PROCEEDINGS

of the

Twenty-Sixth Convention

of the

Association of Municipal Electricity Undertakings

OF SOUTHERN AFRICA

(Founded 1915)

MUNICIPALITY OF

BULAWAYO

held at

BULAWAYO

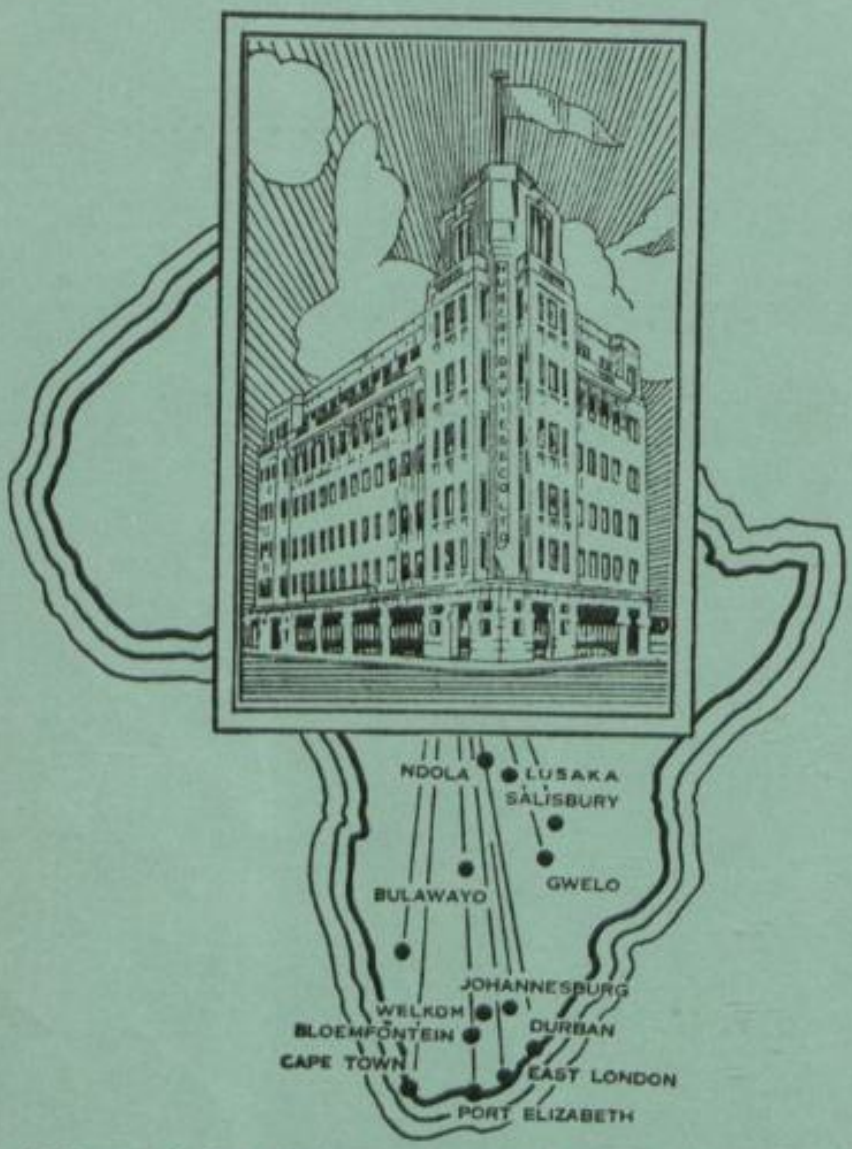
From Monday, May 5th, to

Thursday, May 8th,

1952

PRICE FIFTEEN SHILLINGS

HUDACO HOUSE



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Branches at: Johannesburg, Durban, East London, Port Elizabeth, Cape Town, Bloemfontein, Welkom, Salisbury, Bulawayo, N'dola, Gwelo, Lusaka and London

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S.A. Porcelain Insulator Manufacturers' Association Pty Ltd

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

FOUNDED 1915

EXECUTIVE COUNCIL 1952/53

President:
A. R. Sibson. (Bulawayo)

Vice-President:
J. C. Fraser (Johannesburg)

Past Presidents:
J. C. Downey (Springs)
C. R. Hallé (Pietermaritzburg)

Councillor Members:

Bloemfontein	Bulawayo	Cape Town	Durban
Johannesburg	Krugersdorp	Port Elizabeth	Salisbury

NOTE.—The Town is elected and not the individual Councillors.

Other Members:

D. A. Bradley (Port Elizabeth)	C. G. Downie (Cape Town)
C. Kinsman (Durban)	J. E. Mitchell (Salisbury)
G. J. Muller (Bloemfontein)	L. J. van der Walt (Krugersdorp)

Secretary and Treasurer:
A. T. Taylor, P.O. Box 7462, Johannesburg.

Sub-Committees:

Copper Control	J. C. Downey (Convenor), J. C. Fraser, J. L. van der Walt.
Coal Supplies	C. G. Downie (Convenor), D. A. Bradley, J. C. Fraser and D. J. Hugo.
Papers	President (A. R. Sibson, Vice-President (J. C. Fraser), C. Kinsman.
Safety Precautions Committee to deal with the Promulgation of the Wiring Regulations	J. C. Downey (Convenor), G. J. Muller, C. Kinsman, J. C. Fraser, C. G. Downie and A. R. Sibson
Registration of Electrical Wiring Contractors	C. G. Downie (Convenor), D. A. Bradley and A. Foden

Representatives:

S.A. Bureau of Standards: Safety Codes and other Committees	J. L. van der Walt Alternate: J. C. Downey
Safety Precautions	J. C. Downey Alternate: J. C. Fraser
Coal Allocation Committee	C. G. Downie Alternate: D. J. Hugo
World Power Conference Local Committee	J. C. Fraser
Electrical Wiremen's Registration Board	J. C. Fraser

PAST OFFICERS AND MEMBERS OF COUNCIL

Past Presidents:		Secretary and Treasurer:
1915–17	J. H. Dobson, Johannesburg	F. T. Stokes: E. T. Price
1917–19	J. Roberts, Durban	E. Poole
1919–20	B. Sankey, Port Elizabeth	E. Poole
1920–22	T. C. W. Dod, Pretoria	L. L. Horrell
1922–24	G. H. Swingler, Cape Town	H. A. Eastman
1924–26	J. Roberts, Durban	E. Poole
1926–27	B. Sankey, Johannesburg	R. G. Tresise
1927–29	J. M. Lambe, East London	P. Adkins
1929–31	R. Macauley, Bloemfontein	E. Poole
1931–33	L. L. Horrel, Pretoria	E. Poole
1933–34	L. F. Bickell, Port Elizabeth	F. A. P. Perrow
1934–35	A. R. Metelerkamp, Bulawayo	E. Poole
1935–36	G. G. Ewer, Pietermaritzburg	E. Poole
1936–37	A. Rodwell, Johannesburg	E. Poole
1937–38	J. H. Gyles, Durban	E. Poole
1938–39	H. A. Eastman, Cape Town	E. Poole
1939–44	I. J. Nicholas, Umtata	E. Poole until Dec., 1940
		L. L. Horrell, Jan., 1941
1944–45	A. Rodwell, Johannesburg	L. L. Horrell
1945–46	J. S. Clinton, Salisbury	L. L. Horrell to Nov., 1945
	J. W. Phillips, Bulawayo	A. T. Taylor, December, 1945
1946–47	G. J. Muller, Bloemfontein	A. T. Taylor
1947–48	C. Kinsman, Durban	A. T. Taylor
1948–49	A. Foden, East London	A. T. Taylor
1949–50	D. A. Bradley, Port Elizabeth	A. T. Taylor
1950–51	C. R. Hallé, Pietermaritzburg	A. T. Taylor
1950–51	J. C. Downey, Springs	A. T. Taylor

PAST ORDINARY MEMBERS OF COUNCIL

1915–17	J. Roberts, W. Bellad-Ellis, B. Sankey
1917–19	W. Bellad-Ellis, G. Stewart, T. C. W. Dod, T. Jagger
1919–20	W. Bellad-Ellis, G. Stewart, E. T. Price, A. S. Munro
1920–22	L. F. Bickell, T. Millar, L. B. Proctor, E. Poole
1921–24	L. F. Bickell, T. Millar, R. W. Fletcher, J. Roberts
1924–26	T. Jagger, A. S. Munro, T. Millar, L. F. Bickell
1926–27	L. F. Bickell, T. C. W. Dod, T. Millar, E. Poole
1927–29	L. F. Bickell, R. A. Young, T. Millar, E. Poole
1929–30	L. F. Bickell, T. Millar, F. C. D. Mann, G. H. Swingler, A. Rodwell
1931–32	T. Millar, F. C. D. Mann, G. H. Swingler, A. Rodwell
1932–34	T. Millar, J. H. Gyles, G. H. Swingler, A. Rodwell
1934–35	T. Millar, J. H. Gyles, G. H. Swingler, A. Rodwell

Note.—At the Thirteenth Convention the Rules and Constitution were amended to permit of Councils becoming members of the Association and to be represented on the Executive Council by two Councillor Members, hence the new layout of members of the Executive.

Councillors:	Alternate Councillors:	Engineers:
	1935–36:	
T. P. Gray, Johannesburg	H. W. Dely, Pretoria	G. H. Swingler, Cape Town
J. McLean, Port Elizabeth		J. H. Gyles, Durban
		T. Millar, Harrismith
		E. A. Behrens, Port Elizabeth
	1936–37	
H. Middlebrook, Durban	F. Morrell, Cape Town	G. H. Swingler, Cape Town
T. P. Gray, Johannesburg	J. McLean, Port Elizabeth	T. Jagger, Ladysmith
		E. A. Behrens, Port Elizabeth
		G. M. Pirie, Bloemfontein
	1937–38:	
H. G. Capell, Durban	H. Middlebrook, Durban	L. L. Horrell, Pretoria
W. James, Cape Town	L. Hofmeyr, Stellenbosch	J. S. Clinton, Salisbury
		A. Q. Harvey, Springs
		G. M. Pirie, Bloemfontein

	1938–39:	
E. Spilkin, Umtata	G. C. Starkey, East London	D. J. Hugo, Pretoria
W. James, Cape Town	W. Fowkes, Cape Town	J. S. Clinton, Salisbury
		A. Q. Harvey, Springs
		G. M. Pirie, Bloemfontein
	1939–44:	
E. Spilkin, Umtata	G. C. Starkey, East London	D. J. Hugo, Pretoria
C. Olley, Salisbury	W. Fowkes, Cape Town	C. Kinsman, Durban
		A. Q. Harvey, Springs
		G. M. Pirie, Bloemfontein
		W. N. Powell, Bloemfontein
	1944–45:	
H. H. Verity, Johannesburg	H. E. Gearing, Cape Town	D. J. Hugo, Pretoria
C. Olley, Salisbury	R. M. Thomas, Durban	C. Kinsman, Durban
		J. C. Fraser, Johannesburg
		G. R. E. Wright, Benoni
	1945–46:	
J. Ohlsen, Bulawayo	M. Jaffray, Salisbury	D. J. Hugo, Pretoria
J. W. du Plessis, Bloemfontein	E. Boylan, M.P.C., Johannesburg	C. Kinsman, Durban
		J. C. Fraser, Johannesburg
		G. R. E. Wright, Benoni
	1946–47:	
P. J. C. du Plessis, M.P.C. (Bloemfontein)	A. Immink, Johannesburg	D. J. Hugo, Pretoria
Major J. Raftery, J.P., M.P.C. (Durban)	A. Z. Berman, Cape Town	J. C. Fraser, Johannesburg
		J. C. Downey, Springs
		D. A. Bradley, Port Elizabeth
	1947–48:	
Major J. Raftery, J.P., M.P.C. (Durban)	J. M. Preller, Pretoria	D. J. Hugo, Pretoria
E. H. Tiddy, East London	C. G. Thompson, Johannesburg	J. C. Fraser, Johannesburg
		J. C. Downey, Springs
		H. A. Eastman, Cape Town
	1948–49	
E. H. Tiddy, East London	C. G. Thompson, Johannesburg	D. J. Hugo, Pretoria
J. C. K. Erasmus, J.P., Port Elizabeth	J. Johnston, Durban	J. C. Fraser, Johannesburg
		J. C. Downey, Springs
		H. A. Eastman, Cape Town
	1949–50:	
J. C. K. Erasmus, J.P., Port Elizabeth	W. F. du Plessis, Bloemfontein	J. C. Fraser, Johannesburg
C. E. (Sax) Young, Pietermaritzburg	S. H. Millar, Bulawayo	J. C. Downey, Springs
		H. A. Eastman, Cape Town
		G. J. Muller, Bloemfontein
		A. R. Sibson, Bulawayo
		J. L. van der Walt, Krugersdorp

1950–51:

Note.—At the Twenty-Fourth Convention the Rules and Constitution were amended to permit of eight Councillor Members being elected to the Executive and that these Councillor Members shall be the Councillors of those towns whose Engineer Members (other than the two Past-Presidents) have been elected to the Executive Council.

As a result of this amendment the undermentioned constituted the Executive Council:—

Councils:		**Engineers:**
Pietermaritzburg	(Councillor C. E. Young)	C. R. Hallé
Springs	(Councillor L. P. Davies)	J. C. Downey
Bulawayo	(Councillor J. J. Wrathall)	A. R. Sibson
Bloemfontein	(Councillor W. F. du Plessis)	G. J. Muller
Cape Town	(Councillor J. Muller)	H. A. Eastman
Durban	(Councillor G. Hayward)	C. Kinsman
Krugersdorp	(Councillor E. B. Neill)	L. J. van der Walt
Johannesburg	(Councillor L. M. Weiner)	J. C. Fraser
		D. A. Bradley
		A. Foden

Councils: 1951/52:		**Engineers:**
Pretoria	C. W. Sinclair	J. C. Downey
East London	F. T. Fox	A. R. Sibson
Springs	L. P. Davies	A. Foden
Cape Town	Maj. J. W. O. Billingham	J. C. Fraser
Krugersdorp	Maj. H. Pannall	D. J. Hugo
Bulawayo	C. M. Newman	C. G. Downie
Durban	E. E. Cheek	C. Kinsman
Johannesburg	L. M. Weiner	J. L. van der Walt

RULES AND CONSTITUTION

ASSOCIATION OF

Municipal Electricity Undertakings

OF SOUTHERN AFRICA

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1. TITLE

The name of the Association shall be "The Association of Municipal Electricity Undertakings of Southern Africa."

2. OBJECTS

The objects for which the Association is formed are:—

(a) To promote the interests of Municipal Electricity Undertakings.

(b) To bring Municipal Electrical Engineers and Chairmen and Members of Municipal Electricity Committees together.

(c) To arrange and hold periodical meetings for the reading of papers and discussions of subjects appertaining to Municipal Electricity Undertakings.

(d) To take such action as may be lawful and expedient for the protection and defence of the rights or interests of Municipal Electricity Undertakings.

3. MEMBERSHIP

The Association shall consist of:—

(a) Honorary Members.
(b) Councillor Members.
(c) Engineer Members.
(d) Associate Members.
(e) Associates.

All Hon. Members and Members of the Association of Municipal Electrical Engineers shall *ipso facto* become Hon. Members and Engineer Members of the Association of Municipal Electricity Undertakings and existing Associate Members shall be eligible to transfer to the class of Associate.

4. QUALIFICATIONS

The qualifications for admission to the Association shall be as follows:—

(a) **Honorary Members** shall be distinguised persons who are or who have been intimately connected with Municipal Electricity Undertakings and whom the Association especially desires to honour for exceptionally important services in connection therewith.

(b) **Councillor Members.** The Member whose Chief Electrical Engineer shall have qualifications acceptable to the Council shall be the Committee appointed by the Municipality or Local Authority to have control over its Electricity Undertakings and shall be represented as regards its qualifications to vote by one member of such Committee.

(c) **Engineer Members.** The Member shall be the Chief Electrical Engineer engaged on the permanent staff of an Electricity Undertaking owned by a Municipality or Local Authority and who has had a thorough training in electrical engineering and is otherwise acceptable by the Council of the Association. After 1st June, 1947, one only duly qualified assistant in an undertaking with sales of over 20,000,000 units per annum may also be admitted to this class on the recommendation of the Chief Electrical Engineer.

(d) **Associate Members.** The Member shall be a Technical Assistant engaged on the permanent staff of any Electricity Undertaking represented by its Councillor Member and/or Engineer Member.

(e) **Associates.** Any member resigning from the Class of Engineer Member or Associate Member shall be entitled to apply for transfer to the class of Associate. An Associate may also be an Engineer in the employ of an Authorised Electricity Undertaker other than a Local Authority who is engaged in the supply of electricity to consumers in the area of jurisdiction of a Local Authority.

5. ADMISSION OF MEMBERS

(a) The election of Honorary Members and other classes shall be vested in the Council.

(b) Councillor Members may be admitted on an application signed by the Town Clerk of the Municipality or Local Authority concerned.

(c) Every candidate for election into the Association as Engineer Member shall make application on the prescribed form suitably endorsed by two supporters who shall be either Engineer Members, Councillor Members or Members of the Committee of the Municipal or Local Authority in charge of the Electricity Undertaking of which the applicant is Chief Electrical Engineer.

(d) Every candidate for election into the Association as Associate Member or Associate shall make application on the prescribed form suitably endorsed by the Engineer Member on whose staff he is engaged.

(e) Every candidate for transfer to the class of Associate shall make application in writing for transfer.

6. CONTRIBUTIONS

Contributions shall become due and payable annually on the 1st day of March which shall constitute the new financial year of the Association.

(a) **Honorary Members** shall not be required to pay any contribution.

(b) **Councillor Members.** In the case of the Committee appointed by a Municipality or Local Authority to have control over the Electricity Undertaking, the undermentioned scale of contributions shall apply:

SCALE OF CONTRIBUTIONS

Up to	½	million units	...	4	guineas
½ „	1	„ „	...	6	„
1 „	10	„ „	...	8	„
10 „	50	„ „	...	12	„
50 „	100	„ „	...	14	„
100 „	200	„ „	...	16	„
200 „	300	„ „	...	18	„
Over	300	„ „	...	20	„

(c) **Engineer Members.** The contribution of an Engineer Member in the service of a Committee making a contribution shall merge into and form part of such contribution. When a Committee is not a Member or resigns from membership the Engineer Membership contribution shall be two (2) guineas.

(d) **Associate Members and Associates.** The contribution of Associate Members or Associates shall be one (1) guinea.

Part year contribution. All members shall pay the contribution for the year in which they are elected without reference to the period of the year at which their election takes place and they shall be entitled to receive a copy of the Proceedings or any other publication issued during such year.

Arrear Contributions. No class of member whose contribution is six months in arrear shall be entitled to attend or take part in any of the meetings of the Association or to receive any of the Association's publications.

Any class of member whose contribution is in arrear at any Convention shall deem to have forfeited claim to membership and his name may, by the Council, be removed from the register of the Association, but he shall, nevertheless, be liable for such arrears up to the date of his name being removed.

7. COUNCIL

Management. The affairs of the Association shall be managed by the Council, who shall have power to incur any expenditure necessary for the objects of the Association.

Members of the Council. The Council shall consist of a President, Vice-President, two immediate Past-Presidents, all of whom shall be Engineer Members, six other Engineer Members and eight Councillor Members.

Officers of Council. The officers of the Council shall be President, Vice-President, Secretary and Treasurer.

Election of Council. The officers (other than the Secretary and Treasurer) and the Engineer Members shall be elected by nomination and ballot at the Convention, and shall hold office until the next Convention. In the event of a vacancy occuring during the year, the remaining members shall have power to appoint a member to fill the vacancy. The Councillor Members shall be the Councillors of those towns whose Engineer Members (other than the two Past-Presidents) have been elected to the Executive Council.

Co-option. The Council shall have power to co-opt any members of the Association or other persons for any special purpose whose services in their opinion may advance the objects of the Association.

Election of Secretary and Treasurer. The Council shall appoint and from time to time determine the remuneration (if any) and prescribe the duties of the Secretary and Treasurer who shall hold office during the pleasure of the Council.

8. MEETINGS

Council. The Council shall meet as often as the business of the Association may require and at any meeting five shall constitute a quorum.

Convention. The Association shall hold Conventions yearly (of which the local Press of the town in which the Convention is held shall be given full particulars) as far as may be conveniently arranged, and at that meeting the Secretary and Treasurer shall present the Report and Balance Sheet of the Association for the immediate past period.

Quorum. At any meeting of the Association 15 shall form a quorum.

Chairman. The President shall take the chair at all meetings of the Association, the Council and the Committees, at which he is present, and shall regulate and keep order in the proceedings.

In the absence of the President, it shall be the duty of the Vice-President to preside at the meetings of the Association, and to regulate and keep order in the proceedings. But in the case of the absence of the President, and of the Vice-President, the meeting may elect any member of the Council or, in the case of their absence, any member present to take the chair at the meeting.

Resolve into Committee. The Association shall reserve to itself the right to resolve itself into Committee at any time during its proceedings; moreover, it shall be competent for any member to have his paper read and discussed in committee if he so desires.

Sectional Voting. When a motion is before any Convention or meeting of the Association it shall be competent for any member of either the Councillor or Engineer sections to apply to the Chairman for a "Vote by Section." This application shall be granted by the Chairman whereupon each of these sections shall vote separately on the motion and unless a majority shall be obtained in each section, the motion shall be lost. On a sectional vote being called for, Associate Members and Associates shall not be entitled to vote.

MEMBERS, DELEGATES AND VISITORS ATTENDING THE 26th CONVENTION

ALBERTON
Cr. J. S. Maher
J. E. P. Uys (Town Clerk)

BARBERTON
P. C. Asselbergs

BENONI
Cr. N. C. Korsman
R. Tarran

BETHAL
M. N. Kirberger

BETHLEHEM
Cr. J. H. Loubser
K. M. Fisher

BLOEMFONTEIN
Cr. J. Moffett
G. J. Muller

BOKSBURG
Cr. J. H. de Bruin
E. L. Smith

BULAWAYO
Cr. C. M. Newman
Cr. T. W. Gubb
Cr. J. W. Phillips
A. R. Sibson
R. H. Redman

BRAKPAN
Cr. W. J. C. Roussouw
P. L. Vergottini

CAPE TOWN
Cr. Major J. W. O. Billingham
E. G. Ivey

CRADOCK
A. Rossler

DELMAS
G. C. Delport

DURBAN
Cr. Major J. Raftery
C. Kinsman

EAST LONDON
Cr. D. Ross Thomson
A. Foden

EDENVALE
Cr. F. J. Wagenaar

ESTCOURT
Cr. M. J. Moolman
J. G. F. Erikson

GEORGE
P. H. Newcombe

GREYTOWN
J. S. Craig

GWELO
A. W. K. Hadfield

HEIDELBERG
J. F. Lategan

JOHANNESBURG
Cr. L. M. Weiner
R. W. Kane

KEMPTON PARK
L. Futcher

KIMBERLEY
C. R. Burton

KLERKSDORP
Cr. J. C. Jordaan
J. M. Gericke

KROONSTAD
Cr. F. J. Theron
W. Rossler

KRUGERSDORP
Cr. M. C. Dames
J. L. van der Walt

LADYSMITH
Cr. H. O. Sayer
F. Stevens

LOUIS TRICHARDT
Cr. B. J. Venter
E. L. Buchanan

LIVINGSTONE
K. B. Barlow

MAFEKING
Cr. G. H. Clark
G. E. H. Jones

MIDDELBURG TVL.
N. A. Potgieter

NELSPRUIT
R. R. Lyall

PAARL
Cr. E. du Preez
J. H. Relihan

PIETERSBURG
J. I. Inglis

PIETERMARITZBURG
Cr. C. E. K. Young
C. R. Hallé

PORT ELIZABETH
Cr. L. Dubb
D. A. Bradley

POTCHEFSTROOM
Cr. H. Holtzhausen
M. Singer

PRETORIA
Cr. P. van den Hoogen
D. J. Hugo

QUEENSTOWN
Cr. J. Levin

RANDFONTEIN
Cr. P. Pretorius
J. R. Cherry

ROBERTSON
Cr. A. P. Malherbe
S. de V. de Villiers

ROODEPOORT-MARAISBURG
Cr. J. Schlapo
D. D. Brown

RUSTENBURG
Cr. Dr. J. D. Verster
P. A. Meintjies

SALISBURY
Cr. A. M. Jaffray
J. E. Mitchell

SOMERSET EAST
W. Atteridge

SOMERSET WEST
Cr. R. C. Mackay
F. P. W. Hall

SPRINGS
Cr. P. Urbani
Cr. C. Maltman
J. C. Downey

STELLENBOSCH
Cr. G. P. Blake
E. de C. Pretorius

UMTALI
H. T. Turner

UMTATA
Cr. H. R. Sissons
F. R. Waldron

VEREENIGING
Cr. A. J. Botha
A. F. Turnbull

VRYHEID
Cr. R. Large
W. Rush

VENTERSPOST
Cr. J. P. Marais
L. Dreyer

OTHER MEMBERS (ASSOCIATES)

R. W. Barton, Welkom
W. M. Bellad-Ellis, East London
G. A. Dalton, Johannesburg
P. D. Kruyt, Allanridge
B. Marchand, Witbank
J. W. Phillips, Bulawayo

DELEGATES

GOVERNMENT DEPARTMENTS

Electricity Supply Commission:

W. H. Milton, Johannesburg.
A. B. Cowen, Salisbury.
E. C. Whiskin, Bulawayo.

Other Departments:

G. Williams, Chief Electrical Engineer, S.A.R. & H., Johannesburg.
G. Molyneux, Rhodesia Railways, Bulawayo.
G. J. Apps, Divisional Engineer, Post & Telegraphs Dept., Bulawayo.
R. N. F. Smit, Chief Inspector of Factories, and Chairman, Electrical Wiremen's Registration Board.
C. H. Clutterbuck, Chief Inspector, Factories & Works Dept., Salisbury.
R. S. Worrall, Inspector of Factories, (Eng.), Bulawayo.
C. Mullins, Electricity Control Board, Pretoria.

