENT THOUGHT

6. One does not have to wander too far afield to find eminent support for my advocacy. In 1959, Mr. Eugene R. Black, President of the International Bank for Reconstruction and Development, made the following pertinent observations :

“A steadily expanding supply of essential public utility services is a requisite of economic growth in all under-developed countries today. Over the next decade, many thousands of dollars in capital for these services must be found. There is simply no practical way to raise this money unless a substantial part of it is generated by the utilities themselves through adequate charges to the users of their services.

The Bank has been labouring this point for a long time. We have held that it is dangerous for a developing country to be sentimental or politically expedient about things like railroads and power plants; that policies based on these attitudes only create an intolerable drain on the savings which are the lifeblood of every country's future prosperity. We have said that adequate utility rates especially important in a country where there is no organised capital market.

By 'adequate' rates we have meant rates which enable utilities not only to cover the real cost of their services but also to retain out of earnings substantial sums each year to help finance the

van hul dienste te dek nie, maar ook om uit verdienste elke jaar substansiële bedrae te behou om te help met die finansiering van uitbreidings wat onvermydelik nodig sal wees om toekomstige groei vol te hou. En waar ons op voldoende tariewe aandring het ons geen onderskeid getref tussen privaat- en publiekbeheerde utiliteite nie."

7. Die meeste van u het seker 'n referaat gelees wat in Junie 1960 voor die Wêreldkonferensie oor Kragvoorsiening in Madrid gelees is deur A. D. Spottswood, Hoof van die Publieke Utiliteitsafdeling van die Internasionale Bank vir Rekonstruksie en Ontwikkeling. Ek het hierdie referaat nog altyd beskou as voortreflik in sy waarde-bepaling van finansies waar dit op kragvoorsiening van toepassing is; veral omdat dit die voortbrenging van finansies vanuit die industrie self omlin, maak dit 'n sine qua non vir die departementele biblioteek. Die skrywer sê:

„As lande met nie-bestaande of beperkte kapitale markte en beperkte vermoë om in die buiteland te leen, nie staatmaak op regeringsbegrotings om vir fondse vir uitbreiding voorsiening te maak nie (en in die meeste lande behoort dit die doelwit in in die afsienbare toekoms te wees), hoe gaan die kapitaal verkry word? Die antwoord is dat 'n substansiële deel daarvan verdien moet word deur die utiliteite self deur voldoende tariewe te hef van verbruikers van elektrisiteit. 'n Voldoende tarief behoort genoeg inkomste te voorsien om

- (a) alle werk-, onderhouds- en administratiewe kostes, belasting, rente en waardeverminderingkoste te dek;
- (b) 'n surplus te skep waaruit geskikte voorsiening gemaak kan word om alle lenings terug te betaal in soverre as wat die periodieke skulddeging daarop nie gedek word deur waardevermindering nie; en daarenwens om 'n genoegsame bedrag ter syde te sit om 'n redelike deel van die koste van toekomstige uitbreiding te dek."

8. Om by die Verenigde Koninkryk te kom: die oorspronklike statutêre verpligting van die genasionaliseerde ELECTRICITY SUPPLY INDUSTRY was, net soos in die geval van ander staatsbeheerde industrieë, nie alleen daarop bedag om te voorsien in die aanvraag na sy diens op die mees doeltreffende manier nie, maar ook om sy besigheid so te beheer dat die finansies oor 'n siklus van jare kiets uitkom, nadat 'n bydrae tot reserwes gemaak is. Dit het egter later nodig geword om hierdie breë vereistes meer spesifiek te omlin en in 1967 het 'n Witpapier oor die Finansiële en Ekonomiese Verpligtings van die Genasionaliseerde Industrieë (Commd. 1337) dit baie duidelik gemaak dat die industrieë dit as doelwit moet stel om hulle rekeninge te balanseer binne 'n siklus van vyf jaar na voorsiening vir rente en waardevermindering op historiese kostes. Voorsiening behoort ook gemaak te word vir die verskil tussen waardevermindering teen historiese en vervangingskoste, asook toekennings aan 'n

expansions which inevitably will be needed to sustain future growth.

And we have made no distinction in advocating adequate rates between privately-owned and publically-owned utilities."

7. Most of you will have read a paper presented to the World Power Conference in Madrid during June 1960, by A. D. Spottswood, Chief Public Utilities Division, International Bank for Reconstruction and Development. I have always considered this essay to be outstanding in its assessment of finances required for the Power game; more particularly, its outlines for the generation of finance from within the industry itself, make it a sine qua non for the departmental library. The author says:

"If countries with non-existent or limited capital markets and limited ability to borrow abroad should not depend on government budgets for their funds for expansion (and in most countries this be their goal in the reasonably near future), then how is the capital to be obtained? The answer is that a very substantial part of it should be earned by the utilities themselves through adequate charges to the consumers of electricity. An adequate rate should provide sufficient revenues to

- (a) cover all operating, maintenance and administrative expenses, taxes, interest and adequate depreciation charges;
- (b) create a surplus out of which suitable provision can be made to repay all loans in so far as the periodic amortization payments thereon are not covered by depreciation; and in addition to set aside an amount sufficient to cover a reasonable part of the cost of future expansion."

8. Crossing to the United Kingdom, the original statutory obligation of the nationalised Electricity Supply Industry, in common with other State-owned industries, was not only to contrive to meet the demand for its service in the most efficient manner but also to so conduct its business so that over a cycle of years the finances would break even, after making a contribution to reserves. However, it subsequently became necessary to define these broad requirements more specifically and, in 1967, a White Paper on the Financial and Economic Obligations of the Nationalised Industries (Commd. 1337), made it very clear that the industries should aim to balance their accounts within a cycle of five years, after providing for interest and depreciation on historic costs.

Provision should also be made for the difference between depreciation at historic and replacement costs, as well as allocations to a reserve in order to make some contribu-

reserwe om hydraes te maak tot toekomstige ontwikkelingsuitgawe en as 'n beveiliging teen sulke toevallighede soos vroegetydige veroudering.

9. In die geval van die elektrisiteitsindustrie is die aanvanklike finansiële doelwit gestel op 12.4% — d.w.s. voor faktore soos die rente en waardeverminderingstekoste afgetrek word, moet die bruto inkomste naastenby 12.4% van die gemiddelde netto bates wees; daarna, en ten spyte van teenstand, het die Minister van Elektrisiteitsvoorsiening hierdie finansiële doelwit van 12.4% tot 12.9% verhoog met betrekking tot die jare 1967 — 72. Hoewel dit nie betrekking het op die tema van hierdie referaat nie, is dit noemenswaardig dat die wins gedurende die twaalf jaar tussen 1955 — 67 gewissel het tussen 9.7% en 12.5%.

10. Oor 'n tydperk van sewe jaar het die Sentrale Owerheid en die Gebiedsrade 'n netto surplus van ongeveer £69 miljoen laat ooploop op 'n totale inkomste van £1,897 miljoen oor dieselfde tydperk — 'n gemiddelde grens van 'n rapsie meer as drie persent, soos volg onderverdeel:

	£m.
Sentrale Reserwefonds	11.0
Gekombineerde Gebiedsreserwefonds	10.7
Belastingsreserwes	18.6
Aanvullende Reserwe vir Waardevermindering van Vaste Bates	10.5
Opgehoopde Saldo op Gekonsolideerde Inkomste-rekening	9.5
	£60.3

tions towards future development outlay and as a safeguard against such contingencies as premature obsolescence.

9. In the case of the electrical industry, the initial financial objective (target) was set at 12.4% — that is to say, before deducting the interest and depreciation expense factors, the gross income should approximate 12.4% of the average net assets; subsequently, and despite protests, the Minister of Power increased this financial objective from 12.4% to 12.9% in respect of the years 1967—72. Whilst not germane to the theme of this paper, it is worthy of note that during the twelve years 1955—67, the return has ranged between 9.7% and 12.5%.

10. Over a period of seven years, the Central Authority and the Area Boards accrued a net surplus amounting to approximately £60 million on an aggregate revenue over the same period of some £1,897 million — an average margin slightly in excess of 3 per cent, and allocated thus:

	£m.
Central Reserve Fund	11.0
Combined Area Reserve Funds	10.7
Taxation Reserves	18.6
Supplementary Reserve for Depreciation of Fixed Assets	10.5
Accumulated Balance on Consolidated Revenue Account	9.5
	£60.3

11. Hoewel wetgewing van die Verenigde Koninkryk daarop aandring dat voldoende voorsiening gemaak moet word vir die insluiting van rente en waardeverminderingstariëwe, asook 'n reserwevoorsiening vir die wisseling in waardevermindering gebaseer op historiese teenoor verangskoste, wil dit voorkom asof daar geen ware wetsaandring is op 'n verpligte bydrae tot eie-finansiering van die industrie nie, en hieruit kan 'n mens aflei dat die omvang van enige vrywillige bydrae eintlik volgens die jaar se finale handelsyfers bereken word, eerder as om volgens 'n voorafbeplande program by te dra. Ek dink egter daar kan aangevoer word dat selfs die genasionaliseerde industrie gedagtig is aan sy verpligting om kapitale fondse vanuit sy inkomstes op te bou.

11. Whilst the United Kingdom legislation insists that adequate provision shall be made for the inclusion of interest and depreciation charges, as well as a reserve provision for the variation in depreciation based on historical versus replacement cost, there appears to be no real legislative insistence on a compulsory contribution towards self-financing of the industry and it seems fair to conclude that the extent of any voluntary contributions tend to be determined by the result of the year's trading figures rather than a preplanned contribution.

However, I think it can be contended that even the nationalised industry is mindful of its obligation to generate capital funds from within its revenues.

12. Returning to Rhodesia, a Working Party was appointed by the then Federal Minister of Power in November 1961, for the purpose of advising on the Electricity Distribution of Southern Rhodesia; it reported back in June 1963 and I quote hereunder from its findings:

"64. Throughout the world the acquisition of external capital for development purposes is becoming increasingly difficult and one of the principal reasons for this state of affairs is the growing custom of transferring more and more industrial activity to government or quasi-government control. It is frequently found in legislation governing the

"64. Oor die hele wêreld word die verkryging van van buitelandse kapitaal vir ontwikkelingsdoelendes toenemend moeilik en een van die hoofredes vir hierdie toedrag van sake is die groeiende gebruik om meer en meer industriële bedrywigheid in regerings- of kwasi-regeringsbeheer oor te plaas. Dit word dikwels in wetgewing wat die werking

van statutêre rade of kommissies beheer, gevind dat hulle belas word met die plig om dienste te voorsien „sonder wins of verlies.“ Dus word elke onderneming afhanklik vaneksterne bronne vir sy ontwikkelingskapitaal. Hierdie tendens word erken deur liggame soos die Wêreldbank wat, soos herinner sal word, daarop aangedring het dat die Federale Elektriese Kragraad 'n groot deel van sy toekomstige kapitaal uit inkomste moet voorsien. Die generasionaliseerde elektrisiteitsindustrie in Brittanje voorsien ook nou vir die skepping van substansiële kapitaalreserwes en mag heel moontlik in staat wees om op hierdie manier binne die volgende dekade selfonderhoudend te wees.”

„65. Omdat die Werksparty van mening is dat eie voorsiening van kapitaal van die uiterste belang is, stel hy voor dat wetgewing ingestel word om te verseker dat hierdie praktyk binne ons elektrisiteitsindustrie in werking tree vir ontwikkelingsdoelendes. Die wetgewing moet die Elektrisiteitsraad van magte voorsien sodat dit van ondernemings kan eis om hulle tariewe so te beplan dat minimum proporsies van jaarlikse inkomstes opsy gesit word met die doel om kapitaalreserwes te skep vir ontwikkelingsprogramme sodat die industrie uiteindelik in staat sal wees om in 'n groot mate vir sy eie ontwikkeling te betaal. Terwyl die voorsiening van kapitale fondse uit een bron, naamlik deur die verantwoordelike ministerie (aanbeveel in paragraaf 63 van hierdie verslag), outomaties die tydperk vir die vereffening van lenings sal rig, vereis ons voorgenome stelsel vir die voorsiening van kapitaal dat dié fondse voorgeskietsal word in die vorm van lenings (wat rente verdien) vir die aankoop van bates. Die tydperk waarvoor die lenings aangegaan word, moet dieselfde wees as dié waarvoor die bates behou word. Gestandaardiseerde tydperke moet neergelê word vir die delging van lenings vir verskillende soorte bates.”

13. Laat ek daarmee volstaan dat teen die agtergrond van die voormelde dokumentasie, dit duidelik is dat die bepaling om voorsiening te maak vir eie-finansiering vanuit 'n onderneming heeltemal gegrond, betekenisvol en versienende is in sy doelwit.

HOE EN WAARMEE

14. Dit ly geen twyfel nie dat 'n meer bevoegde persoon as ek 'n verskeidenheid van metodes sal kan voorstel vir die interne voorsiening van kapitaal; ekself moet daarmee volstaan om maniere en middele te ondersoek binne die beperkinge van my eie ervaring en die tyd wat by hierdie geleentheid tot my beskikking is nie. Daarom beperk ek myself tot drie metodes.

KAPITAALONTWIKKELINGSFONDSE

15. Op 12 Oktober 1957 was ek verantwoordelik vir die skepping van individuele kapitaalontwikkelingsfondse vir elk van die Raad se groot ondernemings, bestaande uit die Tariewefonds, die Elektrisiteitsfonds, die Waterfonds, en die Drankonderneming, of, soos dit meer algemeen in

operation of statutory boards or commissions that they are charged with the duty of providing services “without profit or loss.” Thus, each undertaking becomes entirely dependent upon external sources for its development capital. This trend is recognised by bodies like the World Bank who, it will be recalled, insisted upon the Federal Power Board providing a large proportion of its future capital from revenue. The nationalised electricity industry in Britain too, now provides for the creation of substantial capital reserves and may well be able to become self-supporting in this way within the next decade.”

“65. Because the Working Party considers that self-generation of capital is of vital importance, it recommends that legislation be enacted to ensure that such a practice takes place within our own electricity industry for development purposes. The legislation should provide the Electricity Council with powers to require undertakings so to design their tariffs that minimum proportions of annual revenue are set aside for the purpose of creating capital reserves to assist development programmes so that the industry will eventually be able to pay for much of its own development. Whilst the provision of capital funds from one source, namely through the responsible Ministry (recommended in paragraph 63 of this report), would automatically align the period for the redemption of loans, our proposed institution of a system for self-generation of capital requires, too, that such funds shall be advanced in the form of interest-bearing loans for the purchase of assets, the period of the loans to coincide with the lives of the assets. Standardized periods of time should be laid down for the redemption of loans for different types of assets.”

13. Suffice it then to say that against the background of the foregoing documentation, it is evident that the determination to provide self-finance from within an undertaking is well-founded, purposeful, and most far-seeing in its objective.

WAYS AND MEANS

14. No doubt an abler pen than mine could sponsor a variety of methods for the internal generation of capital; for myself I can do no more than examine ways and means within the limits of my own experience and the time available to me on this occasion. Accordingly, I restrict myself to three methods.

CAPITAL DEVELOPMENT FUNDS

15. On the 12th October, 1957, I sponsored the creation of individual Capital Development Funds for each of the Council's major undertakings, comprising Rate Fund, Water Fund, and the Liquor Undertaking or, as it is more commonly known in South Africa, the Bantu Beef

Suid-Afrika bekend is: die Bantoeierrekening. Daaropvolgende wysigings van die Bantoeierregulasies het my ook in staat gestel om voorspraak te maak vir die skepping van 'n Ontwikkelingsfonds vir Bantoebehuising in 1961, maar die gebruik van sulke fondse is beperk tot die voorsiening van behuising teen lae koste.

16. Twaalf jaar later, op 30 Junie 1968, het die onderskeie ontwikkelingsfondse die volgende balanse getoon:

Fonds	Kapitaal £	Voorskot £
Tarief	218,000	85,000
Bantoe-inkomsterekening	46,000	12,000
Bantoeierrekening	539,000	422,000
Bantoe-welnsfonds	197,000	54,000
Elektrisiteitsfonds	884,000	522,000
Waterfonds	300,000	181,000
Bantoebehuisingfondse	340,000	51,000
	<u>£2,524,000</u>	<u>£1,337,000</u>

17. Toe ek my Raad aangespoor het om hierdie bronne van interne finansies te skep, het ek toekomstige groei via drie meganismes in vooruitsig gestel: Eerstens was ek 'n tydlang bekommerd oor hoe die inkomste wat uit die verlyding van bates, billikerwys (of is dit onbillikerwys?) verklaar kon word.

Voorheen is hierdie kapitaal meevaltertjies gebruik om die leningskuld van die betrokke onderneming te verminder en om sodoen die inkomstehekening die onregstreekse voordeel te gee van die oorskotwaarde van bates of die jaarlikse terugbetalings of die tydperk van terugbetaling te verminder. Die grondoorweging hier was te verhoed dat die rekening die regstreekse voordeel uit die oorskotwaarde van bates trek, en om dit liever aan die kapitaal rekening te gee vir toekomstige kapitaal aawending. Dan wou ek ook 'n tweede bron van groei skep uit die jaarlikse verdeling van vaste bedrae uit die inkomsterekening. Die derde bron was die rente wat daarop voorskotte uit die Fonds gevra kan word, en ook rente op saldo's wat nie voorgeskiet word nie, maar belê word.

18. Die individuele mate waarin hierdie drie bronne bygedra het tot die groei van elektrisiteit se kapitaal ontwikkelingsfondse, word getoon in die bygaande tabel wat, terloops, geprojekteer is tot 30 Junie 1973 in ooreenstemming met die ontwikkelingsplan van die onderneming vir dieselfde tydperk.

19. In 1963 toe die stadsingenieur voorstelle ingedien het vir 'n hersiening van elektrisiteitstariewe — ek was met hom geassiseer in hierdie voorstelle — het ons bepaal dat die beraamde uitgawes 'n spesifieke jaarlikse bydrae tot die kapitaal ontwikkelingsfondse van die onderneming moet insluit. Om die taal van my beroep te geneem: dit was 'n „bokant-die-lyn“-bydrae. Meer presies gesê: dit het beteken dat hierdie verdeling nie bepaal sou word wanneer die jaar se bedryfsresultate voor die Raad gelê word nie. Intendeel, wat die resultate vir die jaar ook al was, was daardie bydrae vas en bindend. Dit

Account. Subsequent amendments to the African Beer Regulations also enabled me to advocate the creation of an African Housing Development Fund in 1961 but the use of such funds is restricted to the provision of low-cost housing.

16. Twelve years later, as at the 30th June, 1968, the several Development Funds contained the following balances.

Fund	Principal £	Advances £
Rate	218,000	85,000
African Revenue Account	46,000	12,000
African Beer Account	539,000	422,000
African Welfare Account	197,000	64,000
Electricity Fund	884,000	522,000
Water Fund	300,000	181,000
African Housing Fund	340,000	51,000
	<u>£2,524,000</u>	<u>£1,337,000</u>

17. When urging my Council to create these sources of internal finance, I visualised future growth via three mechanisms. Firstly, I had been concerned for some time past about the equity, or rather the inequity, which can arise when accounting for the proceeds received from the disposal of assets.

Previously these capital windfalls had been utilised to reduce the loan debt of the particular undertaking, thereby giving revenue account the indirect benefit of the scrap value of assets by reducing either the annual repayments or the period of repayment. The basic fundamental in my thinking was to avoid conferring the outright benefit of the scrap value of assets upon revenue account and rather to retain it in capital account or the financing of future capital outlay. My second source of growth was intended to be the annual appropriation of fixed sums from revenue account and my third source was the interest to be charged on advances made by the Fund, as well as interest earned on the investment of unadvanced balances.

18. The individual extent to which these three sources have contributed to the growth of Electricity's Capital Development Fund is shown in the accompanying table which, incidentally, has been projected through to 30th June, 1973, in accord with the Undertaking's Development Plan for the like period.

19. In 1963 when the City Electrical Engineer submitted proposals for a revision of electricity tariffs, and I was associated with him in these submissions, we stipulated that the estimates of expenditure should include a specific annual contribution to the Capital Development Fund of the undertaking. To use the language of my profession, it was an "above-the-line" contribution. Put precisely, this meant it was not to be an appropriation or contribution the amount of which would be determined when the year's trading results were before Council. On the contrary, irrespective of the results for the year, that contribution

ELECTRICITY UNDERTAKING : CAPITAL DEVELOPMENT FUND

Year	Asset Sales	Interest Received	Annual Contribution	Annual Repayment	Total	Advances		Balance
						Annual	Cumulative	
1957	45,281				45,281			45,281
1958	57,487	2,100			104,868			104,868
1959	21,905	5,037			131,810			131,810
1960	37,300	6,533			175,643			175,643
1961	11,496	8,904		200	196,243	22,136		174,107
1962	19,873	10,187		8,904	235,207	24,893	47,029	188,178
1963	17,402	12,042		11,174	275,825	59,932	106,961	168,864
1964	53,581	14,306	50,000	16,770	410,482	61,890	168,851	241,631
1965	30,752	21,071	50,000	28,812	541,117	85,284	254,135	286,982
1966	15,253	22,227	50,000	28,003	656,600	116,262	370,397	286,203
1967	21,971	29,637	50,000	41,228	799,436	152,253	522,650	276,786
1968	27,687	31,855	160,000	53,146	1,072,154	187,674	710,324	361,830
1969 (E)	20,185	36,900	150,000	60,800	1,340,039	212,000	922,324	417,715
1970 (E)	20,000	43,700	150,000	75,000	1,628,739	300,000	1,222,324	406,415
1971 (E)	20,000	54,900	150,000	93,000	1,946,639	300,000	1,522,324	424,315
1972 (E)	20,000	64,600	150,000	111,000	2,292,239	350,000	1,872,324	419,915
1973 (E)	20,000	77,700	150,000	130,000	2,669,939	350,000	2,222,324	447,615
	460,173	441,729	1,110,000	658,037	2,669,939	2,222,324	2,222,324	447,615

(E) Estimated

ELEKTRISITEITSONDERNEMING : KAPITALE ONTWIKKELINGSFONDS

Jaar	Bate Verkope	Rente Ontvang	Jaarlikse Bydrae	Jaarlikse Terugbetaaling	Totaal	Voorskotte		Saldo
						Jaarliks	Kumulatief	
1957	45,281				45,281			45,281
1958	57,487	2,100			104,868			104,868
1959	21,905	5,037			131,810			131,810
1960	37,300	6,533			175,643			175,643
1961	11,496	8,904		200	196,243	22,136		174,107
1962	19,873	10,187		8,904	235,207	24,893	47,029	188,178
1963	17,402	12,042		11,174	275,825	59,932	106,961	168,864
1964	53,581	14,306	50,000	16,770	410,482	61,890	168,851	241,631
1965	30,752	21,071	50,000	28,812	541,117	85,284	254,135	286,982
1966	15,253	22,227	50,000	28,003	656,600	116,262	370,397	286,203
1967	21,971	29,637	50,000	41,228	799,436	152,253	522,650	276,786
1968	27,687	31,855	160,000	53,146	1,072,154	187,674	710,324	361,830
1969 (B)	20,185	36,900	150,000	60,800	1,340,039	212,000	922,324	417,715
1970 (B)	20,000	43,700	150,000	75,000	1,628,739	300,000	1,222,324	406,415
1971 (B)	20,000	54,900	150,000	93,000	1,946,639	300,000	1,522,324	424,315
1972 (B)	20,000	64,600	150,000	111,000	2,292,239	350,000	1,872,324	419,915
1973 (B)	20,000	77,700	150,000	130,000	2,669,939	350,000	2,222,324	447,615
	460,173	441,729	1,110,000	658,037	2,669,939	2,222,324	2,222,324	447,615

(B) Beraamde

was 'n „ingeboude” voorsiening vir die Kapitale Ontwikkelingsfonds en ek was baie dankbaar vir my owerheid se bereidwilligheid om hul departementele hoofde te steun in hul vasberadenheid om 'n vaste bydrae vanuit die onderneming self te verseker. Ons tariefvoorstelle, insoverre as wat hulle van toepassing was op die buite-stedelike verbruikers in die gelisensieerde voorsieningsgebied, moet deur die Suid-Rhodesiese Elektrisiteitsraad ondersoek word, indien daar bevind word dat hulle bevredigend is in hulle moontlike gevolgsomvang en uitwerking, kan dié Raad dit moontlik goedkeur. Aangesien die onderneming ongeveer 48% van sy inkomste verkry van verbruikers buite die munisipale grense en aangesien die buitestedelike residensiële tariewe ongeveer 15% duurder is as die stadstariewe, was dit sonder 'n mate van kommer dat ons ons saak gestel het vir die reg om ons Kapitaalontwikkelingsfondsvoorsiening as 'n item van tariefuitgawe in te sluit nie, en nie as 'n verdeling wat vereffen moet word nadat winste bereken is nie. Hier het die Elektrisiteitsraad die meriete van ons vereistes weer eens ingesien en die insluiting van 'n aanvanklike voorsiening van £50,000 per jaar goedgekeur. Die relatiewe uitwerking van hierdie bydrae kan miskien ten beste gemeet word teen die onderneming se jaarlikse aanwending van inkomste wat op die tydstop waarop daar met die voorsiening begin is, R4.2 miljoen bedra het.

VOORDELE VAN 'N ONTWIKKELINGSFONDS

20. Toe ek in 1963 die konferensie van Munisipale Tesouriers en rekenmeesters in Suid-Afrika toespraak het, het ek die volgende te sê gehad oor kapitale ontwikkelingsfondse:

“25 (a) Die meriete van kapitale ontwikkelingsfondse is ewe bekend aan Suid-Afrikaanse en Rhodesiese tesouriers, maar of hulle hul plaaslike besture kon oorhaal om ontwikkeling op die terrein na hul wense te bevorder, is 'n punt vir bespreking. Vrywillige bydraes uit die algemene tarief lyk alreëls na oorbelasting — beplande bydraes as 'n deel van die gereelde jaarlikse voorsiening uit die begroting laat die Raadslede oop vir 'n aanval op die gewone maar onregverdig grond dat die nageslag van sy verskuldigde verpligting onthef word. Dit is ironies genoeg — en in hierdie referaat sal daar op die beredenering ingegaan word — dat dit beplande en volgehoue jaarlikse bydraes is wat verseker dat die nageslag op sy beurt sy behoorlike bydrae tot kapitaalvorming maak — en nie die spasmodiese bydraes wat moontlik uit 'n onverwagte surplus kan kom nie.

“26. Om op te som: dit is duidelik dat kapitale ontwikkelingsfondse bestem is om 'n toenemende bron van finansies vir alle plaaslike besture te word afgesien van hul grotte of ligging. Met hierdie noodwendig kort en oorsigtelike kykie in Britse plaaslike besture wil daar te kenne gegee word dat met 'n paar uitsonderings, plaaslike besture in die Suidelike Halfrond nog nie ten volle bewus geword het van die groot potensiaal van hierdie, tot dusver, latente bron van kapitale

was fixed and binding. It was a “built-in” provision for the Capital Development Fund and I was very gratified with my authority's willingness to support its departmental Heads in their determination to secure a fixed contribution from within the undertaking itself. Our tariff proposals, in so far as they apply to the peri-urban consumers in the licensed area of supply, have to be examined by the Southern Rhodesia Electricity Council and, if found to be satisfactory in their likely incidence and impact, may then be approved by that Council.

Since the undertaking earns approximately 48% of its revenue from consumers outside the municipal boundaries and since the peri-urban residential tariffs are approximately 15% more expensive than the City tariffs, it was not without some anxiety that we made our case for the right to include our Capital Development Fund provision as an item of tariff expenditure, and not an appropriation to be settled after profits had been ensured. Here again the Electricity Council saw the merits of our requirements and approved the inclusion of an initial provision of £50,000 per annum. The relative impact of this contribution may be best gauged from the information that, at the time of its injection, the annual revenue expenditure of the undertaking was £4.2m.