OTHER REPRESENTATIVES

E. Vivian Perrow, Chairman, Safety Precautions Committee, and representing the S.A. Institute of Electrical Engineers.
J. W. Swardt, S.A. Bureau of Standards.
A. H. Durr, S.A. Bureau of Standards.
A. V. Amm, Johannesburg Chamber of Commerce, Bulawayo.
J. C. Fletcher, Johannesburg Chamber of Commerce, Bulawayo.
J. R. Webb, Johannesburg Chamber of Commerce, Bulawayo.
J. D. C. Baxter, North Cape Regional Electrification Board.
R. W. Kane, President, S.A. Institution of Certificated Engineers, Johannesburg.

VISITORS

S. G. Redman, Merz & McLellan, Johannesburg.
H. J. Beard, Merz & McLellan, Johannesburg.
F. C. Winfield, Merz & McLellan, Newcastle-on-Tyne.

REPRESENTATIVES—ENGINEERING COMPANIES

Aberdare Cables (S.A.) Ltd.	R. J. Bates, Port Elizabeth. G. Yuill, Johannesburg.
African Cables Ltd.	H. G. Sale, Johannesburg.
African Transmission Construction Co. (Pty.) Ltd.	G. Herman, Bulawayo.
Arthur Trevor Williams (Pty.) Ltd.	A. T. Williams, Johannesburg. J. A. Barnett, Johannesburg.
Bartle & Co.	W. J. G. Emery, Johannesburg. W. C. James, Bulawayo.
British Thomson-Houston Co. (S.A.) (Pty.) Ltd.	N. R. Yorke, Johannesburg. K. C. Ford, Johannesburg.
Babcock & Wilcox of Africa Ltd.	J. Callie, Johannesburg.
Edward L. Bateman (Pty.) Ltd.	A. Mills, Bulawayo.
British Insulated Cables (S.A.) Ltd.	L. L. Langton, Salisbury.
Brush Aboe (S.A.) Ltd.	J. White, Johannesburg. H. W. Mullen, Salisbury.
British General Electric Co. Ltd.	O. S. Chalmers, Bulawayo. J. G. Robinson, Salisbury.
Caltex (Africa) Ltd.	C. D. M. Stewart, Salisbury. W. H. Scharges, Johannesburg.
Chloride Electrical Storage Co. (S.A.) (Pty.) Ltd.	A. C. Tilley, Johannesburg.
J. Clack & Co.	T. E. Hendrie, Bulawayo.
Cochrane & Milton Ltd.	A. Robertson, Bulawayo.
Contactor (Pty.) Ltd.	G. A. Wadlow, Zuider Paarl.
Cooper & de Beer (Pty.) Ltd.	C. L. de Beer, Johannesburg.
C. E. G. Cumings Ltd.	I. W. Hamilton, Bulawayo.
Curling & Co. Ltd.	A. Everrett, Bulawayo.
Dowson & Dobson Ltd.	J. R. Wheating, Johannesburg.
K. B. Davies & Co. (Byo.) Ltd.	F. Pritchard, Bulawayo.
Enfield Cables (S.A.) (Pty.) Ltd.	A. E. Torrance, Johannesburg. B. Webb, Bulawayo.
Fraser & Chalmers (S.A.) Ltd.	B. Hearn, Bulawayo.
Falks Electrical Supplies (S.A.) (Pty.) Ltd. ...	R. C. Viviers, Johannesburg.
English Electric Co. Ltd.	L. L. Brinkworth, Johannesburg. L. A. C. Pooley, Salisbury.
Faraday Engineering Co. Ltd.	Major C. A. V. Porter, Bulawayo.
Heieneman Electric Co. (S.A.) Ltd.	G. A. Dalton, Johannesburg.
Henley's S.A. Telegraph Works Co. ...	M. Miller, Johannesburg.
Hopkinsons Ltd.	E. C. Enfield, Johannesburg.
Hubert Davies & Co. Ltd.	A. V. Amm, Bulawayo.
James Howden & Co. Ltd.	A. V. Derereux, Johannesburg.
International Combustion S.A. (Pty.) Ltd. ...	Sir George Usher, Port Elizabeth. Q. R. Nothard, Johannesburg. H. Seabrooke, Salisbury.

REPRESENTATIVES—ENGINEERING COMPANIES—(Continued)

Johnson & Phillips S.A. (Pty.) Ltd. ...	E. W. Dixon, Germiston.
Johnson & Feltcher Ltd.	J. C. Fletcher, Bulawayo.
Harold Marthinusen (Pty.) Ltd.	G. Roeske, Johannesburg.
J. Mann & Co. Ltd.	B. J. Hammett, Bulawayo.
Metropolitan-Vickers S.A. (Pty.) Ltd. ...	R. G. Hunter, Johannesburg. J. Monks, Johannesburg. C. R. Deglon, Salisbury.
John Miles & Co.	F. Chappell, Bulawayo.
Mine Electric Ltd.	B. V. Hawgood, Salisbury. E. Scheager, Bulawayo.
Patrick Murray (Pty.) Ltd.	W. H. Walsh, Durban.
Parsons C. A. & Co. (S.A.)	H. M. Rochester, Johannesburg. T. R. Strawson, Johannesburg. M. C. Coote, Bulawayo.
Reunert & Lenz Ltd.	A. Morcom, Johannesburg. E. McKechnie, Johannesburg.
A. Reyrolle & Co. Ltd.	C. E. R. Langford, Johannesburg.
Rice & Diethelm Ltd.	N. Raban, Salisbury.
Rhodesian Cables Ltd.	J. Bawcutt, Salisbury.
Scottish Cables (S.A.) Ltd.	D. G. Sutherland, Johannesburg. A. C. Grant, Johannesburg.
S.A. Cable Makers' Association	E. R. J. Smith, Johannesburg.
S.A. General Electric Co. Ltd.	E. Crole, Johannesburg. R. W. Kilfoil, Johannesburg.
John W. Searcy (Pty.) Ltd.	H. R. Kuttner, Bulawayo.
Simplex Electric Co. (S.A.) Ltd.	J. A. Morrison, Springs.
Stamcor (Pty.) Ltd.	J. M. Taylor, Johannesburg.
Standard Telephones & Cables Ltd. ...	D. R. Jones, Salisbury.
Stewarts & Lloyds S.A.	P. M. Jackson, Bulawayo. F. H. Higgins, Bulawayo.
Shell Co. of S.A. Ltd.	R. K. Aldridge, Salisbury.
E. W. Tarry & Co.	E. Emery, Bulawayo.
J. H. Vivian & Wilfred Watson Ltd. ...	J. F. Franks, Bulawayo.
Wilson & Herd, Ltd.	Dr. R. G. Edwards, Johannesburg.
Yarrow (Africa) Pty. Ltd.	H. D. T. Harris, Johannesburg. C. W. Suckling, Johannesburg. J. W. Phillips. Bulawayo. W. E. Young, Johannesburg.

LADIES

Mrs. A. V. Amm, Bulawayo.
Mrs. G. J. Apps, Bulawayo.
Mrs. K. B. Barlow, Livingstone.
Mrs. R. J. Bates, Port Elizabeth.
Mrs. J. D. C. Baxter, Kimberley.
Mrs. H. J. Beard, Johannesburg.
Mrs. J. W. O. Billingham, Cape Town.
Mrs. G. P. Blake, Stellenbosch.
Mrs. D. A. Bradley, Port Elizabeth.
Mrs. E. L. Buchanan, Louis Trichardt.
Mrs. C. R. Burton, Kimberley.
Mrs. F. Chappell, Bulawayo.
Mrs. C. H. Clutterbuck, Salisbury.
Mrs. J. S. Craig, Greytown.
Mrs. C. L. de Beer, Johannesburg.
Mrs. J. H. de Bruin, Boksburg.
Miss D. L. de Bruin, Boksburg.
Mrs. C. R. Deglon, Salisbury.
Mrs. A. V. Devereux, Johannesburg.
Mrs. J. C. Downey, Springs.
Mrs. R. G. Edwards, Johannesburg.
Mrs. W. J. G. Emery, Johannesburg.
Mrs. K. M. Fisher, Bethlehem.
Mrs. J. C. Fletcher, Bulawayo.
Mrs. A. Foden, East London.
Mrs. K. C. Ford, Johannesburg.
Mrs. J. Fridjohn, Johannesburg.
Mrs. A. C. Grant, Johannesburg.
Mrs. F. P. W. Hall, Somerset West.
Mrs. D. J. Hugo, Pretoria.
Mrs. R. G. Hunter, Johannesburg.
Mrs. J. I. Inglis, Pietersburg.
Mrs. M. Jaffray, Salisbury.
Mrs. R. W. Kane, Johannesburg.
Mrs. C. Kinsman, Durban.
Mrs. M. N. Kirberger, Bethal.
Mrs. H. R. Kuttner, Bulawayo.
Mrs. C. E. R. Langford, Johannesburg.
Mrs. J. H. Loubser, Bethlehem.
Mrs. C. Maltman, Springs.
Mrs. A. Mills, Bulawayo.
Mrs. J. E. Mitchell, Salisbury.
Miss Mitchell, Salisbury.
Mrs. G. Molyneaux, Bulawayo.
Mrs. G. J. Muller, Bloemfontein.
Mrs. R. C. Mackay, Somerset West.
Mrs. C. M. Newman (Mayoress), Bulawayo.
Mrs. Q. R. Nothard, Johannesburg.
Mrs. E. V. Perrow, Johannesburg.
Mrs. J. W. Phillips, Bulawayo.
Mrs. C. A. V. Porter, Bulawayo.
Mrs. R. H. Redman, Bulawayo.
Mrs. H. M. Rochester, Johannesburg.
Mrs. L. Rodkin, Johannesburg.
Mrs. A. Rossler, Cradock.
Mrs. W. Rossler, Kroonstad.
Mrs. D. Ross Thomson, East London.
Mrs. H. G. Sale, Johannesburg.
Mrs. H. O. Sayer, Ladysmith.
Mrs. J. Schlapo, Roodepoort.
Mrs. A. R. Sibson, Bulawayo.
Mrs. M. Singer, Potchefstroom.
Mrs. R. N. F. Smit, Pretoria.
Mrs. F. Stevens, Ladysmith.
Mrs. D. G. Sutherland, Johannesburg.
Mrs. R. Tarran, Johannesburg.
Mrs. A. T. Taylor, Johannesburg.
Mrs. J. M. Taylor, Johannesburg.
Mrs. P. Urbani, Springs.
Lady Usher, Port Elizabeth.
Mrs. P. van den Hoogen, Pretoria.
Mrs. B. J. Venter, Louis Trichardt.
Mrs. G. A. Wadlow, Zuider Paarl.
Mrs. W. H. Walsh, Durban.
Mrs. L. M. Weiner, Johannesburg.
Mrs. J. R. Wheating, Johannesburg.
Mrs. A. T. Williams, Johannesburg.
Mrs. G. Williams, Johannesburg.
Miss Williams, Johannesburg.
Mrs. N. R. Yorke, Johannesburg.

LIST OF MEMBERS AS AT 31st MAY, 1952

HONORARY MEMBERS

Dobson, Dr. J. H., 35 Central Avenue, Illovo, Johannesburg.
Eastman, H. A. Torwood, Parel Vallei, Somerset West, C.P.
Horrel, L. L., 139 Brook Street, Brooklyn, Pretoria.
Poole, E., 3 Musgrave Mansions, 690 Musgrave Road, Durban.
Rodwell, A. T., "Miranda", Oxford Road, Parktown, Johannesburg.

COUNCIL MEMBERS

Adelaide, C.P., Municipality, P.O. Box 38.
Aliwal North, C.P., Municipality, P.O. Box 46.
Alberton, Tvl., Municipality, P.O. Box 4.

Barberton, Tvl., Municipality, P.O. Box 33.
Beaufort West, C.P., Municipality, P.O. Box 9.
Benoni, Tvl., Municipality, P.O. Box 45.
Bethal, Tvl., Municipality, P.O. Box 3.
Bethlehem, O.F.S., Municipality, P.O. Box 130.
Bloemfontein, O.F.S., City Council, P.O. Box 288.
Boksburg, Tvl., Town Council, P.O. Box 215.
Brandfort, O.F.S., Municipality, P.O. Box 13.
Bulawayo, S.R., City Council, P.O. Box 591.
Butterworth, Transkei, Municipality, P.O. Box 36.
Brakpan, Tvl., Town Council, P.O. Box 15.
Brits, Tvl., Town Council, P.O. Box 106.
Bothaville, O.F.S., Municipality, P.O. Box 12.

Cape Town, C.P., City Council, P.O. Box 298.
Cradock, C.P., Municipality, P.O. Box 24.
Ceres, C.P., Municipality, P.O. Box 44.

Delmas, Tvl., Village Council, P.O. Box 6.
Durban, Natal, City Council, P.O. Box 147.

East London, C.P., City Council, P.O. Box 134.
Elliot, C.P., Municipality, P.O. Box 21.
Ermelo, Tvl., Municipality, P.O. Box 48.
Eshowe, Zululand, Town Board, P.O. Box 37.
Edenvale, Tvl., Town Council, P.O. Box 25.

Fort Beaufort, C.P. Municipality, P.O. Box 36.
Ficksburg, O.F.S., Municipality, P.O. Box 116.

Gatooma, S.R., Municipality, P.O. Box 114.
George, C.P., Municipality, P.O. Box 28.
Grahamstown, C.P., City Council, P.O. Box 176.
Greytown, Natal, Borough, P.O. Box 71.
Gwelo, S.R., Municipality, P.O. Box 278.
Graaff-Reinet, C.P., Municipality, P.O. Box 71.

Harrismith, O.F.S., Municipality, P.O. Box 43.
Heidelberg, Tvl., Municipality, P.O. Box 201.

Johannesburg, Tvl., City Council, P.O. Box 1049.

Kimberley, C.P., City Council.
Klerksdorp, Tvl., Municipality, P.O. Box 160.
Kokstad, E. G., Municipality, P.O. Box 8.
Kroonstad, O.F.S., Municipality, P.O. Box 302.
Krugersdorp, Tvl., Municipality, P.O. Box 94.
Komgha, C.P., Municipality, P.O. Box 21.
Kempton Park, Tvl., Municipality, P.O. Box 13.

Ladysmith, Natal, Borough, P.O. Box 29.
Louis Trichardt, Tvl., Municipality, P.O. Box 96.
Livingstone, N.R., Municipality, P.O. Box 29.
Ladybrand, O.F.S., P.O. Box 64.

Mafeking, Bech'd., Municipality, P.O. Box 42.
Matatiele, E.G., Muhicipality, P.O. Box 35.
Middelbrug, C.P., Municipality, P.O. Box 55.
Middelburg, Tvl., Municipality, P.O. Box 14.

Nelspruit, Tvl., Municipality, P.O. Box 45.
Newcastle, Natal, Borough, P.O. Box 21.
N'Dola, N.R., Municipality, P.O. Box 197.
Nigel, Tvl., Municipality, P.O. Box 23.

Oudtshoorn, C.P., Municipality, P.O. Box 132.
Odendaalsrus, O.F.S., Municipality.

Paarl, C.P., Municipality, P.O. Box 12.
Pietersburg, Tvl., Municipality, P.O. Box 111.
Pietermaritzburg, Natal, City Council, P.O. Box 321.
Piet Retief, Tvl., Municipality, P.O. Box 23.
Port Alfred, C.P., Municipality.
Port Elizabeth, C.P., City Council, P.O. Box 116.
Port Shepstone, Natal, Borough, P.O. Box 5.
Potchefstroom, Tvl., Municipality, P.O. Box 113.
Potgietersrust, Tvl., Municipality, P.O. Box 34.
Pretoria, Tvl., City Council, P.O. Box 440.
Parys, O.F.S., Municipality, P.O. Box 39.

Queenstown, C.P., Municipality, P.O. Box 113.
Que Que, S.R., Municipality, P.O. Box 15.

Randfontein, Tvl., Municipality, P.O. Box 139.
Robertson, C.P., Municipality, P.O. Box 52.
Roodepoort-Maraisburg, Tvl., Municipality, P.O. Box 217, Roodepoort.
Rustenburg, Tvl., Municipality, P.O. Box 16.

Salisbury, S.R., City Council, P.O. Box 990.
Somerset East, C.P., Municipality, P.O. Box 21.
Springs, Tvl., Town Council, P.O. Box 45.
Springfontein, O.F.S., Municipality, P.O. Box 10.
Stanger, Natal, Borough, P.O. Box 72.
Stellenbosch, C.P. Municipality, P.O. Box 17.
Somerset West, C.P., Municipality, P.O. Box 19.
Standerton, Tvl., Municipality, P.O. Box 66.

The Strand, C.P., Municipality, P.O. Box 3.
Theunissen, O.F.S., Municipality, P.O. Box 8.

Uitenhage, C.P., Municipality, P.O. Box 45.
Umtata, Tembuland, Municipality, P.O. Box 57.
Umtalie, S.R., Municipality, P.O. Box 121.
Upington, C.P., Municipality, P.O. Box 17.

Vereeniging, Tvl., Municipality, P.O. Box 35.
Vrede, O.F.S., Municipality, P.O. Box 155.
Vryburg, C.P., Municipality.
Vryheid, Natal, Borough, P.O. Box 57.
Ventersdorp, Tvl., Municipality, P.O. Box 15.
Venterspost, Tvl., Municipality, P.O. Box 19.

Walmer, C.P., Municipality, Town Hall, Walmer.
Winburg, O.F.S., Municipality, P.O. Box 26.
Windhoek, S.W.A., Municipality, P.O. Box 59.
Willowmore, C.P., Municipality, P.O. Box 15.
Worcester, C.P., Municipality, P.O. Box 37.
Wepener, O.F.S., Municipality, P.O. Box 31.

ENGINEER MEMBERS

Aalbers, G., Municipal Electrical Engineer, P.O. Box 116, Ficksburg, O.F.S.
Adams, C. H. Municipal Electrical Engineer, P.O. Box 132, Oudtshoorn, C.P.
Anderson, F., Municipal Engineer, Port Alfred, C.P.
Asselbergs, P. C., Town Electrical Engineer, P.O. Box 33, Barberton, Transvaal.
Atteridge, W. H., Municipal Electrical Engineer, P.O. Box 21, Somerset East, C.P.
Bahr, H., Municipal Electrical and Waterworks Engineer, P.O. Box 15, Ventersdorp, Tvl.
Bailey, R. V., Town and Electrical Engineer, P.O. Box 25, Edenvale, Tvl.
Barlow, K. B., Town Electrical Engineer, P.O. Box 109, Livingstone, N.R.
Barratt, V. E. O., Municipal Electrical Engineer, P.O. Box 113, Queenstown, C.P.
Bradley, D. A., City Electrical Engineer, P.O. Box 369, Port Elizabeth, C.P.
Brown, D. D., Municipal Electrical Engineer, P.O. Box 217, Roodepoort, Tvl.
Burton, C. R., City Electrical Engineer, Kimberley.
Buchanan, E. L., Town Electrical Engineer, P. O. Box 96, Louis Trichardt, Tvl.
Cherry, J. R., Municipal Electrical Engineer, P.O. Box 139, Randfontein, Tvl.
Coetzee, F. J., Municipal Electrical Engineer, Municipal Offices, Postmasburg, C.P.
Cowley, B. W., Borough Electrical Engineer, P.O. Box 21, Newcastle, Natal.
Craig, J. S., Borough Electrical Engineer, P.O. Box 71, Greytown, Natal.
Delport, G. C., Municipal Electrical Engineer, P.O. Box 6, Delmas, Tvl.
de Wet, D. P., Municipal Electrical Engineer, P.O. Box 15, Willowmore, C.P.
de Wit, T., Engineer-in-Charge, Municipality of Brits, P.O. Box 106, Brits, Tvl.
Downey, J. C., Town Electrical Engineer, P.O. Box 45, Springs, Tvl.
Downie, C. G., City Electrical Engineer, P.O. Box 82, Cape Town, C.P.
Dreyer, D. v. s., Town Electrical Engineer, P.O. Box 13, Brandfort, O.F.S.
Dreyer, L., Municipal Electrical Engineer, P.O. Box 19, Venterspost, Tvl.
Dwyer, C. H., Borough Electrical Engineer, P.O. Box 72, Stanger, Natal.
du Toit, A. A., Municipal Electrical Engineer, P.O. Box 44, Ceres, C.P.
Erikson, J. G. F., Borough Electrical Engineer, P.O. Box 15, Estcourt, Natal.
Fainsinger, G. S., Municipal Electrical Engineer, P.O. Box 59, Windhoek, S.W.A.
Ferreira, N., Town and Electrical Engineer, Odendaalsrus, O.F.S.
Fisher, K. M., Municipal Electrical Engineer, P.O. Box 130, Bethlehem, O.F.S.
Foden, A., City Electrical Engineer, P.O. Box 529, East London, C.P.
Fraser, J. C., General Manager, Electricity Department, P.O. Box 699, Johannesburg, Tvl.
Futcher, L., Municipal Electrical Engineer, P.O. Box 13, Kempton Park, Tvl.
Gericke, J. M., Municipal Electrical Engineer, P.O. Box 99, Klerksdorp.
Giles, P. A., Assistant City Electrical Engineer, P.O. Box 529, East London, C.P.
Grandin, P. C., Municipal Electrical Engineer, P.O. Box 114, Gatooma, S.R.
Gripper, H. J., Assistant City Electrical Engineer, P.O. Box 369, Port Elizabeth, C.P.
Hadfield, A. W. K., Town and Electrical Engineer, P.O. Box 278, Gwelo, S.R.
Halliday, K. W. J., Municipal Electrical Engineer, P.O. Box 5, Port Shepstone, Natal.
Hallé, C. R., City Electrical Engineer, P.O. Box 399, Pietermaritzburg, Natal.
Hall, F. P. W., Municipal Electrical Engineer, P.O. Box 19, Somerset West, C.P.
Hattingh, J. D., Municipal Electrical Engineer, P.O. Box 12, Bothaville, O.F.S.
Heese, J. F., Municipal Electrical Engineer, P.O. Box 17, Upington, C.P.