THE MERITS OF A DEVELOPMENT FUND

20. Addressing the 1963 Conference of Municipal Treasurers and Accountants, in South Africa, I made the following observations on Capital Development Funds:

“25 (a) The merits of capital development funds are equally well-known to South African and Rhodesian Treasurers but whether they have been able to prevail upon their local authorities to sponsor development in this field to the extent that they could have wished, is debatable. Voluntary contributions from the general rate hint of over-taxation — planned contributions as a regular provision of the annual budget render Councillors open to attack on the usual but unfair score that prosperity is escaping its due obligation. Ironically enough, and this essay will develop the reasoning subsequently, it is the planned and sustained annual contribution, and not the spasmodic donation consequent upon the unanticipated accrual of a surplus, which does ensure that posterity shall, in its turn, make its due contribution to capital formation.”

“26 Summing up, it is patent that capital development funds are destined to become a progressively increasing source of finance for all local authorities, irrespective of size or situation. This necessarily brief and hurried incursion into the sphere of English local government suggests that, with few exceptions, local authorities in the Southern Hemisphere have not yet become fully conscious to the immense potential of this hitherto latent source of capital finance. Apart from its merits, perhaps

finansiering nie. Afgesien van die meriete, is die voortrefflike eienskap miskien die skepping van finansiële outonomie op die terrien van plaaslike bestuur. Hoewel hierdie deug miskien min belang vir Suid-Afrikaanse plaaslike besture mag hê, het dit sekerlik ware betekenis vir die plaaslike esture van Suid-Rhodesië. Afgesien van die bate dringende behoeftes om alternatiewe, addisionele en onafhanklike bronne van kapitale finansiering te vind binne 'n Federale ekonomie wat die inisiatief van plaaslike besture in hul soeke na kapitale fondse onderdruk, is dit gebiedend dat hierdie plaaslike besture, die diensmaagde van Streeksregerings, wegkom van 'n ekonomie wat op gebonde lenings aangewys is (en dus stremmend werk) deur hul eie kapitale ontwikkelingsfondse te voed."

21. Met die ontbinding van die Federasies in 1963, laat 'n meer verligte regering nou sekere belangrike liggeme toe om regstreeks toegang tot die Rhodesiese geldmark te hê vir openbare flotasië. Hoewel hierdie liberalisering baie waardeer ward, maak dit na my mening nie die lewensbelangrike noodsaaklikheid vir ons elektrisiteitsondernemings om deur middel van tariewe in toenemende mate in hul kapitale behoeftes te voorsien, minder gebiedend nie.

22. Een van die groot voordele wat getrek word uit die gebruik van 'n kapitale ontwikkelingsfonds is ongetwyfeld die vermoë om te put uit hierdie bron in 'n tyd waarin rentekoerse alte vinning in die guns van die belegger styg. Om hom in staat te stel om op hierdie manier op huishoudelike finansies aangewys te wees, stel 'n onderneming in staat om sy uitgawes te isoleer van hewige skommelings in rentekoerse, veral vir langtermyn geld. In Salisbury word rente op voorskotte teen 5% per jaar bereken.

23. Ons het die voorbeeld van die Verenigde Koninkryk gevolg, waar plaaslike besture nie leenmagte uitoefen wanneer hulle voorskotte uit hulle ontwikkelingsfondse neem nie. Die vermyding van die behoeftes om leenmagte te verkry, is voorwaar 'n groot seën — afgesien van die uitskakeling van 'n groot hoeveelheid administratiewe werk en korrespondensie met ons Ministerie van Plaaslike Bestuur, beteken dit dat die onderneming groter mobiliteit geniet en vinniger kan optree. Dus : as ontwikkeling moet voortgaan op kort kennisgewing, of as onvoorsiene uitgawe oornag voorsiening vereis, is 'n voorskot uit die Kapitale Ontwikkelingsfonds op die kortste kennisgewing beskikbaar. Ook in omstandighede waar die Ministerie 'n leenmagt weier, is dit selfs moontlik om die bron van finansies oor te skakel van die leningsrekening tot die Ontwikkelingsfonds en met die projek voort te gaan.

Ek was altyd van mening dat die fondse wat in die Kapitale Ontwikkelingsfonds vloei die huishoudelike eiendom van die plaaslike bestuur is — dit word nie op die openbare leningsmark verkry nie, is dus nie 'n buiteskuld nie — en verg dan ook nie ministeriële beheer oor die vorm wat die aanwending daarvan aanneem nie.

24. Nog 'n groot voordeel wat voortvloei uit die gebruik van hierdie bron van finansies is nie slegs die ver-

its most glorious attribute is the creation of financial autonomy in the sphere of local government. Whilst this virtue may have little significance for South African local authorities, it certainly has real meaning for the local authorities of Southern Rhodesia. Apart from the very urgent need to find alternative, additional, and independent sources of capital finance within a Federal economy which suppresses the initiative of local government in its quest for capital funds, it is imperative that these local authorities, the handmaidens of Territorial Governments, escape from the bondage of a tied loans economy through the nourishment of their own Capital Development Funds."

21. With the dissolution of the Federation in 1963, a more enlightened Government permits certain major bodies to have direct access to the Rhodesian money market for public flotations. Although this liberalisation is greatly valued it does not, in my opinion, minimise the vital necessity for our electricity undertakings to provide an ever-increasing part of their capital requirements through the agency of tariffs.

22. Unquestionably, one of the major benefits derived from the use of a Capital Development Fund is the ability to draw on this source at a time when interest rates are rising all too rapidly in favour of the investor. Resort to this domestic finance allows the undertaking to insulate its expenditures against violent fluctuations in interest rates, particularly for longdated money. In Salisbury, all advances are rated at 5% per annum.

23. Taking my cue from the United Kingdom, where local authorities do not exercise borrowing powers when making advances from their Development Funds, we have followed suit. Avoidance of the need to obtain borrowing powers is indeed a great boon — apart from the elimination of a considerable volume of administrative work and correspondence with our Ministry of Local Government, it means that the undertaking enjoys greater mobility and speed of action. Thus, if development has to proceed at very short notice, or unforeseen expenditure demands a provision over-night, recourse to an advance from the Capital Development Fund is available at the shortest notice. In circumstances too where the Ministry has refused a borrowing power, it is even possible to switch the source of finance from loan account to Development Fund, and proceed with the project. I have always taken the view that the funds flowing into a Capital Development Fund are the domestic property of the local authority — they do not accrue from a public borrowing, that is, external indebtedness — and consequently I reason that no ministerial control is required for the utilisation of this source of Capital finance.

24. Another great merit flowing from the use of this source of finance is not only the ability to act very quickly

moë om baie vinnig op te tree in die verkryging van kapitale bates op kort kennisgewing nie, maar dit laat ook 'n merkwaardige mate van buigzaamheid toe in die reëling van finansies en die voorwaardes waarop dit beskikbaar gestel word.

Indien omstandighede dit dus regverdig, kan voorskotte voor die tyd gedeelg word; 'n situasie wat nie verkry kan word as lenings die vorm van plaaslike geregistreerde effekte aanem nie. Omdat dit dan waarlik interne finansiering is, kan die owerheid die terme van 'n voorskot so reël dat dit aanpas by sy eie huishoudelike vereistes, waar — in die geval van openbare lening — die terme dikwels gereël moet word om die uitliener pleks van die lener te pas.

25. Die voorsiening van 'n gereelde jaarlikse bydrae tot die Kapitale Ontwikkelingsfonds werk ook 'n groter mate van interne stabiliteit in die hand omdat dit skommelings in die omvang die verdelings uit inkomste uit-skakel; laasgenoemde neig om te wissel na gelang van die bedryfsresultate van die jaar: op of af.

26. Toe die verskillende fondse nog in hul babakoene was, was ons aanvanklike voorskotte beperk tot die aankoop van korttermynbates. Dit is verstaanbaar. Ons primêre doelwit was om die terugbetaling van voorskotte in die kortste moontlike tyd te verseker sodat die fondse wat aan ons beskikbaar gestel is so vinnig moontlik gesirkuleer en aangewend kon word. Met die uitbreiding van die fondse was ons egter in staat om ons leningstermyn te verleng, slegs tot vyf-en-twintig jaar.

27. U sal teen hierdie tyd reeds besef het dat ons 'n rede volg wat elke onderneming in staat stel om sy eie Kapitale Ontwikkelingsfonds in die lewe te roep en uit te bou. Toe ek die skepping van hierdie bron van inkomste aan my Raad voorgelê het, het ek dit ernstig oorweeg of dit 'n beter reëling sou wees om 'n pool in die lewe te roep wat die gemeenskaplike eiendom van al die munisipale ondernemings sou wees, of om afsondering fondse vir elke onderneming te skep. In die loop hiervan het ek toe dit slotsom gekom dat die skepping van afsonderlike fondse sonder twyfel 'n groter stimulus sou voorsien om van binne te bespaar en bowendien sou dit die moontlikheid van tussendepartementele wrywing uit-skakel — iets wat uit die aard van die saak maar al gou sy kop kan uitsteek as voorskotte uit 'n gemeenskaplike pool gemaak word en sommige deelnemers toekennings ontvang wat hulle deposito's grootliks oorskry.

28. Ek dra nie kennis van die mate, indien enige, waarin die Provinsiale Rade van die Republiek wette gemaak het vir die bestuur en administrasie van Kapitale Ontwikkelingsfondse nie, afgesien van die Kaapse Provinsiale Ordonnansie Nr. 4 van 1968 wat die skepping van 'n Gekonsolideerde Kapitale Ontwikkelings- en Leningsfonds toelaat, maar tot op datum het ons in Rhodesië nog nie verstrik geraak in enige wetgewing nie. Die verantwoordelike ministerie het egter onlangs 'n wetsontwerp oor Plaaslike Bestuur aangevoer wat, indien dit van krag word, die groter plaaslike besture sal verplig om 'n Kapitale Ontwikkelingsfonds in die lewe te roep. Die wetsontwerp maak verder voorsiening dat alle voorskotte

in securing capital assets at short notice but also it permits a remarkable degree of flexibility in arranging for finance and the terms of its availability.

Thus, if circumstances so warrant, advances can be redeemed prematurely, a situation not achievable when loans take the form of local registered stock. Because it is truly internal finance, the authority can arrange the terms of an advance to suit its own domestic requirements whereas, in the case of public borrowing, more often than not the terms must be tailored to suit the lender rather than the borrower.

25. Then too the provision of a regular annual contribution to the Capital Development Fund makes for a greater degree of internal stability since it eliminates fluctuations in the amount of revenue appropriations; the latter tend to vary in accordance with the trading results for the year, up or down.

26. Understandably, when the several funds were in their infancy, our initial advances were confined to the purchasing of short-life assets. Our primary objective was to ensure repayment of advances in the shortest time possible in order to obtain maximum velocity in the circulation and use of the funds available to us. However, as the funds have expanded, we have been able to go longer in our lending, even to the extent of twenty-five years.

27. Ere now it will have been appreciated that we pursue a policy which allows each undertaking to establish and prosper its own Capital Development Fund. At the time when I sponsored the creation of this source of finance for my Council, I did give a great deal of thought as to whether it would be a better arrangement to set up a pool being the common property of all the municipal undertakings or to create separate funds for each undertaking. In the event I reasoned the creation of separate funds was bound to provide the greater stimulus to save from within and, moreover, it would eliminate the possibility of inter-departmental friction which must inevitably be near the surface when advances are made from a common pool and some participants receive allotments greatly in excess of their deposits.

28. Whilst I am not knowledgeable of the extent, if any, to which the Provincial Councils of the Republic have legislated for the management and administration of Capital Development Funds, apart from the Cape Provincial Ordinance No. 4 of 1968, permitting the establishment of a Consolidated Capital Development and Loans Fund, to date, we in Rhodesia have not been entrammelled by any legislation. However, the responsible Ministry has recently sponsored a draft Local Government Bill which, if enacted, will compel the bigger local authorities to establish a Capital Development Fund. The Bill further provides that all advances are repayable except those made for the purchase of land and envisages the charging

terugbetaalbaar is behalwe die wat gemaak is vir die aankoop van grond, en stel die heffing van rente op uitstaande voorskotte in die vooruitsig. Wat belangrik is, is dat die wetenskap swyg oor die vraag of voorskotte slegs toegestaan gaan word as 'n uitoefening van leenmagte, of nie.

BYDRAES TOT INKOMSTE

29. Voorstanders van die lopende betaal-beleid is altyd onderhewig aan vurige kritiek en die algemene klag dat só 'n beleid onregverdig is teenoor huidige verbruikers wat onnodig belas word ten einde bates te voorsien wat deur toekomstige verbruikers gebruik gaan word sonder dat hulle enigiens daartoe bygedra het.

Ek kan net daarop wys dat hierdie beleid toegepas is in die Bantoebierrekening vandat munisipaliteite hul die eerste keer as brou-owerhede gevestig het; alle bates word verkry deur die masjinerie van inkomstebydraes. Net so ook in die geval van die Diensheffingsfonds wat 'n instelling in die Republiek is, en nie in Rhodesië nie, word inkomsteheffings vir die verkryging van kapitale bates aangewend.

Laastens: is dit nie 'n feit dat die geld wat verkry word parkeermeters en parkeerterreine regstreeks gebruik word om kapitale uitleg te finansier nie? 'n Mens kan dus argumenteer dat indien dit as gesonde fiskale beleid op hierdie terreine van plaaslike bestuursbedrywighede beskou word, dit ewe aanvaarbaar op die terrein van elektrisiteit moet wees.

30. In die betoeg vir die aanvaarding van hierdie beleid, word die volgende gevolgtrekkings aan u voorgelê:

- (i) Dit word regverdig en billik wanneer elke geslag sy eweredige bydrae maak. Van geslag word billikheid verkry as elke geslag eweveel tot geslag word billikheid verkry as elke geslag eweveel tot die duur van die bydra, afgesien daarvan of dit tien of twintig jaar is. Maar enige verandering in finansiële beleid wat die uitwerking het dat een geslag minder hoef te dra ten koste van 'n ander geslag, maak misbruik van die vertroue wat verbruikers wat reeds hul eweredige inkomstebydraes vroeër gemaak het, in hul nageslag gestel het.
- (ii) Dit is 'n aanbevelenswaardige beleid wanneer daar 'n skaarste aan kapitaalfondse is, maar die gemeenskap eis nietemin die voorsiening van noodsaaklike dienste en is bereid om die koste te betaal deur middel van die tariewe.
- (iii) Dit ontwikkel 'n dieper gevoel van burgerlike verantwoordelikheid aan die kant van die owerheid wat die lening aangaan as wat misken die geval is wanneer daar maklike toegang tot leningsfondse is.
- (iv) Dit skakel regerings- of provinsiale beheer oor kapitale besteding uit en verhoed die noodsaaklikheid om leenmagte te soek.
- (v) Die beleid is uitres buigsam in sy toepassing op kapitale projekte.

31. Binne Rhodesië self is daar geen wetgewing wat plaaslike bestuure verplig om 'n sekere deel van hul kapi-

of interest on outstanding advances. Most importantly, the draft legislation is silent on the point as to whether or not advances are to be permitted only against the exercise of borrowing powers!

REVENUE CONTRIBUTIONS

29. Advocates of the "pay-as-you-go" policy are always subjected to fierce criticism and the invariable accusation that the implementation of such a policy is unfair to current consumers, who are being taxed unduly in order to provide assets which will be used free of charge by future consumers. I can but point to the fact that this policy has been applied in the African Beer Account ever since municipalities first established themselves as brewing authorities; all assets are acquired through the machinery of revenue contributions. Similarly too, as I know the Services Levy Fund operating within the Republic, but not Rhodesia, revenue collections are used for the acquisition of capital assets. Lastly, is it not a fact that the fees which accrue from parking meters and car parks are used directly to finance capital outlay? One is therefore entitled to argue that if it is considered sound fiscal policy in these fields of local government activity, then it should be equally acceptable in the world of electricity.

30. In arguing the case for acceptance of this policy the following conclusions are advanced:

- (i) It becomes fair and equitable when each and every generation makes its proportionate contribution. As between generations of users, equity is achieved if each generation makes its like contribution during the life-cycle of the asset, be it ten or twenty years. But any variation of financial policy which has the effect of relieving one generation at the expense of another generation constitutes a real breach of faith with the users who have already made their proportionate revenue contribution previously.
- (ii) It is a commendable policy when there is dearth of capital funds but the community nevertheless demands the provision of essential services and is willing to pay the cost through the agency of the tariffs.
- (iii) It develops a deeper sense of civic responsibility upon the part of the borrowing authority than is perhaps the case when there is easy access to loan funds.
- (iv) It eliminates governmental or provincial control of capital spending and avoids the necessity for seeking borrowing powers.
- (v) It is extremely flexible in its application to capital projects.

31. Within Rhodesia itself there is no legislation which would direct local authorities to finance some part of their

tale programme uit inkomstbronne te finansier nie. Desnieteenstaande het die meeste munisipaliteite en dorpsbestuursrade hul geruime tyd al gedissiplineer om beplande inkomstbydraes in die jaarlikse begroting om te sluit. Die metode en omvang van hierdie bydraes wissel aansienlik onder plaaslike besture, maar die algemene kenmerk skyn aanwendig van sike finansies in bates van relatiewe kort lewensduur — bv. meters en rollende materiaal — te wees.

32. As 'n mens die tradisionele onwilligheid van baie Stadsvaders om die Tesourier te steun wanneer hy daarop aandring om 'n kapitale program uit inkomste te finansier, in aanmerking neem, veral as die kiesers nie 'n verhoging van die tariewe goedgesind is nie, is daar min dinge wat meer aanmoedigend kan wees as om wetgewing van dié aard te gebruik as 'n wettige verskoning om die tariewe te verhoog.

DIE GROTER BILLIKHEID VAN KAPITALE ONTWIKKELINGSFONDSE

33. Die skeidingslyn tussen verdelings wat na Kapitale Ontwikkelings oorgeplaas word en (regstreekse?) inkomstbydraes tot kapitale uitleg is relatief fyn, maar die basiese onderskeid is eenvoudig — in die eerste geval word die geld geleen en bewaar deur middel van 'n self-aanvallende fonds; in die laaste geval word dit eens en vir altyd bestee.

34. Na my beskeie mening is dit meer billik om 'n kapitale ontwikkelingsfonds te hê as wat dit is om 'n beleid te volg waardeur regstreekse inkomstbydraes vir die finansiering van kapitale uitleg gemaak word. Soos ek reeds in Paragraaf 30 aangevoer het: billikheid tussen belastingbetaalers word alleen gehandhaaf solank as wat daar elke geslag vereis word om sy pro rata bydrae vir die aankoop van bates uit inkomste te maak; maar dit is 'n onomstootlike feit dat daar 'n onvermydelike neiging is om die bedrag van die inkomstbydrae te varieer volgens die finansiële vereistes van die begroting omdat plaaslike besture dikwels moeilikheid ondervind om die finansies van die Tariewefonds te balanseer. Dit beteken eenvoudig dat die algemene toestand van die plaaslike bestuur se finansies sommige jare so sal wees dat min of geen inkomstbydraes voorkom nie; in jare van oorvloed mag inkomstbydraes toeneem, maar nooit in die mate dat dit vir die tekorte van die maer jare sal kan vergoed nie. Dit is hierdie stop-gaan, stop-gaan-benadering wat die lopende betaalbeleid benadeel omdat die bydrae uit inkomstbronne altyd wisselend en onseker is.

35. Terwyl die voorsiening van 'n gereelde jaarlikse paaimeent van die inkomsterekening die billikste reëling is in die navolging van 'n lopende betaalbeleid, maak die onvermoë om hierdie beleid vol te hou dit selfs meer verstandig om deur middel van 'n Ontwikkelingsfonds te werk. Die kern van my standpunt is dat indien inkomstbydraes in 'n fonds inbetaal word, die waarde en voordeel van die bydraes onbepaald bewaar word omdat hulle 'n integrerende deel van die fonds se kapitaal word en self-

capital programmes from revenue sources. Nevertheless most municipalities and town management boards have long since disciplined themselves to the inclusion of planned revenue contributions in the annual budget. The methods and extent of these contributions vary considerably amongst local authorities but the common characteristic tends to identify in the application of such finance to assets of relatively short-life — e.g. meters and rolling stock.

32. When regard is had to the traditional reluctance which many City Fathers display in the face of the Treasurer's exhortions to finance some part of the capital programme from revenue resources, particularly at a time when the electorate is antagonistic to any increase in the general rate, what could be more fortifying than to be able to point to such legislation as the legitimate excuse for increasing tariffs?

THE GREATER EQUITY OF CAPITAL DEVELOPMENT FUNDS

33. The dividing line between appropriations to Capital Development Funds and revenue contributions to capital outlay is relatively fine but the basic distinction is simple — in the former case the money is lent and preserved in perpetuity through the agency of a revolving fund — in the latter case it is spent at once and for all time.

34. In my humble opinion, it is more equitable to operate a capital development fund than it is to pursue a policy of making outright revenue contributions for the financing of capital outlay. As I have already argued in Paragraph 30, equity as between taxpayers is preserved only as long as each generation is required to make its pro rata contribution for the purchase of assets ex revenue; but, and it is an undeniable fact, because local authorities invariably experience difficulty in balancing the finances of the Rate Fund, there is an unavoidable tendency to vary the amount of the revenue contribution according to the financial exigencies of the budget; this simply means that in some years the overall state of the local authority's finances will be such that little or no revenue contributions are forthcoming; in years of plenty, revenue contributions may increase but never to the extent of making good the short-falls of the lean years. It is this stop-go approach which damns the pay-as-you-go policy because the contribution from revenue resources is always so fickle and uncertain.

35. Whilst the most equitable arrangement in the pursuance of pay-as-you-go policy is the provision of a regular annual instalment from revenue account, the inability to sustain this policy makes it even more judicious to operate through the agency of a Development Fund. The essence of my contention is that if revenue contributions are paid into a fund, the value and benefit of the contributions are preserved indefinitely as they become an integral part of the fund's principal and re-

aanvullend bly. As die bates daarenteen regstreeks teen kontant gekoop word, is die voordeel beperk tot 'n bepaalde dekade.

Nie alleen word die bydrae onbepaald in die fonds bewaar nie, maar omdat daar aangedring word dat die geld geleen en terugbetaal word dieselfde tydperk as die duur van die bate, volg dit dat elke geslag outomaties sy regverdige deel vir gebruik van die bate betaal, en op hierdie manier word maksimum billikheid geskep vir huidige en toekomstige verbruikers. Die heffing van rente gedurende die voorskottydperk werk ook 'n groter mate van billikheid onder verbruikers in die hand omdat hierdie reëling verseker dat daar vir die onvermydelike erosie in die waarde van geld gekompenseer word deur huidige voordeeltrekkers te verplig om 'n heffing te betaal vir die gebruik daarvan. Laastens: die insluiting van die rentefaktore verseker ware vergelykbaarheid van kostes tussen verskillende bronne van finansies.

36. Daarom is dit my standpunt dat die storting van inkomstebydraes op 'n Ontwikkelingsfonds, met terugbetaalbare voorskotte wat 'n rasionale renteheffing dra, miskien die beste manier is om enige element van onbillikheid uit die weg te ruim — 'n element wat miskien andersins sal bestaan as inkomstebydraes vir die aankoop van kapitale bates aangewend sou word.

KAPITALE BYDRAES

37. In Rhodesië is dit die praktyk van plaaslike besture om aansluitingstariewe ten opsigte van water, elektrisiteit en riooldienste te hef. Hierdie kapitale bydraes is betaalbaar wanneer die dienste gelewer word. Daar was 'n tyd toe my eie bestuur, wat ook die elektrisiteitsowerheid vir die Groter Salisbury-kompleks is, buitestedelike verbruikers toegelaat het om hulle aansluitingstariewe in paaiemente te betaal. Ek het egter die standpunt gestel dat die aansluitingstariewe gesien moet word as 'n integreerde deel van die kostestruktuur van 'n nuwe huis of besigheid en dat dit dus altyd van die voornemende verbandhouer van die eiendom verkry kan word.

38. Dit is my persoonlike beskouing dat omdat 'n verbruiker van noodsaaklike dienste in staat is om sy aansluitingstariewe te kapitaliseer, d.w.s. hy is in staat om sy kapitale skuld oor twintig of vyf-en-twintig jaar te vereffen in die vorm van maandelike paaiemente, kan en behoort aansluitingstariewe verhoog te word tot meer realistiese vlakke, met die sekerheid dat die regstreekse uitwerking op die verbruiker nie so groot is as wat met die eerste oogopslag mak lyk nie.

39. Die relatiewe mate waartoe ons onderneming staatmaak op sy verbruikers om kapitale steun in die voorsiening van ontwikkelingsfinansies, kan afgelei word uit die volgende statistiese tabel:

volve in perpetuity whereas, if the assets are brought outright for cash, the benefit is limited to a particular decade. Not only is the contribution preserved indefinitely in the fund but, because of an insistence that the money be lent and repaid over the life of the asset, it follows that each generation automatically pays its fair share for use of the asset, thus creating maximum equity amongst users, present and future. The charging of interest during the period of the advance also makes for a greater degree of equity as amongst consumers because this arrangement ensures that the inevitable erosion in the value of money is compensated for by making current beneficiaries pay a charge for its use. Lastly, the inclusion of the interest factor ensures true comparability of costs as between different sources of finance.

36. Accordingly, I contend that the diversion of revenue contributions into a Development Fund, with advances repayable, and carrying a rational interest charge, is perhaps the best way in which to eliminate any element of inequity that might otherwise obtain as a consequence of making outright revenue contributions for the purchase of capital assets.

CAPITAL CONTRIBUTIONS

37. In Rhodesia it is local government practice to impose connection fees in respect of water, electricity, and sewerage services; these capital contributions are payable when the services are installed. Time was when my own authority which is also the electricity authority for the Greater Salisbury complex, allowed peri-urban consumers the facility for paying their connection fees in instalments. However, I advanced the contention that the connection fees must be seen as an integral part of the cost structure of a new residence or business and therefore these could always be obtained from the prospective mortgagee of the property.

38. It is my personal view that because a consumer of essential services is able to have his connection fees capitalised, that is to say, he is able to redeem his capital debt over twenty or twenty-five years in the form of monthly instalments, connection fees could and should be increased to more realistic levels in the certain knowledge that the direct impact on the consumer is not as great as appears at first sight.

39. The relative extent to which our undertaking depends on its consumers for capital assistance in the provision of development finance may be gleaned from the following table of statistics.

Jaar	Kapitale Uitleg £	Aansluitings Tariewe £	%
1957	2,447,233	68,123	2.78
1958	3,483,516	101,420	2.78
1959	1,325,304	96,322	7.27
1960	1,105,889	72,302	6.54
1961	1,007,639	39,928	3.96
1962	413,179	22,277	5.39
1963	507,199	14,652	2.89
1964	458,719	11,742	2.56
1965	417,149	10,127	2.43
1966	506,436	19,032	3.76
1967	517,241	31,531	6.10
1968	511,675	54,942	10.74
1969 (B)	674,356	40,000	5.93
	<hr/>	<hr/>	<hr/>
	£13,375,535	582,398	4.35

(B) Beraamde

Year	Capital Outlay £	Connection Fees £	%
1957	2,447,233	68,123	2.78
1958	3,483,516	101,420	2.91
1959	1,325,304	96,322	7.27
1960	1,105,889	72,302	6.54
1961	1,007,639	39,928	3.96
1962	413,179	22,277	5.39
1963	507,199	14,652	2.89
1964	458,719	11,742	2.56
1965	417,149	10,127	2.43
1966	506,436	19,032	3.76
1967	517,241	31,531	6.10
1968	511,675	54,942	10.74
1969 (E)	674,356	40,000	5.93
	<hr/>	<hr/>	<hr/>
	£13,375,535	582,398	4.35

(E) Estimated

DIE GROOT DWAALBEGRIP

40. In my finansiële verbintenis met die voorsiening van elektrisiteit, het ek dikwels gewonder waarom raadslede eerlik glo dat die prys van elektriese krag 'n faktor van groot belang is wanneer 'n voornemende nyweraar 'n geskikte perseel vir sy nywerheid soek. As gevolg hiervan spoor hulle hul Raad aan om aan die nyweraar voorkeurtariewe vir elektrisiteit en water te gee, plus goedkoop grond. Raadslede sal insgelys verhogings in elektrisiteitstariewe teenstaan, veral as die nuwe tariefvoorstelle voorsiening maak vir hidraes tot die Tariefstabilisasiefonds, die reserwefonds vir die veroudering van voorrade en natuurlik die Kapitale Ontwikkelingsfonds. Hulle sal aanvoer dat tariewe onnodig hoër is wat dit moet wees en dat die hewig skok van die voorgestelde verhogings sal veroorsaak dat nywerhede 'n ander tuiste sal soek.