ENGINEER MEMBERS—(Continued)

Hugo, D. J., City Electrical Engineer, P.O. Box 423, Pretoria, Tvl.
Inglis, J. I., Town Electrical and Water Engineer, P.O. Box 111, Pietersburg, Tvl.
Iverach, J., City Electrical Engineer, P.O. Box 176, Grahamstown, C.P.
Jones, G. E. H., Municipal Electrical Engineer, P.O. Box 42, Mafeking, Bechuanaland.
Kane, R. W., Assistant General Manager, Electricity Department, P.O. Box 699, Jo'burg.
Kinsman, C., City Electrical Engineer, P.O. Box 147, Durban, Natal.
Kramer, T., Municipal Electrical Engineer, P.O. Box 113, Potchefstroom, Tvl.
Kirberger, M. N., Town Engineer, P.O. Box 3, Bethal, Tvl.
Kruger, M. J. C., Municipal Electrical Engineer, P.O. Box 10, Butterworth, Transkei.
Leishman, R., Chief Engineering Assistant, Electricity Department, P.O. Box 699, Jo'burg.
Lategan, J. F., Town Electrical Engineer, P.O. Box 201, Heidelberg, Tvl.
Lotter, G. A., Town Engineer, P.O. Box 48, Ermelo, Tvl.
Lyall, R. R., Municipal Electrical Engineer, P.O. Box 45, Nelspruit, Tvl.
Mathews, J. A., Municipal Electrical Engineer, P.O. Box 45, Uitenhage, C.P.
Meintjies, P. A., Municipal Electrical Engineer, P.O. Box 16, Rustenburg, Tvl.
Mitchell, J. E., City Electrical Engineer, P.O. Box 73, Salisbury, S.R.
Mocke, T. M., Town and Electrical Engineer, P.O. Box 23, Piet Retief, Tvl.
Muller, G. J., City Electrical Engineer, P.O. Box 288, Bloemfontein, O.F.S.
Newcombe, P. H., Municipal Electrical Engineer, P.O. Box 28, George, C.P.
Nicholas, I. J., Municipal Electrical Engineer, P.O. Box 57, Umtata, Transkei.
Potgieter, N. A., Municipal Electrical Engineer, P.O. Box 14, Middelburg, Tvl.
Pretorius, D. R., Town Electrical Engineer, P.O. Box 39, Parys, O.F.S.
Pretorius, E. de C., Municipal Electrical Engineer, P.O. Box 17, Stellenbosch, C.P.
Prevost, H. A., Municipal Electrical Engineer, P.O. Box 21, Somerset East, C.P.
Redman, R. H., Assistant City Electrical Engineer, P.O. Box 1803, Bulawayo.
Relihan, H. J., Municipal Electrical Engineer, P.O. Box 12, Paarl, C.P.
Reyeneke, G. M., Town Electrical Engineer, P.O. Box 10, Springfontein, O.F.S.
Roberts, L. J., Municipal Electrical Engineer, P.O. Box 35, Matatiele, E.G.
Rogers, J., Municipal Electrical Engineer, P.O. Box 36, Fort Beaufort, C.P.
Roode, L., Town and Electrical Engineer, P.O. Box 34, Potgietersrust, Tvl.
Rossler, A., Municipal Electrical Engineer, P.O. Box 24, Cradock, C.P.
Rossler, W., Town Electrical Engineer, P.O. Box 302, Kroonstad, O.F.S.
Rush, W., Borough Engineer, P.O. Box 57, Vryheid, Natal.
Robson, K. G., Town Electrical and Waterworks Engineer, P.O. Box 46, Aliwal North, C.P.
Rozendal, D., Municipal Electrical Engineer, P.O. Box 31, Wepener, O.F.S.
Sibson, A. R., City Electrical Engineer, P.O. Box 1803, Bulawayo, S.R.
Sims, C. N., Municipal Electrical Engineer, P.O. Box 3, The Strand, C.P.
Smith, E. L., Municipal Electrical Engineer, P.O. Box 215, Boksburg, Tvl.
Smith, M. M., Municipal Electrical Engineer, P.O. Box 38, Adelaide, C.P.
Stevens, F., Borough Electrical Engineer, P.O. Box 56, Ladysmith, Natal.
Sprighton, C. R., Town and Electrical Engineer, P.O. Box 66, Standerton, Tvl.
Tarran, R., Municipal Electrical Engineer, P.O. Box 45, Benoni, Tvl.
Thackwray, W. G., Town Electrical Engineer, P.O. Box 8, Kokstad, E.G.
Theron, W. C., Municipal Electrical Engineer, P.O. Box 37, Worcester, C.P.
Turner, H. T., Town and Electrical Engineer, P.O. Box 121, Umtali, S.R.

ENGINEER MEMBERS—(Continued)

Turnbull, A. F., Town Electrical Engineer, P.O. Box 35, Vereeniging, Tvl.
Van der Walt, J. L., Town Electrical Engineer, P.O. Box 94, Krugersdorp, Tvl.
Vergottini, P. L., Municipal Electrical Engineer, P.O. Box 15, Brakpan, Tvl.
Verschoor, D. R., Town and Electrical Engineer, P.O. Box 155, Vrede, O.F.S.
White, J. H. Municipal Electrical Engineer, P.O. Box 197, N'Dola, N.R.
Wilson, J., Assistant City Electrical Engineer, P.O. Box 423, Pretoria, Tvl.
Woolridge, W. E. L., Town Electrical Engineer, P.O. Box 24, Harding, Natal.
Williams, A. H., Assistant Electrical Engineer, P.O. Box 45, Springs, Tvl.

ASSOCIATES

Andrew, W. M., 15 Chamberlain Street, King William's Town, C.P.
Ashley, T. P., P.O. Box 113, Queenstown, C.P.
Barton, R. W., P.O. Box 20, Welkom, O.F.S.
Bellad-Ellis, W., P.O. Box 255, East London.
Campbell, A. R., P.O. Box 584, Johannesburg.
Clinton, J. S., P.O. Box 4648, Johannesburg.
Coulthard, R. D., "Hadleydene," 98 Jesmond Road, Pietermaritzburg, Natal.
Conradie, D. J. R., P.O. Box 1009, Bloemfontein, O.F.S.
Dalton, G. A., 111 Eckstein Street, Observatory Extension, Johannesburg, Tvl.
Dawson, C., Electricity Supply Commission, P.O. Box 2408, Durban.
Ewer, Col. G. G., 174 Edmonds Road, Durban, Natal.
Foley, C. B., c/o Electrical Engineer, P.O. Box 35, Vereeniging, Tvl.
Gyles, J. H., P.O. Gilletts, Natal.
Heasman, G. G., P.O. Box 77, Fort Victoria, S.R.
Kruyt, P. D., Electrical Engineer, Allanridge, P.O. Box 306, Odendaalsrus, O.F.S.
Lloyd, R. K., P.O. Box 1336, Dar es Salaam, Tanganyika.
Lutsch, W. J. F. S., c/o Faculty of Engineering, University of Stellenbosch, C.P.
Marchand, B., P.O. Box 223, Witbank, Tvl.
McIntyre, H. A., Assistant Electrical Engineer, P.O. Box 35, Vereeniging, Tvl.
Mercier, G., P.O. Box 377, Salisbury, S.R.
Milln, D. R., Kongola Phiri Estate, P.O. Fort Manning, Nyasaland.
Milton, W. H., P.O. Box 1091, Johannesburg.
Mole, E. W., P.O. Box 428, Port Elizabeth.
Muller, H. M. S., Engineer, Kakamas, C.P.
Powell, W. N., 15 Casa Mia Mansions, Soper Road, Berea, Johannesburg.
Phillips, J. W., P.O. Box 592, Bulawayo, S.R.
Simpson, H. G., Engineering Department, Searles Ltd., Great Brak River, C.P.
Theron, G. C., P.O. Box 1, Vanderbijl Park, Transvaal.
Tubb, B. H. T., P.O. Box 1699, Salisbury, S.R.
West, J. A., "Edgerton," P.O. Box 24, St. Michael's, South Coast, Natal.
Wright, G. R. E., P.O. Box 465, Benoni, Tvl.
Williams, J. T., c/o S.A. Bureau of Standards, Private Bag 191, Pretoria, Tvl.
Williams, V. E., c/o Electricity Supply Commission, P.O. Box 606, Kimberley, C.P.
Waldron, F. R., Assistant Electrical Engineer, P.O. Box 57, Umtata, Tembuland.

AGENDA AND PROGRAMME

Twenty-Sixth Convention held in the City Hall, Bulawayo, from the 5th May to 8th May, 1952

AGENDA

1. Annual Report of Secretary and Treasurer.
2. Election of President.
3. Retiring President's Valedictory Address.
4. Presidential Address.
5. Venue of next Convention.
6. Election of Officers —
   (*a*) Vice President.
   (*b*) Executive Committee.
   (*c*) Sub-Committees and Representatives.
7. Reports of Sub-Committees and Representatives.
   (i) World Power Conference.
   (ii) International Conference on Large Electrical Networks (C.I.G.R.E.)
   (iii) Electrical Wiremen's Registration Board.
   (iv) S.A. Standards Institution.
   (v) Registration of Electrical Wiring Contractors.
   (vi) S.A. Bureau of Standards.
   (vii) Safety Precautions Committee.
   (viii) Coal Supplies.
8. Right of Supply.
9. Auditors — Appoihtment of.
10. General.

RETIRING OFFICERS

President: J. C. DOWNEY, Springs.

Vice-President: A. R. SIBSON, Bulawayo.

Past Presidents: D. A. BRADLEY, Port Elizabeth. C. R. HALLE, Pietermaritzburg.

Councillor Members: Pretoria, Springs, Krugersdorp, Durban, East London, Cape Town, Bulawayo, Johannesburg.

Note.—The Town is elected and not the individual Councillors.

Other Members: A. FODEN, East London; C. G. DOWNIE, Cape Town; J. C. FRASER, Johannesburg; C. KINSMAN, Durban; D. J. HUGO, Pretoria; J. L. VAN DER WALT, Krugersdorp.

MEMBERS OF SUB-COMMITTEES AND REPRESENTATIVES

Sub-Committees:—

S.A. Standards Institution: J. C. DOWNEY. Alternate: D. J. HUGO.

S.A. Bureau of Standards: Safety Codes and other Committees: J. L. VAN DER WALT. Alternate: J. C. DOWNEY.

Safety Precautions: J. C. DOWNEY. Alternate: J. C. FRASER.

Registration of Electrical Wiring Contractors: C. G. DOWNIE (Convenor); D. A. BRADLEY and A. FODEN.

Coal Supplies: D. A. BRADLEY (Convenor); C. G. DOWNIE; J. C. FRASER and D. J. HUGO.

Import Control: J. C. FRASER, D. J. HUGO; J. C. DOWNEY. Alternates: C. G. DOWNIE; C. KINSMAN; J. L. VAN DER WALT.

Import Control Committee authorised to deal with the question of copper if there was any need for it.

Representatives:—

World Power Conference Local Committee: J. C. FRASER.

Electrical Wiremen's Registration Board: J. C. FRASER.

C.I.G.R.E.: J. C. FRASER. Alternate: A. FODEN.

PROGRAMME

Sunday, 4th May, 1952

9.00 a.m. Meeting of Executive Council in Committee Room, Municipal Offices.

Monday, 5th May, 1952

9.00 a.m. Registration, Issue of Papers, etc.

10.00 a.m. Official Opening of the Convention by His Worship the Mayor of Bulawayo, Councillor C. M. Newman, O.B.E., M.C., V.D., E.D., J.P.
10.30 a.m. Refreshment Interval.
11.00 a.m. Annual General Meeting:
Annual Report of Secretary and Treasurer.
Election of President.
Retiring President's Valedictory Address.
Presidential Address.
Venue of next Convention.
Election of Officers, etc.
12.30 p.m. Luncheon adjournment.
2.30 p.m. Convention resumes:
Reports of Sub-Committees and Representatives.
3.30 p.m. Refreshment Interval.
4.00 p.m. Official Photograph.
6.00 p.m. to 7.30 p.m. Mayoral Sundowner Party in City Hall.

Tuesday, 6th May, 1952

8.30 a.m. Meeting of Executive Council.
9.30 a.m. Convention resumes:
Business Matters.
Right of Supply.
Appointment of Auditors.
10.30 a.m. Refreshment Interval.
11.30 a.m. Paper by E. L. Buchanan, A.M.(S.A.)I.E.E., A.M.(S.A.)I. Mech.E., A.M.I. Cert. E., Town Electrical Engineer, Louis Trichardt: "The Rupturing Capacity of Switchgear and the evaluation of Short Circuit Currents in an A.C. System."
12.30 p.m. Luncheon adjournment.
2.30 p.m. Visit to Matopos — Tea at Matopos Dam Hotel.
7.30 p.m. Gaieties entertainment by Bula-Theatre Club in small City Hall.

Wednesday, 7th May, 1952

8.30 a.m. Meeting of Executive Council.
9.30 a.m. Convention resumes:
Paper by R. H. Redman, B.Sc., A.M.I.E.E., M.Inst.F., Deputy City Electrical Engineer, Bulawayo: "The Development of the Bulawayo Electricity Undertaking."
Discussion on Papers.
10.30 a.m. Refreshment Interval.
11.00 a.m. Discussion on Papers and other business.
12.30 p.m. Luncheon adjournment.
2.30 p.m. Convention resumes:
Paperette by J. W. Swardt, B.Sc. (Eng.), A.M.I. Mech. E., A.M.I.(S.A.)E., Principal Technical Officer, Engineering, South African Bureau of Standards.
5.00 p.m. Adjourn.
8.15 p.m. Concert in large City Hall by Bulawayo Municipal Orchestra.

Thursday, 8th May, 1952

8.30 a.m. Meeting of Executive Council.
9.30 a.m. Convention resumes:
Discussion on Papers and other business.
10.30 a.m. Refreshment Interval.
11.00 a.m. Convention resumes.
12.30 p.m. Convention closes if business completed.

LADIES' PROGRAMME

Monday, 5th May, 1952

10.00 a.m. Assemble for official opening of Convention.
10.30 a.m. Refreshments.
11.00 a.m. Annual General Meeting.
4.00 p.m. Assemble for official photograph.
6.00 p.m. Sundowner Party in City Hall.

TUESDAY, 6th May, 1952

10.00 a.m. Visit to Khami Ruins.
2.30 p.m. Visit to Matopos with refreshments at Matopos Dam Hotel.
7.30 p.m. Gaieties Show at Small City Hall by Bulawayo Theatre Club.

Wednesday, 7th May, 1952

10.30 a.m. Morning Tea at the Swimming Baths with Mayoress.
2.30 p.m. Bus tour of City with afternoon tea at Hillside Dam.
8.15 p.m. Orchestral Concert at City Hall by Bulawayo Municipal Orchestra.

Thursday, 8th May, 1952

10.30 a.m. Assemble for refreshments at City Hall and closing sessions of Convention.

A. R. SIBSON, Bulawayo
President, 1952-1953

THE ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

Proceedings of the Twenty-Sixth Convention, 1952

The Twenty-Sixth Convention of the Association was opened in the City Hall, Bulawayo, by His Worship the Mayor of Bulawayo (Councillor C. M. Newman, O.B.E., M.C., V.D., E.D., J.P.) at 10.00 a.m. on Monday, 5th May, 1952.

Representatives of 53 Councils attended the Convention, including 40 Councillor Members, 50 Engineer Members, 4 Associates, 22 Delegates or Representatives of Government Departments, other Supply Authorities, etc., 81 Trade Representatives and 80 Ladies — a total of 278.

CIVIC WELCOME

PRESIDENT (Mr. J. C. Downey, Springs):

Ladies and Gentlemen: Firstly it gives me great pleasure to welcome all of you here this morning to the Twenty-Sixth Convention of the Association of Municipal Electricity Undertakings of Southern Africa. I would like especially to welcome the new Councillor Members and the new Engineer Members.

Secondly, it is my very pleasant duty to introduce to you His Worship the Mayor of Bulawayo, Councillor Newman, who has kindly consented to open the proceedings of this Convention.

HIS WORSHIP THE MAYOR OF BULAWAYO (Councillor C. M. Newman, O.B.E., M.C., V.D., E.D., J.P.):

Mr. President, Ladies and Gentlemen: It is my duty—and a very pleasant one—to welcome you here on behalf of the citizens of Bulawayo.

It is no mean compliment that so important a body should have decided to make Bulawayo its venue for this year's Convention. To me personally the pleasure of welcoming you is enhanced as it gives us in some small degree the opportunity to return some of the amazingly generous hospitality that we Rhodesians have received from our neighbours south of the Limpopo.

In a gathering such as this it is perhaps not irrelevant to refer to the overwhelming dependence of the peoples of Southern Africa, both in the Union and in Rhodesia, on the activities of electricity undertakings, national and civic.

It is perhaps fortunate for the subcontinent that the rise and development of mining, of industry and of commerce should have coincided with the discovery, introduction and application of electricity as one of the most important factors in the progress of the human race. This coincidence was the more fortunate in that it occurred at a time when we did not have to battle with the vested interests of gas and of steam which so heavily affected countries in other parts of the world.

It is not surprising, therefore, to find that Southern Africa is probably one of the most highly developed parts of the world in the matter of electricity and has developed electricity for public use to a greater degree than anywhere else in the world. Likewise Rhodesia, having emerged later into civilization, is probably one of the most electrically-minded parts of Southern Africa.

It would not become me to enlarge on progress in the Union, because I should be talking to people who know a good deal more about it than I do; but perhaps you would bear with me for a moment or two if I do call your attention to electrical progress in Bulawayo. Here I must be careful not to trespass on the preserves of my good friend Mr. Redman, who will be giving you a paper showing what has happened on the technical side of electricity in Bulawayo.

When Cecil Rhodes was straining every ounce of his dynamic energy to create the great white civilization in Central Africa and trying to find the finance for it, he adopted a method of giving quite considerable concessions and monopolies to financial houses in return for their assistance. One of the monopolies so granted was

the sole right to supply water and electric power to the infant and pioneer community of Bulawayo. Monopolies in those days were considered a normal state of affairs, not having then attained the somewhat evil reputation which they bear in present times.

There is a certain amount of romance attached to the start of electricity in Bulawayo. The Bulawayo Waterworks and Power Company was quickly off the mark, but the railhead was in the neighbourhood of Mafeking, and every single piece of equipment for generators, boilers and distribution had to be hauled in by ox-wagon, at the pace of the ox, over hundreds of miles of literally roadless veld, over unbridged rivers, and facing all the hardships entailed by such conditions. Cattle died in their thousands because rindepest was sweeping the country. But, despite these difficulties, public power supply commenced in Bulawayo in 1897, only seven years after the first pioneer column went into Mashonaland and only four years after the Matabele War, as a result of which European Bulawayo was born.

I am informed that Bulawayo was the fourth town in the whole of Southern Africa to adopt electricity for its lighting and power. I believe the other three who were in front of us were Cape Town, Johannesburg and Pretoria.

The Concession Company carried on and performed an important public function for some thirty years. In 1926 the Municipality exproripated and compensated the concessionaires. I may say that in our first year of activity the sales of units totalled only 900,000, at a cost of between 1s. 9d. and 2s. 0d. per unit. Possibly the smallness of the sales was responsible for the high charges, though I prefer to think that the high charges led to small business.

That was twenty-six years ago, and in the intervening period, under Municipal control, we have indeed progressed mightily. From 900,000 units at an average price of 1s. 9d., we have progressed to 200,000,000 units at an average cost to the consumer of between 0·7d. and 0·8d., and it is with the utmost difficulty that we are keeping pace with an ever-increasing demand.

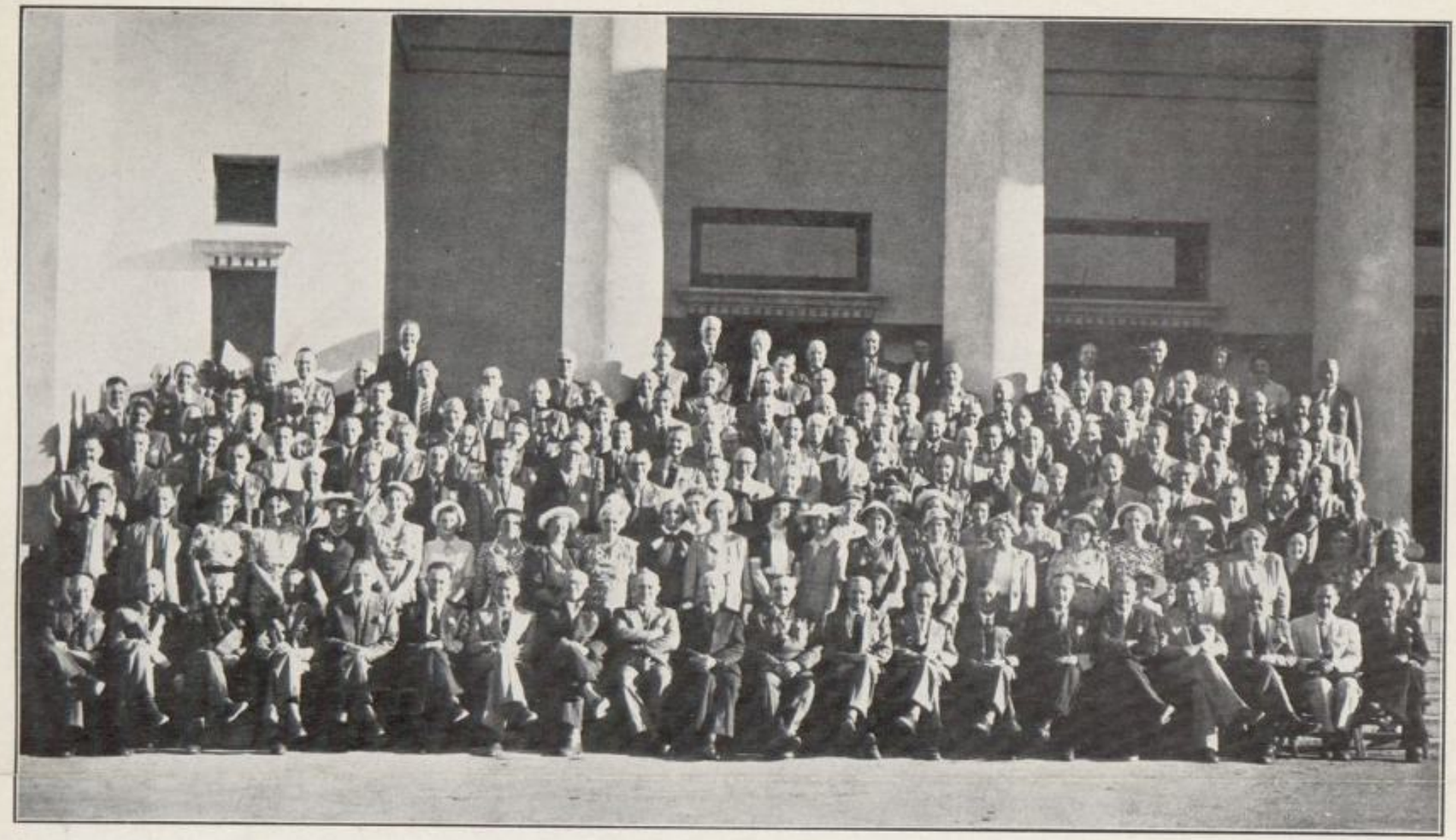
Bulawayo is essentially an electricity-conscious community. It may interest you to know that electric cooking appliances are used in no less than 7,000 of the houses in Bulawayo, or by over 90 per cent of our domestic consumers, whilst the use of refrigerators, water heaters, washing machines and other appliances is continually and rapidly increasing.

As a result of this we are now supplying an average of 3,600 units per head of the European population. I believe I am right in saying that the corresponding figure for Johannesburg is something over 2,000.

Until some two months ago we had avoided for many years any increase in our electricity tariffs; indeed, until that time, two months ago, our tariffs were no less than 11 per cent lower than our 1939 figure, despite the great and sometimes almost astronomical increases in cost for every item of equipment, consumable stores and labour, and also despite the charge made by the Municipality of 3s. 0d. per thousand gallons for water and 19s. 2d. per ton for coal delivered. I may mention, in relation to those figures, that the pound is reputed to have something slightly less purchasing power than the pound in the Union.

I have only just returned from a holiday in the Cape Peninsula, and I noted with interest that you have been having trouble with or are anxious about your reserves of coal. In the Cape press reference was made to the fact that a highly dangerous position had arisen as you only had some three to four days' reserve in hand. I seem to remember that last year, when I was at the Conference in Cape Town, the same sort of matter was engaging the attention of your Executive and of your Conference; and I believe I am right in saying that Mr. Bradley informed the Conference on that occasion that Port Elizabeth had only seven hours of steam — and a very anxious man he was. But, when we look at your figure of three to four days' reserve, we envy you your riches, for that is our normal state of affairs and not our extraordinary state of affairs. On several occasions we have been down to twelve hours' steam, and on more occasions than I care to think about we have been in the position of having 24 to 48 hours of coal on hand.

LIST OF PERSONS IN GROUP PHOTOGRAPH—BULAWAYO CONVENTION — MAY, 1952



Seventh Row: L. to R.—Cr. H. R. Sissons (Umtata); D. J. Hugo (Pretoria); Cr. F. J. Theron (Kroonstad); A. C. Tilley (Johannesburg); P. H. Newcombe (George); J. F. Franks (Bulawayo); Cr. G. H. Clark (Mafeking); G. E. H. Jones (Mafeking); C. E. R. Langford (Johannesburg); T. R. Strawson (Johannesburg); J. R. Wheating (Johannesburg); N. R. Yorke (Johannesburg); Mrs. K. C. Ford (Johannesburg); E. C. Enfield (Johannesburg).

Sixth Row: L. to R.—L. A. C. Pooley (Salisbury); A. C. Grant (Johannesburg); B. Marchand (Witbank); Cr. W. J. C. Rossouw (Brakpan); C. W. Suckling (Johannesburg); Cr. R. C. Mackay (Somerset West); H. G. Sale (Johannesburg); ————————; J. H. Relihan (Paarl); Cr. J. Levin (Queenstown); S. G. Redman (Johannesburg); G. A. Wadlow (Paarl).