41. Weer eens wil ek my die vryheid veroorloof om aan te haal uit dieselfde bron wat ek in Paragraaf 6 gebruik het, te wete Mnr. Eugen R. Black :

"... die opvatting dat gesubsidieerde utiliteite — veral kunsmatige goedkoop krag — om een of ander rede nodig is om die handel en nywerheid te trek. Waarom hierdie opvatting soveel gangbaarheid verkry het, kan ek nie verstaan nie. Dit is waar dat groot hoeveelhede krag teen lae koste nodig is om aluminium-vervaardiging lonend te maak. Maar vir so te sê al die ander nywerhede waaraan oorgewing geskenk word in die onderontwikkelde wêreld, is die vraag hoeveel krag beskikbaar is, eerder as hoeveel dit gaan kos, wat die nywerhede trek."

Moenie dat ek verkeerd verstaan word nie. Dit is nie my standpunt dat die prys van elektriese krag van minimale belang is in die komponente van 'n kostestruktuur nie. Hoegenaamd nie! Ek is inderdaad baie bewus van die rol

THE GREAT FALLACY

40. In my financial association with the supply of electricity, I have often pondered why some councillors sincerely believe that the price of energy is a factor of considerable importance when a prospective industrialist seeks a suitable location for his industry; they therefore urge their council to offer him preferential rates for electricity and water plus cheap acres of land. Similarly too, Councillors will resist increases in electricity tariffs particularly if the new tariff proposals provide for contributions to the Tariff Stabilisation Fund, the Stores Obsolescence Reserve, the Leave Reserve and of course the Capital Development Fund. They will maintain that tariffs are unnecessarily higher than needs be the case and the severe impact of the proposed increases will cause industry to seek out a new home.

41. Once again I therefore take the liberty of quoting from the same source as I used in Paragraph 6, to wit, Mr. Eugene R. Black :

"..... the notion that somehow subsidised utilities — particularly artificial cheap power — are necessary to attract commerce and industry. Why this notion has gained so much currency I do not understand. It is true that large amounts of power are needed at low cost to make aluminium manufacturing pay. But for almost all other industries now being contemplated in the under-developed world it is how much is available, rather than how much is charged, which attracts industry."

Let me be not misunderstood. I do not contend that the price of electrical energy is of minimal importance in the in the components of a cost structure. Not at all! I am indeed most mindful of the role it plays in the gold-

wat dit speel in die goudmynbedryf van die Republiek en in chroomverwerking in Rhodesië. Maar die aard van hierdie ontginningswyerhede vereis dat krag na die myn gebring word, eerder as die omgekeerde reëling.

42. Nee, die primêre bedoelings wat ek het om van so 'n vooraanstaande gesaghebbende aan te haal, is om die mite te ontmasker dat die prys van elektrisiteit 'n hoofbepaler is in die keuse van 'n terrein deur die nywerheid, en— selfs meer belangrik — om te stand te bied teen enige suggestie dat voorsiening vir 'ingeboorde' bydraes tot 'n Kapitale Ontwikkelingsfonds 'n nadeling uitwerking op die verkoop van elektriese krag kan hê.

TARIEFSTABILISASIEFONDS

43. Om enige gedagteverwarring of misverstand uit die weg te ruim, wil ek dit graag baie duidelik stel dat ons Tariefstabilisasiefonds 'n heeltemal afsonderlike fonds binne die onderneming is en dat dit uitsluitlik gebruik word vir die doel wat deur sy naam aangedui word.

WINSTE TER VERLIGTING VAN TARIEWÊ

44. Dit sou suiwer domastrantheid van my kant wees om aan te dring op die noodsaaklikheid van finansiële selfonderhoudendheid binne 'n munisipale elektrisiteits-onderneming en om my dan terselfdertyd blind te hou vir die roofigtige neigings van plaaslike besture in hulle vasbeslote om elektrisiteitswinste te gebruik vir die spesifieke doel om die stad se tariewe so laag as moontlik te hou. Ook verstaanbaar is dat sommige finansiële beaamptes nie altyd hulle kollegas steun in 'n eiehandige stryd om sy swaarverdiende winste vir die vooruitgang van die onderneming te behou nie.

45. In die loop van 'n presidensiële rede voor my eie Instituut van Munisipale Tesouriers en Rekenmeesters in Suid-Afrika, het ek my die vryheid veroorleef om die volgende te verklaar:

" 32. Ondervinding het al lankal getoon dat plaaslike besture nie van hul reg sal afstand doen om bedryfwinste vir tariefverligting aan te wend nie, en ek word gedwing tot die gevolgtrekking dat — hoewel die verbruiker miskien bietjie verligting mag kry na die instelling van beperkende wetgewing t.o.v. tariefaanwending — volkome verligting nie verkry sal word nie tensy die wetgewing van die land plaaslike besture verplig om hul ondernemings te laat funksioneer op 'n geen wins/geen verlies-grondslag, of so nie as die onderneming oorgeplaas word na die Elektrisiteitsvoorsieningskommissie. Laat dit duidelik wees: ek maak nie 'n saak uit vir die Elektrisiteitsvoorsieningskommissie nie; my primêre oorweging is dat die eindverbruiker sy krag teen die laagste moontlike koste moet koop. Mag ek ook om misverstand uit die weg te ruim sê: ek kritiseer nie die doeltreffendheid van munisipaal-beheerde ondernemings nie. Intendeel, ek kan hulle net aanprys vir

mining industry of the Republic, as well as chrome processing in Rhodesia. But the character of these extractive industries demands that energy be brought to the mine location rather than the reverse arrangement.

42. No, my primary objectives in quoting from so eminent an authority are to debunk the myth that the price of electricity is a major determinant in the siting of industry and, even more importantly, to counter any suggestion that provision for "built-in" contributions to a Capital Development Fund could have an injurious impact on the sale of electrical energy.

TARIFF STABILISATION FUND

43. Lest there be any confusion of thought or misunderstanding, I would wish to make it very clear that our Tariff Stabilisation Fund is an entirely separate fund within the undertaking and is used expressly for the purpose indicated by its title.

PROFITS IN RELIEF OF RATES

44. It would be sheer brashness on my part to urge on the need for financial self-sufficiency within a municipal electricity undertaking and, at the same time, blind myself to the predatory tendencies of local authorities in their determination to use electricity profits for the specific purpose of keeping the City's rates as low as possible. Understandably too, some finance officers do not always back their colleague in a single-handed struggle to keep his hardearned profits for the advancement of the undertaking.

45. In the course of a Presidential Address to my own Institute of Municipal Treasurers and Accountants in South Africa, I was sufficiently audacious to make these statements.

" 32. Experience has long since shown that local authorities will not abandon their right to appropriate trading profits for rate relief and I am forced to the conclusion that, although the consumer may gain some relief consequent upon the introduction of limiting legislation in respect of rate appropriations, complete relief will not be obtained unless the legislation of the land directs local authorities to operate their undertakings on a no profit/no loss basis or, alternatively, the undertaking is transferred to the Electricity Supply Commission. Let it be clear I am not pleading the case for the Electricity Supply Commission; my primary concern is that the end consumer should purchase his energy at the lowest possible cost. May I say too, lest there be any misunderstanding, I do not criticise the efficiency of municipally operated undertakings. On the contrary, I can only

die doeltreffendheid wat hulle bereik het in hul werksaamheid binne die administratiewe opset van die plaaslike bestuursmasjinerie."

46. Nadat ek myself van sulke ketterse menings verlos het, het ek stelling ingeneem terwyl afgevaardigde Raadslede teen my uitgevaar het oor so 'n groot vertoning van domheid; ek het daarna te voorskyn getree met bebloede, maar ongeboë hoof.

47. Hoe dit ook al sy, wees verseker dat ek nie vandag nuwe stryd wil uitlok nie. My enigste doel met die terugkeer aan hierdie verklaring, is om my vroeëre standpunt te herbevestig, naamlik, die ware noodsoeklikheid om deur wetgewing presies vas te stel hoeveel 'n plaaslike bestuur mag neem d.m.v. elektrisiteitswinste vir die subsidiering van die stad se tariewe. Na my kennis word die enigste wetlike beperking in Durban gevind waar provinsiale ordonnansies die mate van tariefaanwending van die onderskeie bedryfsondernemings beheer. Ironies genoeg bepaal Afdeling 234 van Ordonnansie Nr. 10 van 1953, soos gewysig, spesifiek dat, ongeag van behoeftes:

- (1) Die Raad elke jaar uit die totale inkomste van elke bedryfsonderneming wat in subartikel (3) genoem word aan die Inkomstefondsrekening van die Dorpsraad t.o.v. tariefverligting minstens 2 persent en hoogstens 4 persent van óf die geld wat op die leningsrekening van genoemde onderneming uitstaande is, óf op die kapitale aanwending daarvan moet betaal, na gelang van die Raad se beslissing van tyd tot tyd.
- (2) Die maksimum presentasie van vier persent wat in onderafdeling subartikel (1) genoem word, mag t.o.v. enige sodanige onderneming oorskry word met dié addisionele presentasie wat die Administrateur t.o.v. sodanige onderneming mag goedkeur.
- (3) Die bepalings van subartikels (1) en (2) geld vir die volgende ondernemings:—

Elektrisiteit
Telefoon
Markt
Vervoer
Water

48. Die Rhodesiese Werksparty waarna daar in Paragraaf 12 verwys is, het hierdie omstrede aangeleentheid ondersoek en soos volg verslag gedoen:

"70. Die Werksparty was bekommerd oor die feit dat surplusse wat deur die elektrisiteitsindustrie verdien is op die munisipale terrein, dikwels gebruik word om tariewe te verlig. Wetgewing vir die beheer van winste is aanbeveel deur die konsultante wat verantwoordelik was vir die "Electricity Review, 1960." Hulle aanbevelings kon egter nie

commend them for the efficiency they have achieved whilst operating within the administrative set-up of local government machinery."

46. Having delivered myself of such heretical opinions, I then stood my ground whilst Councillor delegates railed upon me for so great a display of stupidity; I subsequently emerged with bloody head unbowed!

47. However, be assured that I seek not to provoke new strife today. My sole purpose in reverting to this statement is to re-affirm my earlier view-point, namely, the very real necessity to legislate as to just how much a local authority may take by way of electricity profits for subsidisation of the City's rates. As far as I am aware, the only legal limitation is found in Durban where provincial ordinances do control the extent of rate appropriations from the several trading undertakings. Ironically enough Section 234 of Ordinance No. 10 of 1953, as amended, specifically directs that, irrespective of need, the

- (1) "The Council shall pay each year to the Borough Fund Revenue Account in relief of rates from the gross earnings of each of the trading undertakings set out in sub-section (3) a sum not less than two per cent and not exceeding four per cent upon either the monies outstanding on the loan account of the said undertaking, or upon the capital outlay thereof, as the Council may from time to time determine.
- (2) The maximum percentage of four per cent referred to in sub-section (1) may be exceeded in respect of any such undertaking from time to time by such additional percentage as the Administrator may approve in respect of such undertaking.
- (3) The provisions of sub-sections (1) and (2) shall apply to the following undertakings:

Electricity
Telephone
Market
Transport
Water

48. The Rhodesian Working Party referred to in Paragraph 12 examined this controversial issue and reported:

"70. The Working Party was concerned by the fact that surpluses earned by the electricity industry in the municipal field are frequently used for purposes such as relief of rates. Legislation for the control of profits was recommended by the consultants responsible for the "Electricity Review, 1960." Their recommendation could not be imple-

deur die Federale Regering in werking gestel word nie omdat dit nie grondwetlik verantwoordelik was vir die finansiering van munisipale elektrisiteits-ondernemings nie. U Werksparty vind die aanbeveling wat in 1960 gemaak is, 'n gesonde een.

71. Terwyl ons die reg van 'n plaaslike bestuur erken om 'n wins te maak op die verkoop van elektrisiteit, beveel ons aan dat die aandeel van so 'n wins wat 'n munisipaliteit kan aanwend vir ander doeleindes as elektrisiteit, deur wetgewing beheer behoort te word."

49. Geen wetgewing van hierdie aard is tot dusver ingestel t.o.v. elektrisiteit nie, maar in die geval van water wat ons Raad op streekgrondslag aan die agt Rade op Salisbury se buitewyke verkoop, maak hulle plaaslike bestuurswetgewing egter daarvoor voorsiening hoe die voorsieningsowerheid sy buitestedelike tariewe moet opstel en dit laat toe dat

"'n algemene heffing uitgedruk as 'n persentasie van die koste gemaak moet word om die koste van administrasie te dek wat betrokke is by die voorsiening aan die raad en om 'n klein bedryfswins te lewer."

50. Ek is dus van mening dat indien die groei van 'n Kapitale Ontwikkelingsfonds wil voortgaan teen maksimum snelheid, wetgewing ingestel moet word vir die uiteindelijke doel om beheer uit te oefen oor die mate waartoe 'n plaaslike bestuur uit die winste van hulle elektrisiteits-ondernemings mag neem vir verligting van die algemene tarief.

TEN SLOTTE

51. En nou het my betoeg vir die skepping van Kapitale Ontwikkelingsfondse vir vandag ten einde gekom. Moontlik laat ek in u gedagtes 'n beeld van 'n ouerige hoof finansiële beampte, effens van balans af, wat van plek tot plek voortwandel met die swaard van finansiële onafhanklikheid omhoog. As dit so is, laat dit so wees, maar laat die eerlikheid van sy oortuiging verskoning maak vir sy oënskynlike fanatisisme. Wat u betref, het ek maar net hoop dat die saad van my aansporing nie op klipperige grond geval het nie, en ek wens u alle sukses toe in u eie pogings om kapitale finansies eerder van binne as van buite u ondernemings te verkry.

"Mense wat begin deur hul onafhanklikheid te verloor, sal eindig deur hul energie te verloor." (Buckle)

mented by the Federal Government, however, because it is not constitutionally responsible for the finance of municipal electricity undertakings. Your Working Party considers the recommendation made in 1960 to be sound.

71. Whilst we recognise the right of a local authority to make a profit on the sale of electricity, we recommend that the proportion of such profit which a municipality can appropriate for purposes other than electricity should be controlled by legislation."

49. No such legislation has been enacted to date in respect of electricity; however, in the case of water which our Council sells regionally to the eight Councils on Salisbury's perimeters, their local government legislation does direct how the supply authority shall construct its peri-urban tariffs and it permits for

"a general charge expressed as a percentage on cost shall be made to cover the costs of administration involved in the supply to the board and to yield a small operating profit."

50. I am therefore of the view that if the growth of a Capital Development Fund is to prosper at maximum speed, then legislation should be enacted for the express purpose of controlling the extent to which local authorities may appropriate from the profits of their electricity undertakings for the relief of the general rate.

CONCLUSION

51. And now my crusading for the creation of Capital Development Funds is at an end for today. Possibly, I leave in your minds the image of an elderly chief financial officer, slightly off-balance, wandering forth from place to place, and brandishing aloft the sword of financial independence. If it be so, so be it but let the sincerity of his belief apologise for his seeming fanaticism. For yourselves I can but hope that the seeds of my urging have not fallen upon stony ground and I wish you every success in your own questings for capital finance rather from within than without your undertakings.

"Men who begin by losing their independence will end by losing their energy." (Buckle).

ELEKTRIESE STANDAARDE IN SENTRAAL-AFRIKA

deur

R. L. RICHARDS

Direkteur van die

STANDAARDEVERENIGING VAN SENTRAAL-AFRIKA

INLEIDING.

Dit is welbekend dat die elektrotegniese profesie en selfs die elektrotegniese nywerheid, nog altyd baie standaard-bewus was. Op hierdie reël is Sentraal-Afrika geen uitsondering nie en toe die Standaardvereniging in 1957 gestig is, het daar reeds 'n aktiewe elektrotegniese onderkomitee van die Vereniging se voorganger, nl. 'n plaaslike komitee van die Britse Instituut vir Standaarde, bestaan. Hierdie onderkomitee het in 1949 in Rhodesië tot stand gekom op 'n wenk van die Britse Instituut vir Standaarde, en het ten doel gehad die daarstelling van nouer skakeling tussen Rhodesië en die B.I.S., en in die besonder om kommentaar te lewer oor Britse konsepstandaarde. Die idee was om seker te maak dat Britse Standaarde, waar moontlik, geskik moet wees vir gebruik in Rhodesië, asook in ander lande met soortgelyke klimaats- en ander toestande. Boonop het die Komitee toegesien dat voorrade van Britse Standaarde in stand gehou en versprei word. Met die koms van die Federasie het die Komitee sy bedrywighede en sy lidmaatskap in die drie samestellende lande uitgebrei, met die gevolg dat, in 1957, die twee tegniese subkomitees, soos hulle bekend gestaan het — een wat met bouwerk en siviele ingenieurswese handel het, en die ander met die elektrotegniese ingenieurswese — goed gevestig en heel verteenwoordigend was.

Die bestaan van hierdie komitees het baie gehelp met die totstandkoming van die Standaarde-vereniging en veral om die werksaamhede daarvan aan die gang te kry. In werklikheid het die elektrotegniese subkomitee verander na die nuwe Vereniging se Raad vir die Elektrisiteitsbedryf en hierdie Raad was verantwoordelik vir die opstelling van 'n program van aksie vir die ses nuwe tegniese komitees. Hierdie komitees was soos volg:—

1. Apparate.
2. Installasie-materiaal en bykomstighede.
3. Kables en geleiers.
4. Telekommunikasie- en verwante elektroniese toerusting.
5. Swaar skakeltoestel, spesiale omhulsels en kragmeters.
6. Bedradingsregulasies.

Die bestekke van die eerste vyf van hierdie komitees is ontwerp met die doel om dié onderwerpe wat vir die Federasie van besondere belang was, te dek, en weereens was die hoofdoel om met die komitees van die B.I.S. te skakel. Daar is indertyd nie veel elektriese toerusting in die Federasie-ervaardig nie.

ELECTRICAL STANDARDS IN CENTRAL AFRICA

by

R. L. RICHARDS

Director

STANDARDS ASSOCIATION OF CENTRAL AFRICA

INTRODUCTION

As is well known the electrical profession and indeed the electrical industry has always been very standards conscious. Central Africa is no exception and when the Standards Association was established in 1957 there was already in existence an active electrical sub-committee of the Association's predecessor, a local committee of the British Standards Institution. This was set up in Rhodesia in 1949 at the suggestion of the British Standards Institution with a view to establishing liaison between Rhodesia and the B.S.I., in particular obtaining comments on draft British Standards. The idea was to make sure that British Standards, where possible, would be suitable for use in Rhodesia and indeed in countries with similar climatic and other conditions. In addition the committee organised the stocking and supply of British Standards. With the advent of Federation the committee extended its activities and membership into the three constituent countries so that, in 1957, the two technical sub-committees as they were called — one dealing with building and civil engineering and the other with electrical engineering — were well-established and very representative.

The existence of these committees helped considerably in the setting up of the Standards Association and particularly in making it operational. In effect, the electrical sub-committee became the electrical industry council of the new Association and was responsible for setting out a programme of work to be undertaken by six new technical committees. These were as follows:

1. appliances.
2. installation materials and accessories.
3. cables and conductors.
4. telecommunication and allied electronic equipment.
5. heavy switchgear, special enclosures and power metering.
6. wiring regulations.

The scope of the first five of these committees was designed to cover the subjects which were of particular interest in the Federation and again the main intention was to maintain liaison with the B.S.I. Committees. At that time there was little manufacture of electrical equipment in the country.

Die besluit om die tegniese komitee insake elektriese bedradingsregulasies in die lewe te roep, het voortgespruit uit 'n oorsig van toestande in die Federasie op daardie tyd. 'n Studiegroep van die Ministerie van Handel en Nywerheid was vir etlike jare, tot in 1957, besig om standaardbedradingsregulasies vir gebruik in die Federasie op te stel. Net vóór die stigting van die Standaardvereniging in Junie 1957 is daar 'n Federale Ministerie van Kragvoorsiening geskep en die werk voorheen deur die Ministerie van Handel en Nywerheid gedoen is, deur 'n klein komitee binne die Ministerie van Kragvoorsiening oorgeneem. Toe die Standaardvereniging gestig is, met 'n breë grondwet en 'n voltydse tegniese personeel, is dit slegs as logies beskou dat die voorbereiding van die regulasies deur die Vereniging oorgeneem moet word, en daar is allerweë hiertoe ingestem.

Die Komitee wat aangewys is om hierdie projek te hanteer is behoorlik gekonstitueer en het op dieselfde wyse as al die ander tegniese komitees van die Vereniging begin werk, dog in twee opsigte was dit uniek. Eerstens was dit die grootste van al die tegniese komitees, en is dit nog, met 'n lidmaatskap van meer as dertig, wat 'n aanduiding gee van die belangstelling in die onderwerp. Tweedens was dit die eerste tegniese komitee van die Vereniging wat 'n vergadering gehou het, en wel op 28 Februarie 1958. Vanaf lsg. datum tot 1 Junie 1960 het die komitee 11 vergaderings gehou, waarvan die meeste twee dae lank geduur het. By hierdie vergaderings is alle moontlike poginge aangewend om die bespreking tot beginselsake te beperk, terwyl die gedetailleerde formulering oorgelaat is aan 'n formuleringspaneel wat uit die Voorsitter en drie lede bestaan het. Hierdie paneel het gedurende die betrokke tydperk feitlik wekeliks vergader, en dit is dus duidelik dat 'n groot aantal man-ure aan die formulering van hierdie reëls bestee is.

Na voltooiing van die formulering het daar 'n taamlik moeilike beleidsvraagstuk ontstaan, nl. hoe die reëls of regulasies afgekondig moes word. Dit het nl. geblyk dat daar twee alternatiewe was. Een was dat die Ministerie van Kragvoorsiening die finale konsep moes oorneem en dit as 'n stel regulasies moes publiseer. Die tweede was dat die Vereniging die reëls op die gewone wyse moes publiseer en dat die Regering dan beknopte regulasies moes afkondig wat bepaal dat installasies aan die vereistes van die reëls moes voldoen. Laasgenoemde prosedure sou die voordeel inhou dat wysigings aan die standaardse baie gouer en makliker is om voor te berei en te publiseer as wysigings aan Regeringsregulasies. Boonop was en is die tegniese Komitee 'n vaste komitee wat te eniger tyd opdrag gegee kan word om wysigings of byvoegings te oorweeg. Daar is egter gevind dat die Parlementêre wetsopstellers, as 'n saak van beleid, nie bereid was om wetgewing by wyse van verwysing te aanvaar nie. Daar word nl. geargumenteer dat, indien 'n Minister op hierdie wyse wetgewing afkondig, hy sy gesag oordra aan 'n buitestaande liggaam waaroor hy geen beheer het nie.

The decision to set up the technical committee on electrical wiring rules followed from a review of the position in the Federation at that time. For several years up to 1957 a working party of the Ministry of Commerce and Industry had been drafting standard wiring regulations for use in the Federation. Just before the setting up of the Standards Association in June 1957 a Federal Ministry of Power had been established and the work previously done by the Ministry of Commerce and Industry had been taken over by a small committee within the Ministry of Power. With the establishment of the Standards Association with a broadly based constitution and full time technical staff it seemed only logical that the preparation of the regulations should be undertaken by the Association and this was generally agreed.

The committee which was set up to handle the project was constituted and operated in the same way as all technical committees of the Association, but it was unique in two respects. First of all it was the biggest technical committee, and still is, with a membership of over thirty — indicative of the interest in the subject.

Secondly, it was the first technical committee of the Association to hold a meeting, which was on the 28th February 1958. From then until 1st June 1960 the committee held eleven meetings, most of which extended over two days. At these meetings every attempt was made to confine discussion to matters of principle the detailed drafting being left to a drafting panel consisting of a Chairman and three members. This drafting panel met practically once a week during this time. It will be seen that a good many man-hours went into the preparation of the rules.

With the completion of the drafting a rather difficult point of policy rose. This was how the rules or regulations were to be promulgated. There seemed to be two alternatives. One was for the Ministry of Power to take over the final draft and publish it as a set of regulations. The second was for the Association to publish the rules in the normal way and the Government to promulgate brief regulations requiring that installations should be in accordance with the standard rules. The advantage of the second procedure was that amendments to standards are much easier and quicker to prepare and publish than are amendments to Government regulations. In addition the technical committee was and is a standing committee which can be called on at any time to consider amendments or additions. However, it was found that as a matter of policy Parliamentary Draftsmen would not accept legislation by reference. The reasoning is if a Minister legislates in this way he transfers his authority to an outside body over which he has no control.

Die oorgrote meerderheid van die instansies wat by bedringsregulasies betrokke is, het voorkeur verleen aan die publikasie van die reëls deur die standaardvereniging, en daar is veel tyd en aandag gewy aan die vraag van hoe om die regsprobleme te bowe te kom. Die oplossing is uiteindelik daarin gevind dat die Ministerie van Kragvoorsienings bondige algemene regulasies uitgevaardig het ten effekte dat alle elektriese installasies veilig, duursaam ens. moet wees. Boonop moet die kontrakteur sertifiseer dat die bedrading aan die vereistes van die bedringsreëls voldoen voordat die installasie aan 'n kragbron gekoppel kan word. Na my mening is hierdie soort wetgewing baie gesond. Dit laat die Minister en sy beambtes volle vryheid om hul oordeel en diskresie te gebruik, en tog verskaf dit aan hulle 'n maatstaf oftewel 'n standaard waarteen hulle die geskiktheid van die installasie kan meet. Dieselfde beginsel geld reeds van baie jare lank in die Verenigde Koninkryk vir sover dit bouregulasies betref. Die modelbouregulasies kan as funksioneel beskou word, insoverre hulle bepaal aan watter uiteindelige standaarde die gebou moet voldoen, bv. insoverre dit betref sy vermoë om normale bedryslaste, te weerstaan, weerstand teen die drukking van wind, die termiese isolasie van mure en dakke en sy weerstand teen reën. Ná elke spesifieke vereiste volg daar 'n stelling daarteenoor dat die gebou in ooreenstemming met die betrokke Britse Standaard ontwerp en opgerig is, daar aanvaar sal word dat dit aan die vereistes van die regulasies voldoen. Die gevolg van hierdie benadering is dat die regulasie in daardie vorm vir baie jare behoue kan bly en terselfdertyd nie 'n remmende invloed op vooruitgang uitoefen nie, aangesien laasgenoemde deur middel van standaarde bevorder word. Dit is ook nou die posisie vir sover dit die bedringsregulasies betref, en die aanvaarde praktyk kan net so modern en gevorderd wees as die denkrigtings en oortuigings van die tegniese komitee.

Wat die tegniese aspekte betref, is daar verskeie punte wat van belang mag wees. Basies is die bedringsreëls van die Standaardvereniging dieselfde as die bedringsregulasies van die S.A.I.E.I.

Die uitgawe van 1955 is as 'n voorlopige dokument aanvaar en die prosedure wat in die praktyk gevolg is, was om hierdie dokument klousule vir klousule deur te gaan en dit te vergelyk met die huidige regulasies van die I.E.I., dit wil sê die 13de uitgawe, waarby die wysigings van 1958 ingesluit is. In baie gevalle, waar daar twyfel of botsende bepalings bestaan het, is daar verwys na die prosedures wat in Australië, Kanada, Indië, Nieu-Seeland en die Verenigde State gevolg word, soos uiteengesit in die regulasies of standaarde wat in daardie lande in gebruik is.

Laat ons in die eerste plek na die redelik kontensieuse kwessie van kontakskotte kyk. In teenstelling met Suid-Afrika, was Rhodesië geneë om die 13-ampere-stelsel met sekerings in die proppe en ringbane, te aanvaar. Toe die bedringsregulasies opgestel is, was die reëls met betrekking tot ringbane in Suid-Afrika en die

The majority of interests concerned with wiring regulations however, favoured the publication of the rules by the Standards Association and much time and thought was given to overcoming the legal problem. It was eventually solved by the Ministry of Power issuing short general regulations saying in effect that all electrical installations must be safe, durable etc. In addition, before an installation could be connected to a source of supply the contractor must certify that the wiring is in accordance with the wiring rules. This type of legislation is to my mind very sound. It leaves the Minister and his Officials free to exercise their judgement and discretion and yet gives them a yardstick, that is to say a standard against which to measure the suitability of the installation. The same principle has been in operation in the United Kingdom for many years with regard to building by-laws. The model building by-laws are what might be termed functional in that they lay down the ultimate performance of the building in respect of for example ability to withstand normal working loads, resistance to wind pressure, thermal insulation of walls and roofs and resistance to rain. Following each specific requirement there is a statement that if the building is designed and constructed in accordance with the relevant British Standard it shall be deemed to comply with the requirements of the by-laws. The result of this approach is that by-laws can remain in that form for very many years and at the same time not prevent progress which is made through standards. In the case of the wiring regulations this is now the position and accepted practice can be as up-to-date as the thinking and conviction of the technical committee.

On the technical side there are several points which may be of interest. Basically the CAS Wiring Rules are the same as the SAIEE Wiring Regulations. The 1955 edition was taken as the preliminary document and in practice the procedure was to go through this clause by clause comparing it with the current IEE Regulations, that is the 13th edition including the 1958 amendments. In many cases where there was doubt or conflict reference was made to practice in Australia, Canada, India, New Zealand and the United States as set out in the regulations or standards used in those countries.

First let us take the rather contentious subject of socket-outlets. Unlike South Africa, Rhodesia has tended to adopt the 13-amp fused plug-top system with ring circuits. At the time of drafting the wiring rules, South African and United Kingdom rules for ring circuits were the same in that they did not limit the number of socket-outlets on a ring circuit, in domestic premises, provided

Verenigde Koninkryk dieselfde, insoverre dat daar geen beperking op die aantal kontakskokke op 'n ringbaan in woongebue geplaas is nie, mits die vloer-oppervlakte wat voorsien word, nie 1,000 vk. vt. te bowe gegaan het nie. Dit is waarskynlik dat daar, toe hierdie regulasie in Suid-Afrika aanvaar is, nog maar min kontakskokke van 13 ampere in gebruik was. In Rhodesië het die groot oplewing in die boubedryf gedurende die Federasie-dae en die oorwegende invloed van verskaffers uit die Verenigde Koninkryk daartoe gelei dat die 13 ampere-kontakskok vroeg en vinnig ingevoer is en teen die tyd dat die regulasies opgestel is, het die installasies van hierdie stelsel 'n gevestigde gebruik geword. Ons komitee wat die regulasies van Suid-Afrika en die Verenigde Koninkryk in hersiening geneem het, het die feit in aanmerking geneem dat die omringende temperature in Suidelike Afrika hoër en groter is as die Verenigde Koninkryk, met die gevolg dat die beperking van 1000 vk. vt. nie werklik toepaslik was nie. Boonop moet in gedagte gehou word dat die verbruiker tog in enige vertrek, deur middel van een of meer dubbele proppe, alles sal aanskakel wat hy nodig het by wyse van staanlampe, radios en platespelers, verwarmers en so meer. Die Komitee het dus besluit dat, met 'n gewone 7/029-stroombaan met 30-ampere-beskerming as voorbeeld, daar geen beperking op die aantal kontakskokke in enige twee kamers in 'n huis, of selfs in gemeenskaplike geboue soos koshuise, geplaas hoef te word nie, met dié voorbehoud egter dat die kombuis, met sy relatief hoër belasting van voedselvoorbereidingsmasjinerie, as twee vertreke getel moet word. Die mening is uitgespreek dat elektrisiers nie dikwels die grootte van 'n perseel in duisende vierkante voete bedink nie — dis makliker om die vertreke te tel!

Hieruit blyk dat die verskeidenheidstabel van die I.E.I. in die Sentraal-Afrikaanse Bedravingsregulasies ingesluit is. Hierdie tabel is nie in die regulasies van die S.A.I.E.I. ingesluit nie, vermoedelik op grond van die feit dat dit slegs as 'n leidraad bedoel is en dat dit, as sodanig, nie in 'n stel regulasies tuisgehoort het nie. Ons komitee was egter van mening dat, in baie installasies, die Konsultant aandag aan die verskeidenheid van belasting sou moes skenk en dat daar, by ontstentenis van enige gesaghebbende handleiding, afgesien van reëls, geen basis vir bespreking sou wees nie.

Daar sal egter opgemerk word dat daar aan die anderkant in die reëls voorsiening gemaak is vir die installasie in nywerheids- en handelspersele van veelvoudige sok-uitgange wat as enkele sok-uitgange beskou kan word. Dit is gedoen ten einde voorsiening te kan maak vir bv. kantore met 'n groot aantal rekenmasjiene of klerefabrieke met talryke naaimasjiene. Aan die ander kant moet voorsiening ook gemaak word vir sulke installasies soos werkswinkels waar daar 'n aantal swisemasjiene is wat oor 'laag afstande moet werk. Lewer as om kabels te hê wat oral oor die werkswinkelvloer rondlê, waar hulle maklik beskadig kan word, is dit verkieslik om 'n stroombaan daar te stel wat ontwerp is om al die masjiene van krag te voorsien en wat tog 'n hele aantal keer soveel uitgange

the floor area supplied did not exceed 1,000 square feet. It is probable that, when this regulation was adopted in South Africa, there were few 13-amp socket-outlets in use. In Rhodesia however, the building boom of the Federal days and the predominant influence of the U.K. suppliers led to the early rapid introduction of the 13-amp socket-outlet, and by the time the rules were being drafted it had become established practice to use this system. Our committee reviewing the South African and U.K. regulations took into account the fact that ambient temperatures are higher and generally larger in Southern Africa than in the U.K., hence the 1,000 square feet limit was not really appropriate. Moreover, in any room, the consumer will connect to socket-outlets, through one or more dual adaptors, whatever load he finds necessary in the way of table lamps, hi-fi, heaters, and so on. The Committee, therefore, decided that, taking a common example of a 7/029 circuit, with 30-amp protection, there need be no limit to the number of socket-outlets in any two rooms in a house, or indeed in institutional premises such as hostels, with the proviso that the kitchen, with the comparatively high loading of food preparation machines, should be counted as two rooms. Another thought was that electricians very rarely think in terms of thousands of square feet; rooms are much easier!

Arising from this it will be noted that the IEE table of diversity has been included in the CAS Wiring Rules. This table was not included in the SAIEE regulations, presumably on the grounds that it was merely for guidance and, as such, out of place in Regulations. However, our committee felt that in many installations the consultant would have to take into account diversity of loading and, in the absence of any authoritative guide, as distinct from rules, there would be no basis for discussion.

As a corollary it will be noted that in the rules provision has been made for the installation of multiple socket-outlets which may be regarded as single socket-outlets in industrial and commercial premises. This is to take account of, for example, offices with large numbers of accounting machines and clothing factories with numerous sewing machines. At the other extreme, provision must be made for such installations as work-shops where there are several welding machines required to operate over long distances. Rather than have trailing cables all over the work-shop floor where they would be subject to damage by traffic, it is preferable to run a single circuit designed to cater for these machines and yet have a number of outlets equal to many times the number of machines. Finally, I should mention the fact that

het as wat daar masjiene is. Laastens moet ek melding maak van die feit dat die gebruik van klampbedrading behou is in die Sentraal-Afrikaanse Standaard-bedradings reëls, wat, na ons gehoop het, ten tye van publikasie so modern as moontlik sal wees. Dit lyk na 'n anachronisme dat, in teenstelling met die onbuigbare reëls in verband met leipypbedrading en mineraal-geïsoleerde kables met metaalmantels, klampbedrading nog toegelaat word.

Klampbedrading is egter veilig as dit ongestoord en ontoeganklik gelaat word, dog mens hoop nogtans dat dit leigs gebruik sal word waar hierdie toestande altyd sal heers en dat dit, ten minste in ons land, al minder gebruik sal word. Ten slotte wil ek graag aandag skenk aan 'n punt wat ten tye van die opstelling van die reëls baie sterk na vore gebring is deur mnr. Hooley van die destydse Ministerie van Kragvoorsiening, n.l. dat daar baie gesê kan word ten gunste daarvan dat daar, in aardvrye situasies, met aardeverbinding weggedoen kan word. Met die toenemende gebruik van dubbel-geïsoleerde toestelle en leipype wat nie van metaal gemaak is nie, kan daar 'n baie goeie saak uitgemaak word vir die weglatting van verpligte aard-kontinuiteit in sulke omstandighede.

Met die oog op die konserwatisme van die mense wat verantwoordelik is vir die opstelling en veral vir die toepassing van regulasies, besef ek egter dat dit 'n besonder moeilike taak sal wees om hierdie idee te laat posvat. Andersyds glo ek dat dit reg is, insoverre dat dit die gevaar verminder, en dat dit miskien oor twintig of dertig jaar as aanvaarde standaardgebruik sal geld.

INSTALASIE MATERIAAL

Die eerste Sentraal-Afrikaanse Standaard in hierdie verband was vir PVC-geïsoleerde kables, wat meer as 15 jaar gelede die eerste keer in Rhodesië vervaardig is. Dit het nodig geword om hierdie standaard op te stel aangesien sommige kopers die Britse Standaard gespesifiseer het en andere dié van die S.A. Buro vir Standaarde. Sentraal-Afrikaanse Standaard No. C 1 is in werklikheid 'n kompromie tussen die twee.

Die tweede Sentraal-Afrikaanse Standaard wat direk op installasie betrekking het, is No. C13 vir leipype wat nie van metaal gemaak is nie. Alhoewel die bedradingsreëls nog altyd voorsiening gemaak het vir die gebruik van hierdie soort leipyp, is dit nie op enige noemenswaardige skaal geïnstalleer nie, aangesien daar nie 'n volledige spesifikasie beskikbaar was nie. Nou dat die standaardspesifikasie gepubliseer is, behoort daar in toenemende mate van hierdie plaaslikvervaardigde produk gebruik gemaak te word. In die verbygaan is dit van belang om te noem dat, in afwagting van die publikasie van S.A. Standaard No. C13, die Australiëse standaard algemeen aanvaar is en dat C13 in werklikheid tot groot hoogte op A.S. No. C173 gebaseer is.

In die laaste plek is daar S.A. Standaard No. C9 vir distribusieborde met minatuurstroom brekers vir laag- en mediumspanning, Gedeelte I, enkelfasige borde (maksimum inkomende vrag 80 ampere).

Cleated wiring has been retained in the CAS Wiring Rules, which we had hoped at the time of publication would be as up-to-date as possible. It seems an anachronism that, in contrast to the rigid rules regarding wiring in conduit and M.I.M.S. cable, cleated wiring is still permitted. However, cleated wiring, if left undisturbed and inaccessible, is safe, but it is to be hoped that it will only be used where these conditions will always obtain and that, at least in this country, its use will be minimised. In conclusion I should like to take up a point which was very forcibly put forward by Mr. Hooley of the then Ministry of Power during the drafting of the rules, i.e. that a lot is to be said for having no earth connection in earth free situations. With the increase in the use of doubly-insulated appliances and non-metallic conduit, there is very good case for removing earth continuity for requirements under such circumstances. Bearing in mind the conservatism of the people responsible for drawing up and, even more so, implementing regulations, I realise that this will be a very hard case to put over. On the other hand, I believe it is right in that it reduces the risk of danger and that perhaps in twenty or thirty years time, it will become accepted as standard practice.

INSTALLATION MATERIALS.

The first Central African Standard in this field was for PVC-insulated cables, the manufacture of which started in Rhodesia over fifteen years ago. The need for this standard arose from the specifying of British Standards by some purchasers and SABS standards by others. CAS No. C1 is, in effect, a compromise between the two.

The second CAS relating directly to installation is No. C13 for non-metallic conduit. Although the wiring rules have always provided for the use of non-metallic conduit, its installation on any scale has been held back because of the absence of a full specification. Now that the standard has been published, the use of this locally produced conduit should increase. In passing, it is worth mentioning that, pending the publication of CAS No. C13, the Australian Standard was generally accepted and, in fact, C13 is based largely on A.S. No. C173.

Finally, CAS No. C9 Distribution M.C.B. boards for low and medium voltages, Part 1, single phase boards (80 amp maximum incoming load).

TOESTELE.

Die eerste Sentraal-Afrikaanse Standaard vir elektriese apparaat was C2, wat oor termiese elektriese opbergingswaterverwarmers gehandel het. Die opstelling hiervan is noodsaak deur die swak gehalte van baie van die waterverwarmers wat gedurende die oplewing in die boubedryf in die vyftigerjare vervaardig is. Sover dit werkverrigting betref is die vereistes van C2 dieselfde as die ooreenstemmende Britse en S.A.B.S.-Standaardspesifikasies.

Daar is onlangs 'n begin gemaak met die vervaardiging van ander huishoudelike elektriese toestelle in Rhodesië, en daar is ooreengekom dat die betrokke Britse Standaarde as grondslag vir die Sentraal-Afrikaanse standaarde aanvaar sal word, aangesien slegs geringe wysigings aan eersgenoemde aangebring sou hoef te word.

Hierdie Standaarde is die volgende:—

C7 Kookplate

C8 Yskaste en voedselbevriesters vir huishoudelike gebruik.

Vier bykomstige Britse Standaarde is as Sentraal-Afrikaanse Standaarde aanvaar ten einde hulle in werking te stel vir sover dit plaaslike produksie betref en om die aanbring van gesertifiseerde merke moontlik te maak.

Hierdie Standaarde is die volgende:—

C5 Vulmengsels met bitumenbasis.

C10 Ge-emaaljeerde kopergeleiers (selfvloeiende emalje met 'n poli-uretaan-basis) Ronde drade.

C11 Ge-emaaljeerde kopergeleiers (emalje met 'n poli-ester-basis).

C12 Ge-emaaljeerde kopergeleiers (selfvloeiende emalje met 'n poli-uretaan-basis) Ronde drade van 0.0014 vk. dm. deursnee en kleiner).

GESERTIFISEERDE MERKE.

Die aanbring van gesertifiseerde merke is nou goed gevestig in Rhodesië en word basies op dieselfde wyse as in Suid-Afrika toegepas, dit wil sê gelisensiëerde fabriek is aan periodieke inspeksie onderworpe, terwyl monsters van hul produkte aan kontroletoetse onderwerp word. Ten einde hierdie merkskemas op 'n suksesvolle wyse in werking te stel, het die Vereniging in 1961 sy eie laboratoriums daargestel. Voor daardie tyd is al die inspeksies en toetse deur konsultante uitgevoer. Self nou nog is die elektriese laboratoriums redelik klein, met beperkte geriewe, en baie van die kontroletoetse word in die vervaardigers se fabriek, onder toesig van die Vereniging se inspekteurs, uitgevoer.

Dit is 'n ekonomiese gesonde beginsel in gevalle waar slegs een vervaardiger en die toetstoerusting duur is, aangesien daar oor die algemeen van die vervaardiger verwag word om toerusting te hê wat hom in staat stel

APPLIANCES.

The first CAS for electrical appliances was C2 thermal storage electric water heaters. Its preparation was prompted by the poor quality of many water heaters being made during the building boom of the fifties. As far as performance is concerned, the requirements of C2 are the same as the corresponding BS and SABS specifications.

Recently the manufacture of other domestic electrical appliances started in Rhodesia and it was agreed that the relevant British Standards should be taken as bases for Central African Standards, minor amendments only being necessary.

The Standards are:

C7 Cookers and boiling plates.

C8 Refrigerators and food freezers for household use.

Four further British Standards have been endorsed as Central African Standards to establish their use as far as local production is concerned and to enable certification marking to be applied.

These are:

C5 Bitumen-based filling compounds.

C10 Enamelled copper conductors (self-fluxing enamel with polyurethane base). Round wire.

C11 Enamelled copper conductors (enamel with polyester base).

C12 Enamelled copper conductors (self-fluxing with polyurethane base). Round wires 0.0014 in. diameter and under.

CERTIFICATION MARKING.

Certification marking is now well established in Rhodesia and operates basically in the same way as in South Africa. That is to say, licenced factories are subject to frequent inspection and their products sampled for check testing. It was to enable the marking schemes to be operated satisfactorily that the Association established its own laboratories in 1961 — until then all testing and inspection had been carried out by consultants. At present the electrical laboratories are quite small and limited in their facilities, and much testing is carried out in the manufacturer's factories under the supervision of the Association's inspectors.

This makes economic sense in cases where there is only one manufacturer and the test equipment is expensive.

om sy produksie tot so 'n hoogte te kontroleer dat hy vir die merk kan kwalifiseer.

In die geval van ys- en vrieskaste is daar egter etlike vervaardigers, en die Vereniging beskik oor al die toerusting wat nodig is om al die verlangde toetse uit te voer, insluitende die werkverrigting van die apparaat in 'n omringende temperatuur van 110° F.

SLOT.

Die ontwikkeling en toepassing van standaarde in Sentraal-Afrika was slegs moontlik vanweë die groot waarde wat feitlik alle sektore van die gemeenskap aan die noodsaaklikheid van gehalte, veiligheid en betroubaarheid geheg het, en van hulle was diegene wat met elektrisiteit te doen het, beslis nie die geringste nie. Die Standaardvereniging is opreg dankbaar teenoor al die komitee-lede, en teenoor die organisasies wat hulle verteenwoordig, vir hulle toewyding aan die bevordering van hierdie ideale, en in die besonder aan diegene in die veld van elektriese ware, deur wie die Vereniging se bedrywighede prakties daargestel is.

sive because, in general, the manufacturer is required to have the equipment to control his production sufficiently to qualify for the mark.

However, in the case of refrigerators and deep freezers, there are several manufacturers and the Association is fully equipped to carry out all the tests, including performance at an ambient temperature of 110°F.

CONCLUSION.

The development and applications of standards in Central Africa has only been possible because of the importance which practically all sectors of the community attach to the need for quality, safety and reliability.— none more so than those concerned with electricity.

The thanks of the Standards Association are due to all committee members and the organisations which they represent for their dedication to foster these ideals and, particularly to those in the electrical field who virtually set the pattern for the Association's activities.

**JAARVERSLAG OOR DIE WERKSAAMHEDE VAN
DIE DEPARTEMENT VIR FISIKA EN ELEKTROTEG-
NIESE INGENIEURSWESE VAN DIE S.A. BURO
VIR STANDAARDE.**

Samesnoerende verteenwoordiger : G. C. Theron

1. ALGEMEEN.

Die werksaamheid van die buro oor die afgelope 12 maande in oorsig was lewendig en besielend. Baie spesifikasies en wysigings is afgehandel en het die lig gesien. Baie nuwe en interessante projekte is aan die gang maar jare verloop soms van wanneer die aanvoerwerk begin totdat dit finaal gepubliseer word. Volle besonderhede van die projekte in die verskillende stadiums van ontwikkeling word maandeliks in die S.A.B.S. bulletin gepubliseer en ingenieurs word sterk aanbeveel om daarop in te teken.

U verteenwoordigers op die verskillende komitees probeer so ver moontlik om die siening van die voorsieningsondernemings te vertolk maar meer hulp van alle ingenieurs sal waardeur word. Konsepsiespesifikasie is van die buro beskikbaar en deur kommentaar te lewer wanneer hierdie stadium in die bulletin aangekondig word, sal die meer algemene aanvaarding van spesifikasies verseker kan word.

Die terugvoer van praktiese ondervinding by die toepassing van enige spesifikasie deur ingenieurs sal hoog waardeur word. Dit alles behoort verkieslik deur middel van die sekretariaat van u vereniging te geskied.

In plaas van die Konvensie met lyste van projekte te belas word aandag liewers gevestig op 'n paar spesiale aangeleenthede van belang vir ingenieurs.

2. GEBRUIKSKODE VIR ELEKTRIESE KABELS.

Die nuwe spesifikasie vir papier geïsoleerde kables, S.A.B.S.97, het reeds die lig gesien en daar word gewerk aan die hersiening van die spesifikasie vir P.V.C. geïsoleerde kables, S.A.B.S.150. Dit is dus verblydend om te kan aankondig dat die lang rustende komitee vir 'n "Gebruikskode vir Elektriese Kables" nou weer saamgestel is om hierdie baie belangrike werk te onderneem.

3. METRISERING IN S.A.

Hierdie is tans 'n baie aktuele onderwerp en u vereniging geniet verteenwoordiging op 'n komitee wat handel met kables en geleiers en die verwante probleme. Hierdie onderwerp behels baie werk om die aanvaarding van voorkeurstandaarde en die aanpassing by die verwante toerusting te verseker.

4. AARDLEKRELES.

Die spesifikasie vir hierdie artikel, S.A.B.S.767, word tans hersien. Ingenieurs vir die voorsiening van elektrisi-

**ANNUAL REPORT ON THE ACTIVITIES OF THE
PHYSICS AND ELECTRICAL ENGINEERING
DEPARTMENT OF THE S.A. BUREAU OF
STANDARDS**

Co-ordinating representative : G. C. Theron

1. GENERAL

The activities of the Bureau during the 12 months under review have been lively and inspiring. Many specifications and amendments have been finalised and published. Many new and interesting projects are underway but may take years from the time of the issue of the first enquiry until final publication. Full details of the projects in the various stages of development are published monthly in the S.A.B.S. Bulletin and engineers are urgently recommended to subscribe to this publication.

Your representatives on the various committees endeavour as far as possible to voice the views of the supply undertakings but the further assistance of all engineers will be appreciated. By submitting comments during this stage as published in the bulletin, on any draft specification available from the Bureau, the more general acceptance of specifications can be assured.

Also feed-back of field information from engineers working to any specification will be greatly appreciated. All this should preferably be done through the secretaries of your association.

Instead of burdening the convention with lists of projects, attention will rather be focussed on a number of special issues of importance to engineers.

2. CODE OF PRACTICE FOR ELECTRIC CABLES.

The new specification for paper insulated cables, S.A.B.S.97, has been published and revision of P.V.C. insulated cables specification, S.A.B.S.150, is underway. It is therefore gratifying to note that the long dormant committee on "Code of Practice for Electric Cables" has been resurrected to undertake this important work.

3. METRICATION IN S.A.

This subject is very much in the news at present and your association is represented on a committee dealing with cables and conductors and the associated problems. This subject opens up a vast field of work to ensure acceptable preferred standards and co-ordination with the associated equipment.

4. EARTH LEAKAGE RELAYS.

The specification for this commodity S.A.B.S.767 is under review at present. Supply engineers are in agree-

teit is dit eens dat die spesifikasie heelwat opgeknep moet word gesien in die lig van vorige ondervinding en moderne ontwikkeling. Daar word gemeen dat die relé en die stroombreker een eenheid moet vorm ten einde zepeter daarmee moontlik uit te skakel en dat geen verstelling van die gevoeligheid bo die perke gestel in die spesifikasie toelaatbaar is nie.

g. STANDAARD GROND EN OMRINGENDE LUG TEMPERATURE VIR SUID-AFRIKA

Die S.A.B.S. is versoek om hierdie belangrike onderwerp te ondersoek. 'n Baie interessante en omvattende verslag was die gevolg en word in sy geheel gepubliseer. Die voorgestelde standaard temperature sal gebruik word by die opstel van nuwe tabelle vir die stroomvermoë van kables ens.

Daar word aanbeveel

Dat hierdie konvensie

Grond temperatuur — — — — 25°C

en lug temperatuur — — — — 30°C

as standard temperature vir kables en elektriese toerusting in S.A. aanvaar.

6. SPESIALE TOETSVEREISTES DEUR INGENIEURS VERLANG.

Daar is gedurende die jaar klagtes van vervaardigers en aannemers ontvang dat sekere ingenieurs stoottoetse op elektrisiese installasies in geboue vereis. Hierdie toetse word nie in die Standaard regulasies vir die bedraaiing van geboue of die betrokke S.A.B.S. spesifikasies vir die betrokke toerusting gedek nie en in baie gevalle kan die toebehore nie voldoen nie.

Daar is niks wat ingenieurs verbied om binne die grense van hulle besondere onderneming hulle eie vereistes te stel nie, maar so-iets is egter baie onwenslik en verswak die stem van die vereniging by die komitees.

As ingenieurs weens besondere plaaslike toestande nie met die aanvaarde aanbevelings en standaarde saamstem nie, behoort hulle die aangeleentheid deur die sekretariaat by die betrokke komitee aanhangig te maak. Op die wyse kan die besonderhede ondersoek word en die probleem op 'n nasionale vlak aangepak en uitgestryk word tot die moontlike voordeel van alle ondernemings.

7. GEBRUIKSKODE VIR OPENBARE VELIGTING.

Deel 2 van hierdie kode, vereistes vir verligting van spesiale strate, wat handel met brue, burgersentrums, voetganger oorgange, sirkels, ens. is nou as dokument 5, leër verwysing 19/9/27/1 vir kommentaar gepubliseer.

Die werkgroep het lank en hard aan hierdie baie ingewikkelde taak ge-arbei en moet geluk gewens word met die voortreflike publikasie en ons vertrou daar sal 'n vloedgolf van opbouende kritiek wees.

ment that the specification requires considerable lightening up in light of past experience and modern development. It is considered that the relay and circuit breaker should be combined in one unit in order to make it as tamper proof as possible and that no adjustment of the sensitivity above the limits set by the specification should be allowed.

5. STANDARD GROUND AND AMBIENT AIR TEMPERATURES FOR SOUTH AFRICA

The S.A.B.S. was asked to investigate this important subject. The very interesting and comprehensive report from the Bureau is published in full in these papers and the recommended standard temperatures for S.A. will be used in new current rating tables.

It is recommended

that this convention accepts

Ground temperature — — — — 25°C

Air temperature — — — — 30°C

as standard temperatures for cables and electrical apparatus generally in S.A.

6. SPECIAL TEST REQUIREMENTS CALLED FOR BY ENGINEERS.

During the year of review complaints were received from manufacturers and contractors that certain engineers called for special impulse testing of electrical installations in buildings. These tests are not covered in the Standard Regulations for the Wiring of Premises or the appropriate commodity S.A.B.S. specification and in many cases the fittings could not pass the test.

There is nothing stopping engineers from setting their own requirements within the area of jurisdiction of their particular undertaking although this most undesirable and weakens the voice of the Association at the committees.

If engineers disagree with the set standards and recommendations due to special local conditions they should raise such issues via the secretaries with the appropriate committee so that the details can be investigated and the problem tackled on a national basis and ironed out to the possible advantages of all undertakings.

7. CODE OF PRACTICE FOR PUBLIC LIGHTING.

Part 2 of this code, special street lighting requirements, dealing with the lighting of bridges, town and city centres, pedestrian crossings, roundabout etc., has now been published for comment as document No. 5 file ref. 19/9/27/1.

The working group who has laboured long and hard on this very complex subject must be congratulated on the excellent document produced and we trust there will be plenty of constructive comments.

8. STAANDE RAADGEWENDE KOMITEE VIR ELEKTRIESE VEILIGHEID.

Hierdie komitee het die eerste vergadering in Februarie 1968 gehou. Dit het dadelik duidelik geword dat AARDING veel meer om die lyf het as oppervlakkig lyk en die buro het dadelik weggespring met navorsing en ondersoek van die aangeleentheid.

Die tweede vergadering van die komitee is op 6 Maart 1969 gehou toe die volgende aanbevelings aangeteken is:—

- (a) Die gebruik van stoom-gebalanseerde aardlekrelés word **sterk aanbeveel**. Weens 'n gebrek aan inligting en vertroue word die verpligte installering van aardlekrelés op huishoudelike installasies nie op hierdie stadium gesteun nie. Die maontlike verslapping van aardingsvereistes mag ook oorweeg word.
- (b) Die S.A.B.S. spesifikasie 767 moet gewysig word om:
 - (i) uitklink perke te stel op tussen 30 en 50 milliampere;
 - (ii) nie vermindering van die gevoeligheid toe te laat nie;
 - (iii) die relé en skakelaar moet in een eenheid saamgevoeg word ten einde die gepeuter met die beveiliging so ver maontlik uit te skakel.
- (c) Alle apparate insluitende die stoom moet beskerm word aangesien die onderste uitklinkpeil nou hoog genoeg is om lastige uitklinking te voorkom.
- (d) Dat die verpligte veiligheidspeisifikasies uitgebrei word om haardroërs, badkamertoehore ens. in te sluit.
- (e) Statistieke bewys dat die vermeerdering van ongelukke as gevolg van elektrisiteit veel vinniger in Suid-Afrika is as in die V.S.A., Duitsland en Brittanje en dat 'n onrusbare aantal van die ongelukke die oorsaak van onverskilligheid is. 'n Veldtog om die publiek oor die aansluiting van toestelle in te lig word aanbeveel.