Fifth Row: L. to R.—G. C. Delport (Delmas); J. E. P. Uys (Alberton); R. G. Edwards (Johannesburg); J. F. Lategan (Heidelberg); A. F. Turnbull (Vereeniging); R. W. Barton (Welkom); Cr. A. J. Botha (Vereeniging); M. N. Kirbirger (Bethal); C. R. Burton (Kimberley); H. D. T. Harris (Johannesburg); C. R. Deglon (Salisbury); ————————; H. J. Beard (Johannesburg); P. D. Kruyt (Odendaalsrus); R. K. Aldridge (Salisbury); Cr. A. P. Malherbe (Robertson); S. de V. de Villiers (Robertson); R. S. Worrall (Bulawayo); R. N. F. Smit (Pretoria); ————————; G. Molyneux (Bulawayo); W. Rossler (Kroonstad); E. V. Perrow (Johannesburg); Cr. E. du Preez (Paarl); R. G. Hunter (Johannesburg); J. W. Swardt (Pretoria); H. M. Rochester (Johannesburg); H. W. Mullen (Johannesburg); K. C. Ford (Johannesburg); C. L. de Beer (Johannesburg); G. Yuill (Johannesburg); H. Seabrooke (Salisbury).

Fourth Row: L. to R.—G. Herrman (Bulawayo); P. L. Vergottini (Brakpan); W. Rush (Vryheid); Cr. R. Large (Vryheid); A. V. Devereux (Johannesburg); D. G. Sutherland (Johannesburg); J. D. C. Baxter (Kimberley); L. L. Brinkworth (Johannesburg); F. Chappell (Bulawayo); N. R. Yorke (Johannesburg); T. Kramer (Potchefstroom); Cr. P. Pretorius (Randfontein); J. R. Cherry (Randfontein); A. Rossler (Cradock); D. D. Brown (Roodepoort); J. S. Craig (Greytown); C. Mullins (Pretoria); L. Futcher (Kempton Park); W. H. Milton (Johannesburg); J. A. Barnett (Johannesburg); H. T. Turner (Umtali); R. Tarran (Benoni); G. Williams (Johannesburg); F. Stevens (Ladysmith); J. I. Inglis (Pietersburg); Cr. J. W. Phillips (Bulawayo); Cr. J. R. Moffett (Bloemfontein); Cr. Col. H. O. Sayer (Ladysmith);Cr. B. J. Venter (Louis Trichardt); J. Bawcutt (Salisbury); J. White (Johannesburg); G. A. Dalton (Johannesburg); J. Monks (Johannesburg).

Third Row: L. to R.—Cr. J. S. Maher (Alberton); R. W. Kilfoil (Johannesburg); R. C. Viviers (Johannesburg); A. H. Durr (Pretoria); P. C. Asselbergs (Barberton); J. C. Cellie (Johannesburg); Cr. M. J. Moolman (Estcourt); J. G. F. Erikson (Estcourt); W. H. Attridge (Somerset East); E. de C. Pretorius (Stellenbosch); J. M. Gericke (Klerksdorp); Cr. J. C. Jordaan (Klerksdorp); Cr. H. H. Holtzhausen (Potchefstroom); G. Roeske (Johannesburg); A. Foden (East London); ————————; Cr. J. P. Marais (Venterspost); L. Dreyer (Venterspost); E. L. Smith (Boksburg); Cr. I. Schlapo (Roodepoort); Cr. Dr. J. D. Verster (Rustenburg); Cr. G. P. Blake (Stellenbosch); Cr. J. H. de Bruin (Boksburg); P. A. Meintjies (Rustenburg); Cr. P. van den Hoogen (Pretoria); E. L. Buchanan (Louis Trichardt); Cr. C. E. K. Young (Pietermaritzburg); R. J. Bates (Port Elizabeth).

Second Row: L. to R.—R. R. Lyall (Nelspruit); E. W. Dixon (Germiston); Mes. D. G. Sutherland (Johannesburg); Mrs. C. Kinsman (Durban); Mrs. W. A. Walsh (Durban); Mrs. A. V. Devereux (Johannesburg); Mrs. J. D. C. Baxter (Kimberley); Mrs. C. R. Burton (Kimberley); Mrs. J. C. Downey (Springs); Mrs. D. A. Bradley (Port Elizabeth); Mrs. R. W. Kane (Johannesburg); Miss P. Roeske (Johannesburg); Mrs. Morton-Jaffray (Salisbury); Miss Mitchell (Salisbury); Mrs. J. E. Mitchell (Salisbury); Mrs. A. T. Taylor (Johannesburg); Mrs. C. R. Deglon (Salisbury); Mrs. C. L. de Beer (Johannesburg); Mrs. I. Tarran (Benoni); Mrs. A. C. Grant (Johannesburg); Mrs. D. L. de Bruin (Boksburg); Mrs. G. Roeske (Johannesburg); Miss O. L. de Bruin (Boksburg); Mrs. A. Rossler (Cradock); Mrs. E. L. Buchanan (Louis Trichardt); Mrs. F. Stevens (Ladysmith); Mrs. J. I. Inglis (Pietersburg); Mrs. G. P. Blake (Stellenbosch); Mrs. H. G. Sale (Johannesburg); Mrs. E. V Perrow (Johannesburg); Mrs. H. M. Rochester (Johannesburg).

Front Row: L. to R.—W. Bellad-Ellis (East London); E. G. Ivey (Cape Town); Cr. Maj. J. W. Billingham (Cape Town); J. E. Mitchell (Salisbury); Cr. Morton-Jaffray (Salisbury); Cr. M. C. Dumes (Krugersdorp); J. L. van der Walt (Krugersdorp); Cr. L. M. Weiner (Johannesburg); R. W. Kane (Johannesburg); Cr. Lt. Col. C. M. Newman (Mayor of Bulawayo); A. R. Sibson (President—Bulawayo); J. C. Downey (Springs); Cr. L. Dubb (Port Elizabeth); D. A. Bradley (Port Elizabeth); Cr. Maj. J. Raftery (Durban); C. Kinsman (Durban); ————————; C. R. Halle (Pietermaritzburg); G. J. Muller (Bloemfontein); A. T. Taylor (*Secretary and Treasurer*—Johannesburg).

I mentioned this fact to the Consulting Electrical Engineer to the International Bank for Reconstruction and Development in Washington and he was horrified. He told me that the great thermal stations in the United States aim at having six months' reserve of coal; that they consider they are in a highly dangerus position if they drop to three months, when they immediately start to squeal to their Senators and Representatives to put a stop to this intolerable state of affairs!

I do not know if you have managed to impress the Government of the Union of South Africa with the importance of these matters, but in Southern Rhodesia until comparatively recently our representations have not had much effect. The position is now a little better but we still live literally from hand to mouth. The Government seemed to be totally incapable of realizing the calamitous, the almost catastrophic, state of affairs that could ensue from a total stoppage of power supply in any large urban community. Every drop of water that comes into this town, some 25,000 tons of it a day, comes in by virtue of electrically-operated pumps. If those pumps were to stop, not only would there be the question of drinking and washing water, but the whole of our water-borne sanitation would come to a standstill. Bad as this might be in the case of residential property, one hesitates to think of the chaotic conditions that would arise in large hotels and big blocks of flats. Then, again, all industries in the city would come to a standstill, thousands of workers would be thrown out of employment, with colossal loss of revenue not only to the individual but to the industries themselves. A very considerable area of the countryside is supplied by Bulawayo through the distribution system of the Electricity Supply Commission, and over very great areas gold mines would case to work, other industries would cease, and cement production would stop.

That is all I have to say about our electricity.

I would like to conclude by saying that I hope your deliberations will be fruitful and profitable, both to yourselves and to the communities you serve. We hope that you will enjoy your stay in Bulawayo, and we look forward to the day when it will again be our good fortune to be your hosts.

I now have pleasure, Sir, in declaring this Convention duly opened.

PRESIDENT (Mr. J. C. Downey, Springs):

Mr. Mayor, on behalf of the Association I thank you most sincerely for giving up some of your valuable time in order to come here and open the proceedings of this Convention.

You have given us some very interesting facts concerning not only the history of this Colony but also the history of this city. In addition, I think you have given us some very valuable tips on how to handle the coal situation in our respective countries, namely, by bringing home our difficulties to those who direct our affairs in the House of Assembly.

I thank you once again, Mr. Mayor, for the way you have launched this Convention, and I hope that our subsequent proceedings will be conducted in an equally successful manner.

I will now call upon the Secretary to read the Annual Report.

ANNUAL REPORT

March, 1952.

To the President and Members of the Association.

Gentlemen: I have the honour and pleasure of submitting to you the Annual Report, together with the Revenue and Expenditure Account and Balance Sheet for the financial year ended 29th February, 1952.

Obituary

I regret to have to record the passing on of Mr. C. E. Gregor, late Electrical Engineer of Alberton.

Twenty-Fifth Convention

The Twenty-fifth Convention of the Association was held in Cape Town from Tuesday, 8th May, to Friday, 11th May, 1951, inclusive.

In all, 292 members, delegates and visitors attended the Convention.

It is fitting at this stage to express the appreciation and sincere thanks of the President, members of the Association, delegates and visitors to His Worship the

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA
BALANCE SHEET — 29th FEBRUARY, 1952

Accumulated Funds			£2,528 16 10			
Balance at 28th February, 1951 ...	£2,261 14 7					
Add: Excess of Income over Expenditure for year ended 29th February, 1952	267 2 3					
				Presidential Badge ... ... Nominal Valuation		1 0 0
				Furniture and Fittings ... ... At Cost less Depreciation		70 19 9
				Investments ... ... United Building Society Fixed Deposits including interest accrued.		2,054 17 0
				Debtors		3 0 0
J. C. DOWNEY, Chairman.				**Cash**		399 0 1
A. T. TAYLOR, Secretary.				At Barclays Bank (D.C. & O.) ...	397 5 9	
				On Hand	1 14 4	
			£2,528 16 10			£2,528 16 10

To the Members of the Association of Municipal Electricity Undertakings of Southern Africa.

We report that we have examined the above balance sheet with the books and vouchers of the Association for the year ended 29th February, 1952; that we have satisfied ourselves of the existence of the securities; and certify that, in our opinion, the above balance sheet is properly drawn up so as to exhibit a true and correct view of the state of affairs of the Association as at 29th February, 1952 according to the best of our information and the explanations given to us and as shown by the books of the Association.

Johannesburg,
26th March, 1952.

SAVORY & CO.
Incorporated Accountants
Auditors.

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 29th FEBRUARY, 1952

Audit Fees			12 12 0	Subscriptions			952 7 0
Bank Charges			7 13 8	Proceedings			46 12 8
Convention Expenses	123 18 0			Sale	183 15 0		
Less: Donation	2 2 0			Advertising — Net	381 1 10		
		121 16 0			564 16 10		
Insurance		2 9 0		Less: Cost of Printing	518 4 2		
Depreciation of Furniture and Fittings		7 17 9		Interest on Fixed Deposits			70 3 10
Printing and Stationery		20 6 3		B.E.A. Journal			4 6
Postages and Telegrams		19 4 1		Subscriptions Received	1 16 0		
Rent		48 0 0		Less: Cost	1 11 6		
Secretarial Expenses		85 3 4					
Secretary's Salary		395 6 8					
Telephone		12 1 11					
Executive Committee Expenses		43 9 1					
Subscriptions		25 5 0					
Sundry		1 1 0					
Excess of Income over Expenditure transferred to Accumulated Funds		267 2 3					
		£1,069 8 0					£1,069 8 0

SAVORY & CO.

Mayor and the City Council of Cape Town for the excellent entertainment provided, especially for the ladies, for the facilities offered for holding our meetings, and to those officials who assisted us in successfully dealing with the business portion of the agenda.

Our thanks and appreciation are also due to the Municipality of Stellenbosch for the hearty welcome given us by Councillor G. P. Blake, the Deputy-Mayor, at the morning session of our meeting and again at the excellent luncheon they provided. Last but not least to the Municipality of Paarl for the most enjoyable afternoon tea party presided over by His Worship the Mayor of Paarl, Councillor J. F. Knott-Craig.

Papers

Two papers were presented:-
"Economics in the Electricity Supply Industry," by Mr. A. C. T. Frantz, Chief Technical Officer, Electricity Department, City of Cape Town.
"The Repair and Testing of Meters," by Mr. E. L. Smith, Electrical Engineer, Boksburg.

As usual, the papers aroused a considerable amount of discussion, the details of which are recorded in the 1951 Proceedings.

1952 Convention

An invitation received from the City Council of Bulawayo to hold the Twenty-sixth Convention in that city during the month of May, 1952, was unanimously accepted at the Cape Town Convention in May, 1951.

Membership

The following new members were elected during the period 1st March, 1951, and 29th February, 1952.

Council Members:

Komgha, Cape Province.
Ladybrand, O.F.S.
Parys, O.F.S.
Standerton, Transvaal.
Wepener, O.F.S.

Engineer Members:

W. H. Atteridge, Electrical Engineer, Somerset East.
C. Fletterman, Town and Electrical Engineer, Ladybrand.
J. F. Heese, Electrical Engineer, Upington.
D. R. Pretorius, Town Electrical Engineer, Parys.
D. Rozendal, Electrical Engineer, Wepener.
C. R. Sprighton, Town and Electrical Engineer, Standerton.
D. R. Verschoor, Town and Electrical Engineer, Vrede.

Associates:

G. A. Dalton, 111 Eckstein Street East, Observatory Extension, Johannesburg.

Transfers from Engineer Membership to Associate:

T. P. Ashley, P.O. Box 113, Queenstown.
H. R. Bevington, Municipal Electrical Engineer, P.O. Box 13, Burghersdorp, C.P.
W. Bellad-Ellis, P.O. Box 255, East London.
D. R. Millin, Kongola Phiri Estate, P.O. Fort Manning, Nyasaland.
V. E. Williams, c/o Electricity Supply Commission, P.O. Box 606, Kimberley.

The comparative figures for the years 1950/1951 and 1951/1952 are:-

	1950/51	1951/52
Council members ..	97	100
Engineer members ..	92	98
Honorary	4	5
Associates	28	35

Financial

It is pleasing to note from the Balance Sheet that income for the period under review exceeded expenditure and that the general financial position of the Association is sound.

I wish to take this opportunity of thanking the Council Members and Advertisers, on behalf of the Executive Council and Members, for their financial support and continued keen interest shown in the Association's welfare.

In conclusion, my thanks is due to the President and members of the Executive Council for the advice, assistance and courtesy at all times extended to me.

I remain,
Mr. President and Gentlemen,
Yours faithfully,
A. T. TAYLOR,
Secretary and Treasurer.

PRESIDENT:

Ladies and Gentlemen: You have heard the Secretary's Report.

OBITUARY

Before I call upon someone to move the adoption, I should like to refer, as the Secretary has done, to the passing of our very old and esteemed friend, Mr. C. E. Gregor, late Town Engineer, Alberton. I suggest that we should all rise at this juncture as a mark of respect.

(Delegates rose to pay their respects.)

APOLOGIES AND GREETINGS, ETC.

The President read the following telegrams that had been received:-

T. P. Ashley, Queenstown: Heartiest congratulations on coming appointment as President of the Association stop Sincerely regret circumstances prevent me from attending stop Trust all are well and everything goes off according to plan stop Regards.

J. S. Clinton, Johannesburg: Best wishes successful Conference stop Am sorry I cannot be present.

H. A. Eastman, Somerset West: Best wishes for successful Convention.

G. J. Gripper, Port Elizabeth: Best wishes successful deliberations in conference hall and lobby twenty-sixth Convention stop Congratulate President Elect and appreciate efforts of retiring officers stop Ratepayers may criticize annual conferences but consumers never have done.

Communicated:-

Councils:

Beaufort West, Bothaville, Brandfort, Grahamstown, Ladybrand, Newcastle, Odendaalsrus, Uitenhage, Windhoek, Worcester.

Other Members:

A. Rodwell, Johannesburg, Hon. Member.

C. G. Downie, Cape Town (Member of Executive Council).

J. C. Fraser, Johannesburg (Member of Executive Council).

S. J. Nicholas, Electrical Engineer, Umtata.

Government Departments and Other Institutions:

P. Machanik, Acting Chief Engineer, Engineering Branch, G.P.O., Pretoria.

H. H. Jagger, Manager, Cape Western Undertaking, Electricity Supply Commission.

E. L. Damant, Manager, Natal Undertaking, Electricity Supply Commission.

C. L. A. Borckenhagen, Director of Imports and Exports.

Sir Arthur Griffin, General Manager, Rhodesia Railways.

H. W. Woodruff, United Kingdom Trade Commissioner, Salisbury.

E. G. G. Marsh, Local Government Officer, Department of Internal Affairs, Salisbury.

P. H. Haviland, President, Rhodesian Institution of Engineers.

H. B. Hichens, Managing Director, Geo. Kent (S.A.) (Pty.) Ltd., Johannesburg.

Tea interval.

PRESIDENT (Mr. J. C. Downey):

I will now call for someone to move the adoption of the Secretary's Report.

Mr. D. A. BRADLEY (Port Elizabeth):

Mr. President, Ladies and Gentlemen: I have much pleasure in moving the adoption of the Report.

Mr. A. FODEN (East London):

I have much pleasure in seconding that motion.

PRESIDENT:

Is there any discussion on the Annual Report?

(Adopted.)

ELECTION OF PRESIDENT

We will now turn to the next item on our Agenda, the election of President. I call for nominations.

Councillor Major J. RAFTERY, J.P., M.P.C. Durban):

Mr. President, Your Worship, Ladies and Gentlemen: It gives me great pleasure to propose that Mr. A. R. Sibson be

President for the ensuing year. As Mr. Sibson is the City Electrical Engineer of this city, you, Mr. Mayor, and citizens of Bulawayo will know even better than I the services he has rendered to this city, not alone in its material advancement but in its cultural activities as well.

In this respect I well remember the last time Mr. Sibson was in the city that I come from—Durban—when our famous and, shall I say, forceful musical conductor, Mr. Edward Dunn, invited Mr. Sibson to conduct our Municipal Orchestra before an audience of Durban citizens and music-lovers. Mr. Sibson conducted one of his own compositions, to the great joy of those present. I have a message to you, Mr. Sibson, from those people. It is the old and simple one: "Wull ye no' come back again?"

Mr. Sibson has done much for our Association and it is very fitting that we should honour him by making him our President.

With these few words I formally propose that Mr. A. R. Sibson be elected President for the ensuing year.

Mr. C. KINSMAN (Durban):

Mr. President, Your Worship, Ladies and Gentlemen: As one who has had the pleasure and opportunity of serving on the Executive of this Association for a number of years with Mr. Sibson, it is with great confidence and considerable pleasure that I second the proposition that he be appointed our President for the ensuing year.

PRESIDENT (Mr. J. C. Downey):

Are there any further nominations? (There were no further nominations.) I declare Mr. Sibson duly elected President of this Association for the ensuing year. Mr. Mayor, may I call upon you to do us the honour by investing Mr. Sibson with the Chain of Office.

(On receiving the Chain of Office, Mr. Sibson assumed the Chair in place of Mr. Downey.)

PRESIDENT (Mr. A. R. Sibson):

Mr. Mayor, Ladies and Gentlemen: I will not weary you at this stage with a lengthy speech, because you have before you an address that I shall be giving a little while later this morning, but I do wish to take this opportunity of expressing to Councillor Raftery, to Mr. Kinsman and to all of you my very sincere appreciation of the honour that you have done to me this morning. The job is by no means an easy one, as I who have been in somewhat intimate contact with numerous Past Presidents know only too well; and, as I intimated to the Cape Town Convention, it is even more difficult for one who resides in Rhodesia adequately to sustain the responsibilities that that high office of this Association imposes upon him. I can only say that I shall do my best, and with the very able assistance of my Past Presidents and those whom you will in due course elect to the other offices of this Executive, I am completely confident that I shall be able to sustain what is required of me. Thank you, gentlemen.

I now call on the immediate Past President, Mr. J. C. Downey, to deliver his Valedictory Address.

VALEDICTORY ADDRESS

By

J. C. DOWNEY, M.(S.A.)I.E.E., M.I.Cert.E.,
Electrical Engineer, Town Council, Springs

My year of office has come to a close and I wish to take this opportunity of thanking all members of our Association for the goodwill and co-operation I have received during the past year. I am particularly indebted to the members of the Executive Council and the Secretary/Treasurer for their assistance and untiring efforts to carry out the work of the Association.

The year has not been an easy one for many of us. Almost immediately following the last Convention at Cape Town saw the electricity supply industry in the Union faced with the greatest crisis in its history, namely, the restricted supply of coal to the generating stations and the reduction in supplies of electricity throughout the Witwatersrand supply area, owing to the shortage of generating plant capacity. The position may be more serious this year than last, a condition that is brought about by increasing demands, the shortage of generating plant, and an overloaded transport system.

The standards of living of our urban communities have increased during the past ten years, and are now more marked in the older established towns where the cost of electricity is lowest and where measures are now being introduced, or considered, to limit the system loadings by demand tariffs, load shedding by remote control or other means because the rate of demand on the undertakings has increased beyond that at which new generating plant can be commissioned.

It will have been noted that the increases have necessitated the consideration of large schemes to increase the capacity of the distribution systems in the old established areas, where the fresh demands have increased beyond that of the old networks. It may be said that this is due to the outset of industrial development but, while this is partly true, records show that one of the greatest rates of increase of an established undertaking is that of the domestic consumer.

What are the causes of this high rate of increase in the demand for electricity? During the crisis of the electricity supply in Britain in 1947, it was stated that the breakdown of the electricity supply had been made more certain by the failure to check the rapid growth in the production of electric fires. I have no doubt that in the Witwatersrand area during the winter months, the heater is more of a curse to the Municipal Electrical Engineer than a blessing. The water heater, which is a boon to the housewife, usually comes in for a fair amount of criticism and is often the first victim of a cut-off where remote control is in use. The water heater is probably one of the best load builders on a system, and is one of the greatest labour-saving devices in any home; I cannot agree that it is the objectionable loading device on the system some would have us believe. While there may be quie a lot to be said for the flexibility of controlling the loading on a system by cutting off the water heating load, I do not think that this is either the right or the desirable thing to do to any consumer on the system. If willing to pay, why should the consumer be forced to accept partial disconnection at a time inconvenient to him?

There is, however, something more important than freedom of choice at stake. The diversity of loads on a system, you will agree, is a desirable thing. It is a factor the higher mathematicians assure us depends upon chance, permutations and combinations of human activities, habits and desires. It is a factor which, I submit, decides all progress.

I do not believe it is sound practice to abandon the foundations from which we derive the blessing of diversity for a planned campaign to regulate consumers' times of use and demand. The result of regimentation of the consumers' use, in my opinion, will not approach the diversity we presently obtain.

Now when mistakes or difficulties show up, clear thinking is essential. It is not the free choice of the consumer which is the root of the evil but something entirely different. If the consumers' demand is causing us difficulties, it is dangerous to resort to dictatorial action. It is an admission of failure and the attempt to penalize all consumers is more fundamental.

When demand takes charge, it may be that the price charged is the incentive to the consumer to make greater use of electricity. If so, would not the better way be to examine the tariff and devise a demand charge based on a cheap form of metering so as to control the problem by the sound application of basic rules, rather than to discourage all users by a general dislocation of supply to water heaters? While passing on this thought to you, I should like to mention another problem closely related to it in principle.

The price mechanism is something inherent in our system of free enterprise. Most economists of the old school insist that it is a generating force and that the system won't work satisfactorily without allowing it freedom to operate. My view on the demand by domestic users is an extension of the principle. When the price is "cheap," buyers follow. If the tariff is too low compared with the cost of producing electricity in unlimited quantities, a brake must be applied. It should be done sensibly so that the buyer still has freedom of choice but at a figure satisfactory also to the seller.

I began by asking what caused high rates of growth in the demand for electricity. We must be alert when administering an electricity undertaking to understand the economic forces beyond the horizon of our concerns. The curve of expansion of our undertakings is really one dominated by the drive which is conditioning the development of the country. Years ago Australia passed through a similar stage. The forces are economic ones. Industrialization is afoot and the curve shown at the end of my address last year indicates the milestone we have reached. With industrialization comes a higher output per head, and usually a higher expenditure upon things like electricity. The use of electricity by Europeans and Non-Europeans is not conditioned merely by cleanliness and comfort. Again the force is mainly economic. Soon we shall be compelled, I am sure, in our own and the interest of the Non-European to make available the facilities the reduction in living costs electricity can achieve.

We must not lose sight of these driving forces and must be prepared to meet the development they will cause. If we are unready, public ownership of an electricity undertaking is failing in its stewardship. It might have been better to have left development in the hands of private enterprise where the forces of the market give signals at the proper time. Unless we learn to use and to recognize other mechanisms which give out danger signals we shall fail.