9. SLOT

U verteenwoordiger wil dank van die vereniging aanteken vir al die hulp en bystand wat van die personeel van die buro ondervind is sowel as aan al die ingenieurs wat u op die komitees verteenwoordig. Baie ure van werk word opgeoffer maar dit is belonende werk in belang van die voorsieningswyerheid en die verbruikers.

PROPOSED STANDARD GROUND AND AMBIENT AIR TEMPERATURES FOR S.A.

1. It is proposed to establish standard temperatures for ground and for ambient air for South Africa. These standard temperatures will then be used to compile cur-

8. STANDING ADVISORY COMMITTEE ON ELECTRICAL SAFETY.

This committee had its first meeting in February, 1968.

It became clear at this meeting that EARTHING was a vast and complicated field to cover, requiring much research and investigation, and the bureau immediately started delving into the subject.

The second meeting of the committee was held on the 6th March, 1969 when the following recommendations were minuted:

- (a) The use of current balance earth leakage relays is **strongly recommended**. There is, however, not enough information and confidence available at present to justify the **compulsory** installation of earth leakage relays in domestic installations. The possible relaxation of earthing requirements may also be considered.
- (b) The S.A.B.S. specification 767 should be amended:
 - (i) to set tripping limits between 30 and 50 milliamps;
 - (ii) not to permit any desensitising devices;
 - (iii) to combine the sensing unit and tripping circuit breaker in order to make the unit as tamper-proof as possible.
- (c) All appliances including the cooker unit to be protected; the lower tripping limit now being high enough to eliminate nuisance tripping.
- (d) That the compulsory safety specifications should be extended to cover hairdryers, bathroom fittings and other appliances.
- (e) Statistics show that the electricity accident rate of increase is much higher in South Africa than in U.S.A., Germany or U.K. and that a surprising large number is due to sense of irresponsibility. A campaign to educate the public as to how appliances should be connected is recommended.

9. CONCLUSION.

Your representative wishes to record the thanks of the association to the staff of the S.A. Bureau of Standards for all their assistance and help and to the many engineers who are serving on committees on your behalf. Many hours of work are sacrificed but it is a rewarding work in the interests of our supply industry and consumers.

rent ratings for cables to be included in the Code of Practice for the Handling, Installation and Operation of Electric Cables and also generally for electrical apparatus.

2. The values of ground and the ambient air temperatures at present used, are usually those given in overseas

publications and are not always suitable for South Africa.

3. Ground and ambient air temperatures for every month of the year taken over a period of years and averaged over each period are shown graphically.

4. GROUND TEMPERATURE

Graphs 1 and 2 show the variation of the ground temperature over the year at Cape Town and Elsenburg (Paarl) at three different depths. Each point plotted represents the mean temperature for a given month taken over the number of years indicated. Graphs 3 to 8 indicate the variation of the mean monthly temperature, over the year at various localities in the R.S.A. at 2 ft. depth. The mean temperatures for the year (representing the mean of the twelve points plotted) are also given on the graphs. The average of these mean temperatures for the localities shown on graphs 3 to 8 is 20.4°C. The average of the maximum temperatures is 25.0°C with 19.0°C lowest and 30.8°C highest of the maximum temperatures. The results of the eighteen representative localities considered are as follows:

- Average yearly temperature — — — 20.4°C
- Average of maximum temperatures — — — 25.0°C
- Lowest maximum temperature — — — 19.0°C
- Highest maximum temperature — — — 30.8°C

The daily variation in ground temperature is negligible. It is proposed to take 25°C, the average of the yearly maximum temperatures, as standard ground temperature for the Republic.

5. AMBIENT AIR TEMPERATURE

Ambient air temperature varies considerably over the 24 hour period. Graphs 9 to 12 show the hourly variation of ambient air temperature in Durban, Johannesburg, Cape Town and Bloemfontein. There is also a considerable variation in temperature over the month. Graphs 13 to 20 show the variation of the mean maximum temperature over the year. Every point plotted represents the mean of the maximum daily temperature for any one month. Nineteen centres are represented throughout the R.S.A. and S.W.A. The result of the nineteen localities considered is as follows:

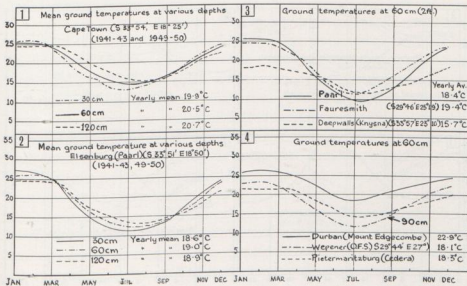
- Average of the maximum temperatures 29.5°C
- Lowest maximum temperature — — — 16.0°C
- Highest maximum temperature — — — 35.0°C

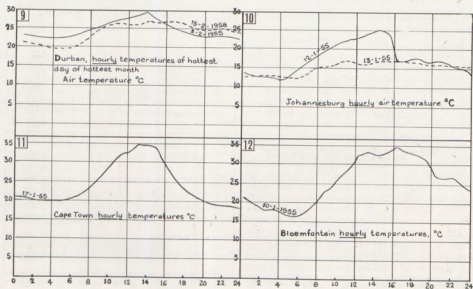
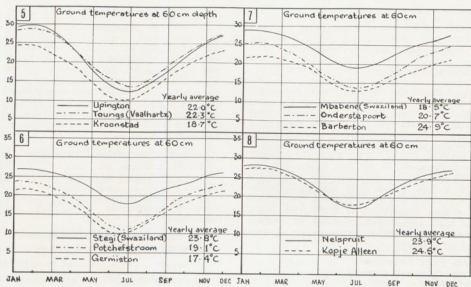
It is proposed to take 30°C, the average of the yearly maximum temperatures as standard ambient air temperature.

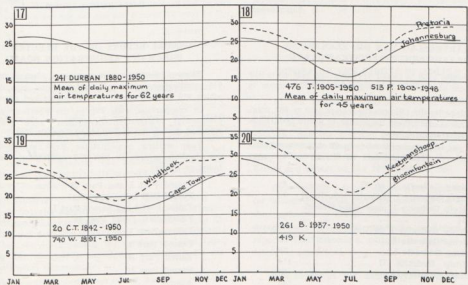
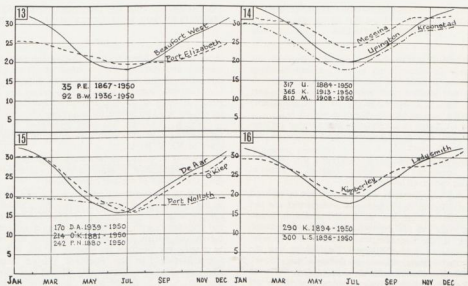
6. Comparison of standard temperatures of other countries with reference to cable ratings.

Country	Ground Temp.	Air Temp
Great Britain	15°C	25°C
U.S.A.	20°C	40°C
Italy	25°C	35°C
Germany	20°C	20°C
S.A.	25°C	30°C

(proposed)







**JAARVERSLAG VAN DIE KOMITEE BELAS MET
AANBEVELINGS VIR NUWE ELEKTRIESE
HANDELSARTIKELS.
(27/8)**

Die Komitee het driekeer vergader gedurende die afgelope jaar en aanbevelings is aan lede-ondernemings bekendgemaak deur middel van die Nuusbrief.

Dit is met leedwese dat ons die afsterwe moet aantekene van mnr. D. I. Jones van die Buro vir Standaard wat vir etlike jare in hierdie Komitee gedien het.

Mnr. R. A. Leigh is aangestel as alternatiewe verteenwoordiger van die Bedradingsregulasiekomitee in die plek van mnr. V. Hart.

Drie-en-twintig aansoeke is gedurende die jaar oorweeg. Die oorweging van sommige hiervan is uitgestel in afwagting van meer besonderhede.

As gevolg van probleme wat opgeduik het in verband met die installering van ingevoerde artikels wat nie aan die spesifikasie van die S.A. Buro vir Standaard beantwoord nie, maar wel aan die toepaslike Britse Standaard-spesifikasie, is die Bedradingsregulasiekomitee versoek om die posisie te verduidelik met inagneming van die Standaard Bedradingsregulasie se definisie van "Spesifikasie." Die Komitee is sedertdien meegedeel dat waar daar 'n S.A.B.S.-spesifikasie is, sodanige spesifikasie sal geld.

Ons bedank al die verteenwoordigers van die verskillende organisasies en liggeme wat in die Komitee gedien het vir hulle heelhartige en waardevolle bystand asook die S.A. Buro vir Standaard vir hul ondersteuning in die toets van artikels waar nodig.

C. Lombard,
Saamroeper.

**JAARVERSLAG VAN DIE ELEKTRIESE
DRAADWERKERSREGISTRASIERAAD**

Gedurende 1968 is twaalf vergaderings belê en is 919 aansoeke om registrasie oorweeg waarvan 915 aanvaar is vir die voorgeskrewe eksamen.

Vergelyke by die 901 van die vorige jaar is 683 voorlopige registrasiesertifikaat toegestaan of hernu gedurende die jaar onder bespreking.

Daar was vier eksamensessies in 46 eksamensentrums vir die toets van 777 kandidate en die uitslae was soos volg:

Geslaag Gedeelte I, en II	41
Geslaag Gedeelte I, Gedruip Gedeelte II	74
Gedruip Gedeelte I, maar slaag Gedeelte II	25
Gedruip Gedeelte I en Gedeelte II	183
Gedruip Gedeelte I	82
Geslaag Gedeelte I	78
Gedruip Gedeelte II	113
Geslaag Gedeelte II	39
Afwesig	142

**ANNUAL REPORT OF THE RECOMMENDATIONS
COMMITTEE FOR NEW ELECTRICAL COMMODITIES**

(27/8)

Three meetings were held during the past year and member undertakings were notified of all recommendations through the medium of the News Bulletin.

It is with regret that we have to record the death of Mr. D. I. Jones of the S.A. Bureau of Standards who has served on this Committee for a number of years.

Mr. R. A. Leigh has been appointed as alternate representative of the Wiring Regulations Committee in place of Mr. V. Hart.

Twenty three applications were considered during the year. Consideration of some of these was deferred pending the receipt of further information.

Due to the fact that problems had arisen with regard to the installation of imported commodities which did not comply with the S.A. Bureau of Standards Specification but did comply with the relevant British Standard Specification, the Wiring Regulations Committee was requested to clarify the position in relation to the definition of "Specification" in the Standard Wiring Regulations. The Committee was subsequently advised that where there was an S.A.B.S. Specification, that specification must apply.

We thank all the representatives of the various organisations and bodies who served on the Committee for their generous and valuable assistance and also the S.A. Bureau of Standards for its assistance in carrying out tests on commodities where necessary.

C. Lombard,
Convener.

**ANNUAL REPORT OF THE ELECTRICAL
WIREMAN'S REGISTRATION BOARD**

Twelve meetings were convened during 1968 and 919 applications for registration were considered of which 915 were accepted for the prescribed examination.

In comparison with 901 in the previous year, 683 provisional registration certificates were granted or renewed during the year under review.

Four written examinations were arranged at 46 examination centres to test 777 candidates, the results being as follows:

Passed Part I and Part II	41
Passed Part I, Failed Part II	74
Failed Part I but passed Part II	25
Failed Part I and Part II	183
Failed Part I	82
Passed Part I	78
Failed Part II	113
Passed Part II	39
Absent	142

Vyf-en-dertig praktiese eksamens is by die 10 hoof-sentrums afgeneem en van die 1006 kandidate was 117 suksesvol.

Ten einde voorsiening te maak vir kandidate met taal- of ander tekortkominge is verskeie mondelinge eksamens gereël.

Registrasiesertifikate is aan 219 persone uitgereik; hiermee kom die totaal sedert 1940 nou op 10,025 te staan.

Hoewel daar, in vergelyking met ander jare, 'n afname was in die totale aantal persone wat in 1968 vir volle registrasie gekwalifiseer het, word 'n verbetering in die vooruitsig gestel van 1969 af, en wel om die volgende redes:

- (i) Die verbeterde opleidingsmetodes van vakkleerlinge deur middel van die ononderbroke opleidingskema.
- (ii) Kandidate wat nie 'n algemene slaagmerk in die praktiese eksamen behaal nie maar wat eenigeen van die drie gedeeltes van hierdie eksamen bevredigend deurkom, word nou vrygestel van die verpligting om 'n verdere eksamen ten opsigte van daardie besondere gedeelte af te lê.
- (iii) Die inligting in verband met die verwagte standaard van werk vir die Raad se praktiese eksamen soos deur die Sentrale Organisasie vir Vaktoetsing vrygestel is in Oktober 1968 is voorwaar van groot hulp vir kandidate.

Die gevestigde Raadgewende Komitees in Durban, Kaapstad en Bloemfontein het gereeld byeengekom sedurende die afgelope jaar.

Ten besluite wil ek graag die Raad bedank vir die inligting wat in hierdie verslag beskikbaar gestel is en vir die toestemming om dit aan die Konvensie voor te lê.

C. Lombard,
Verteenwoordiger.

Thirty-five practical examinations were conducted at the 10 principal centres and 117 of the 1006 candidates were successful.

In order to accommodate candidates with language or other disabilities several oral examinations were arranged.

Registration certificates were issued to 219 persons bringing the total number issued since 1940 to 10,025.

Although, in comparison with previous years, there has been a decline during 1968, in the total number of persons who qualified for full registration, it is expected that the position will improve from 1969 onwards for the following reasons:

- (i) The improved training of apprentices under the block release system.
- (ii) Candidates who do not obtain an overall pass mark in the practical examination but have satisfactorily passed any one of the three parts of this examination are now exempted from undergoing a further examination in respect of that particular part.
- (iii) The information made available by the Central Organization for trade Testing during October, 1968, in regard to the standard of work required for the Board's practical examination is proving to be of considerable assistance to candidates.

The advisory Committees established at Durban, Cape Town and Bloemfontein have held meetings regularly during the past year.

In conclusion, I wish to thank the Board for the information provided in this Report and for permission to submit it to the Convention.

C. Lombard,
Representative.

VERSLAG VAN DIE ONDER-KOMITEE OOR OOR VOORSIENINGS EN OPWEKKINGSREGTE.

Op die Tegnieuse Vergadering gehou te Vanderbijlpark gedurende Mei 1968, het mnr. Percy Giles onder andere verslag gedoen oor samesprekings wat afgevaardigdes van die Verenigde Munisipale Bestuur en die onderkomitee van die V.M.E.O. op 23 Augustus 1967 gehad het met sy edele die Minister van Ekonomiese Sake, die Voorsitter van die Elektrisiteitsbeheerraad, die Voorsitter van Evkom en andere.

Daaropvolgend is 'n skrywe van die Sekretaris vir Nywerhede ontvang waarin die beskouing van die Minister en die kommentaar van Evkom weergee word in sake die argumente wat deur die afvaardiging voorgelê is. Hierdie skrywe het oor die algemeen die verslag van Mnr. Giles bevestig. Die Minister se standpunt word deur die volgende uittreksel opgesom:—

“Wat hierdie Departement betref, kan ek u verseker dat in die uitvoering van die huidige beleid, alles moontlik

REPORT OF THE RIGHTS OF SUPPLY AND GENERATION SUB-COMMITTEE

At the technical meeting held at Vanderbijlpark during May, 1968, Mr. Percy Giles reported, amongst other things, on a meeting which United Municipal Executive delegates and the A.M.E.U. Sub-Committee had with the Honourable the Minister of Economic Affairs, the Chairman of the Electricity Control Board, the Chairman of Escom and others on the 23rd August, 1967.

Subsequently a letter was received from the Secretary for Industries setting forth the views of the Minister and the comments of Escom on the points submitted by the delegation. This letter generally confirmed Mr. Giles report. The Minister's attitude is summed up in the following extract:—

“In so far as this Department is concerned, I can assure you that in the implementation of the current

gedoen sal word ten einde alle gesigspunte van elke saak wat deur die Administrateurs aan my voorgelê word vir kommentaar, deeglik en gerdevdig te oorweeg. Ek vertrou derhalwe dat u bestuur die Regeringsbeleid daadwerklik sal steun en u lede sal aanmoedig om hulle beplanning aan te pas by die regering se doelstellings. U samewerking in die verband sal hoog op prys gestel word.

"Indien u voel dat daar enige verdere punte is wat nie duidelik is nie, sal ek dit met graagte met u bestuur bespreek.

"Die regering het onlangs die beleid t.o.v. die opwekking en verspreiding van elektrisiteit heroorweeg en tot die slotsom gekom dat Evkom verantwoordelik behoort te wees vir die voorsiening van elektrisiteit in grootmate wanneer dit bewys kan word dat Evkom dit teen 'n laer koste kan doen as 'n plaaslike bestuur. By die bepaling van vergelykbare kostes moet nie slegs die huidige toestand in aanmerking geneem word nie maar liever die toestand wat waarskynlik sal heers oor die ekonomiese leeftyd van die opwekkingsfasiliteite wat aangebring sal word.

"Hierdie gesigspunt is deur die Minister van Ekonomiese Sake aan al die Administrateurs voorgelê in 'n skrywe gedateer 4 Desember 1967. 'n Afskrif van hierdie brief word vir die inligting van u bestuur hierby aangeheg. Al die Administrateurs het serdient die Minister in kennis gestel dat hulle met sy standpunte saamstem en dat hulle die algemene beleid soos deur hom omskrywe in die toekoms sal uitvoer."

Die V.M.B. het hulle ontevredenheid uitgespreek oor hierdie antwoord en die kommentaar van Evkom en 'n verdere onderhoud met die Minister versoek. Hierdie vergadering het op 17 Februarie 1968 in Kaapstad plaasgevind toe 'n deputasie van 11 persone die Minister sy Edele mnr. Haak en die Sekretaris vir nywerhede, mnr. Kitshoff ontmoet het, bygestaan deur die Algemene Bestuurder, mnr. de Villiers en mnr. Smit van Evkom en mnr. Retief, Conradie en du Toit van die Kaapse Provinsiale Administrasie.

Ses persone het namens die deputasie gepraat met repliek deur mnr. Kitshoff en de Villiers. Die verskillende argumente wat op die vorige vergadering genoem was, is weer bespreek. Evkom het hulle vorige ooreenkomste herhaal dat die kleinhandel in elektrisiteit in die algemeen aan plaaslike besture oorgelaat behoort te word, en dat waar daar verskille ontstaan, dit deur die Elektrisiteitsbeheerraad bygelê word.

Dit is betekenisvol dat die Minister gesê het dat hy bereid sal wees om met die Administrateurs die moontlikheid te bespreek om 'n onafhanklike liggaam in die lewe te roep om geskille tussen Evkom en Munisipale opwekking te bestig maar dat dit 'n wysiging van die elektrisiteits wet verg en dat dit tyd sal neem om te bewerkstellig.

Een of twee ander sake is nog sub-judice en daar kan nie op hierdie stadium daaroor kommentaar gelever word nie, alhoewel daar hopelike mondelings verslag gedoen sal word by die Konvensie.

R. W. Barton,
Konvenor.

policy, every possible endeavour will be made to give due and fair consideration to all aspects of every case submitted to me by the Administrators for comment. Accordingly I trust that your Executive would give positive support to the Government's policy and that it would encourage its members to tailor their planning so as to fit in with the Government's objectives. Your co-operation in this matter would be sincerely appreciated.

"Should there be any points which you consider require further clarification, I would be only too happy to discuss these with your Executive.

"The Government recently reviewed the policy with respect to the generation and distribution of electricity in the Republic. It reached the conclusion that Escom should be responsible for THE BULK SUPPLY OF ELECTRICITY WHEREVER IT COULD BE SHOWN THAT Escom could do so at a lower cost than a local authority. In measuring comparable costs regard should be had not only to the immediate situation but rather to the situation that is likely to obtain over the economic life of the generating facilities to be established.

"This point of view was placed before the several Administrators in the Republic by the Minister of Economic Affairs in a letter dated the 4th December, 1967. For the information of your Executive a copy of that letter is attached. All the Administrators have since replied to the Minister to the effect that in principle they are in agreement with the views expressed by him and that the general policy as outlined by the Minister will be given effect to in future."

The United Municipal Executive then expressed dissatisfaction with this reply and the comments made by Escom and requested another interview with the Minister. This meeting took place in Cape Town on the 17th February, 1968, when an 11-man deputation met the Honourable Minister, Mr. Haak, and the Secretary for Industries, Mr. Kitshoff, with the General Manager, Mr. de Villiers, and Mr. Smit of Escom, and Messrs. Retief, Conradie and du Toit of the Cape Provincial Administration in attendance.

Six persons spoke on behalf of the deputation with replies from Messrs. Kitshoff and de Villiers. The various points raised at the previous interview were again argued. Escom reiterated their earlier agreement that the retailing of electricity should in general be left to local authorities, and that where differences arose, these should be settled by the Electricity Control Board.

Significantly, the Minister said that he was prepared to discuss with the Administrators the possibility of setting up an independent body to decide between Escom and municipal generation but this will require an amendment to the Electricity Act and will take some time.

One or two other matters are still sub judice and cannot be commented on at this stage, although it is hoped that a verbal report can be made to the Convention.

R. W. Barton,
Convener.

DIÉ WERELD-KRAGKONFERENSIE.

WORLD POWER CONFERENCE

Die jaarvergadering van die Suid-Afrikaanse Nasionale Komitee van die Wêreld-Kragkonferensie het op 24 Februarie 1969 onder voorsitterskap van Dr. Strazacker in Johannesburg plaasgevind. Die volgende verslag, opgestel uit die verrigtinge van hierdie vergadering word vir kennisname voorgelê:—

Soos op die Tegniesse Vergadering te Vanderbijlpark gedurende Mei 1968, gemeld, was op daardie datum nog geen uitnodiging van die Sewende Wêreld-kragkonferensie wat gedurende Augustus 1968 in Moskou gehou sou word, van die gasheerland ontvang nie. Hierna het die uitnodiging wel aangekom, maar veel te laat om iets daaraan te kon doen en derhalwe was die Suid Afrikaanse Nasionale Komitee nie in Moskou verteenwoordig nie.

Twee afgevaardigdes, wat SASOL verteenwoordig het, in die persoon van Dr. Stander en mnr. J. W. v. d. Merwe, assistent algemene bestuurders van die Korporasie, het egter die konferensie bygewoon. Ons is dank aan hulle verkuldig vir die volgende samevatting van hulle indrukke:—

Die Konferensie: Die tema van die Sewende Wêreld-Kragkonferensie was: „Wêreldbronne van Energie en die Aanwending daarvan tot Voordeel van die Mensdom.” Ongeveer 2500 afgevaardigdes was teenwoordig en meer as 250 referate is gelewer in elf onder-afdelings gedurende die drie werksdae van die Konferensie.

Reserwevoorraad van Energiehulpbronne:

Die Konferensie het besluit dat die Wêreld se energiehulpbronne feitlik onuitputlik is, wat bevestig word deur die voortdurende ontdekking van nuwe verslae van fossiel-brandstof sowel as die vordering wat gemaak word in die aanwending van nuwe vorme van energie. Die belangrikste probleem vir die huidige is derhalwe nie die gevaar dat die wêreld se reserwevoorrade energie uitgeput sal raak nie, maar die voorsiening van goedkoop energie aan die mensdom.

Die algehele geologiese reserwevoorraad word op ongeveer die volgende beraam:—

Steenkool 7500 tot 15,000 biljoen ton.

Olie 200 tot 430 biljoen ton.

Natuurlike Gas 140 tot 170 miljoen miljoen kubieke meters.

Uranium ... lae koste ontginning, 1,5 miljoen ton.

Uranium ... hoë koste ontginning, 15 miljoen ton.

Daar word geglo dat die aanwending van kernenergie die wêreld se energiehulpbronne kan verdubbel.

Opwekking en Verbruik van Energie:

Oor die afgelope twee of drie dekades het groot veranderinge in die patroon van energieverbruik plaasgevind en dit duur steeds voort. Die presentasie verbruik van olie, die raffinadery produkte en natuurlike gas neem toe, terwyl die verhouding van steenkool en organiese brandstof afneem. Daar is 'n bestendige vermeerdering in die gebruik van sekondêre energiebronne vernameklik elektriese krag.

The annual meeting of the South African National Committee of the World Power Conference was held in Johannesburg on the 24th February, 1969, under the chairmanship of Dr. Strazacker. The following report derived from the proceedings of this meeting is submitted for information:—

As indicated at the Technical Meeting held in May, 1968 at Vanderbijlpark, an invitation from the host country to send delegates to the Seventh World Power Conference to be held in Moscow during August, 1968 had not been received at that date. Subsequently the invitation did arrive, much too late for anything to be done about it, and consequently the South African National Committee was not represented in Moscow.

However, two delegates representing SASOL, in the persons of Dr. Stander and Mr. J. W. v. d. Merwe, assistant general manager of the Corporation, attended the conference. We are indebted to them for the following resume of their impressions:—

The Conference: The theme of the Seventh World Power Conference was “World Energy Resources and their Utilization for the Benefit of Mankind.” Approximately 2,500 delegates attended and more than 250 papers were presented in eleven sections during the three working days of the conference.

Reserves of Energy Resources: The Conference concluded that world energy resources are practically inexhaustible, which is confirmed by the continuous discovery of new deposits of fossil fuel as well as by the progress made in the utilisation of new forms of energy. Therefore the main problem at present lies not in the danger of exhausting the energy reserves of the world, but in providing humanity with cheap energy.

The overall geological reserves are estimated, very approximately as:—

coal 7,500 to 15,000 billion tons.

oil 200 to 430 billion tons.

natural gas 140 to 170 million million cubic meters.

uranium low cost extraction, 1.5 million tons.

uranium high cost extraction, 15 million tons.

It is believed that the utilization of nuclear energy may double the world energy resources.

Energy Production and Consumption: Over the last two or three decades great changes in the pattern of energy consumption have taken place and are continuing at the present time. The percentage use of oil, oil refinery products and natural gas is increasing while the proportion of coal and organic fuels is declining. There is a steady rise in the use of secondary energy resources, especially electric power.

Die wêreld se lewering van elektriese energie in 1966 het 30% van alle energiehulpbronne beloop. Die gemiddelde jaarlikse vermeerdering oor die afgelope 15 jaar was ongeveer 8%. 'n Ontleding van die elektrisiteitslewering en bevolking van 164 lande (China uitgesluit) met 76% van die totale bevolking van die wêreld, toon dat 121 van hierdie lande 70% van die bevolking het, maar slegs 8% van die elektrisiteitslewering verbruik. Hierdie 121 lande het 'n jaarlikse verbruik per kop van op tot 1000 kWh. (insluitend 95 met minder as 100 kWh). Die oorblywende 92% van die totale elektriese energie opgewerk word deur 43 lande met 30% van die wêreld se bevolking verbruik.

Meer as 70% van die elektriese krag is opgewerk in termiese kragentrales deur middel van fossielbrandstof. Waterkragentrales het 26% gelewer. Ongeveer 1% was van kernkragentrales afkomstig. Dit word beraam dat gedurende die tydperk 1975 tot 1980, 30% en in die tydperk 1980 tot 2000, 65% van al nuwe sentrales kern aangedrewe sal wees.

Daar is 'n verband tussen die verhouding van aanwas van die totale nasionale opbrengs, totale energieverbruik, en elektrisiteitsverbruik. Die gewone patroon is dat die groeitempo van elektrisiteitsverbruik groter is as die groeitempo van totale nasionale opbrengs terwyl die groeitempo van primêre energieverbruik kleiner is.

Vir die tydperk 1960 tot 1965 het oor die hele wêreld die totale nasionale opbrengs met 31% vermeerder, die produksievolume met 40%, die verbruik van alle soorte primêre energiehulpbronne met 24% en elektrisiteitsverbruik met 46%.

Die ontwikkeling van die brandstof en energie ekonomie, en in besonder elektrifisering in lande wat op nywerheidsgebied ontwikkel is, verg $\frac{1}{2}$ tot $\frac{1}{3}$ van alle kapitale beleggings in die ontwikkeling van 'n land se ekonomie.

Opwekkingskoste van Energie:

Gedurende die jare 1960 tot 1966 het die ontginningskoste van steenkool in die V.S.A. gedaal met 3%, terwyl dit in Brittanje en Wes Duitsland met slegs 8% tot 10% toegeneem het. Dit was grotendeels bereik deur maganisasie en outomatisasie, die konsentreeer van produksie en groter eenhede en in verhouding 'n groter mate van dagmynbou. Die nuutste uitgrawingstoerusting het 'n produksievermoë van ongeveer 25,000 ton per uur. Die kapasiteit van emmergraafmasjiene het vermeerder tot 153 kubieke meters.

Elektrisiteit: Die koste van elektrisiteit in fossielbrandstof aangedrewe termiese sentrales is afhanklik — afgesien van brandstofkoste — van die doeltreffendheid van die stoomkettels en turbines en die grootte van die sentrales. Daar is gevolglik 'n neiging in die algemeen na hoër drukke en temperature in stoom ketels en die ontwikkeling van groter turbines en ook in samegestelde stelsels. Daar kan bespaar word deur sentrales aaneen te koppel wat gebiede bedien waar spiltasie nie saamval nie. Dit wil egter voorkom dat, betreffends druk en grotte,

The world output of electric energy in 1966 amounted to 30% of all energy resources. The average increase per annum over the past fifteen years was about 8%. An analysis of the population and electricity output statistics for 164 countries (not including China) with 76% of the total population of the world, shows that 121 of these countries have 70% of the people but consume only 8% of the electricity produced. These 121 countries have an annual per capita consumption of up to 1000 Kwh. (including 95 with less than 100 Kwh.) The remaining 92% of the total world electric energy generated is consumed by 43 countries with 30% of the world's population.

More than 70% of the electric power was produced in thermal stations using fossil fuel. Hydro-power stations produced 26%. Approximately 1% was derived from nuclear stations.

It is estimated that during the period 1975 to 1980, 30% and in the period 1980 to 2000, 65% of all new stations will be nuclear.

There is a relationship between the ratio of growth of the Gross National Product, total energy consumption and electricity consumption. The usual pattern is that the growth rate of electricity consumption is higher than the Gross National Product growth rate, while the primary energy consumption growth rate is smaller. For the world as a whole over the period 1960 to 1965, the Gross National Product increased by 31%, the volume of industrial production by 40%, the consumption of all kinds of primary energy resources by 24% and electric power consumption by 46%.

The development of the fuel and energy economy especially electrification in industrially developed countries requires $\frac{1}{2}$ to $\frac{1}{3}$ of all capital investments in the development of a country's economy.

Production Cost of Energy: Between the years 1960 to 1966 the cost of mining coal in the U.S.A. dropped by 3% while in Britain and Western Germany it increased by only 8% to 10%. This was achieved largely by mechanisation and automation, the concentration of production into larger units, and a larger proportion of open-cast working. The latest excavation equipment has a production rate of about 25,000 tons per hour. Mechanical bucket shovel capacities have increased to 153 cubic metres.

Electricity: The cost of electricity in fossil fuel-fired thermal stations is dependent — apart from the cost of fuel — on the efficiency of the boilers and turbines and size of the stations. Hence there is a general tendency towards increased boiler pressures and temperatures and the development of larger turbines and also in unified power systems. Costs can be saved by interconnecting stations serving areas where the peak loads do not occur simultaneously. However, as far as pressures and size are concerned, it seems as if the limits have been reached. Supercritical pressures (above 3,226 p.s.i.a.) find wide application, but steam temperatures beyond 650 degrees

die toppunt bereik is. Daar word heelwat gebruik gemaak van superkritiese druk (meer as 3226 p./vk. d.m.a.) maar stoomtemperatuur hoër as 650 grade C word voorlopig nie gebruik nie omdat geskikte metale nie beskikbaar is nie. Die uitgangsvermoë van turboalternators word geleidelik hoër, en eenhede van 1000 MW is in gebruik terwyl eenhede met nog hoër vermoë in aanbou is. Eenhede van 2000 MW sal gebou word indien daar 'n oplossing gevind kan word van die probleem om 'n ander vloeistof dan water in die laedrukstadium van turbines te kan gebruik. Die voordele verbonde aan die gebruik van groter eenhede word egter minder met die vermeerdering in kapasiteit.

Die eerste koste verminder steeds met vermeerdering in grootte maar die termiese doeltreffendheid verminder by eenhede groter as 1000 MW.

Die groot probleem met baie groot eenhede is egter die beskikbaarheidsfaktor en die versoiening van reserve kapasiteit. Die probleem om genoegsame verkoelingswater vir hierdie sentrales te vind, word voor oë gebou en droë kondensators word ontwikkel om in hierdie gevalle te gebruik.

In 1964 is beraam dat kernkrag met steenkool kan begin meeding wanneer die prys van steenkool 86 sent (Suid Afrikaans) per miljoen kalories bereik.

In 1966 is die syfer op 68 sent gestel en vir hoër vermoë sentrales op 54 sent. Dit is van belang om te noem dat die prys van steenkool wat in 1967 aan die Kaapstadse Sentrale van EVKOM voorsien is, meer as R1.00 per miljoen kalorieë was en dié aan Durban 85 sent.

Vervoer: 'n Belangrikke element in die prys van krag is die vervoerkoste van energie of energiedraers. Die volgende syfers is van belang:—

Materiaal en Metode van Vervoer.	Koste V.S.A. cent/ton Steenkool Ekwivalent/Kilometer.
Kernbrandstof	0.01
Olie, tenkskip	0.04
Olie, pyplyn 5 - 15 × 10 ⁶ ton/jaar	0.15
Olie, pyplyn 1 × 10 ⁶ ton/jaar	0.50
Olie, spoorweg	0.70
Steenkool, konvensionele trein	0.75
Steenkool, heen-en-weer trein	0.30
Gas, pyplyn	0.30
Hoogspanning elektrise kraglyne	0.70—2.10

Die neiging in die algemeen is om die grootte van bulkvervoereenhede te vermeerder, groter skipe, groter deursnit van pyplyne, groter treinvragte en hoër spanning kraglyne. 'n Aansienlike verlaging in die koste van langafstand brandstof-en energievervoer word hierdeur teweeggebring in teenstelling met die koste van distribusienetwerke. 'n Ooglopende voorbeeld hiervan is die huidige gebruik om raffinaderye so naby as moontlik aan markte te plaas, waar dit voor die tweede wêreldoorlog die gebruik was om die eindprodukte na die markte te verskeep vanaf raffinaderye by die olievelde.

Voorbeelde van die ontwikkeling van grootmaatkarriers in die verskillende bedrywe sal van belang wees.

C are excluded for the time being because suitable metals are not available. Turbo-alternator outputs are steadily rising, units of up to 1,000 MW capacity being in service and units of still higher capacity are under construction. Units of 2,000 MW will be built if a solution can be found for the problem of using a working fluid other than water for low pressure stages of the turbine. However, benefits from using larger units decrease as capacity increases. First costs continue to decrease with increase in size, but the thermal efficiency decreases for units greater than 1,000MW. The main problem with large units, however, is the availability factor and the provision of reserve capacity.

The problem of finding sufficient cooling water for these stations in certain areas is recognised and dry condensers are being developed for these cases.

In 1964 the estimate was that nuclear power became competitive at a coal price of 86 cents (South African) per million calories. The 1966 estimates placed this figure at 68 cents and for high output stations 54 cents. As a matter of interest the price of coal supplied to the Cape Town station of Escom in 1967 was more than R1.00 per million calories and at Durban the price was 85 cents.

Transport: An important element in the cost of power is the cost of transporting energy or energy carriers. The following figures are of interest:—

Material and Means of Transport.	Cost U.S. cents/ton coal equivalent/kilometer.
Nuclear fuel	0.01
Oil, ocean going tanker	0.04
Oil Pipeline 5-15 x 10 ⁶ tons/yr.	0.15
Oil Pipeline 1x 10 ⁶ tons/yr.	0.50
Oil, Railroad	0.70
Coal, Conventional trains	0.75
Coal Shuttle train	0.30
Gas Pipeline	0.30
High Voltage electric power line	0.70—2.10

The general tendency is towards increasing size of bulk transport units, larger ships, larger diameter pipelines, bigger train-loads and higher voltage power lines. This is resulting in a significant lowering of the cost of long distance fuel and energy transport as opposed to the expenses of the distribution networks. An obvious example is the present practice of siting refineries close to the product markets whereas before the Second World War the finished products were shipped to markets from refineries located on the oil fields.

Examples of the development of bulk carriers in various trades will be of interest.

Olle: Die nuwe olietenskepe met kapasiteite van 207,600 dwt. en planne vir skepe van tweemaal die grootte het reeds baie publisiteit ontvang. Olivervoerkoste word deur die gebruik van die skepe gehalveer.

Oliepylyne van 1020mm deursnit is in die U.S.S.R. in gebruik en in werklikheid is 21% van die 16,900 km. pylyne in daardie land van hierdie deursnit.

Die langste oliepylyn in die wêreld is 8000 km. lank en word gebruik om olie te vervoer na Oos-Siberia en die stille-oseaan gebiede van die U.S.S.R.

Gas: Gaspylyne van 1020mm is in die U.S.S.R. in aanbou en lyne van 2000mm tot 2500mm deursnit (meer as 8 voet) word beplan. Die dravermoë van 'n 2500mm lyn is 10½ maal dië van 'n 1020mm lyn, terwyl die koste daarvan 6.15 maal soveel is. Die kapitaalbelegging van so 'n lyn per eenheid dravermoë is net meer as helfte van die van 'n 1020mm lyn.

Steenkool: Die steenkool pylyn wat in die V.S.A. in gebruik was is welbekend. Hierdie lyn is gesluit toe die koste om steenkool per spoor te vervoer verminder is. Daar is begin met die konstruksie van 'n steenkool pylyn wat 5,000,000 ton steenkool per jaar van myne in noordoos Arizona na 'n nuwe kragentrale in Nevada sal vervoer.

Verminderings van meer as 40% in vrageldtariewe is teweeggebring deur die gebruik van „eenheid” treine in die V.S.A. Vragwaens van 91 ton kapasiteit word gebruik en die gemiddelde trein-gewig is 6000 tot 9000 ton. Die vragwaens nooit oorkoppel nie en dit deur twee ure om te laai en die aflaaierekord is 20 minute.

In steenkoolgebiede word die opbrengs van kleiner myne na oorlaastasies vervoer van waar eenheidtreine oorneem.

In die U.S.S.R. word soortgelyke treine met 125 ton vragwaens gebruik.

Elektrisiteit: Daar bestaan 9000 kilometer 500 kV transmissielyste in die U.S.S.R. en 3000 km. in die V.S.A. 'n Studie in die U.S.S.R. het aan die lig gebring dat hierdie kraglyne met eenheidtreine wat steenkool vervoer kan meeding slegs in die gevalle van lae-grad steenkool. Dit blyk asof 500 kV lyne in die V.S.A. effens goedkoper is as die vervoer van steenkool per trein.

In die U.S.S.R. moet geweldige groot hoeveelhede energie van oos na wes oorgedra word (2,500 tot 5,000km) 2,200 kV Gelykstroom lyne en 1000 kV tot 12,000 kV wisselstroom lyne word bestudeer vir die verre toekoms. Daar word verwag dat 1500 kV lyne in sewe tot tien jaar in gebruik sal wees. Die ontwerp van 'n 1500 kV. gs. lyn wat 6000 MW kan oordra word tans onderneem. Dit sal die vervoer van 22 miljoen ton steenkool per jaar uitkakel.

Die Ekonomiese Aanwending van Energie en die Voorspelling Vraag en Aanbod.

Dit is die moeite werd om te let op die aktuele, ingewikkelde en veelsydige aard van die probleem om die ontwikkeling van die energiebalans te voorspel, beplan en op sy gunstigste te stel. Die deskundiges in verskillende

Oil: Much publicity has been given to the new ocean tankers with capacities of 207,600 dwt. and the plans for vessels twice this size. Oil transport costs are being halved by these vessels.

Oil pipelines of 1,020mm diameter are in use in the U.S.S.R. In fact 21% of the 16,900 kilometers of pipeline in that country are of this diameter. The longest oil pipeline in the world is 8,000 kilometers long and carries oil to Eastern Siberia and the Pacific areas of the U.S.S.R.

Gas: Gas pipelines of 1,220mm diameter are under construction in the U.S.S.R. and there are plans for 2,000mm to 2,500mm (more than 8 feet) diameter lines. The carrying capacity of a 2,500mm line is 10½ times that of a 1,020mm line whilst its capital cost is 6.15 times as much. The capital investment of such a line per unit carrying capacity is just over half that of a 1,020mm line.

Coal: The coal pipeline which was operated in the U.S.A. is well known. This was shut down when the rail cost of coal transport was reduced. Construction has now started on a coal pipeline which will transport 5,000,000 tons of coal a year from mines in North East Arizona to a new power station in Nevada.

Reductions of more than 40% in freight rates have been made by the introduction of "unit" trains in U.S.A. Trucks of 91 ton capacity are used and the average train load is 6,000 to 9,000 tons. The trucks are never unoccupied, loading takes two hours and the record unloading time is 20 minutes.

In coal mining areas the production from small mines is delivered to a transloading station from where unit trains operate.

In the U.S.S.R. similar trains with 125 ton trucks are in use.

Electricity: There are 9,000 kilometers of 500 kV transmission lines in the U.S.S.R. and 3,000 kilometers in U.S.A. A study in the U.S.S.R. showed that these powerlines can compete with unit train coal transport only in the case of low grade coals. In the U.S. 500 kV lines seemed to be slightly cheaper than coal transport by train.

In the U.S.S.R. where vast amounts of energy must be transmitted from east to west (2,500 to 5,000 kilometers) 2,200 kV D.C. lines and 1,000 to 12,000 A.C. lines are under study. These are for the far future. It is expected that 1,500 kV lines will be in use in seven to ten years' time. At present the design is under way for a 1,500 kV D.C. line to transmit 6,000 MW. This will eliminate the transport of 22 million tons of coal per year.

The Economic Utilization of Energy and Forecasting Supply and Demand.

It is worth pointing out the topical complex and versatile character of the problem of forecasting, planning and optimizing the development of the energy balance. The experts in various countries in their attitude

lande benader die probleem gedeeltelik van uit dieselfde standpunt waar daar is egter nou heelwat verskille in sienwyse. Die fundamentele beginsel wat deur blykbaar almal aanvaar word, is die dringendheid en ingewikkeldheid van dié probleem en die noodsaaklikheid om dit op die regte manier te benader, wat onder andere insluit die bepaling van die langtermyn neegings vir 25 — 30 jaar vooruit. Daar bestaan egter verbasend baie uiteenlopende sienwyses betreffende die benadering van die probleem en in besonder die middele waardeur die oplossings gevind kan word.

Dit is van belang om daarop te let dat die S.A. Nasionale Komitee aan die Departement Beplanning voorgestel het dat 'n gekoördineerde energieplan vir Suid Afrika opgestel word wat van tyd tot tyd gewysig kan word wanneer nodig.

Algemeen: 'n Geweldige hoeveelheid inligting wat op die Wêreld Kragkonferensie gelewer was, is beskikbaar. Afskrifte van al die referate word in die hoofkantoor van EVKOM in Johannesburg gehou en is beskikbaar vir deurlesing aldaar deur lede van die V.M.E.O.

Die Voorsitter, Dr. Strazacker en die eresekretaris, mnr. H. J. de Villiers van die S.A. Nasionale Komitee sal die volgende vergadering van die Internasionale Uitvoerende Komitee in Ankara, Turkye bywoon in Junie 1969.

Daar word verwag dat afgevaardigdes na die volgende Wêreld Kragkonferensie gestuur sal word wat in 1971 in Bucharest gehou sal word, waar die tema sal wees:

„Verbetering in die Aanwending van Energie, met Besondere Verwysing na Ingewikkelde Verbruiker.“

but there are still considerable differences of opinions. It seems that the basic common principle, shared by practically everyone, is the urgency and the complexity of the problem and the necessity of properly dealing with it, which includes among all other things the determination of the long-term trends for 25 — 30 years ahead. However there exists a remarkable divergence of opinions concerning the approach to the problem and, especially, the means for obtaining the desired solutions.

It is of interest to note that the S.A. National Committee has proposed to the Department of Planning that a co-ordinated energy plan for South Africa be prepared and continually revised as necessary.

General: A tremendous amount of information is available and was delivered at the World Power Conference. Copies of all the papers read are kept at Escom's headquarters in Johannesburg and are available for perusal there by A.M.E.U. members.

The Chairman, Dr. Strazacker, and the Honorary Secretary, Mr. H. J. de Villiers, of the S.A. National Committee are to attend the next meeting of the International Executive Committee to be held in Ankara, Turkey, during June, 1969.

It is expected that delegates will be sent to the next World Power Conference to be held in Bucharest in 1971, when the theme will be — "Improving the Utilization of Energy, with Special Reference to Complex Uses."

VERSLAG INSAKE S.A.N.K.V. -KONGRES 1968

Die vyftiende algemene jaarvergadering van die Suid-Afrikaanse Nasionale Komitee vir Verligting is vanaf 1 tot 3 Mei 1968 te Kaapstad gehou.

Die vergadering is bygewoon deur sewe-en-neëntig persone, waaronder 14 munisipale afgevaardigdes, sowel as verteenwoordigers van die S.A.S. & H., die W.N.N.R., die Kaaplandse Provinsiale Administrasie, die P.W.D., die S.A.B.S., die Universiteite van Kaapstad, Stellenbosch en Natal, die Instituut van S.A. Argitekte en vervaardigers van straatligte en binnenshuise verligtingstoerusting.

Aan die einde van die vergadering is die ampsdraers gewys, en twee lede van die V.M.E.O., nl. mnr. R. M. O. Simpson en P. A. Giles, is tot lede van die Bestuur verkies.

Sewe referate is by die kongres gelewer:—

1. 'n Nuwe metode om skittering wat ongerief verskak, te meet, deur Dr. H. D. Einhorn:

Die twee vernaamste gevolge van skittering is ongerief en 'n verminderde sienvermoë. Verblindende skittering is nie 'n hoë graad van ongerief-skittering nie, dog 'n heeltemal ander effek, wat te wyte is aan te veel lig wat die oog binneval. Ongerief-skittering is te wyte aan 'n te groot kontras in die helderheid van die ligbron, of die geweerkaatste beeld daarvan, en die omliggende agtergrond. Skittering sal groter word namate die helderheid van die ligbron toeneem, terwyl dit sal verminder indien die helderheid van die agtergrond toeneem of die bron van die skittering verder vanaf die gesiglyn verwyder word. Skittering wat vanaf meer as een bron afkomstig is, is Kumulatief van aard. Die standaardindev van ongerief-skittering (S.S.I.) en die ongerief-skitteringsfaktor (S.S.F.) is bespreek, en daar is aangedui dat die verhouding, soos in veldtoetse vasgestel, $S.S.F. = 1.2 S.S.I.$ Voorbeelde van hoe dié metode toegepas kan word, is gegee.

2. Verspreiers en Straalbrekers, soos in binnenshuise verligtingsinstallasies gebruik, deur D. N. Lee:

Verligting is vandag 'n sielkundige onderdeel van alle geboue. Doeltreffende beheer oor die uitstraling van lig vanaf die ligbron is noodsaaklik ten einde kroniese skitteringstoestande te verhoed. Weerkaatsing word op voordelige wyse gebruik in gloeiligte en Kwartz-halogen-armature van middelmatige wattsterkte. 'n Straalbreker bestaan uit 'n stukkie opaalwit materiaal wat 'n ligstraal opbreek en sodoende sy strale in verskillende rigtings versprei.

Verspreiding bevorder gemaklike sig teen lae verligtingspeile, dog daar is 'n daling in die gemaklike sienvermoë soos die verligtingspeil styg. Soos plafonhoogtes laer word, kom die afgeleë verligtingseenhede in die 60° tot 90° direkte flikkeringsone. Die direkte lig kan by wyse van straalbreking van hierdie sone af weggebui word. Teen meeste hoeke word lig tweekeer gebuig soos dit deur 'n plat glas- of platiekplaat gaan. Indien 'n ligstraal die oppervlakte van 'n plaat teen 'n reghoek tref, sal dit regdeur gaan sonder

REPORT ON S.A.N.C.I. CONGRESS 1968

The fifteenth annual general meeting of the South African National Committee on Illumination was held at Cape Town from the 1st to 3rd May, 1968.

Ninety seven persons attended, including 14 municipal delegates together with representatives from the S.A.R. & H., C.S.I.R., C.P.A., P.W.D., S.A.B.S., Universities of Cape Town, Stellenbosch and Natal, Institute of S.A. Architects and manufacturers of street lighting and interior lighting equipment.

At the conclusion of the meeting, office bearers were appointed and two members of the A.M.E.U. were elected to the Executive viz. R. M. O. Simpson and P. A. Giles.

Seven papers were read at the congress:—

1. A new method for the assessment of discomfort glare by Dr. H. D. Einhorn.

The two main effects of glare are discomfort and reduced ability to see. Disability glare is not a high degree of discomfort glare but an entirely different effect due to excessive light entering the eye. Discomfort glare is due to excessive contrast in brightness between the light source or its reflected image, and the surrounding background: Glare will increase if the source luminance is increased. Glare will be lessened if the background luminance is increased or the glare sources are further removed from the line of sight. Glare from a number of glare sources is cumulative. The standard discomfort glare index (S.G.I.) and the discomfort glare factor (S.G.F.) were discussed, the ratio being $S.G.I. = 1.2GI$ in field tests. Examples for the application of the method were given.

2. Diffusers and Refractors as used for interior lighting installations by D. N. Lee.

Lighting is a psychological component in all buildings today. Effective control of emission from the light source is necessary to avoid chronic glare conditions. Reflection is put to good use in incandescent down lights and medium wattage quartz-halogen fittings. A diffuser consists of a piece of material, opal white in colour, which breaks up a beam of light and so spreads its rays in many directions.

Diffusion promotes comfortable seeing at low illumination levels but there is a reduction in visual comfort as the lighting level rises. As ceiling heights become lower the distant lighting units are brought into the 60° to 90° direct glare zone. By means of refraction the emitted light can be bent away from this zone. At most angles light is bent twice as it passes through a flat sheet of glass or plastic. If a light beam strikes the surface at right angles it will pass straight through without being bent at all. If the light beam strikes the

om hoegenaamd gebuig te word. Indien die ligstraal die oppervlakte teen 'n baie skuins hoek tref, sal geen lig deurgaan nie, aangesien dit alles binne-in weerkaats word. As die deursigtige materiaal in die vorm van 'n prisma gebruik word, kan die ligstraal in enige rigting gebuig word deur die tipe, grootte, vorm en kombinasie van die "ligbrekers" te bepaal. Besonderhede is gegee van die vervaardigingsmetodes van ligbrekers; die hitte van lampe is bespreek. Goeie verligting is minder afhanklik van die intensiteit of die hoek waarteen die lig val, soos deur die ligmeter aangedui, as wat dit afhang van die verspreiding van lig op die werksruk.

Dis baie jammer dat daar geen meter beskikbaar is om hierdie belangrike aspek van ligverspreiding te meet nie.

3. Die instandhouding van binnenshuise lig-armature, deur M. C. Rayner :

Die doel van binnenshuise verligting is om ons in staat te stel om te sien wanneer daar geen daglig beskikbaar is nie. Gereelde instandhouding sal op die lang duur ons oë ten goede kom. Doeltreffende verligting lei tot die vermoë om gou en duidelik te sien. Daar was 'n afwaartse neiging in die koste van verligting, wat op sy beurt weer tot 'n toename in produksie gelei het. Goeie verligting het stimulasie, genot en 'n meer doeltreffende sienvermoë tot gevolg. Die gemiddelde verligting van installasies wat in diens is, is 80% van die aanvanklike waarde indien armature elke ses weke skoongemaak word. Die effektiewe lewensduur van gloeilampe voordat hulle vervang moet word, is 1000 uur, en dié van fluoëreserende ligte, 2000 uur. Daar is dus 'n toename in verwagte lewensduur van 50%. Daar is bespreking gewy aan die ekonomiese aspekte van die vervanging van lampe en die skoonmaak van armature. Kontrolerende voetkerslesings behoort met gereelde tussenposes van een maand geneem te word.

4. Kleurbehandeling van ligbronne, deur Dr. M. C. Boshoff :

Die kleurbehandeling van gloeilampe is 'n goeie ding, aangesien die spektrale verspreiding van energie baie naby daglig kom. Fluoëreserende lampe veroorsaak swak kleureffekte, aangesien die spektrale verspreiding onreëlmatig is, wat op sy beurt weer tot onjuiste kleureffekte aanleiding gee. Daar is 'n verduideliking gegee van die spektrale bandmetode om kleurbehandeling te spesifiseer deur gebruik te maak van verwysing na kleur-temperatuur. 'n Stelsel van agt bande is in 1948 ontwikkel, maar die enkele merietesysfer wat aldus verkry is, is gekritiseer aangesien dit 'n gemiddelde afwyking vir alle bande gegee het en baie min aanduidings gegee het van enige besondere golflengte-gebied. Ewewydig met die bandstelsel is 'n kleurmethode om 'n lamp se ontwerpv vermoë volgens 'n kleureindeks R te toets, in 1964 ontwikkel. 'n Tabel van minimum kleur-indeks, tesame met kleurtemperatuur (K.) is met betrekking tot fluoëreserende lampe

surface at a very glancing angle none passes through. It is all reflected internally. By forming the transparent material into a prism the beam of light can be bent into any direction by determining the type size, shape and combination of the "refractor." Methods of manufacturing refractors were described: Lamp heat was discussed: Good lighting depends less upon intensity on the working plane as indicated by the light meter, and more upon the distribution of light on the work. Regrettably there is no meter available to measure this important element of distribution.

3. Maintenance of interior lighting fittings by M. C. Rayner.

The purpose of interior lighting is to enable us to see when daylight has been excluded. Regular maintenance will prove beneficial to our eyes. Effective lighting results in fast and accurate seeing. There has been a decrease in the cost of light leading to productive benefits. Good lighting provides stimulation, pleasure and seeing efficiency. Average illumination in service is 80% of initial value when fittings are cleaned every six weeks. Renewal life of incandescent lamps 1000 hours: Life of fluorescent lamps 2000 hours: 50 per cent increase in life expected. The economics of lamp replacement and cleaning of fittings was discussed. Check foot candles readings should be taken at regular intervals of one month.

4. Colour rendering of light sources by Dr. N. C. Boshoff

Colour rendering of incandescent lamps is good as spectral energy distributions are very close to daylight. Fluorescent lamps give poor colour rendering as spectral energy distributions are irregular which give rise to false colour effects. The spectral band method of specifying colour rendering by reference to colour temperature was described. An eight band system was evolved in 1948 but the single figure of merit so obtained was criticized as being average deviation for all bands and gives little indication for any particular wave length region. Parallel to the band system a test colour method of rating a lamp in terms of a colour rendering index R was evolved in 1964. A table of minimum colour rendering indices together with

aangegee in gevalle waar kleurbehandeling so goed as moontlik moes wees (bv. eksamenkamers); of goed (bv. kantore en voedselwinkels); of medium (bv. gange en pakkamers) of geen (bv. gieterye en walsmeulens).