In examining the causes of increases in the demands for electricity by the industrial user, a few fundamental reasons for the use of electricity should be considered. It is perhaps surprising to be told that the rate of production of power by a bricklayer over an eight-hour day is not much more than 0·0007 horsepower. That of other workers must therefore be correspondingly lower. (I suppose some of you are already suggesting that the managing directors are down to 10^{-4}.) Greater productivity and the steady improvement in the standards of living of communities are dependent on the availability of sufficient electric power. It has been stated in America that about 2,500 kilowatthours per annum are produced per head of population, while in India the figure is 14 and in Pakistan only 2. America utilizes this power as one of its tools, to achieve its high industrial output. One must accept that in countries less technically developed human beings are relegated to positions of energy producers rather than operators of machines. This must be all the more evident when it is realized that the average normal healthy human at his best can produce only one kilowatthour in the course of a twelve-hour working day. If, then, the output of a community is to be increased, means other than physical must be used to augment it. Having electricity available for stepping up the industrial output brings in its train the snowballing effect of the increased demand by workers I mentioned earlier. The industrial population is increasing rapidly in this country and to keep living costs down electricity must be used.

The large amount of capital invested by industry in plant and machinery which is dependent on electricity for its energy is tremendous, and only serves to point out the heavy responsibility of the Municipal Electricity Department to its consumers and the need for the utmost reliability in the continuity of supply. There are industries in my own particular area that are so dependent on electricity that an interruption of supply for three hours would ruin the total output of the industry for weeks. There are others in which a half-minute delay in the supply would prevent the machines from returning to full capacity for at least three hours. A long list of such examples could be given to show how dependent we all are on electricity for our everyday needs.

Although we have heavy responsibilities to maintain an adequate and assured supply, we have to be extremely careful that our enthusiasm does not outrun discretionary interpretation of economic signals given out by forces beyond the undertaking itself. Just as one can overcapitalize a business, so a country can put too much of its resources for capital investment in our particular concerns. It is not a good thing necessarily for every undertaking to be in the market for the same goods at the same time. I cannot cover the subject matter of a capital investment policy in my address, but it would, in my opinion, pay everyone to examine the matter objectively. One con-

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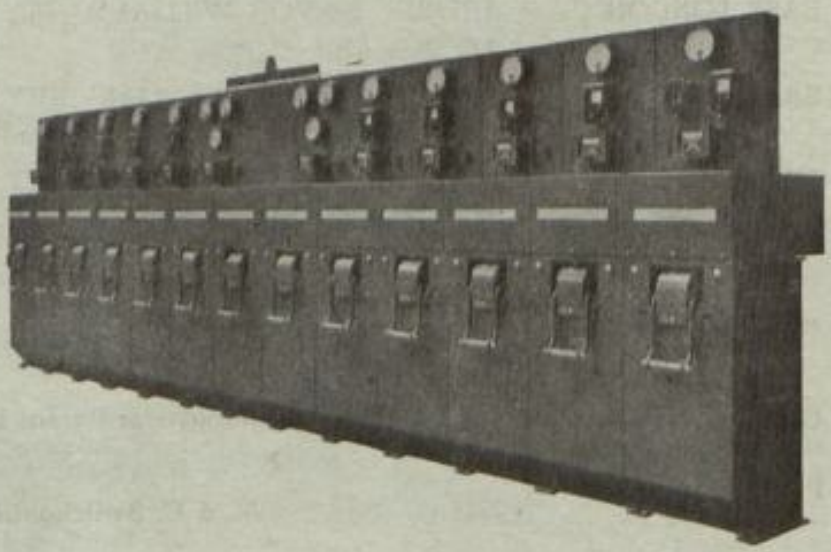

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clusion I have reached in connection with capital demand it that an overcentralized organization, as opposed to a number of small units in the capital money market, has defects. It is our old friend "diversity" coming into a different field and doing the same good work if he is allowed reasonable freedom to operate. I know "reasonable" is a gem with many facets. State guidance in financial policy is the best we can expect. Mistakes are to be expected anyway. They are the price of progress and without them it must be supposed our system is stable, in equilibrium, perfect perhaps and certainly one with no impulse to change. The mistakes of some small units won't be major ones. Just a case of an odd man out of step, not the whole country, leaving half left and half right.

An undertaking should not be allowed in my opinion to develop as a master-planned, politically-controlled body where no consideration is given to the economic side of the development. A political policy of bringing electricity to the country at low tariffs may well mean that a slum dweller in a town has to contribute to the cost of providing electricity to the country mansions of the wealthy. This arises from the failure to recognize that the tariff is a measure of the satisfaction which a consumer derives from the supply. It also abandons the price mechanism of welfare, and short circuits the signals given out by the economic machine's protective gear. In many cases one finds the spirit of socialism so permeating the design of tariffs that irritation creeps into the minds of some officials at the very existence of certain types of consumer.

We are beset by a clamour for planning on a global scale. Master plans have brought in their wake many difficulties. Modern planning, while imbued with goodwill and noble intention to control things better than chance does, invariably ends up by controlling men and imposing petty restrictions. The plans won't work otherwise. An economic system which multiplies unenforceable laws increases the opportunities of breaking them. We must continue to develop ourselves without controls and stop running to the Government to rectify every little upset.

The tendency for business to clamour for legislation for the control of this and that is to be deprecated. We must learn to take the rough of the competitive system with the smooth. A sensibly conceived economic system should sweat the business man, and why not? Such arrangements are not pleasant for him and why should they be? It is not pleasant to dig for coal, drive a locomotive year in and year out, mine for gold, operate machines, climb poles, and the hundred and one other duties required to be done by individuals. We need shed no tears for the business man. Brisk competition may be a strain, but nobody forces anyone to be a business man. Our undertakings should be run on lines similar to those of any other concern working for profit, in this we can assure ourselves that we are serving the consumers in their greatest interest. Red tape and administrative clumsiness should be eliminated wherever possible and a progressive outlook should be maintained at all times. The electricity undertaking should be kept at good business levels, and the full responsibility and importance of the undertaking to the community should be fully realized and recognized as a business concern by councillors, engineers and consumers.

In conclusion, I wish to thank all of you for the consideration and tolerance you have shown me during my term of office as your President, and I am pleased to hand over the reins of your Association to one so able as Mr. Sibson, and I sincerely trust, as your President during the coming year, he will have a full measure of success and happiness.

PRESIDENT:

I now call upon Mr. van der Walt to propose a vote of thanks to Mr. Downey.

Mr. J. L. VAN DER WALT (Krugersdorp):

Mr. President, Mr. Mayor, Ladies and Gentlemen: It is with great pleasure that I express on your behalf the appreciation of our Association for the work done by Mr. Downey during the past year. In his Valedictory Address he mentioned that the year under review has been an extremely difficult one. To Mr. Downey it was even more so, because upon his shoulders rested the responsibility of safe-

guarding the interests of our Association. This task he performed very ably indeed, and I am quite sure that he exceeded that remarkably high figure of man at his best of one kilowatthour per day.

On several occasions your Association had to make representations on matters of extreme importance to its members. Mr. Downey could be relied upon to be the spearhead of it all, and for this we are very deeply indebted to him.

In his address he has given us thought-provoking material, something we shall not forget—in particular his reference to the important part electricity plays in the economic structure of any country.

Mr. Downey, we thank you for your untiring efforts and work you have done for this Association. May you have many happy memories of your year of office, and the thought that you have served, be your reward.

Mnr. J. L. VAN DER WALT (Krugersdorp):

Mnr. die President, Mnr. die Burgermeester, Dames en Here: Dit is met genoë dat ek namens u die waardeering van ons Vereniging uitspreek vir die werk gedoen deur Mnr. Downey.

In sy toespraak is melding gemaak van 'n uiters moeilike jaar agter die rug. Vir hom was dit seker meer die geval, want die verantwoordelikheid het op sy skouers gerus om ons sake te behartig onder hierdie moeilike omstandighede. Dat hy dit deeglik gedoen het is nie aan te twyfel nie, en ek is oortuig daarvan dat sy daaglikse kwota, die hoë pyl van 1 kilowatt uur ver oorskry het.

Gedurende die afgelope jaar moes u Vereniging op verskeie kere vas staan op beginsels van groot belang vir al die lede. Mnr. Downey was dan ook altyd 'n krag om op te reken. Hiervoor kan ons hom nie genoeg dankie sê nie.

Hy het in sy toespraak ons baie materiaal vir oordenking gegee en as 'n diep dinker sal ons hom onthou, in besonder sy verwysing na die belangrikheid van elektrisiteit en hoe dit die ekonomie van 'n land raak.

Mnr. Downey, baie dankie vir alles wat u vir hierdie Vereniging gedoen het. Mag u herinneringe aangenaam wees en die gedagte dat u gedien het, u beloning.

PRESIDENT:

I will ask Mr. Downey to take the Chair for a few moments.

Mr. J. C. DOWNEY:

It gives me great pleasure, Mr. Mayor, Ladies and Gentlemen, to call upon our President to give you his Presidential Address.

PRESIDENTIAL ADDRESS

Ladies and Gentlemen: I propose to direct your attention for a few moments this morning to the place that a municipal electricity undertaking fills in the hierarchy of civic government as we understand it, in the hope that we may be enabled to understand the various problems that confront us and more effectively to play our part as public servants operating for the greatest good of the greatest number.

In appreciating the implications of municipal administration it is necessary to examine for a moment the history of municipal affairs which, as everyone knows, is a very old history indeed. Commonwealth municipal government, with which we are primarily concerned, derives its traditions largely from the town life of mediaeval Britain and it is not often realised that parliamentary government is a comparative newcomer in the field of democratic institutions.

Autocratic control of widely dispersed populations was a reasonably easy task, but wherever large aggregations of people were assembled in a small area the facility with which such people could offer coherent objections to their domestic affairs being subject to arbitrary rulings was sufficient to lead to the establishment of some form of local government. A powerful factor in this movement was the interests of the various guilds of craftsmen, and particularly the goldsmiths, who were concentrated in the towns as their modern counterparts are at the present time. When we examine the records of the early councils we find that municipal government, of a character not dissimilar to that being practised today, was developed nearly a thousand years ago and has been in continuous operation ever since.

Initially it was concerned with safeguarding the rights of property ownership both individually and collectively; the provision of rudimentary water supplies; the maintenance of streets; and the upholding of civic dignity. In the absence of medical knowledge, health matters received scant attention, but they were potentially the concern of municipal councils. Subject to the gradual growth of sciences and techniques, all the matters at present dealt with by councils—with the single exception of electricity supply—have been matters of municipal concern for centuries.

A mere seventy years ago the inventions of Kelvin, Ferranti, and others introduced a more economic way of lighting streets than the methods that had been employed previously, and so the electrical industry was born, primarily to fulfil a minor function of municipal administration. It was not long before the use of electricity for domestic lighting purposes was also mooted, but at this stage it did not occur to anyone that this might also be a municipal function. Water and gas supplies to individual householders had been regarded as matters for private enterprise, and electricity, too, followed generally in the same path. While some municipalities in Britain later entered into the business of supplying domestic services, by far the majority of such supplies were effected through private companies. In Southern Africa there was a sporadic outbreak, at the beginning, of private electricity supplies, and I think it is true to say that, apart from a few negligible exceptions and the outstanding example of The Victoria Falls & Transvaal Power Company, Bulawayo was probably the last civic area of any dimensions to retain private company supplies of electricity and water, and this was brought to an end in 1924.

The obvious economy—in a country of such wide spaces—of using overhead mains almost to the exclusion of cable systems, led to the further economy of combining the reticulation of street lighting with that of domestic supplies and this, no doubt, had something to do with the marked tendency to make electricity supply a matter concerning the municipalities rather than private enterprise. The smallness of the towns may also have offered too slight an incentive to the profit instincts of company promoters. Whatever may be the reasons, it is a fact that at the turn of the last century municipalities in Southern Africa began to find themselves saddled with an entirely new function, and one with which the historic framework of municipal administration was not necessarily designed to deal. Electricity is so specialised and remote a study that it was soon found to be incapable of being handled as merely another engineering matter, as was the case with water supply, and before long most towns found it necessary for a separate and distinct department to be set up to handle its affairs.

But, due to the fact that the electricity department was a cohesive whole with its own resources to meet expenditure, it became a business concern, rather out of step with traditional municipal procedure. Given the assumption that an adequate supply of electricity was the right of every ratepayer who could pay for it, expediture was governed by engineering necessity rather than civic desirability and was usually geared to a developing revenue that the growing use of electricity automatically made available. An entirely different outlook in administration inevitably developed and the tendency for electricity departments to "hive off" was accentuated by the fact that, since revenues were not derived from the general rates, these departments did not join in the annual scramble for the proceeds of municipal taxation for desirable projects that of necessity brought other departments into intimate contact.

Now this tendency is, in my view, one that ought to be combatted, and a useful corrective is undoubtedly the control exercised in financial matters by the municipal treasury. In spite of the apparent drag on such a volatile department as electricity that the conservative outlook of the treasury may appear to impose, this, in the broadest sense, is a valuable stabilising factor. I believe that it is important that the major communal activities of a town should be identified with the municipality—and that they should be wholeheartedly carried out by a team of municipal workers aiming at the whole good of the community and not

merely the good of any particular department.

On the other hand, electricity departments do have special problems that it is difficult if not impossible easily to reconcile with the technique of municipal administration as developed over the centuries for the more normal civic activities. Special dangers in both generation and distribution call for a staff discipline and staff selection that is not always consistent with an administration designed primarily to handle the more mundane local authority functions. The so-called "municipal-stroke," undesirable as it is in any department, cannot be tolerated in areas where split-second decisions may mean life or death and the safety or otherwise of large quantities of expensive plant.

The differences can most clearly be appreciated when there is a deficiency in plant to meet the requirements of consumers. Electricity is a commodity that cannot be shared out when in short supply in the way such things as water can. There is only one way practically to ration electricity, and that is to cut off supplies entirely to varying proportions of consumers, so that the total instantaneous demand can be kept within the technical limits of the generating plant supplying it. Nor is it of any use to say, of a developing area, for example, that an increase of cable, transformer, or switchgear capacity can be postponed and the consumers asked to endure poorer supplies—as is frequently done with water—until it is financially or otherwise possible to effect improvements. A few hours overload on such equipment will result in its complete destruction and a permanent cessation of all supplies until it can be replaced.

These sort of considerations make electricity supply something that fits very uncomfortably into the routine of municipal estimating and tender procedure, particularly in these days when materials and labour have to be snatched at if they are to be obtained at all. Factors associated with danger to life are recognised factory and machinery legislation which, of necessity, imposes on the engineer in charge of an electricity undertaking and other defined officials responsibilities which can only be carried out if rather more authority and discretionary powers are granted than is customary with most municipal councils. The picture of engineers chafing, quite justifiably, under some particularly irksome limitation imposed by their municipal harness is by no means an uncommon one, and the hiatus between the plain necessities of a safe and efficient electricity supply and the somewhat archaic rigidity of municipal procedure is sometimes so obvious as to lead some to the conclusion that they are quite incompatible.

But this, I am convinced, is a short-sighted view. Technical efficiency and safety are extremely important factors, it is true, but there is an overriding political factor that is even more important. Local government as it is practised in the Commonwealth is one of the grandest institutions that our forefathers have handed down to us. By its very diversity it assures the freedom of the common man to decide his own destiny in the personal and domestic things of life, and it stands today as one of the few bulwarks against the flood of bureaucratic remote controls that arise inevitably from the increasing powers of State government.

And so I would urge municipal electrical engineers and their staffs to give thought to all the implications of the age-old administrative machine of which they are honoured to be members: to remember that the greatest good of the whole is in the long run in the best interests of any part, and to regard themselves as municipal servants first and electrical engineers next. At the same time I would remind Councillors and administrative officials of other departments that the birth of the youngest municipal department towards the end of last century imposed upon them the inevitable responsibilities of parenthood. An understanding of the special problems of this child is all-important, for the child is all-important, for the child has come of age all of a sudden and is found to be a person of considerable significance in the highly mechanised age in which we live.

If it is right that electricity should continue as one of the major municipal activities, it is also right that the whole municipal body should be to some extent modified as a result of so close an associa-

tion with this new and virile undertaking. Councillors, too, should not be content to say that they know nothing about electricity any more than the ratepayers would be content if they felt that such councillors knew nothing whatever about health matters, traffic control, or municipal rating procedure. It is also necessary for State and Provincial legislators to remember that municipal activities are no longer confined to such items as sanitary removals, road maintenance, and tree-planting programmes, for it is largely the strait-jacket of Municipal Acts and Ordinances that imposes the limitations on municipal procedure to which I have already referred.

With all its weaknesses, however, I am a firm believer in the municipal system of government as it is practised in Commonwealth countries, and I am sure that it is capable of development to meet the rapidly varying needs of this era of change, if all those concerned approach the problems associated with such developments with wisdom, understanding and enthusiasm.

Mr. J. C. DOWNEY:

I will now call on Councillor Dubb to propose a vote of thanks to our President.

Councillor L. DUBB (Port Elizabeth):

Mr. Mayor, Mr. President, Ladies and Gentlemen: On behalf of the delegates present I have very great pleasure in proposing a vote of thanks to you, Mr. President, for a very interesting and, if I may say so, a very illuminating address. As one who is an exponent of the system of private enterprise as best suited to our way of life, I was particularly interested in the historical sketch which you gave, showing how electricity undertakings have become departments of the municipalities. It was interesting, too, to learn that this position has arisen not from any deliberate encroachment by the municipalities on the preserves of private enterprise but rather as the logical development of those recognized functions of municipalities to cater for the essential services of the community.

Mr. President, in your address you have appealed to the Municipal Electrical Engineer to recognize his department as an integral part of the municipal economy. I feel that this appeal could be directed with no less emphasis to the Chairmen of Electricity Committees, because we often share with our Engineers that feeling of annoyance, when we find that there is an urgent need for new plant or new transformers or sub-stations and so on, and we have to submit to the cumbersome procedure of municipal finance, when we all of us assert—and with justification—that our Department must be run on business lines.

In your address, Mr. President, you have given us very cogent reasons as to why we should submit to this procedure, and I am sure that all members here will take heed of what you say and will recognize our true position within the framework of municipal government.

Once again, Mr. President, I want to thank you very much for a very interesting and constructive paper and to wish you a very successful year of office.

PRESIDENT:

Thank you very much, Councillor Dubb.

VENUE OF NEXT CONVENTION

The next item on the Agenda is the venue of the 1953 Convention, and I would ask for any offers that there may be from the body of the hall in this connection.

Councillor L. M. WEINER (Johannesburg):

Mr. President, it is indeed a great pleasure for me, on behalf of the Johannesburg City Council, to invite you to hold your next Convention in our city.

I know that inland delegates are not at all enthusiastic when they are asked to come to Johannesburg, because we in Johannesburg always look for conferences at some port town; but, should the Convention accept Johannesburg's invitation, I do want to tell you that we have just as many amenities in Johannesburg as you have at the port towns. I would therefore appeal to those who are not at the moment enamoured of the idea to come to our city next year, and assure them that they will be given a royal welcome—the sort of welcome Johannesburg always gives.

Although we are not a port town, I do want to say that at least our Electricity Departments have made provision for those delegates who like fishing by giving them the opportunity, at Orlando, to enjoy the finest fishing known in South Africa. I can guarantee delegates that if they come to Johannesburg they will not miss the sea and that, if they happen to be keen on fishing, they will not be disappointed.

Johannesburg, of course, is one of those undertakings which comes into the limelight and is at times considered to be rather ostentatious. I was very interested to learn from the Mayor of Bulawayo that Bulawayo at the present moment is selling no less than 200,000,000 units per annum. That may seem colossal to some delegates here this morning, but, Mr. President, in Johannesburg for 1950-51 our total sales of units reached the colossal number of 756,090,586 units.

Now, for the coming year, 1952-53—and this is a conservative estimate—we will be selling no less than 865 000 000 units. So it is a pity that we could not hold the Convention a year later in Johannesburg, by which time we shall have reached a higher mark.

I venture to suggest, Mr. President, that it would be worth coming to Johannesburg to see how this colossal number of units is generated, apart from enjoying the entertainment that we would give to every delegate. I can assure you that if you come to Johannesburg you will remember the Convention there for many years to come.

May I close by expressing the wish that you will agree to come to Johannesburg, that in the year to come we shall all enjoy good health, and meet again next year in Johannesburg. I hope there will be no opposition to my suggestion, and that it will be accepted with acclamation.

PRESIDENT:

Thank you, Councillor Weiner. We are a democratic institution, so, in spite of the appeal for unanimity, it is my duty to ask if there are any other offers of hospitality for next year. (There was no response. Then I declare that the 1953 Convention will be held in Johannesburg.

ELECTION OF VICE-PRESIDENT

We now come to the election of the remaining officers. You will see from your Agenda the existing personnel. It is necessary first to elect a Vice-President, and I will call for nominations.

Mr. D. A. BRADLEY (Port Elizabeth):

Mr. President, Ladies and Gentlemen: It is indeed a great privilege to me this morning to be permitted to make a nomination for the vice-presidency, and my nomination will be that of Mr. J. C. Fraser, of Johannesburg. He, of course, needs no introduction to any of us, for he has been a member of the Executive of this Association for some years, and it has been my pleasure to be associated with him there. I have been associated with him in the trade and in the profession for close on thirty years, and in the past ten years he has done yeoman service for this Association in his capacity as an Executive Member. In fact, if it were not for our worthy Executive Members who are stationed on the Reef and thereabouts, it would be a most difficult task—and a most expensive one—for this Association to carry on, so magnificently do all our delegates from the Reef do their work. That is by the way. Mr. Fraser has attained the heights as an Engineer; he has given wonderful service to this Association and, since the Convention is to take place in Johannesburg, following the very cordial invitation to which we have listened from Councillor Weiner, I now have great pleasure in nominating to this assembly as Vice-President Mr. J. C. Fraser.

Councillor C. E. K. YOUNG (Pietermaritzburg):

Mr. President: I do not think it is necessary for me to eulogize the services of Mr. Fraser. I have known him for some years, and he is held in high esteem in the electrical world of South Africa, so I have very much pleasure indeed in seconding the proposition.

PRESIDENT:

Are there any other nominations? (There was no response.) I now declare Mr. J. C. Fraser duly elected Vice-President for the ensuing year.

Mr. R. W. KANE (Johannesburg):

Mr. President, Ladies and Gentlemen: In Mr. Fraser's absence it is only fit and proper that I should thank you for the honour you have done him, and particularly the honour you have done Johannesburg. I am sure that you have chosen a very worthy Vice-President.

ELECTION OF EXECUTIVE COUNCIL

PRESIDENT:

The next requirement is the Members of the Executive Council. I would remind you that we now have a President, a Vice-President and two Past Presidents. The Past Presidents, Mr. Hallé and Mr. Downey, are ex-officio members of the Executive. It is necessary, therefore, to elect the rest of the Executive Council, consisting of six members. In this connection I would like to put to you a recommendation from the outgoing Executive, to the effect that it is felt that it is most desirable that each Province of the Union, and Southern Rhodesia, should be represented on the Executive Council. Without attempting in any way to dictate to the Convention, it is the suggestion of the Executive that there are many advantages in ensuring that each Province should have a representative on the Executive Council. If you agree with that suggestion, when you come to ballot I would further suggest that you should first give the names of four persons representing each of the four Provinces of the Union. That would ensure that the first four names were representatives of the four different Provinces. Rhodesia is, of course, already represented, but that does not by any means mean that it should not have further representation. I now call for nominations for the six vacancies on the Executive Council.

There were twelve nominations, duly moved and seconded, as follows:-

Mr. E. L. Smith (Boksburg).
Mr. C. Kinsman (Durban).
Mr. G. J. Muller (Bloemfontein).
Mr. A. F. Turnbull (Vereeniging).
Mr. J. E. Mitchell (Salisbury).
Mr. D. A. Bradley (Port Elizabeth).
Mr. F. Stevens (Ladysmith).
Mr. J. L. Van der Walt (Krugersdorp).
Mr. C. G. Downie (Cape Town).
Mr. A. Foden (East London).
Mr. D. J. Hugo (Pretoria).
Mr. W. Rossler (Kroonstad).

All members nominated agreed to stand, the ballot took place and the following were duly elected: Mr. C. Kinsman (Durban); Mr. J. E. Mitchell (Salisbury); Mr. G. J. Muller (Bloemfontein); Mr. D. A. Bradley (Port Elizabeth); Mr. J. L. Van der Walt (Krugersdorp); Mr. C. G. Downie (Cape Town).

(**Adjourned** from 12.30 to 2.30 p.m.)

WORLD POWER CONFERENCE

PRESIDENT:

We now proceed to the next item on the Agenda, the Reports of the Sub-Committees. The first of those deals with the World Power Conference, and in Mr. Fraser's absence it will be given by Mr. Kane.

Mr. R. W. KANE (Johannesburg):

As far as can be ascertained there has been no meeting of the South African National Committee of the World Power Conference since the last Convention.

A communication has been received from the Secretary, advising of a meeting of the International Executive Council in Chicago on the 4th September, 1952, and not being aware of any of our Executive members being in Chicago on that date, the Secretary was advised we would not be represented.