5. **Moderne ligbronne, deur J. J. Sullivan :**

Gedurende die afgelope vyf jaar is daar ingewikkelde lampe op die mark gebring, soos bv. die hoë-druk natrium-, die tungsten-halogen- en die kwik-halied-lampe. Die gewone gloeilamp word al meer gebruik. Tungsten-halogenlampe het oorspronklik bekend gestaan as kwarts-jodiumlampe, omdat jodium toe die enigste halogeen was wat gebruik is. Die vier halogeen is jodium, broom, chloor en fluor. Die vervaardiger gebruik die een wat hy vir 'n besondere doel as die mees geskikte beskou. Daar is onlangs 'n halogeenlamp vir beeldradioateltjies ontwerp van 1,250 watt, 3,200° K., 274/W en 'n lewensduur van 150 ure. Wat fluoresserende lampe betref, is die grootste vooruitgang wat tot dusver gemaak is, die inwerkings-telling van 'n gasvulsel wat bestaan uit 'n mengsel van argon en neon, in plaas van suiwer argon soos voorheen. Dit skyn of daar tans geen nuwe soort fluoresserende lampe onder oorweging is nie. Aansitter-skakelaars en kitsaansitters of fluoresserende lampe aan die gang te sit, is spreek en daar is klem gelê op die noodsaaklikheid van goeie aarding vir kitsaansitterskakelaars. Die doeltreffendheid van 'n hoë-druk natriumlamp wat 'n goue-wit lig voortbring is 100 L/W en die karaktertrekke van die aansitters is verbeter. Daar is melding gemaak van hoë-druk kwiklampe, laedruk natriumlampe en vaste-staat-lampe.

6. **Voedverligting, deur D. H. Pieksma :**

Voedverligting kan vir vier doeleindes gebruik word, nl.: Nuttigheid (sportvelde); versiering (geboue en standbeelde); advertering (uithangborde) en beskerming (veiligheidsverligting).

In verband met nuts-voedverligting sê die skrywer dat die enigste vertroubare metode om buitemuur voedverligting vir sportvelde te meet, die punt-tot-punt-metode is, waar die verligtingspeil in die middel van 'n 20' x 20' vierkant ten opsigte van 'n vloedlig of 'n groep vloedligte bereken word. Die doel is om 'n goeie ligbalans binne die gesigsveld daar te stel, met genoeg kontras om bewegings in hul ware perspektief te stel, terwyl enige skittering vanaf die ligbron vermy moet word. Hoe hoër die standaard van die spel is, hoe beter moet die verligting wees.

Daar is besprekings gevoer oor ligbronne en daar is 'n oorsig van die uitwerking wat die onder- of oorbelasting van die spanning van hoofgeleidings op die lamp uitoeën. Daar is voorkeur gegee aan die vierhoekstelsel by die gebruik van konvensionele voedverligting, wat 'n elliptiese patroon op die grond vorm. Halogeen-vloedligte vorm 'n "baksteen"-patroon en kan ewewydig met die kantlyne van die veld opgerig word. Om die verligtingspeil vir die dekoratiewe voedverligting van geboue word die lumenmetode

colour temperature (OK) was given in respect of fluorescent lamps where colour rendering was required to be as good as possible (examination rooms), good (Offices, food shops) medium (corridors, storerooms) none (foundries, rolling mills).

5. **Modern Lightsources by J. J. Sullivan.**

During the past five years complex lamps such as the high pressure sodium, the tungsten halogen and the mercury halide lamps have been marketed. The G.L.S. lamp continues to increase in usage. Tungsten halogen lamps were originally known as quartz iodine lamps because iodine was then the only halogen in use. The four halogens; iodine, bromine, chlorine and fluorine. The manufacturer uses what is considered most suitable for a particular application. A recent halogen lamp for television studios is 1,250 watts, 3,200°K, 274/W and life of 150 hours.

In fluorescent lamps the biggest advance to date has been the introduction of a gas filling of argon/neon mixture, in place of pure argon. No new type of fluorescent lamps appear to be under consideration. Starter switch and instant start switch for striking fluorescent lamps were discussed and emphasis on good earthing for instant start switching was mentioned. The efficiency of a high pressure sodium lamp producing a golden white light is 100 L/W and the starting characteristics have been improved.

Mention was made of high pressure mercury lamps, low pressure sodium lamps and solid state lamps.

6. **Floodlighting by D. H. Pieksma.**

Floodlighting can be used for four purposes: Utility (Sportsgrounds), Decorative (buildings, Statues), Advertising (Poster panels) and Protective (Security lighting). In regard to utility floodlighting, the author states the only correct method for assessing outdoor floodlighting for sports is the point-by-point method where the illumination level at the centre of a 20ft. by 20ft. square is calculated for a floodlight or a group of floodlights. The aim is the provision of a good balance of luminance within the field of view, with sufficient contrast to give a true perspective of movement while glare from the light source is to be avoided. The higher the standard of play the better the illumination must be. Light sources were discussed and the effect of under or over running the mains voltage on the lamp was outlined. Four corner system was advocated when using conventional floodlights which produce an elliptical pattern on the ground. Halogen floodlights produce a "Brick" pattern and can be erected parallel to the side line of the field. To calculate the illumination level for decorative floodlighting of buildings the lumen method is used. The luminance contrast should

gebruik. Die luminansie-kontras moet nie hoër as 10:1 wees nie. Daar is 'n beskrywing van vloedverligtingstoebehoere gegee. Die mees gewilde ligbron is die gloeilamp. Drie tipes word gebruik: die gewone gloeilamp, die binnereffeksie-tungstenlamp en die halogeenlamp. Die tegniek wat by die vloedverligting van 'n gebou gebruik word, is nie uitsluitlik op die beginsels van die verligtingsingenieurswese gebaseer nie. Aanvoeling en insig is belangrik. Vir advertensie-vloedverligting met behulp van gewone gloeilampe word die gewone punt-tot-punt-berekening gebruik om die verligtingspeil te bereik. Vir fluoereserende lampe word die Einhorn-sektorvloedmetode gebruik. Die outomatiese klank-en-lig-vertoning in die Kangogrotte is by wyse van skyfies geïllustreer.

7. Verligting van boupersele tydens konstruksie, deur Dr. W. M. H. Rennhackkamp :

Die probleme wat i.v.m. die verkryging van genoegsame arbeidskragte vir die boubedryf ondervind word, maak dit nodig dat voldoende verligting verskaf moet word ten einde produktiwiteit te verhoog, veral in diep kelderverdiepings en wanneer beton gegiet moet word of wanneer skuifluke gedurende nagskofte gebruik word. Goëie verligting lei tot 'n afname in die aantal ongelukke. Minimum verligtingspeile wat ekonomies regverdigbaar is, word aan die hand gedoen. Daar word voorts voorgestel dat hoë-risikogebiede met rooi lampe of verligte tekens aangedui moet word. Skittering wat vanaf lampe afkomstig is, belemmer die werkverrigting en behoort met behulp van skerm; tot 'n minimum beperk te word. Bykomstige ligbehoefte vir pleister- of verfwerk kan by wyse van draagbare lig-armature wat volgens aanvaarde veiligheidsstandaarde aangesluit is, aangevul word. Buitenshuise verligting by wyse van vloedligte word aanbeveel. Deur vloedligte in die regte rigting te plaas, word 'n meer egalige verligtingspeil gehandhaaf. Geskikte vlamvrye toerusting behoort gebruik te word waar ontvlambare of plofbare stowwe geberg of gehanteer word. Die skerp lig wat deur sweisapparate afgegee word, moet behoorlik afgeskerm word. Gereelde inspeksies ten einde die toerusting in goeie orde te hou, is noodsaaklik.

P. A. Giles,
Verteenwoordiger.

not exceed 10:1. Floodlight fittings were described. The most popular light source is the incandescent lamp. Three types are used: G.L.S. lamp, internal reflectorised tungsten lamp and the halogen lamp. The technique of floodlighting a building is not based solely on lighting-engineering principles. Feeling, insight are important. For advertising floodlighting using incandescent lamps the method to obtain the illumination level is the normal point-by-point calculation. For fluorescent lamps the Einhorn sector flux method is used. The automatic sound and light spectacle at the Congo Caves was illustrated by slides.

7. Construction lighting of building sites by Dr. W. M. W. Rennhackkamp.

The difficulty of obtaining adequate labour in the building industry demands the provision of adequate lighting to increase productivity especially deep basements and when pouring concrete or using sliding shutters on night shift. Good lighting is conducive to the reduction of accidents. Minimum levels of illumination that can be justified economically are suggested. The marking of high risk areas with red lamps or illuminated signs is advocated. Glare from lamps interfere with work and should be minimised by screening. Additional light for painting or plastering can be obtained by means of portable light fittings with electrical connections to accepted standards of safety. Exterior lighting by floodlights is suggested. Correct aiming of floodlights provides a better uniformity of illumination. Suitable flame proof equipment should be used where flammable or explosive products are stored or handled. Bright light emitted from welding plants should be shielded. Regular inspection to keep the equipment in good order is essential.

P. A. Giles,
Representative.

VERSLAG AAN DIE „A.M.E.U.“
OPLEIDING VAN INGENIEURS EN TEGNICI

My verslag aan die Tegniëse vergadering op Vanderbijlpark in 1968 het die baanbrekerswerk van die Johannesburgse Elektrisiteitsafdeling geskets met die doel om praktiese rigtings aan andere aan te dui waardeur hulle behuysaam kan wees om die nasionale tekort aan tegniëse personeel te bowe te kom.

Ondervinding tot nou toe bring twee basiese aspekte na vore :—

- (1) Ongelukkig is daar talle werkgewers wat tevrede is om die opbrengs van gevorderde opleidingsgeriewe, daargestel deur 'n groot onderneming, te roof en vind weinig drang om hulle eie soortgelyke en duur geriewe, op te bou. Dit geld van vakleerlinge met wie Johannesburg 'n 98% vakoets slaag syfer behaal teenoor 'n 17% gemiddelde vir die Republiek as 'n geheel; van tegnisi in wie ons 'n 80 wekelang voltydse bywoning aan die Tegniëse Kollege op volle salaris en R386 klasgelede vir die 4 jarige Diploma kursus bestee; sowel as vir gegraduateerde ingenieurs op 'n selfs hoër kursus-koste oor vier jaar.

Die eerste studente het die Tegniëse Diploma 8 jaar gelede behaal. Binne die afgelope maand het die nywerheid twee mans, wat beide die volle vakleerling-skap en die Tegniëse Diploma kursusse ontvang het, weggekol teen loonsverhogings tussen R900 en R1,600 per jaar plus vergelykende pensioen, gesondheids en vervoersvoordele. Die salaris vergelyk met die wat aan intelligente gegraduateertes met 100 jaar professionele ondervinding betaal word op salarisskale wat die hoogste te vinde is in die openbare diens.

Wat moet die uitslag wees vir publieke liggame wat swaar beleggings maak in opleidings maatreëls om in die behoeftes van noodsaaklike openbare dienste te voorsien teenoor sulke onrealistiese „oorname“ salarisse?

Ons tempo van verlies het 80% te bowe gegaan gedurende die eerste ses jaar na opleiding van personeel!

- (2) Ek het afdoende bewyse om die vroeëre uitgesproekte stelling te bewys naamlik dat die ingenieurs bedryfse toelatings norme op selfmoord neerkom in 'n sneluitbreidende ekonomie. Tot nog toe was die beperk tot een van twee rigtings — of om 'n vakleerling-skap te onderneem of om Universiteit toe te gaan. Minder as 20% vind hulleself getrokke deur een van hierdie alternatiewe.

Die nuwe rigting, soos in verlede jaar se verslag beskrywe, rakende die aanstelling van matrikulante vir tegniëse opleiding wat nie vakmans-rigtings oorvleuel nie, het 100 aansoekse gelok aan die begin van 1968 en weer in 1969. Sommige is direk Universiteit toe gestuur en andere weer is opgeneem vir departementele opleiding, gerig op die Diploma vir Tegnisi. 'n Aansienlike presentasie matrikulante is tegniëse

REPORT TO A.M.E.U.
TRAINING OF ENGINEERS AND TECHNICIANS

My 1968 report to the Technical meeting at Vanderbijl Park outlined the measures being pioneered by Johannesburg Electricity Department for the purpose of indicating to others practicable directions in which they may assist in overcoming the national shortage of technical personnel.

Experience to date highlights two fundamental aspects :

- (1) Unhappily numerous employers are content to pirate the output of the advanced training facilities set up by a large organisation and find little motivation in setting up their own similar facilities which are costly. This applies to apprentices with whom Johannesburg is achieving a 97% trade-test pass-rate vs. 34% average for the whole Republic, to technicians in whom we have invested 80 weeks full-time attendance at Technical College on full pay and R306 covering the 4 year Diploma course and to engineering graduates at even higher course-cost over four years.

The first students passed Dip. Tech. only 8 years ago. Within the last month industry has taken from Johannesburg two men, who have received both the full apprenticeship and the Dip. Tech. course, at salary increments of R900 and R1600 per annum plus comparable pension, health and locomotion benefits. The salary compares with that given to bright engineering graduates having 10 years of professional experience on salary scales which are the highest to be found in public service.

What is to be the outcome for public bodies investing heavily in training measures to meet the needs of essential public-services, in face of such unrealistic "take-over salaries"?

Our loss-rate exceeds 80% during the first 6 years following training!

- (2) I have ample evidence to sustain the claims previously expressed that the engineering profession's admission-criteria are suicidal in a rapidly expanding economy. Hitherto this has been limited to one or two routes — either serve an apprenticeship or attend University. Less than 20% of school-leavers are attracted by either alternative.

The new route described in last year's report covering engagement of matriculants for technical training which does not overlap artisan fields, drew nearly 100 applicants at the beginning of 1968 and again in 1969. Some were sent direct to University and others inducted for departmental training orientated towards the Technicians Diploma. A considerable proportion of

aangelê maar gaan verlore vir tegniese loopbane deur gebrek aan rigtingskeuse.

Die voorgaande gee die agtergrond vir die konsep manekrag opleidingswetontwerp wat nou voor die parlement dien. Soos in Brittanje, is die basiese doel van die wet om 'n heffing te lê op werknemers sonder opleidingskemas van hulle eie om sodoende die koste te verhaal van goewerments gesteunde opleidings skemas deur die nywerheidsrade.

Tot op die tyd van hierdie skrywe het die konsep wetsontwerp nog nie voor hande gekom nie, maar 'n verslag daaroor het op bladsy 3 van die „Rand Daily Mail” van 5 Februarie 1969 verskyn. Belang-hebbende instansies word tot 21 Februarie tyd gegee om kommentaar te lewer en die „T.U.C.” het aansoek gedoen om 'n maands se uitstelling.

Dit is duidelik dat enige vooruitgang wat deur die sub-kommittees van die „A.M.E.U.” bereik kan word alleenlik bereikbaar is deur middel van die geriewe wat deur die wetsontwerp daargestel sal word en dit kan moontlik uitloop op 'n nywerheidsraad vir die elektrisiteits-voorsienings industrie.

R. Leishman,
Sameroeper.

JAARLIKSE VERSLAG VIR 1968 AAN DIE S.A.I.E.E. STANDAARD BEDRADINGS REGULASIES

Omrede 'n hele aantal voorstelle ontvang is vir veranderinge of nuwe regulasies om aan te pas by nuwe ontwikkelings, is dit besluit om die „1969 Amendemente” tot die tweede edisie van Mei 1951, uit te gee. Dit volg op die 1960, 1963 en 1966 amendemente.

'n Voldaagse vergadering van die Hoof Kommissie is op 17 Oktober 1968 gehou, in voorbereiding waarvoor die konsep agenda en wysigings aan die einde van Julie uitgedeel is aan die Streeks Sub Kommissies van Natal en Wes-Kaapland sowel as aan die Streeks Takke van die „A.M.E.U.” Hierdie procedure het 'n gunstige reaksie uitgelok ter rade van die Hoof Kommissie, wie se finale voorstelle vir wysigings, tesame met die notule van hulle vergadering aan die voormelde liggame gestuur is vir verdere kommentaar voordat dié aan die Raad van die S.A.I.E.E. voorgelê is in Februarie 1969.

Druk en uitgawe van die amendemente word verwag vir die middel van 1969 maar, waar gevalle van dringende praktiese noodsaaklikheid opduik, is proef afdrukke van die konsep ter insaag by die kantore van die Sekretarise tot Kelvin Huis.

Die 1969 amendemente dek hoofsaaklik :—

- (i) Meer uitgebreide toepassing van aardkrelasies.
- (ii) Regulasies vir „kits” water verwarmers.
- (iii) Nuwe Regulasies vir Onder water- en verhoogsbeligting en bedrading.
- (iv) Isolasië weerstand waar groot installasies nie kan voldoen aan 1 megohm nie.
- (v) Vermoë van „P.V.C.” en aluminium geleier kables vir „rowwe” en „fyn” oorlae beveiliging.
- (vi) Vermoë van kables wat buite die bestek van die vermoë tabelle val.

R. Leishman,
Voorsitter.

matriculants are technically-orientated but are lost to technical careers for lack of choice of outlet.

The foregoing gives background to the draft Manpower Training Bill currently before Parliament. As in the United Kingdom, the essential motive of this Bill is to levy employers, who have no training schemes of their own, for the costs of operating government-sponsored training schemes via Industrial Councils.

Up to the time of writing, this draft Bill has not come to hand but is reported on page 3 of the Rand Daily Mail of 5th February 1969. Interested parties are given until 21st February to submit comments and the T.U.C. has applied for a month's extension of time.

It is clear that any progress achievable by the A.M.E.U. sub-committee can only be activated in directions afforded by this Bill and perhaps may lead to an Industrial Council for the electric power supply industry.

R. Leishman,
Convener.

1968 ANNUAL REPORT TO S.A.I.E.E. STANDARD WIRING REGULATIONS

Because of a number of suggestions received for alterations or new regulations to cover new developments it was decided to issue "1969 Amendments" to the Second Edition of May 1951, following the 1960, 1963 and 1966 amendments.

A full-day meeting of the Main Committee was held on 17th October, 1968, in preparation for which the draft agenda and amendments were issued at the end of July to the regional Sub-Committees of Natal and Cape Western and also to Regional Branches of the A.M.E.U. This evoked a good response for the guidance of the Main Committee whose final proposals for amendments and the minutes of their meeting were circulated to the foregoing parties for final comment before submission to the S.A.I.E.E. Council in February 1969.

Printing and issue of the amendments is expected before the middle of 1969 but, where instances of urgent practical necessity arise, specimen copies of the drafts may be inspected at the Kelvin House offices of the Secretaries.

The 1969 Amendments cover principally :—

- (i) Extended application of earth leakage relays ;
- (ii) Regulations for "instant" water heaters ;
- (iii) New underwater and stage-lighting and wiring requirements ;
- (iv) Insulation resistance where large installations cannot comply with 1 megohm ;
- (v) Rating of P.V.C. and aluminium conductor cables for "coarse" or "close" overload protection ;
- (vi) Rating of cables outside scope of rating tables

R. Leishman,
Chairman.

**VERSLAG VAN „A.M.E.U.”
KOMMISSIE VIR KOORDINANSIE VAN HOOGSPAN-
INGS NAVORSING EN HULPMIDDELS**

Die tweede samekoms van hierdie kommissie het by die W.N.N.R. Pretoria plaasgevind op 15 Oktober 1968. Met die doel om vordering in navorsing te hersien, om geriewe in die land as 'n geheel te tabuleer en om navorsingsrigtings voor te stel, is die studieveld verdeel onder drie sameroepers :-

Isolering	— — — —	Professor G. R. Bozzoli
Korona	— — — —	Professor F. G. Heymann
Weerlig en Stuwings	— — — —	Mnr. R. B. Anderson

Elke onderwerp is opgedeel in onder-afdelings wat betrekking het op elektrisiteitsvoorsiening op die elektriese vervaardigings bedryf en op basiese navorsing.

In verskeie studieveldde is vordering in die wiede gery deur gebrek aan tegniese hulp, tensypte van die feit dat werk in die rigtings aan Universiteite in verband met gevorderde grade, onderneem word.

Heelwat besprekings is gevoer oor die moontlikheid om 'n verspreidings-leiding te voorsien vir toets doeleindes in verband met beligtings navorsing, maar dit gaan gemeoid, met aansienlike kapitaal uitgewas behalwe nog die vir navorsings personeel.

Eskom het samewerking van die Universiteite, S.A.B.S. en die W.N.N.R. aangevra in die bekragtigings en skakelstuwings-toets van die eerste 400kV transmissie leidings waarin heelwat probleme opgeduik het in verband met meting en verklaring. Die W.N.N.R. is besig om 'n reisende veldnavorsingsvoertuig uit te rus vir navorsing in verband met transmissie en verspreidings leidings en elektrisiteitsvoorsienings owerhede word versoek om in hierdie verband mee te help.

Die volgende is verdere sake wat aandag geniet :-
materiale.

- (i) Korona in transmissie.
- (ii) Inwendige ontladings en spoorvorming in isolasie.
- (iii) Uitwendige oorflitsing van isolatore en gapings.
- (iv) Eienskappe van vlamboë.
- (v) Aard-weerstand en aardleidings.
- (vi) Prestasie van sisteme.
- (vii) Inheemse houtpale.
- (viii) Uitgebreide biblioteek met naslaan geriewe.

Lede van die „A.M.E.U.” wat behulpsaam kan wees deur toesig te hou oor toetsapparaat wat by hulle ondernemings opgestel is, of wat besonders verskynsels wat aandag verdien, aanhangig kan maak, word versoek om in verbinding met die Vereniging se Sekretaris te tree.

R. Leishman,
Verteenwoordiger.

VERSLAG VAN DIE „A.M.E.U.”

S.A. ELEKTROLITIESE KORROSIE HOOF KOMMISSIE

Die derde vergadering van hierdie Kommissie is te „Escom Centre” Johannesburg gehou op 28 Oktober 1968. Daar was kennis geneem dat die bykomende Noord-Kaap-

**REPORT TO A.M.E.U.
CO-ORDINATING COMMITTEE FOR HIGH VOLTAGE
RESEARCH AND FACILITIES**

The second meeting of this Committee took place at the C.S.I.R. — Pretoria on 15th October, 1968. For the purpose of reviewing research progress, tabulating facilities throughout the country and proposing avenues of research, the field has been sub-divided under three coordinators :-

Insulation	— — — —	Professor G. R. Bozzoli
Corona	— — — —	Professor F. G. Heymann
Lightning and Surges	— — — —	Mr. R. B. Anderson

Each subject has been classified into the sub-divisions of electricity supply, electrical manufacturing industry and basic research.

In several directions progress is being hampered by lack of technical assistance, despite the work being undertaken in these directions at Universities relating to advanced degrees.

Considerable discussion has been devoted to the possibility of providing a test transmission line for lightning research, but this involves appreciable capital apart from research personnel.

Escom invited co-operation from the Universities, S.A.B.S. and C.S.I.R. in the energising and switching-surge tests of the first 400kV transmission lines which raised several measurement and interpretation problems. The C.S.I.R. is equipping a mobile field research vehicle for research on transmission and distribution lines and supply authorities are invited to co-operate.

The following are further items engaging attention :-

- (i) Corona on transmission.
- (ii) Internal discharges and tracking in insulation.
- (iii) External flashover of insulators and gaps.
- (iv) Properties of Arcs.
- (v) Earth resistivity and earthing.
- (vi) Performance of systems.
- (vii) Indigenous timber poles.
- (viii) Extended library — reference facilities.

Members of the A.M.E.U. who are able to afford assistance by the supervision of test equipment installed on their undertakings, or who can draw attention to specific phenomena meriting investigation, are requested to communicate with this Association's Secretaries.

R. Leishman,
Representative.

REPORT TO A.M.E.U.

S.A. ELECTROLYTIC CORROSION MAIN COMMITTEE

The third meeting of this Committee was held at Escom Centre, Johannesburg, on 28th October 1968. It was recorded that the additional Cape Northern Regional

landse Streeks-Veldkommissie gestig is op 19 Februarie 1968 en sy basis te Kimberley het sowel as dat mnr. J. A. Mathews die verteenwoordiger op die Hoof Kommissie is.

Maatreels vir die samevoeging en uitruil van verslae van die Streeks-Veldkommissies is nou uitgevoer vir uitreiking in die vorm van tegniese pamflette, die eerste waarvan in Desember 1968 beskikbaar sal wees. Die volgende is die opskrifte van die verskillende bydraes :—

- (1) Invloed van swerfstrome op 'n „vrye” lengte ondergrondse netwerk.
- (2) Moontlikheid van elektrolise tussen 'n verbonde sisteem van 'n onderlinge katode.
- (3) „Half-cell” tegnieke.
- (4) Aanbeveling oor die gevoeligheid van meetinstrumente „CuSO₄ half-cell” meting.
- (5) Uitwerking van beskermde meervoudige aarding op elektrolitiese probleme.
- (6) Metode om die rigting van swerfstrome te bepaal teenoor aanliggende ondergrondse bouwerke.
- (7) Die meganisme van gedwonge afvoer na 'n spoorlyn.
- (8) Die gebruik van instrumente.

'n Onder Kommissie is besig met die opstel van konsep wysigings ter verduideliking van die „Gebruikskode vir kables en pylleidings wat onder spoorlyne deurgaang” wat oorspronklik uitgegee is in November 1967. Hierdie sal nie veranderings in prinsiep raak nie.

'n Konsep Gebruikskode vir katodiese beveiliging van ondergrondse strukture word nou opgestel.

R. Leishman,
Voorsitter.

Field Committee was established on 19th February 1968 based on Kimberley and that Mr. J. A. Mathews was its representative on the Main Committee.

Means have now been implemented for the co-ordination and exchange of reports from the Regional Field Committees for issue in the form of Technical Bulletins the first of which became available in December 1968. The following are the headings of the various contributions :—

- (1) Influence of stray currents on a “free” length of underground reticulation.
- (2) Possibility of electrolysis between bonded system of a common cathode.
- (3) Half-cell techniques.
- (4) Recommendation on the sensitivity of measuring instruments for CuSO₄ half-cell measurements.
- (5) Affect of protective multiple earthing on electrolysis problems.
- (6) Method for determining direction of stray currents in relation to adjacent buried structures.
- (7) Mechanism of forced drainage to rail.
- (8) Instrumentation.

A sub-committee is drafting amendments for clarification of the “Code of Practice for Cables and Pipelines Crossing beneath Railway Tracks” originally issued in November 1967. These will not affect changes of principle.

A code of practice for cathodic protection of buried structures is being drafted.

R. Leishman,
Chairman.

deur

A. A. Middlecote, B.Sc. (ELEK.) L.S.A.I.E.I.

1. ALGEMEEN.

Die doel van hierdie kort referaat is om die ontleding van verbruikskurwes vir elektriese energie aan te moedig, veral uit twee oogpunte gesien. Eerstens kan so 'n ontleding die ingenieur in staat stel om sy toekomstige verbruik van elektrisiteit meer noukeurig te voorspel. Tweedens kan dit van waarde wees by die beraming van die algemene ontwikkeling van die betrokke stad, gebied of land, en dit kan moontlik selfs 'n hydrae tot streeksbeplanning lewer. Laasgenoemde standpunt is gebaseer op die opvatting dat die verbruik van energie 'n goeie aanduiding van algemene ontwikkeling gee.

2. ONTWIKKELINGSTEMPO'S.

2.1 Die ontwikkeling van gebiede: Die ontwikkelingspatroon van 'n gebied hang hoofsaaklik van sy natuurlike hulpbronne af. Die mees voor die hand liggende hulpbronne is :

- (a) water ;
- (b) energie ;
- (c) benutbare natuurlike hulpbronne, soos bv. landbouprodukte of minerale, en
- (d) mense,

sowel wat hoeveelhede as gehalte betref.

Tussen hierdie elemente is daar 'n wisselwerking en as hulle aldus verenig is, neem hulle die vorm van 'n Staat van ewewig, waarvan verandering en die tydsfaktor noodsaaklike onderdele uitmaak. Dit stem weer ooreen met die opvatting van "holisme" of die "teorie van stelsels."

Die meting van energie-verbruik kan 'n aanduiding gee van die gevolglike ontwikkeling van 'n gebied, met inagneming van veranderinge en die tydsfaktor. Aangesien energie hoofsaaklik in die vorm van elektrisiese energie verskaf word, en aangesien laasgenoemde maklik en doeltreffend gemeet kan word, is dit baie handig om in staat te wees om 'n idee te kry van die ontwikkelingspatroon van 'n gebied, aan die hand van die jaarlikse verbruik van elektrisiteit in daardie gebied.

Indien die natuurlike hulpbronne in 'n gebied stabiel en die gevolglike wisselwerking harmonieus sou wees, kan 'n mens verwag dat daardie gebied op 'n egalige wyse volgens gegewe wette sal ontwikkel, min of meer op dieselfde wyse as wat 'n kolonie bakterieë groei. So 'n ontwikkelingskurwe kan op sy beste in 'n logaritmes-normale vorm weergegee word, soos aangegee deur die diklynkurwe in figuur 1.

In die praktyk is natuurlike hulpbronne egter glad nie stabiel nie. Watervoorrade kan bv. in 'n siklus van 10 jaar heeltemal verander, en net so kan bv. landbouprodukte verander. Daar kan ook onderbrekings in die verskaffing van erts of ander basiese materiale voorkom,

by

A. A. Middlecote B.Sc (Elec) MSAIEE

1. GENERAL

The objective of this short paper is to encourage the analysis of electrical energy consumption curves, especially from two points of view. Firstly, such analysis might enable the engineer to predict his future electricity consumption more accurately. Secondly, it might well help in assessing the general development of the city, area, or country concerned and possibly even help in regional planning. This latter view is based on the concept that energy consumption is a good indication of general development.

2. DEVELOPMENT RATES

2.1 Development of areas. The pattern of development of an area depends primarily on its natural resources. The most obvious natural resources are :

- (a) water,
- (b) energy,
- (c) exploitable natural resources such as agricultural products or minerals, and
- (d) people

both in quantity and quality.

These elements act and react on each other and thus united achieve the character of a state of equilibrium in which change and the time factor become essential components. This is in accordance with the concept of "holism" or the "systems theory."

Measurement of energy consumption can indicate the consequent pattern of development of an area with regard to change and the time factor. Since most energy is provided in the form of electrical energy, and since the latter can be conveniently and accurately measured, it is very useful to be able to obtain some idea of the pattern of development of an area from the annual consumption of electricity in that area.

If the natural resources in any area were stable and the consequent action and reaction harmonious, one could expect that area to develop regularly in accordance with a law in a manner similar to the growth of a colony of bacteria. Such a growth curve is best given in a logarithmic — normal form as shown by the thick line curve in Figure 1.

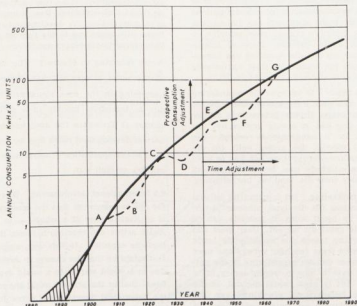
However, in practice the natural resources are anything but stable. Water supplies can vary in something like a ten-year cycle and in a similar manner can agricultural products. There may be discontinuity in supplies of ores or basic material. But above all one must accept the vagaries of man. Man is gregarious by nature and this combined with his inherent creative ability results in conflict of hate and love. Thus one must expect that

dog bo alles moet daar met die ongerymdhede van die mens self rekening gehou word. Die mens is van nature grysugtig en hierdie eienskap, gekombineer met sy inherente skeppende vermoë, lei tot 'n botsing tussen haat en liefde. Om hierdie rede moet mens verwag dat die mens se politieke natuur in 'n aansienlike mate 'n uitwerking op die tempo van ontwikkeling sal uitoefen.

Hierdie feit word miskien op sy beste geïllustreer as mens figuur 1 bestudeer. 'n Gebied kan ooreenkomstig

man's political nature will considerably modify the rate of development.

Perhaps this is best illustrated by considering Figure 1. An area may develop along its theoretical growth curve till a point A is reached. At this point there might be a drought which would depress the normal development of the area until point B is reached, when the area



STANDARD GROWTH CURVE - ELECTRICITY CONSUMPTION

FIGURE 1

sy teoretiese groeikurve ontwikkel totdat punt 'A' bereik is. In hierdie stadium kan daar miskien 'n droogte voorkom wat die normale ontwikkeling van die gebied sal onderdruk totdat punt 'B' bereik word, waarna die gebied miskien goeie reëns kan kry en teen 'n baie vinnige tempo kan ontwikkel totdat dit punt 'C' bereik, wat die peil van ontwikkeling verteenwoordig wat dit onder normale omstandighede sou bereik het indien daar nie 'n droogte sou voorgekom het nie. In hierdie stadium sal daar egter, vanweë die gevolglike laer ontwikkelings tempo langs die teoretiese kurwe, soos vergelyk met die werklike ontwikkelings tempo gedurende die tydperk van herstel, waarskynlik arbeidsnorus, stakings, ens. voorkom, wat op hul beurt weer die ontwikkeling kan vertraag totdat punt 'D' bereik word, wanneer hierdie probleme as opgelos beskou kan word. Daarna kan weer 'n skerp opwaartse ontwikkelingsneiging ondervind word, en so verder voort.

might obtain the benefit of better rains and develop at a very high rate until it reaches the point C bringing it to the stage of development it might have reached under normal conditions had the drought not occurred. At this stage however, because of the consequent lower rate of development along the theoretical curve as compared with the actual rate of development during the recovery period, there may well be labour troubles, strikes etc., which could again depress the development until a point D is reached where these problems are solved.

Again a sharp rate of development may be expected — and so on.

2.2 Nasionale Ontwikkeling. In die praktyk bestaan gebiede egter nie as alleenstaande eenhede nie. Hulle is op sigself onderdele van 'n sub-geheel, wat die provinsie of land waarin hulle geleë is, kan wees. Al die gebiede wat die land uitmaak, handhaaf 'n wisselwerking met mekaar, en elke gebied sal, by wyse van terugvoering na die ander, voortdurend sy gedragslyn of ontwikkeling aanpas ten eiende 'n staat van ewewig te handhaaf. Dit is die opvatting van "homeostase." 'n Gebied kan dus oorwegend 'n spoorwegaansluiting wees wat 'n nywerheidsgebied bedien, of 'n landbougebied, of 'n gebied rondom 'n hawe wat hoofsaak met die in- en uitvoerhandel te doen het. Dit ly geen twyfel nie dat afwykings van die normale ontwikkeling in enige gebied 'n invloed moet uitoefen op die ontwikkeling van ander gebiede, alhoewel laasgenoemde, in ooreenstemming met die opvatting van homeostase, hulself sal aanpas ten eiende die staat van ewewig te handhaaf.

Om weer eens na figuur 1 te verwys: die verandering in die ontwikkeling van punt 'B' kon miskien nie te wyte gewees het aan enige direkte gebeurtenis in die betrokke gebied nie, dog kan 'n gevolg gewees het van bv. nywerheidsnorus in 'n aangrensende gebied. Die veranderinge by 'E,' voordat die gebied selfs tot die normale ontwikkelingskurwe teruggekeer het, kan te wyte wees aan landwyse moeilikhede soos bv. die toepassing van wêreldwye sanksies teen die land, of burgeroorlog.

2.3 Internasionale Ontwikkeling. Dit is natuurlik belangrik dat mens moet onthou dat die land, alhoewel dit 'n sub-geheel vorm, op sy beurt weer 'n gedeelte van 'n geheel is — in hierdie geval die wêreld. Daar moet dus ook hier 'n wisselwerking tussen die verskillende lande verwag word. Op hierdie wyse (en hier verwys ons weer na figuur 1) kan dit wees dat die verandering in die ontwikkeling by 'E' te wyte is aan 'n wêreld-oorlog of 'n wêreldwye depressie. Dit ly geen twyfel nie dat, in die moderne wêreld, die belangrikste afwyking van die teoretiese ontwikkelingskurwe vir enige gebied, sy dit stad, dorp of platteland, hoofsaaklik deur internasionale ontwikkelinge veroorsaak word. Hierdie feit is veral beklemtoon deur die ontwikkeling op die gebied van vervoer, waardeur lande nader aan mekaar gebring en 'n toename in internasionale handel teweeggebring is. Die origne afwykings is aan plaaslike of nasionale gebeure te wyte.

2.4 Standard-ontwikkelingskurwe. Die mening is uitgespreek dat die vorm van meeste van die teoretiese ontwikkelingskurwes soortgelyk van aard kan wees. Figuur 1 is verkry deur die verbruikskurwes vir elektrisiteit van vyf lande en sowat twee dosyn plaaslike owerhede op lukrake wyse met mekaar te vergelyk. Daar word nie op aanspraak gemaak dat hierdie kurwe absoluut korrek of betroubaar is of dat 'n veel wyer variasie in die vorm daarvan moontlik is nie, maar daar skyn goeie rede te wees om dié kurwe as uitgangspunt vir die ontleding van kilowatt-ur-kurwes te aanvaar. Daar is meer werk om te doen. In die hieropvolgende gedeelte van hierdie referaat sal aangeneem word dat die teoretiese kurwe as standaard-

2.2 National Development. In practice however areas do not exist on their own. They are themselves parts of a subwhole which might be the province or country in which they are situated. All the areas comprising the country will act and react on each other, and each area will by means of feedback continuously adapt its behaviour or development to maintain a state of equilibrium. This is the concept of "homeostasis." Thus an area may be predominantly a railway junction serving an industrial area, an agricultural area, and an area having a port, largely concerned with export and import trade. There is no doubt that deviations from normal development in any area must act on the development of other areas though these will, according to the concept of homeostasis, adapt themselves to maintain equilibrium.

Again referring to Figure 1: The change of development at the point B may not have been due to some direct happening in the area concerned but might have been due to industrial trouble in a neighbouring area. The change at E, before the area has even recovered to the normal development curve may be due to national troubles such as the application of world-wide sanctions against the country or civil war.

2.3 International Development. It is important, of course, for one to remember that the country, though a subwhole, is in itself a part of a whole — in this case, the world. Again action and reaction between the different countries must be expected. In this way, again referring to Figure 1, it might be that the change in development at point E is due to a world war or to a world depression. There is no doubt that in the present world the major deviations from the theoretical development curve for any area, whether city, town, or rural community will be modified mostly by international affairs. This has been accentuated by the developments in transport, which have brought countries closer together and increased international trade. The remaining deviations will be due to local or national events.

2.4 Standard Development Curve. It was felt that there might be a similarity in the forms of most of the theoretical development curves. By trial and error, using the electrical energy consumption curves of five countries and some two dozen local authorities, the curve in Figure 1 was obtained. It is not claimed that this curve is absolutely correct or reliable or that much wider variation in the form might be possible, but there appears to be good reason for accepting the curve as a starting point in the analysis of kilowatt-hour curves. Much more work has still to be done. In the rest of this paper however it will be assumed that the theoretical curve is acceptable as a standard curve. In practice it can be moved vertically to

kurwe aanvaarbaar is. In die praktyk kan dit vertikaal verskuif word om aan te pas by 'n gebied of land se uiteindelige ontwikkeling op die grondslag van sy natuurlike hulpbronne, terwyl dit horisontaal kan skuif om aan te pas by die datum waarop die ontwikkeling begin het. Hierdie kurwe is in die eerste plek een van "probeerstae en foute" maar dit berus op die holistiese begrip dat ontwikkeling afhanklik is van die wisselwerking tussen alle natuurlike hulpbronne en nie op menslike hulpbronne in die besonder nie. Dit verskil van en is skynbaar meer pessimisties as meeste van die ontwikkelingskurwes vir ontwikkelende lande wat deur middel van ander metodes opgestel word. Die mening word gehuldig dat daar in laasgenoemde kurwes te veel klem gelê word op energieverbruik per persoon in verhouding tot die bevolkingsgroei.

3. DIE ONTLEDING VAN VERBRUIKSKURWES TEN OPSIGTE VAN ELEKTRISITEIT.

3.1 Nasionale Verbruik. Die kurwes in figuur 2 toon die werklike jaarlikse verbruik van elektrisiteit in kilowatt-

suit an area or country in terms of its ultimate development based on its natural resources and horizontally to line up the date at which development started. This curve is essentially a trial and error curve, but it is based on the "whole" concept that development depends on the interaction of all natural resources and not particularly on human resources. Thus it is different from and appears to be more pessimistic in most cases than development curves for developing countries produced by means of other methods. It is felt that in the lastmentioned curves too much emphasis has been placed on energy consumption per capita related to population growth.

3. ANALYSIS OF ELECTRICITY CONSUMPTION CURVES

3.1 National Consumption. Figure 2 reflects the actual curves of annual electricity consumption in kWh over the

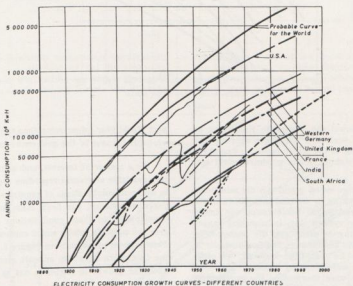


FIGURE 2

ure oor 'n aantal jare in ses verskillende lande. Die Standaardkurwe is in elke geval aangepas om by die besondere land te pas, en dit wou voorkom asof hierdie standaardkurwe tog 'n goeie idee gee van die uiteindelige ontwikkeling van die betrokke land. Die vorm van die kurwes ten opsigte van werklike verbruik in die vyf ontwikkelde lande is soortgelyk, en internasionale invloede soos die Eerste Wêreldoorlog, die wêreldwye depressie van 1930 en die Tweede Wêreldoorlog word duidelik in

years for six different countries. The standard curve has been adjusted in each case to suit the particular country, and it appears that this standard curve does give a good idea if the ultimate development of the country concerned. The forms of the actual consumption curves of the five developed countries are similar and international influences such as World War I, the 1930 world depression, and World War II are clearly seen in all curves. It is also interesting to note the great similarity between the

al die kurwes weerspieël. Dit is ook interessant om te let op die groot ooreenkoms tussen die kurwes ten opsigte van die Verenigde Koninkryk en die Republiek. Dit val lig te begrype, aangesien die ekonomie van die twee lande altyd nou aan mekaar verbonde was en hulle albei tot onlangs 'n gedeelte van 'n groot "geheel," n.l. die Gemeene-

curves of the United Kingdom and the Republic. This is understandable since their economies have always been closely tied together and both were till recently part of that "whole," the Commonwealth. Both the United Kingdom and the Republic show a far more pronounced

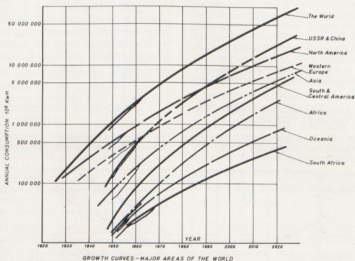


FIGURE 3

bes, uitgemaak het. Sowel die Verenigde Koninkryk as die Republiek toon 'n veel meer merkbare depressie ná die Eerste Wêreldoorlog as die ander lande — waarskynlik as gevolg van die staking in die goudmynbedryf aan die Witwatersrand.

Interessantheidshalwe en op grond van die min inligting tans tot ons beskikking in verband met die verbruik van elektrisiteit in verskillende kombinasies van lande gedurende die afgelope vyftien jaar, is 'n poging aangewend om 'n voorspelling te maak van die toekomstige ontwikkeling van hierdie kombinasies van lande en om 'n aanduiding te gee van die moontlike verbruik van elektrisiteit dwarsdeur die wêreld in die toekoms. Dit word in figuur 3 op grafiese wyse voorgestel. Die groeitempo van die Kominternlande kom 'n mens as verontrustend voor, terwyl die ontwikkeling in Afrika, aan die ander hand, nie so groot is as wat mens geneig sou wees om te verwag nie.

3.2 Streeksontwikkeling in die Republiek. Miskien nog die beste aanduiding van die Streeksontwikkeling is te vinde in 'n ontleding van die elektrisiteitsverbruikskurwes van die verskillende ondernemings van E.V.K.O.M. Hierdie kurwes verskyn in figuur 4, waar 'n poging aangewend is om die standaardkurwe en die kurwe ten opsigte van werklike elektrisiteitsverbruik bymekaar aan te pas, ten

post World War I depression than the other countries do—probably because of the gold strike on the Witwatersrand.

As a matter of interest, and using the little information available at present regarding electricity consumption in different combinations of countries over the past fifteen years, an attempt has been made to predict the future development in these combinations of countries and to give the possible future world consumption of electricity. This is given graphically in Figure 3. The growth rate of the Comintern countries appears alarming. On the other hand the growth in Africa is not as great as one would expect.

3.2 Regional Development in the Republic. Perhaps the best indication of this is given if one examines the electricity consumption curves of the different ESCOM undertakings. These are given in Figure 4, where an attempt has been made to fit the standard curve to the actual curves of electricity consumption to obtain some idea of possible future development. Thus it is indicated that the

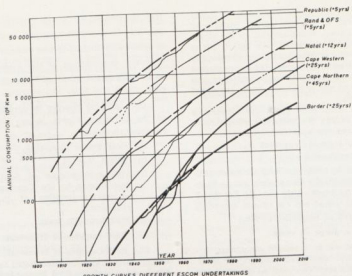


FIGURE 4

einde 'n idee van die moontlike toekomstige ontwikkeling te vorm. Hiervolgens is dit duidelik dat die verbruikskurve ten opsigte van die Randse en Oranje-Vrystaatse ondernemings dieselfde patroon ten opsigte van die tyds-

consumption curve of the Rand and O.F.S. undertaking has been similar in time displacement to that of the whole Republic, i.e. 5 years behind the world standard curve. Natal is 12 years behind the world curve, the Cape

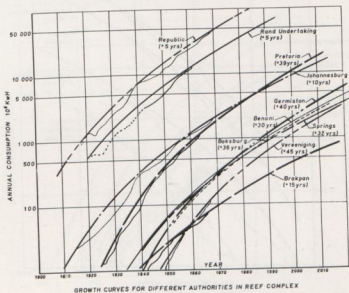


FIGURE 5

faktor gevoig het as die res van die Republiek, nl. 5 jaar agter die standaardkurwe vir die hele wêreld. Natal is 12 jaar agter die wêreldkurwe, Wes-Kaapland en die Grens 25 jaar agter, en Noord-Kaapland 45 jaar agter. Dit is redelik logies as mens die geskiedkundige en ekonomiese ontwikkeling van die land in ag neem. Dit is interessant om te let op die gesonde ontwikkelingsvooruitsigte van daardie deel van die land wat so laat eers begin ontwikkel het, nl. Noord-Kaapland.

Mens kan ook in wisselende grade die uitwerking waarneem van onder andere die volgende gebeurtenisse op die kurwe ten opsigte van werklike verbruik :

- (a) Die wêreldwye depressie van 1930 ;
- (b) die tweede Wêreldoorlog ;
- (c) die reoriëntasie, in 1960, van Suid-Afrika se politieke verhouding tot die Gemenebes, wat sy hoogtepunt in die totstandkoming van die Republiek van Suid-Afrika gehad het ('n effense resessie);
- (d) die voorspoedgolf ná Republiekwording.

3.3 Die ontwikkeling van dorpe en stede :

3.3.1 Die Rand-kompleks, wat as 'n redelik aanmeekaar verbonde stelsel bestaan, het aanvanklik rondom die goudmynbedryf ontwikkel, dog later (en veral ná die vestiging van Yskor te Pretoria) het dit tot 'n algemene nywerheidsgebied gegroei. Die verbruikskurwes van die hoofdorpe en -stede van hierdie kompleks word in figuur 5

Western and Border 25 years behind the world curve, and the Cape Northern 45 years behind the world curve. This is reasonably logical if one examines the historical and economic development of the country. It is interesting to note the sound future of that late starter the Northern Cape.

One can also observe in varying degrees the effect of the following events, among others, on the actual consumption curve :

- (a) 1930 World Depression ;
- (b) World War II ;
- (c) 1960 reorientation of South Africa's political relationship to the Commonwealth culminating in the declaration of the Republic (slight recession);
- (d) Post Republic boom.

3.3.1 Reef Complex of Transvaal. The Reef Complex,

3.3.1 Reef Complex of Transvaal.—The Reef Complex, which exists as a fairly interrelated system, was primarily developed around the Gold Mining Industry but thereafter (particularly after the location of Iscor at Pretoria) as a general industrial area. The consumption curves of the major cities and towns of the complex are given in Figure

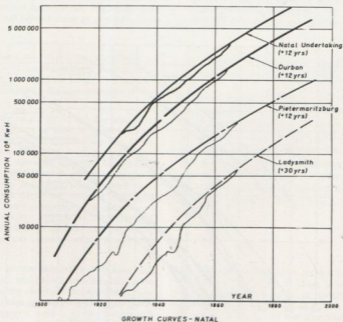


FIGURE 6

weergegee. Hierdie kurwes beklemtoon die onderlinge verwantskap van hierdie dorpe en stede.

Dit is interessant om te let op die ooreenkoms tussen Johannesburg se verbruikskurwe en dié van die Republiek. Dit is slegs logies as mens Johannesburg se posisie as die sentrum van die land se nywerheidsontwikkeling in ag neem. Pretoria het sowat 30 jaar later eers begin, maar dit openbaar 'n baie skerp ontwikkelingstempo, wat Johannesburg teen ongeveer 1990 behoort verby te steek. Dis die moeite werd om daarop te let dat Pretoria die enigste sentrum in die Transvaal is wat gedurende die oorlogjare 'n versnelde ontwikkelingstempo getoon het. Aangesien Pretoria die Administratiewe Hoofstad is, waar boonop die Verdedigingshoofkwartier geleë is, is dit weer 'n heel logiese ontwikkeling. Daar sal ook gemerk word dat Kaapstad en Durban, as belangrike hawens, ook gedurende die oorlog 'n redelike ontwikkelingstempo gehandhaaf het.

Die verbruikskurwes toon ook aan dat Vereeniging, wat eweneens laat begin ontwikkel het, ook nou 'n skerp styging in sy ontwikkelingstempo toon.

3.3.2 Natalse Stede. Figuur 6 toon die verbruikskurwes vir Durban, Pietermaritzburg en Ladysmith. Ook hier is die onderlinge verwantskap tussen dié sentra merkbaar, alhoewel die ontwikkeling van Ladysmith heelwat later as dié van die ander twee begin het.

3.3.3 Uitgesoekte stede en dorpe. Figuur 7 toon 'n algemene dwarsprofiel van stede en dorpe in die Republiek,

5. These curves emphasize the interrelationship of these towns and cities.

It is interesting to note the closeness of the form of the consumption curve for Johannesburg to that of the Republic. This is logical in view of Johannesburg's position as the centre of industrial development. Pretoria started somewhat 30 years behind but has a very sharp rate of development and should pass Johannesburg by about 1990. It is worth noting that Pretoria is the only centre in the Transvaal that shows an increased rate of development during the war. Since Pretoria is the Administrative Capital, having Defence Headquarters situated here, this is again quite logical. It will be noticed that the Cape Town and Durban, important sea ports, also show a reasonable rate of development during the war.

The consumption curves also indicate that Vereeniging, again a late starter, is now developing at a sharp rate.

3.3.2 Natal Cities. Figure 6 gives the consumption curves for Durban, Pietermaritzburg, and Ladysmith. Again the interrelationship between these can be seen even though Ladysmith's development started somewhat later than that of the other two.

3.3.3 Selected Cities and towns. Figure 7 gives a general cross-section of towns and cities in the Republic. Again

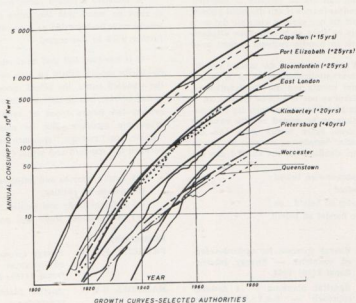


FIGURE 7

wat weer eens die algemene vorm van die land se ontwikkeling weergee. Dit is interessant om daarop te let hoe die kurwe vir Pietersburg, wat ook laat eers begin ontwikkel het, op 'n gesonde ontwikkelingsstempo vir die toekoms dui. Die ander interessante punt is die afname in die ontwikkeling van Kaapstad, Oos-Londen en Queenstown sedert 1955. Dit wou voorkom asof die ontwikkeling sedert 1961 op 'n nuwe teoretiese kurwe gebaseer is. Dit is hoofsaaklik raaiwerk, aangesien dit moontlik is dat die ontwikkeling binne die volgende paar jaar 'n opwaartse neiging mag toon, wat moontlik die oorspronklike teoretiese kurwe kan volg. Andersyds is dit moontlik dat 'n reoriëntasie van natuurlike hulpbronne — veral arbeid — 'n permanente invloed op die teoretiese ontwikkelingskurwe kon uitgeoefen het. 'n Soortgelyke uitwerking op die ontwikkelingskurwe is in die geval van Rhodesiese stede merkbaar, waar daar sedert 1960 — toe die Federasie ontbind is — 'n soortgelyke verplasing plaasgevind het. Hierdie is interessante punte wat slegs binne die volgende tien jaar of wat opgeklar sal word.

4. GEVOLGTREKKINGS

Daar word nie ten opsigte van hierdie kort referaat op enige positiewe toepassingsnut aanspraak gemaak nie. Daar word slegs aan die hand gedoen dat die meeste K.W.H.-ontwikkelingskurwes met 'n standaardkurwe gekombineer kan word, tot voordeel van die ingenieur wat vir die beplanning vir die voorsiening van elektrisiteit verantwoordelik is. Hierdie inligting kan ook met vrug in samehang met ander inligting gebruik word om die algemene ontwikkeling van sekere gebiede te voorspel. 'n Tentatiewe standaardkurwe is aan die hand gedoen, maar daar moet nie uit die oog verloor word nie dat so 'n kurwe baie tentatief is en slegs as 'n moontlike uitgangspunt vir verdere werk in hierdie verband beskou moet word.

Die mening word egter gehuldig dat meeste van die ingenieurs wat vir elektrisiteitsvoorsiening in 'n gebied verantwoordelik is, met behulp van die standaardkurwe, die werklike verbruikskurwe oor 'n gegewe tydperk en 'n intieme kennis van die plaaslike geskiedenis, die toekomstige voorsieningsneigings in sy gebied redelik akkuraat kan voorspel. Hy moet egter bewus wees van die "holistiese" of "stelsels"-benadering en moet afwykings tussen die werklike en standaardkurwes ontleed aan die hand van —

- (a) plaaslike hulpbronne en beleid;
- (b) provinsiale beleid;
- (c) nasionale handel en beleid; en
- (d) internasionale handel en beleid.

Bibliografie.

- FREMONT, FELIX: Energy forecast for underdeveloped countries — Energy International 1(10) 1964.
- MALLOWS, E.W.N.: Spatial planning — a systems approach — S.A.I.S.I.-konvensie, Pretoria, Julie 1968.

the common form of national development can be seen.

It is interesting to note how the curve for Pietersburg, again a late starter in development, indicates a sound development rate for the future. The other point of interest is the fall off since 1955 of the development of Cape Town, East London, and Queenstown. Since 1961 the rate appears to have been based on a new theoretical curve. This is to a large extent guesswork since it is possible that the development may show an upward swing in the next few years to follow the original theoretical curve. On the other hand, it is possible that a reorientation of natural resources — particularly labour — may have had a permanent effect on the theoretical development curve. A similar effect on the development curve can be noticed for Rhodesian cities where since 1960 — the breakup of Federation — there has been a similar displacement. These are interesting points which will only be cleared up in the next ten years or so.

4. CONCLUSIONS

This short paper does not claim to have any positive application. It merely suggests that most kWh consumption curves may be enveloped by a standard curve with benefit to the engineer responsible for planning development of electricity supply. This information could also with benefit be used in conjunction with other information for predicting general development of areas.

A tentative standard curve has been suggested, but it must be noted that the curve is very tentative and should only be regarded as a possible starting point for further work in this regard.

It is however felt that most engineers responsible for electricity supply within an area could, with the help of the standard curve, the actual consumption curve over a period of time, and an intimate knowledge of local history, predict the future trend of supply in his area with reasonable accuracy. But he must be aware of the "whole" or "systems" approach and analyse deviations between the standard and actual curves in terms of

- (a) local resources and politics;
- (b) provincial politics;
- (c) national trade and politics;
- (d) international trade and politics.

Bibliography

- FREMONT, FELIX: Energy forecast for underdeveloped countries — Energy International 1(10), 1964.
- MALLOWS, E.W.N.: Spatial planning — a systems approach — SAICE Convention Pretoria, July, 1968.

NOTES