(There were no comments on the Report.)

PRESIDENT:

I will now ask Mr. Kane if he will be good enough to read Mr. Fraser's Report on the International Conference on Large Electrical Networks (C.I.G.R.E.).

CONFERENCE INTERNATIONALE DES GRANDE RSSAUX ELECTRIQUES (C.I.G.R.E.)

South African National Section

Mr. R. W. KANE (Johannesburg):

Mr. President and Gentlemen: Mr. Fraser states: The annual general meeting of the South Afrcan National Section of the C.I.G.R.E., and the only meeting held

during the year, took place on Friday, 29th February, 1952. The following was the business transacted:-

(1) *Resignation of the Chairman, Mr. A. M. Jacobs.*

Mr. A. M. Jacobs, having relinquished his position as chairman on the Electricity Supply Commission and at present not being associated with any power producer or consumer of electric power, resigned from the position of chairman of the South African National Section. His resignation was accepted with regret, and a letter of appreciation for his services to the section during the past two years was addressed to him.

(2) *Election of Chairman.*

Mr. I. D. de Villiers of the the Electricity Supply Commission was duly elected chairman.

(3) *Election of Executive Committee for 1952.*

The following five members were elected: Professor G R. Bozzoli, Messrs. G. Bradford, J. C. Fraser, J. S. Trelease, I. de Villiers, J. T. Allen (ex officio).

(4) *Subscriptions for 1952.*

By a decision of the Administrative Council in Paris, subscriptions have been raised from 1st January, 1952, to the following (equivalent S.A. currency):- Collective members, £15 15s.; Personal members, £1 5s.

Representations have, however, been made to the Administrative Council with a view to continuing the consession granted in the past, whereby collective members of the South African Section pay 50 per cent of the normal subscription. Pending the Council's decision, collective members are recommended to defer payment of their subscriptions; personal members are, however, asked to forward their remittances as soon as possible.

It was generally agreed that the increase in the collective membership subscriptions from the present (reduced) rate of 5,000 francs to 15,000 francs would be likely to have an adverse effect on the number of collective members, some of whom it was thought would be unwilling to continue their subscriptions at the higher rate; this view was supported by written communications from the University of Cape Town and from the City of Salisbury Electricity Department. The justification for the present reduced subscription rate for collective members, namely, the difficulty of active participation in the Conference by South African members owing to their isolation from Europe, was still valid; if a number of collective members withdrew their support this would offset the increase in revenue which the higher rate was intended to produce. A proposal by Mr. Black, seconded by Mr. Fenwick, that a letter be addressed to the vice-president of the Conference presenting the views of the meeting, and requesting that the collective membership subscription for the South African Section be maintained, as in the past, at 50 per cent of the normal rate, i.e., at 7,500 francs, was approved. Further, no action be taken in connection with the increased personal membership subscription, since, in this case, the increase was small; the future personal membership subscription will therefore be 1,200 francs, or £1 5s. 6d. S.A. currency.

Since the Executive meeting, a further communication has been received from the Honorary Secretary as follows:-

"Subscription for 1952

"Further to the circular dated the 13th March, 1952, regarding the increased subscription rates fixed by the Administrative Council, approval has now been received from Paris for the continuation of the concession granted in the past whereby collective members of the South African Section pay 50 per cent of the normal rate. The revised annual subscription rates for the S.A. Section from 1st January, 1952, are therefore as follows: Collective members, £7 17s. 6d.; Personal members, £1 5s. 6d.

"Members are requested to forward their subscriptions to the Hon. Secretary as soon as possible, and those who have already paid their subscriptions at the old rates are asked to forward the necessary additional payment."

(5) *Invitation to attend the 14th Convention in Parys—May 28th to June 7th.*

An invitation was received from the General Delegate, Vice-President of the C.I.G.R.E., to delegates from South Africa

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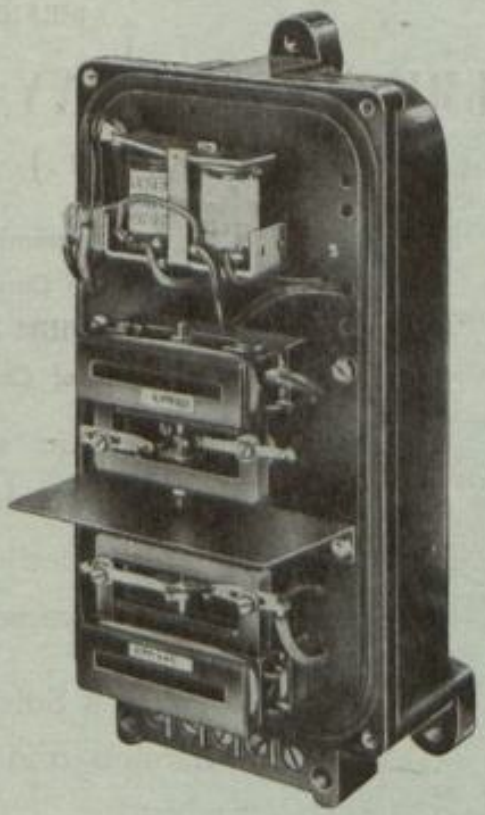

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to attend the meetings of the 14th Congress of the above Conference which will take place in Paris.

Any member wishing to attend should communicate with the local Secretary.

(6) *Conclusion.*

Thanks are due to Mr. L. H. Black, Hon. Secretary, for furnishing the necessary information from which this report has been compiled.

PRESIDENT:

Thank you, Mr. Kane. The Report you have just heard relates to Mr. Fraser's representation on that South African Committee as a member of this Association, and has no direct bearing on the matter I am now going to bring to your attention, namely, the membership of this Association of C.I.G.R.E. In connection with the question of subscriptions, to which Mr. Kane has referred, your Executive considered the matter yesterday and decided to recommend that this Association ceases to be a member of C.I.G.R.E. It was felt that the value of the membership was uncertain, that we received no particular documents from C.I.G.R.E. that we could not easily obtain for no extra cost if we wished to have them; and the increase of the subscription, although it has been agreed to reduce the amount of the increase, is still considered a sufficient justification for our ceasing to be members of the organization. So it is the recommendation of the Executive that we hereby cease subscribing to this body. If there are any comments on that proposal before I put the motion I would like to have them. (There was no response.) Then is that agreed, gentlemen?

(Agreed.)

The next Report, also to be given by Mr. Kane, is on the Electrical Wiremen's Registration Board.

ELECTRICAL WIREMEN'S REGISTRATION BOARD

Mr. R. W. KANE (Johannesburg):

Mr. President and Gentlemen: Mr. Fraser states: It is with pleasure that I present you with a review of the activities of the Wiremen's Registration Board for the year 1951.

(1) *Personnel of the Board.*

During the year 1951 the Electrical Wiremen's Registration Board consisted of Mr. R. N. F. Smit, Chief Inspector of Factories, as Chairman, together with Messrs. J. C. Fraser, A. Elisio, R. Townsend and P. Sommerville. The vacancy occasioned early in the year by the resignation of Mr. D. Harvey, was not filled. The Board held eleven meetings, whilst the Examinations Sub-Committee met on six occasions.

(2) *Applications for Registration.*

The attached Table I gives particulars of the applications which were considered by the Board during the year, as well as comparable figures in respect of earlier years. The table shows that in 1951 the Board considered 372 applications for registration, that 349 applicants were accepted as suitable candidates for examinations and that registration was approved in 282 cases. Thirty-seven applications were refused, in most instances on the ground of lack of documentary evidence of the requisite training and experience in wiring work.

The total applications considered by the Board since its inception number 7,461, while the total number of wiremen registered as at 31st December, 1951, stands at 4,858, or 61·5% of the total number of applications; 888 (or 11·9%) of the total applications were rejected and, deducting these last two figures from the total of 7,461, the balance of 1,715 applications considered by the Board may be accounted for in three main classes, viz.:

(a) Candidates accepted for examination, who have not yet been successful in passing, or who have not entered for the examinations (approx. 1,400);

(b) Applicants in respect of whom the Board's decision was deferred pending submission of further evidence on which to assess their suitability for registration (approx. 200);

(c) Applicants who, having passed the prescribed examination, or being exempted therefrom, had qualified for registration, but failed to submit the necessary application for the issue of certificates (approx. 120).

(3) *Examinations.*

Statistical data in regard to the written examinations conducted by the Board over the last eleven years is shown in Table II and amplified in Table IIA, which gives more detailed figures in regard to the 1951 examinations, while in Table III similar information is given in respect of the practical examinations.

Three written examinations were held during 1951, in respect of which 1,060 notifications were issued. Of the 617 candidates who subsequently entered, 571 presented themselves for examination, and of these 104 (18·2%) passed both in Section I (Regulations) and in Section II (Theory); 141 (24·7%) passed in Section I only and 67 (11/8%) passed in Section II. Of the 259 (45·3%) failures, 161 were required to re-write the full examination, 96 to re-write Section 1, and 78 to re-write Section II. The 236 candidates shown as "complete passes" satisfied the examiners in the section(s) of the examination they were required to take, and thus became eligible for the practical examination, or, if exempted from the latter, for registration.

In accordance with the Board's accepted practice of deleting the names of prospective candidates who fail to respond to three notifications of examinations, 109 names were so deleted during the year, and at 31st December, 1951, 317 remained on the examination lists.

Table II shows that a total of 5,150 candidates were present at the 25 written examinations held since 1941 and of these 1,111 (21·6%) passed in both sections, 1,175 (22·8%) in Section I and 646 (12·5%) in Section II.

Prima facie, it would appear that a comparatively small proportion of candidates is successful in examinations, but it should be pointed out that in the preceding paragraphs and in the relevant tables, the total number of candidates is inflated by the inclusion of a fairly substantial number who have failed to satisfy the examiners on one or more occasions. Were the proportion of successes to be related to the actual number of persons examined, a figure which would approximate that of 3,922 shown in Table I as having been accepted for examination, a more favourable reflection of the position would emerge, the percentage of successful candidates being correspondingly increased. At the time of writing, however, exact figures in this respect were not available.

Information regarding the practical examinations, of which, to date, 58 have been held, is given in Table II, which shows that of the 2,413 candidates examined, a total of 2,120 (87·7%) passed. Seven practical examinations were held in 1951, during which year 253 (87·5%) of the 289 candidates examined were successful. The proportion of successes in the practical examinations is thus shown to be remarkably high, and were the computation referred to in paragraph 8 applied, even more gratifying results would be revealed.

Comparing the number of successful candidates (2,120) in Part II of the examination with the total number of wiremen registered (4,858), and making due allowance for the number of applicants who were required to take Part I of the examination only (approx. 300 to 400), it is clear that a very large proportion of wiremen were accorded registration without being called upon to undergo examination. The majority of the wiremen thus exempt from examination relied, when making application for registration, upon the qualification referred to in Section 12(1)(e), viz., that at the commencement of the Act they were the holders of wiremen's certificates or licences issued by a supplier, whilst the remainder were exempted by the Board by virtue of its powers under Section 12(2).

(4) *Determination of Areas.*

By notice under Section 18 of the Act, the Minister of Labour, during 1951, determined the magisterial districts of Newcastle, Kroonstad and Hermanus as areas to which the provisions of Section 19 (supplier to inspect wiring) and Section 20 (wiring of premises to be done by or under the supervision of registered wiremen) should apply. Notice was also given of his intention so to apply the provisions of these sections, after the lapse of a year, to the magisterial districts of Eshowe, Potgietersrust, Grahamstown, Cradock and Rustenburg and the municipal area of Heidelberg (Transvaal).

(5) *Prosecutions.*

Legal action was taken in six instances for contravention of Section 20(a) in that the accused, not being holders of certificates, performed wiring work in areas in respect of which determinations had been made; in two instances for contravention of Section 20(c) in that the accused caused or permitted wiring work to be done in contravention of the provisions of paragraph (a) referred to above; and in one instance for contravention of Section 17(3) of the Act, which requires the holder of a provisional certificate of registration to return it to the Board within two days of the termination of the period of currency thereof; whilst in two cases municipalities gave notice that they had instituted proceedings for contraventions of Section 20(a) and of by-laws framed under Section 22, respectively.

(6) *Conclusion.*

The Board is grateful to the examiners for the manner in which they have performed their onerous duties. The enthusiasm and care exercised by the examiners enable the Board to function properly.

Thanks are also due to the clerical division of the Department for their assistance without which it would be impossible for the Board to perform its prescribed duties.

Finally, a word of appreciation to the Chairman of the Board for furnishing the necessary information from which this report is compiled.

ELECTRICAL WIREMEN'S REGISTRATION BOARD
STATISTICAL INFORMATION AS AT 31st DECEMBER, 7951

Table I. Applications for Registration

Year	*Number of Applications Received*	*Number of Applicants Registered*	*Number of Applicants Accepted for Examination*	*Number of Applications Refused*
1940	2,668	725	127	92
1941	172	780	282	91
1942	120	193	148	108
1943	281	178	182	54
1944	299	208	159	55
1945	444	218	179	57
1946	721	350	418	93
1947	625	501	603	78
1948	730	418	634	62
1949	569	572	503	39
1950	460	433	338	122
1951	372	282	349	37
TOTALS:	7,461	4,858	3,922	888

Table II. Part A Written Examinations
Divided into Two Sections — Section I (Regulations) and Section II (Theory)

Year	*Number of Examinations Held*	*Number of Candidates Examined*	*Number of Candidates who passed Sections I and II*	*Number of Candidates who passed Section I only*	*Number of Candidates who passed Section II only*
1941	2	93	19	6	6
1942	2	164	65	48	43
1943	2	247	68	45	62
1944	2	296	96	77	47
1945	2	332	101	14	28
1946	2	512	185	135	59
1947	2	639	106	213	35
1948	2	819	132	222	144
1949	3	920	144	139	83
1950	3	557	91	135	72
1951	3	571	104	141	67
TOTALS:	25	5,150	1,111	1,175	646

Table IIA. Written Examinations, 1951

Number of candidates notified 1,060
Number of candidates entered 617 (56·3%)
Number of candidates absent 46 (7·5%)
Number of candidates present 571 (92·5%)

Summary of Results

	Present	*PASSED*			*Failed*
		I and II	*I*	*II*	
Full examination ...	341	104 (30·5%)	41 (12·0%)	35 (10·3%)	161 (47·2%)
Section I	161	——	100 (62·1%)	——	61 (37·9%)
Section II	69	——	——	32 (46·4%)	37 (53·6%)
TOTAL	571	104 (18·2%)	141 (24·7%)	67 (11·8%)	259 (45·3%)

Total number of complete passes 236 (41·3%)
Total number of failures, 335 (58·7%)
these candidates being required to rewrite —
(i) Full examination 161
(ii) Section I only 96
(iii) Section II only 78

Table III. Part B. Practical Examinations

	Number of Examinations Held	*Number of Candidates Examined*	*Number of Candidates who Passed*
1942	2	50	49
1943	2	73	67
1944	3	130	123
1945	4	158	145
1946	7	249	229
1947	8	362	299
1948	7	249	227
1949	9	460	381
1950	9	393	347
1951	7	289	253
TOTALS	58	2,413	2,120

PRESIDENT:

Thank you, Mr. Kane. Are there any remarks on that Report?

Mr. R. N. F. SMIT (Chief Inspector of Factories; Chairman, Electrical Wiremen's Registration Board):

Mr. President and Gentlemen: I should like to thank Mr. Fraser very much for the way in which he has presented his report on the work of the Board. I have not much to add to it, but there are one or two things I would like to say. The testimonials of certain applicants for registration are sometimes rather vague as to the amount of wiring experience they have had. In one instance, an applicant was described in the testimonial as having had ample opportunity in his service to gain experience of wiring work, which means precisely nothing. So please, when you give a man a testimonial, say exactly what experience he has had, in wiring work particularly.

PRESIDENT:

Are there any other contributions? If not, we will pass on to the next item, the Report of our representative on the **South African Standards Institution.**

Mr. J. C. DOWNEY (Springs):

LAST AND FINAL REPORT ON THE SOUTH AFRICAN STANDARDS INSTITUTION

As reported at the last Convention that there would be a possibility that during the coming year the South African Standards Institution would cease to continue to operate, I have now to advise you that on the promulgation appearing in the Government Gazette on 25th May, 1951, the South African Standards Institution discontinued their activities.

The whole of their work has now been taken over by the South African Bureau of Standards.

I feel I would be failing in my duty if I did not refer to the history and the sterling work done by the past members of the Standards Institution.

At the time the British Standards Association was formed, South Africa saw the new rapidly expanding mining industry in the Witwatersrand taking an important role in the country, and the need for a system of standardisation was becoming more evident.

A number of attempts to establish some sort of standardising body was made, but without great success.

An effort that brought lasting results was made in 1909 when the following societies were represented: The Transvaal Institution of Mechanical Engineers, the Chemical Metallurgical and Mining Society of South Africa, the Association of Transvaal Architects, the Federation of Master Builders of South Africa and later the South African Institute of Electrical Engineers of the Transvaal Institute of Mechanical Engineers.

This committee met under the chairmanship of Professor John Orr and was named the Committee of Standardization of Specifications for South African Materials, which later was changed to the South African Standards Institution.

Sub-committees were apointed to investigate various matters and it is interesting to us to note that as early as 1911 an electrical sub-committee was formed to deal with all electrical matters.

In July, 1917, the South African Committee agreed to act as the South African branch of the British Engineering Standards Association.

The technical sub-committees drafted specifications for materials requiring special attention for South African conditions, which were approved by the main committee and published by the Institution.

Various draft specifications received from overseas standardising authorities were examined by sectional committees and commented upon.

A list was drawn up of the British Standard Institution specifications that were approved as suitable for South African conditions.

It will be remembered that one of the last specifications that received the attention of the Institution was for wooden poles.

As most of all this work was done in spare time, and under extremely difficult circumstances, one can appreciate the work that has been done by this valiant band of workers.

The Standards Institution consisting of voluntary workers, and supported by means of voluntary donations fully realised that the industrial needs of the country could only be carried out efficiently by a paid staff of technical men working on a full-time basis.

What was needed was an Act of Parliament and adequate support from the Government.

Attention was therefore paid to this aspect of the case and thus the Standards Act No. 24 of 1945 was passed by Parliament, whereby this scheme was brought into operation and the South African Bureau of Standards was established.

This did not complete the work of the Standards Institution, and in the years following the Standards Institution and the Bureau worked in close collaboration, the younger organisation deriving much benefit from the former's experience.

Later, the Institute recognised that as the Bureau had now become fully established, the latter could now completely carry out all the work of standardisation without the help of the Institution.

On the recommendation of the Standards Institution, the Minister amended the Standards Act in order to meet the needs for the correct representation on the Standards Council, and on the promulgation of the amendment to the Standards

Act the South African Standards Institution then ceased its activities.

I am proud to say that during the last five years I had the honour to be your representative on the main committee and the electrical section sub-committee.

The work of the South African Standards Institution is now completed, but the foresight and work of the voluntary members will continue to the benefit of South Africa, and I am sure the South African Bureau of Standards will always remain as a creditable offspring of the Standards Institution.

To the past members of the South African Standards Institution, I say well done, faithful sons of South Africa.

(There were no comments.)

Mr. C. R. HALLE (Pietermaritzburg):

I would like to propose a vote of thanks for the sterling work that Mr. Downey has done as our representative over five years on that very fine Institution.

Mr. F. STEVENS (Ladysmith):

I have pleasure in seconding that.

PRESIDENT:

If there is no discussion on that item, then I will ask Mr. Van der Walt, our representative on the **South African Bureau of Standards,** to give his Report.

Mr. J. L. VAN DER WALT (Krugersdorp):

Mr. President, Ladies and Gentlemen:

The South African Bureau of Standards

At our Convention in Cape Town, an outline of the organisation of the Bureau and the procedure in drawing up specifications was given.

The attached schedule shows the position regarding specifications in which your Association has an interest.

Your Association has again taken a keen interest in these specifications and were represented on all the committees responsible for drawing up these specifications.

Safety Specifications

As reported previously, it is the intention to promulgate safety specifications and so make them compulsory. After promulgation, and the elapse of a time limit, no article not complying with the safety specification may be offered for sale.

It was reported previously that certain safety specifications would be promulgated at an early date, thus preventing the sale of dangerous commodities. The most urgent specifications under this class being apparatus for heating liquids, radiators and stoves. Due to some legal implication, however, this was not possible, as reference is made to the type of cord to be used. The safety specification for flexible cords was then only in the draft form. It was found extremely difficult to separate the safety specification for cords from the quality specification. This difficulty has now, however, been overcome. It is now envisaged that important developments in the promulgation of safety specifications may take place in the very near future.

In the safety specification for plugs and sockets, your representative is making strong representation to have terminals colour marked for earthing and thus ensure extra safety.

Quality Specifications

Quality specifications are not compulsory but manufacturers may apply for the mark of quality and thus consumers purchasing such material are ensured that rigid control is exercised over the quality of the product.

In the quality specification for porcelain insulators, a delay in its publication was caused by the awaiting of the revised British Standards specification on High voltage insulators. Due to the demand in South Africa, however, for a low voltage insulator specification, the Drafting Committee has decided to draw up a specification for low voltage insulators. A standard design has been adopted with varying dimensions. A separate specification for ceramic materials is being drafted.

Codes of Practice

Explosion Hazards in Hospitals

At the request of the Transvaal Provincial Administration to minimise explosion hazards in anaesthetic laden atmospheres, a committee has now been set up to draw up a code of practice.

Meter Test Code

At the Cape Town Convention it was resolved to adopt the Meter Test Code on a voluntary basis for a period. A circular letter to this effect was sent out by the Electricity Control Board, asking local authorities to adopt the code on a voluntary basis and thus, through experience, recommend amendments.

General

Nomenclature in Electrical Engineering and Standardisation of Electric and Magnetic Magnitudes and Units

It is the intention to draw up a nomenclature in electrical engineering in both official languages as a need for such a nomenclature is desirable.

It is also the intention to recommend the use of the M.K.S. system of units in universities and colleges, and a committee has been formed to prepare a draft recommendation.

The Electrical Engineering Division of the Bureau is continually expanding and acquiring additional testing equipment. An acquisition of interest is standard current transformers for testing current transformers.

It is noticed that one large undertaking now insists on the mark of the Bureau for certain appliances sold under their hire purchasing scheme and that this matter is under consideration by another large undertaking.

I wish to express my appreciation to all members who so willingly offer their valuable time to represent your Association on the various committees. I can assure all members that they are doing excellent work for the Association and consumers.

To the directors and staff of the Bureau, thank you for the co-operation and assistance in matters affecting the Association.

SPECIFICATIONS AND CODE OF PRACTICE PUBLISHED UP TO MAY, 1950

Codes of Practice

03—1947 B	Protection of Buildings from Lightning (under review).
01—1948	Electricity Meter Testing Code.

Quality Specifications

56—1949	Tungsten Filament General Service Lamps.
97—1950	Paper Insulated Electric Cables for General Purposes.
98—1950	Paper Insulated Electric Cables for Heavy Duty.
150—1950	Polyvenyl-Chloride (P.V.C.) Insulated Electrical Conductors.
151—1950	Fixed Electric Storage Water Heaters.
153—1950	Electric Stoves and Hotplates.
154—1950	Electric Cooking Plates.

Safety Specifications

SV—101	Manually Operated Airbreak Switches.
SV—102	Portable Electric Immersion Heaters.
SV—103	Electric Radiators.
SV—105	Fixed Electric Water Heaters.
SV—108	Domestic Electric Washing Machines.
SV—109	Plugs and Socket Outlets and Socket Outlet Adaptors.
SV—111	Replacement Type Heating Units.
SV—112	Electric Hand Lamps.
SV—115	Electric Soldering Irons.
SV—117	Electric Stoves and Hotplates.
SV—123	Portable Electric Reading Lamps.

The following specifications have been published during the ensuing year:-

Safety Specifications

SV—118/1951	Small Extra Low Voltage Transformers.
SV—119/1951	Lampholders and Bayonet Lampholder Adaptors.

In Course of Publication

General

314—1950	Flameproof Enclosures for Electrical Apparatus.
339—1951	Creosoted Wooden Telephone, Telegraph Light and Power Transmission.

Quality Specifications

152—1951 Manually Operated Enclosed Type Air Break Switches and Isolators.
155—1951 Miniature Circuit Breakers for Lighting, Heating and Domestic Installations.
156—1951 Miniature Circuit Breakers for Protection of Electric Motors.
157—1950 Domestic Electric Toasters.
158—1950 Portable Electric Appliances for Heating Liquids.
159—1950 Domestic Electric Irons.
160—1950 Electric Air Heaters and Radiators.
162—1951 Screwed Steel Conduit and Fittings for Electrical Wiring.
163—1951 Wall and Appliance Switches.

Safety Specifications

SV—100/1949 General Requirements for Electrical Apparatus.
SV—107/1950 Portable Electrical Appliances for Heating Liquids.
SV—113/1950 Domestic Electric Toasters.
SV—114/1950 Electric Hand Irons.

Under Review Following Comment

Quality Specifications

Porcelain Insulators and Bushings.
Two Pole and Earthing Pin Plugs and Socket Outlets.
Vulcanised Rubber Insulated Cables and Flexible Cords for Power and Lighting Purposes.

Safety Specifications

Domestic Radio and Electric Apparatus.
Flexible Cords for Power and Lighting Purposes.

Issued for Comment

Storage Batteries. For use in motor vehicles. (Revision.) (Quality.)

In Course of Preparation

General Specifications

*Nomenclature in Electrical Engineering and Standardisation of Electric and Magnetic Magnitudes and Units.
Explosion Hazards in Operating Theatres and Anaesthetic Rooms.

Quality Specifications

*Apparatus Connectors.
*Fuses.
*Insulating Tapes.
Lampholders.
Small Domestic Type Lightning Arrestors.
Vulcanised Rubber Insulated Cables for Telecommunication and Signalling Purposes.
Electric Ceramic Materials.
P.V.C. Moulding Compound for Dielectric Purposes.

Safety Specifications

Electrical Heating Pads.
Fractional Horsepower Motors.
Motor Driven Electrical Appliances.

*New Committees formed during year under review.

PRESIDENT:

Are there any comments?

Mr. C. MULLINS (Electricity Control Board):

Mr. President and Gentlemen: As you are aware, I am representing the Electricity Control Board. My Chairman, Dr. de Villiers, has particularly asked me to see if it is not possible at this Convention to get a definite decision on the adoption of the meter test code. You have had over twelve months to consider the matter and we have written to nearly every one of the Municipalities for their comments. Only one has raised any particular objection to it in reply. I should like to put it before your members now to see if it could not be put into practice in, say, twelve months' time, and incorporated in the Electricity Act Regulations.

PRESIDENT:

Mr. Mullins and Gentlemen: The subject of this test code is one that will have to engage the attention of this Convention, but at our meeting of the Executive yesterday Mr. van der Walt raised certain points about the training of meter mechanicians that we felt it was most desirable the Convention should discuss before reaching any conclusion on the subject of the promulgation of the meter test code. Before we come to that, however, I want to make sure that there is

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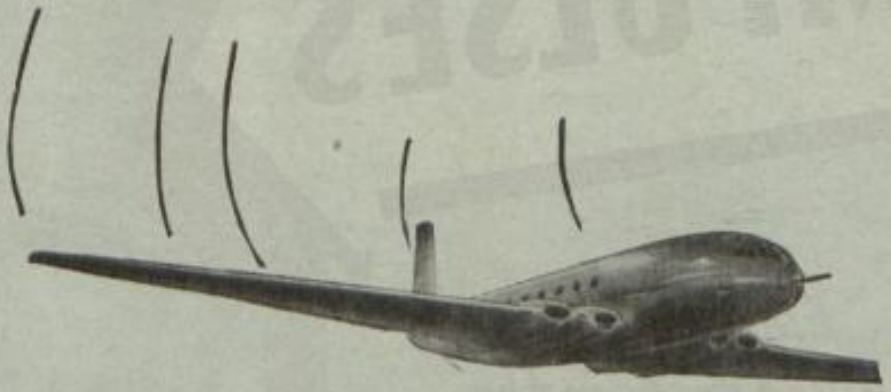

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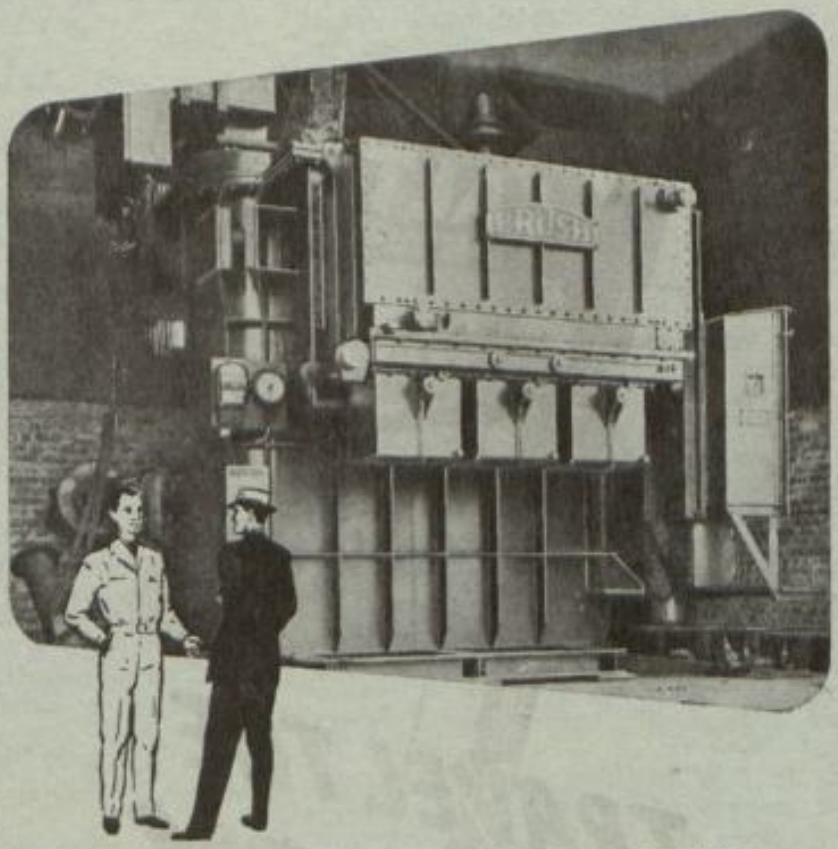

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no other discussion on the Report that Mr. van der Walt has given on the South African Bureau of Standards.

Mr. J. W. SWARDT (S.A. Bureau of Standards):

Mr. President: I would like to thank Mr. van der Walt very much for the extensive report he has given on the activities of the Bureau, and I feel that he has done so very comprehensively. There are, however, one or two points to which I would like to refer in connection with safety specifications. This is a subject that will no doubt be fully discussed at a later stage of this Convention, but at this stage I would like to point out one or two things that have come to my notice.

I have from time to time discussed various subjects, mainly standards, with electrical engineers in various parts of the world—the Union, Europe and beyond—and it has occurred to me that engineers have various ideas on what standards are, particularly in relation to such installations as they have control over. I am particularly thinking of domestic electrical installations such as electric stoves and water heaters.

It strikes me that so many of the electrical engineers do not fully appreciate the value of national standards. If these engineers would adopt national standards in judging the acceptability or satisfactoriness of stoves and hot water cylinders, it would assist the manufacturers no end, and so I would like to commend to electrical engineers that they seriously consider the adoption of safety standards for these particular units, that is, electric hot water cylinder heaters and stoves.

The committees who have prepared these standards are extremely representative. They exchange ideas in a much bigger way than any particular engineer can do with a local manufacturer. In other words, the standard finally reached is much more representative and acceptable mutually.

In regard to the reference to porcelain insulators, it has also occurred to the Bureau that there is an extremely large variety of likes and dislikes amongst the engineers concerning the shapes and sizes and also the functions of electric insulators. As you know, South Africa is now practically the only supplier of porcelain electrical insulators in this southern continent. In order to make the issue simple for the manufacturer, we are very keen to receive as many comments as we can from all those who are concerned in the use of porcelain electrical insulators. When this document is issued for comment very shortly, I would particularly like to have your opinions on it.

Finally, I would like to refer to the extremely valuable contributions in discussion and in other forms that we have received from your representatives on the various committees of the Bureau. The number of committees is expanding very rapidly and it is becoming, I think, an onerous task for your representatives to partake actively on many of these committees. It has occurred to me, therefore, that consideration might be given to a wider representation on the Bureau's committees, not only because of the large number of committees but also because we feel that the A.M.E.U. is an extremely important body, and the better the representation, the better will be the final result.

In conclusion, I would like to thank you again for the wholehearted support you have always given us in our work.

PRESIDENT:

Is there any further discussion on this Report? If not, shall we adopt the Report?

(Agreed.)

COAL SUPPLIES

The next Report is that on Coal Supplies. Possibly a little later in the week further information on this subject will be available, but I would like you to be acquainted with the position up to date, so I will now call upon Mr. Bradley to give his Report; but it is possible that later in the week Mr. Kane may be able to give us some further information.

Mr. D. A. BRADLEY (Port Elizabeth):

Mr. President and Gentlemen: Following my report to the last Convention held in Cape Town when, just at that particular time, the coal shortage to Power Stations was very acute, the representations made by your Association together

with the individual Municipal Authorities was most forceful, and resulted in the Mimister of Economic Affairs appointing a Commission of Enquiry in regard to Coal Shortages. This commission consisting of Messrs. C. C. Frye, O.B.E., Professor J. Goudriaan, C. K. Wilson, A. G. Bosman and I. S. Fleming, heard evidence given on behalf of the Association by Messrs. C. G. Downie, D. J. Hugo, J. C. Fraser, the Secretary and myself and the serious plight together with the many problems associated with inadequate, and irregular coal supplies to Power Stations were thoroughly discussed during the two and a half hour session given to us on the 26th September, 1952. The Commission took evidence in different centres throughout the Union, and we were able to again debate the issues, with emphasis on the difficulties experienced in our respective Undertakings. The "findings" of this Commission have been published and no repetition is necessary here.

Further very serious coal shortages, affecting Cape Town to the extent that measures were being taken to "cut" all other supplies than essential services, took place in July, 1951, and recently Pretoria was down to a matter of eight hours coal supply, which is rather alarming when it is considered that Pretoria is geographically so near to the Witbank Coal Fields. Coal supply is still a matter of grave concern and is accentuated with the constant growth of all Undertakings.

The increase of 3s. 9d., per ton to the price of coal at the pithead, by the Natal Associated Collieries, will prove embarrassing and may mean alterations to Tariffs which in town is an increase in "cost of living." (The Transvaal Collieries, so far as I am aware, have not as yet increased their prices).

A further Committee, to deal with the matter has been appointed by the Minister of Transport and the Minister of Economic Affairs, and consists of one representative from the S.A. Railways, the Transvaal Coal Owners Association, the Natal Associated Collieries, the independant coal purchasers, and Power Stations under the Chairmanship of Dr. Francois de Villiers. This Committee, known as the Coal Allocation Committee, met in Johannesburg on the 10th April, 1952, and after much discussion regarding coal supplies generally, it was decided to hold a further meeting on the 18th April, 1952.

Mr. C. G. Downie was nominated, by the United Executive of South Africa, to represent Power Stations, and he along with Mr. R. W. Kane attended the Meeting on the 10th April at Railway Headquarters, Johannesburg.

A further report will be submitted to the Convention by Mr. Downie and Mr. Kane.

PRESIDENT:

Thank you Mr. Bradley. Would you care to add to those remarks, Mr. Kane?

Mr. R. W. KANE (Johannesburg):

Mr. President and Gentlemen: I was not present at the meeting mentioned in Mr. Bradley's Report. Mr. Downie of Cape Town was there. He wrote to inform Mr. Bradley of this the other day. I just wanted to make that point clear before giving this Report on the Coal Allocation Committee. The Committee met on three occasions. Mr. Downie was present at the first meeting (the one I have just mentioned) and I attended the two subsequent meetings. The most recent meeting was last Friday, but I could not wait until its conclusion as I had to leave for Rhodesia. The terms of reference seemed to be strictly limited to supplies to the railway and power stations, and all the indications are that these concerns have been assured 100 per cent requirements. Mr. Downie makes the point in his letter to Mr. Bradley, and further suggests that it may be advisable for those members of the A.M.E.U. affected to submit particulars of stock and receipts of coal through their representatives and to give a record of the time taken on shipments between pithead and power station. The impression gained at two meetings attended is that there should be no major difficulty in the allocation of power stations' requirements, and possibly the terms of reference of this Committee may be widened at some future period. I would suggest, however, that, apart from the quantity check suggested by Mr. Downie, we should also keep a strict check on the quality and nature of the coal received and inform your representatives accordingly. When Mr. Bradley refers to any further information, it really

deals with the issue of minutes from this Government Committee. At its last meeting, the Secretary of the Committee was asked to ensure that minutes were available within a week of the Committee meeting, instead of having them at subsequent meetings. This morning I sent a wire to Johannesburg on the off chance of these minutes being available and sent up here before the Convention closes, so that we might have the latest information.

PRESIDENT:

Would anyone like to add anything to these comments on coal supplies?

Mr. G. J. MULLER (Bloemfontein):

Mr. President and Gentlemen: This year I have no personal complaint about my winter stock, but I might add, further to what Mr. Bradley said, that the price of our coal is the same irrespective of calorific value, which seems to be rather a curious feature, because one would image it would have the tendency to encourage people to go for the higher calorific values. One wonders why it should have been fixed in that manner.

On leaving for the Convention I received a circular on the subject of the provision of crushing plant at power stations. This has been worrying me, for I feel that as engineers we are gradually being conditioned to accepting the idea that a crushing plant is part and parcel of a power station's equipment. I strongly maintain that it is not. Crushing coal on the site is a very expensive business, and the collieries can do it ever so much better than we can; they have the proper facilities for it. In addition, the truck position will not be improved by carting the larger coals to your stations and crushing them there. I think we as engineers should discourage this growing habit and let it be clearly known that in our opinion crushing is a function of the mines and not of the power stations. We buy crushed coal and we should insist on getting what we buy, and not be burdened with an additional cost on an already high product.

PRESIDENT:

We will continue the discussion on coal supplies towards the end of the Convention, by which time Mr. Kane may have some additional information for us.

I have already announced the names of the Engineers elected to the Executive and it follows from the constitution that Councillors of their towns are also automatically members of the Executive, and so we shall expect those members who have been elected to attend the Executive meeting, together with their Councillors, at 8.30 to-morrow morning. Councillors from the towns of the President and the Vice-President are also automatically Executive members.

There are two items that we have bypassed in the list of Reports, because we are not quite ready to deal with them. , namely, the Registration of Electrical Wiring Contractors, for which a subcommittee has to meet first, and the Safety Precautions Committee, for which a further sub-committee will meet. In this latter connection, I would like to ask the members who were elected at the last Convention in Cape Town to attend after the close of the Wednesday session in order to discuss the promulgation of the Electrical Wiring Regulation. The gentlemen in question are: Mr. Muller, Mr. Kinsman, Mr. Downey, Mr. Ivey (representing Mr. C. G. Downie), Mr. Kane representing Mr. J. C. Fraser); and in addition we should very much appreciate it if Mr. Perrow, the Chairman of the Safety Precautions Committee, and Mr. Mitchell of Salisbury would also attend.

That completes our business for today, Gentlement. We will now adjourn, and re-assemble at 9.30 tomorrow morning.

(Convention **adjourned** for tea at 3.30 p.m., followed by the taking of the official photograph.)

SECOND DAY
TUESDAY, 6th MAY, 1952

METER TEST CODE

PRESIDENT:

A subject which is not detailed on the agenda but which has received the attention of Conventions in the last few years is the meter test code, the promulgation of which has been under consideration for a considerable time. Some discussion of this subject has taken place during the last few years in Executive meetings, and

it has been decided that we would first acquaint you with and permit you yourselves to discuss the problems that are associated with the enforcement of the meter test code, and then proceed to the question whether we would pass a resolution urging that the test code should be promulgated at an early date. I would like to ask Mr. van der Walt, therefore, to open the discussion concerning the problems which Municipalities will have to face when the meter test code has been promulgated.

Mr. J. L. VAN DER WALT (Krugersdorp):

Mr. President and Gentlemen: As the President said, the meter test code has been under discussion for a number of years. At various Conventions we have passed resolutions approving the promulgation of a meter test code, and I do not intend that my remarks this morning should act as a brake; I just want to draw attention to the difficulties we shall have to face as far as the labour position is concerned. But that is not a difficulty experienced in this direction alone; the labour problem is quite general today. The point I want to throw open for discussion is the training of the meter mechanician.

First of all, we find that the meter mechanician is described in various ways throughout the country, so that when advertising a vacancy one is at a loss to know how best to describe it. I may, for instance, call him a meter mechanician. My neighbour may call him a meter technician; somebody else will call him a meter tester, an instrument maker or a repairer. One position we shall have to face, therefore, is the definition of the trade so that there may be a uniform designation of the trade. Then, when we call for applications for vacancies, we shall know what we are calling for and the prospective applicant will know what we actually want. That is the first point.

The second point is that the trade of meter mechanician is not recognized by the Government under the Apprenticeship Act. The result is that in the case of one youngster in my undertaking, whom we have trained in that trade and whom we called an apprentice meter mechanician, we have had to draw up a master and servant agreement with him. Fortunately, this youngster turned out to be the right type, very studious, and did well; but he has left us now, and since then we have been unsuccessful in getting youths interested in this trade. On various occasions we have called for applications, had somebody interested, appointed him, and then after a period of three months the youngster has said that he was definitely not interested in the trade, because his fellow youngsters get their papers after completing five years' apprenticeship; they are then electricians, and he would like to become one too. Nothing can persuade them that there is a future in this trade, bearing in mind the promulgation of the meter test code. I do feel that some uniform designation should be devised for this trade and also that some method of training should be laid down for these youths, making the trade attractive to them.

At a later stage during this Convention you will be asked to vote on a resolution on the meter test code. I think we must take it for granted that some day the meter test code is going to be promulgated and we must prepare for that day.

There is a shortage of labour as far as meter testing is concerned. I think we must all agree that meter testing is not very attractive work to the youth of today, so that it is necessary for us to devise means of making it more attractive to him. One way would be to increase the field of his activities, so that he may have to deal, not only with meter testing, but with testing in general, fault finding, protective equipment, etc.; in other words, should he be a meter mechanician or a junior test engineer, or what would you have?

The third point is that, considering the daily routine nature of meter testing, in order to face up to the labour difficulties, it might be necessary to strongly consider employing unskilled labour on that side of the work. Overseas, the routine testing of meters on the manufacturing side is done by unskilled females, and, bearing in mind the promulgation of the meter test code, I think this point should be given consideration.

If we can hear the views of other members on this question, I think it will be to our benefit.

PRESIDENT:

The question is now open for discussion.

Mr. E. L. SMITH (Boksburg):

Mr. President, Ladies and Gentlemen: Mr. van der Walt has covered most of the remarks that I would have put with regard to the meter test code. I do really feel that we should take time to see how it goes before taking a decision on it.

One question I would like to ask the Bureau of Standards concerns the levying of a charge for every meter tested. I believe it is their intention, when the code is promulgated, to levy a charge in the neighbourhood of 1s. 6d. for every meter going out of the testing station with the Bureau seal of approval. If this is the case, I feel that it is an exorbitant charge, which will greatly increase the cost of meter repair and testing. I think this aspect should be seriously considered.

Then with regard to whether a mechanician or meter tester or test electrician should be employed in these various undertakings, I feel that depends on the size of the undertaking. In very large undertakings naturally they can train meter mechanicians, but with smaller stations the general tendency will be to incorporate the general test work with meter testing, that is, the testing of appliances, of transformers, relays and all general test work. Generally speaking, there is not sufficient scope for meter mechanicians, therefore the station would probably be in the charge of a test electrician instead of a mechanician. I do feel that in order to keep down the cost of meter testing and repairs to a minimum, girls should be used for the cleaning of meters, and I intend at my own station, if possible, to try that out, leaving the testing of meters generally and repair work to the electrician.

Another point is that the Bureau of Standards, when certifying a station, require certain apparatus. One of the articles laid down is a standard clock. Now, for the information of members here, I would like to state that the Union Observatory sends out a beat signal every minute during the 24 hours of the day on 5 megacycles. That beat signal is correct to one in ten million and is checked with the radio station at Washington. This beat signal is primarily for the use of ships at sea, but an ordinary commercial receiver would take the place of a standard clock in a test room, and the timing is very much more accurate than a standard clock. That information may be very useful to all test stations throughout the Union, because they can tune in to this beat signal on six metres and check their stop watches from it. You will find that very useful indeed. I have a letter from the Astrologer of the Union Observatory to that effect.

PRESIDENT:

Are there any other contributions to the discussion?

Mr. G. WILLIAMS (S.A.R.):

Mr. President and Gentlemen: I do not want to weary you with my views on the meter test code, but I would like to say, for the information of delegates, that we have run a central laboratory for the repair, testing and checking of meters for many years with great success. The system has been developed over the years and is working admirably. Generally speaking, we divide the work into two categories: the repair of damaged meters, the renewal of jewels, and so on, which normally our mechanicians do. We are fortunate, like the Post Office, in having a mechanicians' shop for telephone and telegraph work and communications; therefore the actual labour put into the general repair of the instrument passes through that shop.

On the question of testing, we send them into the laboratory, where it is customary to employ test assistants and laboratory assistants .. we differentiate, the technical qualifications for each being different. Generall speaking, we take an electrician with an A.T.C. II, if we can get one, and then he knows his grading will go right up to senior test laboratory assistant. These people do not only do meters; that is only part of their job; they actually do tests on relays, automatic sub-stations, test gear, and so on. It is a wide field and the competition to get in is keen. They observe laboratory hours, which are better than workshop hours, and the work is congenial and in good surroundings, and whilst today there is a general shortage of staff and a lack of

suitable applicants, that is common. If any of the delegates would care to come and visit us at Langlaagte, where our test laboratory is located, we shall be able to give you a lot of useful information on the labour and the equipment side, and on the testing side generally. I give you an open invitation to come along.

PRESIDENT:

Is there any further discussion on the problems associated with meter testing?

Mr. R. W. KANE (Johannesburg):

As I see it, Mr. President, the main problem is not so much that of controlling officials but the sort of artisan trained employee and, shall we say, the operative type of employee—the mechanician who does the repairs generally and, shall we say, the tester. I think we have got to bear in mind, though, that there are certainly some large undertakings, but the bulk of the undertakings are not so large as to be in a position to train anybody in any definite trade. As Mr. van der Walt mentioned, the real problem is the question of suitable personnel. Maybe the right approach would be to the various provincial apprenticeship committees, or perhaps the Labour Department, to consider giving a supply authority electrician training in meter repairing as part of his general training. Then, of course, you have to consider the testing, and I fully agree there may be trouble here with the Unions—we have had it in Johannesburg in our attempts to introduce anything like this. It is surprising how fine a line is drawn between a repair and a test, in that if they change the glass on a meter and have to use a tool then they expect the artisan's rate of pay. I think the real solution is to include this generally for the run of undertakings in the training of electricians, and later on you will find that some people are more suited to substation work or more suited to overhead mains work, and that quite a few will be happy in the meter work.

Mr. A. FODEN (East London):

As many members of the Convention know, Mr. President, this matter has exercised our minds for many years, and I think we should not waste any more time in coming to a decision in putting it into effect. I quite appreciate Mr. van der Walt's remarks with regard to the difficulty in training people, but I think it could be overcome, as my friend Mr. Kane has just said, by including it in the training of apprentices. Let them take part in meter testing and also in repairs of meters. I consider it should be part of their training, and I think the whole matter hinges on the size of the undertaking. We cannot lay down any hard and fast rule that every undertaking has to have a meter mechanician. Many of the smaller undertakings could not possibly afford to keep a man just for that type of work at a high rate of pay, and, as far as we are cncerned in East London, we have electricians who have a flair for that particular class of work—fine work—and those men are put on meter repair. In regard to meter testing, this is done by semi-skilled men, and also in the course of the training of apprentices they do a certain amount of meter testing and repair. I think that would be one of the solutions so far as the small and medium undertakings are concerned and then, as the undertakings grow,, they can start branching out and have meter mechanicians and test mechanicians. They could combine the two jobs, meter repairing and the maintenance and testing of relays, protective devices and so on. I think that if a trade was created in which apprentices are to be meter mechanicians only, it would be purely a dead-end job, and we would never get apprentices to come along to that trade, because they would consider there would be no future for them. I think the best solution is to utilize electricians who have a flair for the repair of meters, so that at any time when there is no meter repairing to be done (which must very often occur in the small undertakings) they can go on to other work; and as far as meter testing is concerned, that can be done by semi-skilled men, and I do not think there will be any objection from the trade unions in so far as that is concerned. Meter repairing is another matter which I repeat could be done in the small and medium undertakings by electricians who have a flair for that particular class of work.

With regard to the use of female labour on meter testing and quite apart from

meter repairing, it might be very expensive for small or medium undertakings if they introduced female labour, because they would immediately have to provide accommodation for female labour in terms of the Factories Act—a very costly job—and this may militate against the introduction of the meter test code. I would strongly suggest that at this stage female labour should not be employed in small and medium undertakings. Let the testing being done by semi-skilled men.

Mr. G. J. MULLER (Bloemfontein):

Mr. President: As you know I have always been rather strongly in favour of the promulgation of the meter test code. I must say that I had not heard of the question of a 1s. 6d. levy. It would obviously, if imposed, be a fairly heavy additional burden on the whole cost of meter testing. I was wondering whether Mr. Downey, who has very close associations with the Standards Bureau, would be in a position to inform us further on this subject, in the absence of Mr. Swardt.

PRESIDENT:

Mr. van der Walt may be able to help us.

Mr. J. L. VAN DER WALT (Krugersdorp):

Mr. President and Gentlemen: I think the levy of 1s. 6d. was mentioned at the East London Convention, but that will not be applied. There will certainly be a fee charged by the Bureau, according to the latest information from them, but it will not be 1s. 6d. When my undertaking applied for a certificate, the figure of 9d. per meter was mentioned in the letter, but I understand now that there are some legal difficulties involved as far as the levying of the charge is concerned. However, from my discussions with the Bureau I think it can be taken for granted that it will definitely not be 1s. 6d. It may even be lower than 9d. That is the fee for the Bureau of Standards checking on your test station. They will be entitled to come in at any time and any meters that have been tested and sealed by your undertaking will be checked to see that you are complying with the code. There is no final figure yet.

Mr. G. J. MULLER (Bloemfontein):

Is this levy, whether 1d. or 9d., to be levied on every single meter tested by your undertaking, or is it a levy on meters tested occasionally by the Bureau when they call to check up?

Mr. J. L. VAN DER WALT (Krugersdorp):

As I understand it now it will be a levy on every meter that goes out of your test station. I am sorry Mr. Swardt is not here at the moment to tell us.

Mr. C. MULLINS (Electricity Control Board):

Originally it was intended, as far as I remember, when the code was drawn up, that a levy would be made, but since then I have been led to understand that there will be practically no levy as far as "per meter" goes. There might be a small charge where a Bureau official comes down to various municipalities to make a check. As you know, the original idea was that a Bureau officer would be there to see every test actually made, but that has been proved to be impossible. That was very strongly taken up by the Board, but it was rather difficult to make a charge at one and the same time as the code was promulgated. However, I can assure you that if a charge is made it will be a very, very infinitesimal one.

Mr. A. H. DURR (S.A. Bureau of Standards):

Since it was decided that undertakings would have their own testing stations and that all meters would not be tested at the Bureau, it would not be right for us to charge a levy per meter, but it would be necessary for the Bureau to send officials around to these testing stations to check the method of testing and the installation at the station, which would involve the Bureau in a lot of money and expense. I think it is the idea, therefore, to charge a fee to cover these expenses, without any profit to the Bureau; in other words, the charge will be on a cost basis, without any profit, to cover the expenses of the Bureau.

Mr. R. W. KANE (Johannesburg):

Could Mr. Durr tell us what he means by

these tests? Will it be an initial test, or will the tests be periodical?

Mr. A. H. DURR:

Visits to the testing stations and regular inspections. It has not been worked out whether it will be once a year or once every six months. It will depend on the cost of the inspections and how it compares with the fees the Bureau would get from the undertakings.

PRESIDENT:

Is there any other general discussion on the problems associated with testing?

Mr. D. A. BRADLEY (Port Elizabeth):

I should like to know whether the Port Elizabeth City Council would be obliged to pay all the expenses concerned with the visit of a Bureau representative coming two or four times a year.

Mr. A. H. DURR:

I do not think so. The charges will be raised on a uniform basis, depending on the size of the station to be inspected, and it will not be an individual charge, because, obviously, going to one place will be more expensive than going to another.

Mr. E. L. SMITH (Boksburg):

I think before we take a decision on this matter, we should have a clear-cut letter from the Bureau stating their policy with regard to the meter test code, otherwise we may find ourselves landed with heavy charges; so I propose that we defer this until next year.

Mr. A. F. TURNBULL (Vereeniging):

I second that proposal. We cannot take a decision until we know exactly where we stand.

Mr. F. P. W. HALL (Somerset West):

It appears to me that the electrical profession is being penalized in having to pay the testing charges for electricity meters, and I was wondering whether the Bureau could let us know whether the water meters are also tested. I have come across some peculiar water meters, with no adjustments or any means of altering their calibration, and I wonder whether they could also bear some of the charges on their side.

Mr. A. H. DURR:

As regards water meters, there does not as yet exist a code for water meters, but if it is felt that such a code should be prepared, I am sure the Bureau would be only too willing to do it..

PRESIDENT:

I permitted Mr. Durr to answer that in the general interest, but in fact the matter does not concern us at all. I would remind you that, as far as the costs of meter testing are concerned, I would not be far wrong in saying that 95 per cent of the errors which crop up in meters are to the benefit of the consumer and not of the supplying authority. It is probably even more than 95 per cent. The sooner an accurate testing of meters is brought about, the sooner will revenues of supply undertakings become a little more buoyant.

I have a proposition, which has been duly seconded, that the matter be deferred until next year. Is there any further discussion on the matter?

Councillor SCHLAPO (Roodepoort):

I believe, Mr. President, that the Association has discussed this matter for quite a number of years. We first have to decide what are the benefits and, in doing so, we must look at the benefits on each side: the supplier's side and the consumer's side. As a layman, it seems to me that the master meter is the one to check, because if that is in order there will be no difficulty of the other meters you test being out of order. That is one point. Then there is Mr. van der Walt's point about apprenticeship. I fully agree with him that something has to be done. We must get our technical colleges to train these youngsters. It is a calling, the same as anything else. There are youngsters who take up the watch-making trade, and repairing and testing meters is similar to that. The meter tester and repairer in our Municipality saves us a lot of money. Meters that would ordinarily have to be thrown away as useless have been repaired. In regard to the

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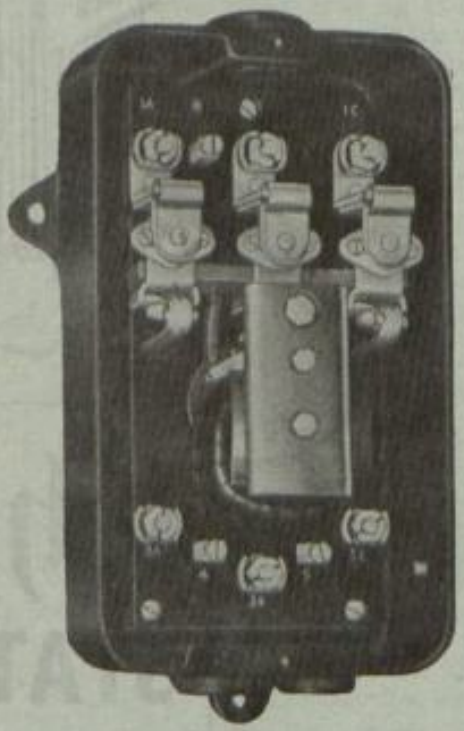

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expense of Bureau representatives, we must remember that an inspector will not make a trip just to Cape Town; he will obviously visit all the other centres on the way. That will reduce the cost considerably. Finally, I suggest that the sooner we get on with the promulgation of the code the better it will be for everyone.

Mr. G. J. MULLER (Bloemfontein):

I feel that for once we should have the courage to decide what we want to do and what we do not want to do. We have been putting this off for a number of years—since 1948 at least—and I do not think it is to our credit that it takes us four years to make up our minds on any subject. As far as inspections are concerned, I do not see why the Bureau should find it necessary to make quarterly or even six-monthly inspections. Boiler inspections are done annually, and they involve a senior official and usually take the best part of a day, yet the charge is very moderate. If the charges for meter testing were more or less on the basis common to boiler inspections, I for one would see nothing to be afraid of there. If the levy falls away and the charge is made on an inspection basis, I cannot see that we have anything to worry about.

Mr. A. H. DURR:

In answer to a previous question as to whether the Bureau would centralize operations in Pretoria as far as inspection is concerned, the idea is that we shall have depots all over the Union at the bigger centres; in other words, the inspector will not be confined to an area round Pretoria. There will be more than one inspector distributed throughout the country.

Mr. A. FODEN (East London):

When this subject was first raised it was never envisaged that there would be any charge made by the Bureau, and that is why we went ahead. I would like to move an amendment "that we accept the meter testing code providing there is no charge from the Bureau of Standards for inspections." I consider it is part of its functions and I do not think there should be any charge. Many of our Councils have been committed to heavy capital expenditure to equip testing stations, never thinking for a second that they would have a charge levied by Bureau officials coming to inspect those stations. Therefore I move that we accept the meter test code, providing there is no charge for the inspection of our meter testing stations, because we do not know how frequently officials will come down, and the electricity undertakings may be faced with very heavy charges which were not envisaged earlier.

Mr. C. MULLINS (Electricity Control Board):

Whatever charge is made, it will be infinitesimal.

Mr. J. C. DOWNEY (Springs):

As a member of the original committee on the meter test code, I can say that it was understood that a small charge would be made for the inspection of meters. That is unavoidable. The Bureau have terrific expenses in dealing with specifications, and I do know that the Government has asked them to curtail expense as much as they possibly can. I think we all appreciate that the Bureau has done wonderful work on our behalf and on behalf of consumers, therefore we must expect a small nominal charge for its inspection services. It would make no difference to my undertaking if the code were made compulsory, for we have been carrying out the code for a number of years. We have our staff difficulties and they will remain with us, but the difficulties in the test department are no greater than they are elsewhere. We accept the charges. Our standards have been certified from time to time in the last few years. The Bureau, we must all agree, is rendering excellent service to us all, and I think we must accept whatever nominal charge is made for the service it renders to us and to our consumers, especially bearing in mind that the charge will be quite small.

PRESIDENT:

Is there a seconder for the amendment?

Mr. J. E. MITCHELL (Salisbury):

I was wondering whether I could second Mr. Foden's amendment if he would be

prepared to vary it slightly. As it seems impossible to find out what the charge is going to be and exactly where every undertaking will stand, would he vary his amendment to say that, provided the charge raised by the S.A.B.S. is such that the Executive could accept it, the Executive be empowered to do so. Would he accept that?

Mr. A. FODEN:

I am quite prepared to alter my amendment along those lines. I can understand that there are heavy expenses, as Mr. Downey has explained, and I think we could safely leave the question to the Executive.

PRESIDENT:

We now have the proposition, moved by Mr. Foden and seconded by Mr. Mitchell, that we recommend the promulgation of the code provided that any charges the Bureau may desire to levy shall be such as are acceptable by the Executive Committee as reasonable. May I take a vote on that?

Mr. J. E. P. Uys (Town Clerk, Alberton):

Mnr. die President, Dames en Here: Ek is 'n leek op die gebied van elektrisiteit, en spreek onder korreksie.

Wat betref 'n bevoegde naam vir die vak, doen ek graag aan die hand, dat die saak verwys word na die Vertalers Vereniging, Johannesburg, wat in noue samewerking met die Universiteit saam werk, in verband met die saak.

"Meter Test Code."

Vir inligting doeleindes, sal ek graag wil weet waarom die elektriese meter afsonderlik behandel word deur die S.A. Buro vir Standaarde, en afsonderlik bespreek op die Kongres, aangesien die elektriese meter nie so nadelig is vir 'n plaaslike bestuur nie, van 'n finansiële oogpunt beskou as 'n water meter nie. Afsaksels word gewoonlik in die waterpyp gevorm en land gewoonlik in die ratte en die meter loop al stadiger totdat dit staan, in ander woorde, die verbruiker baat uit die verliese van 'n plaaslike bestuur, tot 'n aansienlike mate.

In die geval van elektriese meters, is die posisie, dat hulle gewoonlik vinnig is tot die mate van 2 persent ten voordele van die plaaslike bestuur, in ander woorde, die Raad trek voordeel uit die verliese van die belastingbetalers wat gering is.

Dan is daar ook nog die meters van die suigwaens. Alhoewel al die meters onder verskillende hoofde en departemente sorteer, is ek van sienswyse dat dit munisipale aangeleenthede is, wat sorteer onder elektriese en stadsingenieurs. In sommige plaaslike besture is die poste geskei, maar in ander nie, en ek het gevoel dat die saak as 'n geheel behandel moes word in plaas van stuksgewyse.

PRESIDENT:

If electricity meters are handled in this way, I expect water meters will follow as a natural consequence, but that is not a matter for us. It will be for another body to deal with that situation. We are concerned this morning merely with the electrical meter test code, and I shall have to ask you to vote on that matter only. Is there any other discussion?

Mr. E. L. SMITH (Boksburg):

In regard to the last proposition, I think it is rather dangerous to let the Executive deal with such a matter. They may accept something which is not acceptable to the majority of members here. We have to protect our Councils. We may find ourselves saddled, if we are not careful, with charges we are not prepared to meet. I feel that such a decision should rest with the body of Engineers here and not with the Executive.

Mr. A. F. TURNBULL (Vereeniging):

I fully support the idea of a meter test code, but I do feel that we have to be cautious, as we have no definite information yet on the question of levying a charge. The only reason I seconded the proposal was so that we could have a full report on all the implications before taking a decision. I feel personally that I cannot take a decision without knowing what it is I am deciding.

Mr. A. H. DURR (S.A.B.S.):

Mr. Swardt is dealing with this question at the Bureau and I daresay he will be able to give us the information we want

as to the levying of charges. Perhaps the matter could be stood over until he arrives.

PRESIDENT:

I think we might wait until Mr. Swardt is here and is able to give us the facts we want and answer the questions raised. Therefore I will not ask for a vote on it at this stage. Perhaps Mr. Swardt will be able to clear matters up after the tea interval.

(Adjourned from 10.30 to 11.00 a.m.)

PRESIDENT:

Before resuming with our business, I have to inform you that our old friend Mr. Rettie is unfortunately at the moment in a nursing home in Johannesburg. It is felt that he would appreciate a word from us, so with your agreement I will have a message sent to him wishing him a speedy recovery.

(Agreed.)

When we adjourned we were still dealing with the meter test code. Mr. Swardt is now with us and will be able to clear the matter up. Before I ask him to do that are there any other views on this matter?

Mr. P. L. VERGOTTINI (Brakpan):

Mr. President and Gentlemen: The delegates to this convention cannot take decisions that will bind their respective Councils. The meter testing code can, however, be accepted in principle. Having done that, the South African Bureau of Standards should circularize all Municipalities with a complete scheme showing in detail what the financial implications will be. The Bureau can also make suggestions to get uniformity and then each Council will be in a position to make a decision.

PRESIDENT:

I think I should explain here that this Convention accepted the meter test code in principle in 1948, so that that part of it has already been done. Action taken by this Conference does not bring the meter test code automatically into force. That could be done without any bother whatever. The Control Board could bring it into force at any time they so desired, but they naturally asked us our views on the matter, because they do wish to co-operate as far as possible. I do not think any vote taken here could possibly be held as binding any Council in those circumstances. All that may be suggested is a resolution saying that we are prepared for the Control Board to promulgate this legislation. That, as I say, is something they have the right to do, with or without our consent, but up to now they have sought our co-operation in the matter.

Mr. Swardt is here and we can now hear what he has to say.

Mr. J. W. SWARDT (Bureau of Standards):

Mr. President: First of all may I apologise for my absence this morning. However, I am glad that the matter was left open, so that the issue could be satisfactorily clarified.

The meter test code, when it was first introduced into discussion at these Conventions, was based on a comprehensive scheme of testing throughout the country, as centralized stations and there was a control or supervision scheme as part and parcel of it. During the years the matter has gradually assumed a slightly different form, inasmuch as the centralized control or testing stations have to a large extent fizzled out, as it appears to us, since many of the local authorities have arranged to test their own meters. In doing so, for their own reasons, they will probably find that the testing of meters may be more expensive, but that is their own affair.

The adoption of the meter code is something which need not necessarily be associated with the Bureau of Standards administering that code or charging a fee for it. I think this Convention should understand quite clearly that the adoption of the meter code and the introduction of it as such by the Electricity Control Board is purely a criterian of what a meter should be. The crux of it is that it must be correct to plus or minus 2½ per cent and meters should be periodically re-calibrated, every four years. If the Electricity Control Board introduce that, that is one issue.

Now, coming to the administration of the code, if it is felt that supervision should be undertaken for the Electricity Control Board by the Bureau, only then would the Bureau come into it, and that is

why at the last Conference I indicated that that aspect was a matter between the Electricity Control Board and yourselves. However, as this matter now stands, it appears that this Convention would like a clear-cut picture of that side of the story.

I would like to suggest that the meter code could be adopted without the Bureau figuring in it as inspectors at the first stage. Where there is a test-station which tests for neighbouring authorities who are supplying electricity but have no facilities for testing their own meters, that test station would be free to test and certify meters in accordance with the code.

Now, as a second stage, if it is desired that such testing and certification should be under the supervision of the Bureau, then that testing station can apply to the Council of the Bureau for a Bureau seal with which each meter is sealed after testing. Such sealed meters will be subject to random inspection and retesting by the Bureau before they leave the test-station. For the use of the Bureau seal and the periodic check-testing and inspection, the Bureau must get a fee to recover its expenses. In this voluntary scheme you will see the complete similarity with the S.A.B.S. mark for commodities complying with standard specifications.

If the Electricity Control Board promulgates the meter code and in addition stipulates that the Bureau must recover its expenses for the inspection services by some means such as a levy per tested meter, as has previously been suggested. What the fee will be has not yet been finalized.

Those are the main features that I wanted to clarify. One other point I might make is that we have been getting comments on the meter code from various local authorities, and we would be very much obliged if we could have all the comments you think should be taken into consideration in revising the code, which we anticipate in the near future. The sooner we can get these comments the sooner it can be tackled again.

Mr. C. R. HALLE (Pietermaritzburg):

Mr. President and Gentlemen: I think this whole thing has got slightly out of hand through the introduction into the subject of the Bureau of Standards. Originally the idea was that we sell units and that the units sold should bear some relationship to the meter readings, and in some instances I do not think that was so where people were equipped with a 100 watt lamp and a wrist watch as their meter test equipment. It then developed from that into the sort of thing mentioned by Mr. Smith, where we were going to introduce everything from an electron microscope to a horoscope. We want to bring matters back to common sense, and what Mr. Swardt has said does level the whole thing up. There is nothing fundamentally wrong with this idea of the meter test code, and provided we are not going to be penalized for having put in an expensive test room (we in Pietermaritzburg have spent between £4,000 and £5,000 on this) by having to pay a levy of 1s. 9d. for every meter we test correctly, it will no doubt be of general benefit. I think a consumer should have the right, when he has disputed the reading, to have the meter tested either by the Standards Bureau or by any meter testing equipment passed by the Bureau, in which case a special test fee should be made. I also think that any undertakings that do not conform to the general specifications should be penalized in some way for not doing so. I think that if we pass a resolution here it should be merely that in principle we agree with the promulgation of the code, and that the matter of charges should be throughly investigated so that the people who do the thing properly are not penalized for so doing.

PRESIDENT:

I think the substance of Mr. Hallé's remarks was that any resolution passed this morning should refer only to the introduction of the meter test code, which does not bind anybody to any charges from the Standards Bureau, and that, when such charges do come up for consideration, that should be dealt with in a separate manner altogether possibly at some subsequent meeting of the Convention. I gather that is the position.

Now, I have had a proposition that we postpone consideration of the matter for another year. Then I had an amendment, that the promulgation of the code be agreed to, subject to the Executive

vetting the charges to be made. Perhaps Mr. Foden will agree that, after hearing Mr. Swardt and Mr. Hallé, his amendment does not quite fit the position now?

Mr. FODEN (East London):

Yes, with the agreement of my seconder, I will withdraw my amendment, as the matter is now clarified.

Mr. A. F. TURNBULL:

I agree.

PRESIDENT:

In view of all the discussion that has taken place on this matter this morning, I think it would be wise to give you yet another opportunity to talk it over amongst yourselves before we take a vote. It will therefore, with your agreement, remain on the agenda for decision later on in the Convention.

(Agreed.)

RUPTURING CAPACITY OF SWITCH-GEAR AND THE EVALUATION OF SHORT CIRCUIT CURRENTS IN AN A.C. SYSTEM

By

E. L. BUCHANAN, Nat. Eng. Dip.(Hons.), A.M.(S.A.)I.E.E., A.M.(S.A.)I.Mech.E., A.M.I.Cert.E.,

Town Electrical Engineer, Louis Trichardt

It is now my pleasure to introduce to you Mr. E. L. Buchanan, who is to give the abovementioned paper, and I think that those of you who have had an opportunity to examine his paper will agree with me that he has prepared something which will be of considerable value to our proceedings.

INTRODUCTION

When this paper was first contemplated it was intended to provide a much wider and more detailed discussion on the subject.

As the work progressed it became obvious that quite a lot of detail would have to be left out in order to avoid becoming too text bookish.

In setting out the contents of the abridged paper the author has attempted to retain as many points of interest as possible for a paper of this nature, where the subject is so vast, and the materials so rich, that any attempt at condensation fills one with a sense of embarrassment.

The Author desires to record his thanks and appreciation to the switch gear manufacturers who placed at his disposal so much of the data forming the basis of this paper.

Further indebtedness is acknowledged to Mr. J. S. Clinton whose suggestions were extremely helpful in producing a balanced paper, Mr. A. S. Leith for his assistance in procuring an important oscillographic record, Mr. C. J. Close and Mr. P. Foley for proof reading and checking.

SHORT CIRCUIT TESTING

It is not so many years ago that the term rupturing capacity claimed very little attention in so far as small consumers were concerned, and even then, when attention to this was given, the rating assigned to such switch gear was usually that given by the designer of such equipment. Much therefore depended upon the skill of the designer and how much experience he had gained on the performance of similar gear in actual service.

The researches of the E.R.A. laid down certain empirical formulae but there was never much authority on which such empirical formulae could be established, and much could therefore be considered as guesswork.

The desire for more accurate information, spurred on no doubt by frequent failures, as well as the rapid development of ever larger power plant, made it necessary to provide means of testing switch-gear and other equipment under all possible service conditions so that precise scientific records of the pheenomena associated with such apparatus under tests could be made.

Today, with 6 test plants in the United Kingdom alone, the guess work previously associated with electrical apparatus, in particular switch-gear, has been completely eliminated and ratings can be assigned with exact knowledge of the behaviour of such apparatus under actual service conditions.

The six test plants mentioned are associated in the interests of standardisation, and are known as the Association of Short Circuit Testing Authorities generally abbreviated to A.S.T.A., who issue test certificates of rating, and the fact that these are accepted the world over bears testimony of the thoroughness of the work done.

Similar test plants exist in America and on the Continent of Europe.

TYPICAL MODERN TEST PLANT

The main equipment of the modern Testing Station may be considered as consisting of the following:—

1. Main Generator: to give 2,000,000 kVA at 6·6/11kV based on the symmetrical current in the first half cycle. This machine is generally a two pole cylindrical rotor type, running at 3,000 r.p.m. and driven by a slipring motor of 1,200 b.h.p. The rotor, a solid steel forging provided with heavy damper windings, is designed to withstand large short circuit torques. Special features included in the stator design are such as to secure minimum resistance at maximum short circuit output.

Mounted on top of the generator are fans driven by 36 b.h.p. motors at 1500/3000 r.p.m. for use during extra heavy testing service.

The machine is excited from an independent unit, separately mounted and driven by a 125 b.h.p. squirrel cage motor, the d.c. generator having an output of 50 kW at any pressure between 110 and 250 volts for operating solenoids on the tested apparatus. The main exciter consists of a 75 kW de-compounded generator with brush gear and commutator designed to carry 500 amperes which represents the current induced in the main field circuit at maximum short circuit output.

The sub exciter is a 4 kW machine providing a maximum range of control over the excitation current, and to further facilitate the control of excitation a motor driven potentiometer type rheostat is provided and operated from a control desk.

2. Master Circuit Breaker and Main Closing: The master circuit-breaker, a standard type fitted with cross blast gate contacts, has a normal rating of 1,200 amps at 15,000 volts. Special insulated bracings introduced between the oil pots prevent movement during the passage of maximum current. The main closing switch, on which the most severe duty falls, consists chiefly of three heavy built up copper bars, to withstand and hold contact with currents reaching a peak value of 420,000 amperes. These contacts are propelled by a series of springs exerting a pressure of approximately 6 tons. This switch is opened by a cam, driven by a motor and tripped by two d.c. solenoids taking approximately 10 kW.

The circuit-breaker contacts are so arranged that a complete set can be replaced in approximately half an hour.

3. Reactors: Three current limiting reactors, each consisting of five sections bolted together, with insulated non-magnetic tie rods, and each section supported separately on heavy porcelain insulators. The windings are of bare stranded copper, spaced between turns and layers as in standard 11 kV reactors and the whole section cast solid in a concrete block.

4. Step Up: Three main step up transformers consisting of 260,000 kVA 11/132 kV 50 cycle single phase units, oil insulated and self cooled. The secondary (HV) windings in each transformer are arranged in twelve sections which can be connected in different series and parallel combinations to give a very wide range of secondary voltages.

This method, with a 3 phase 11 kV supply to the primary windings, permits a maximum symmetrical output of 780,000 kVA in the first half cycle at standard pressures of 22, 33, 66, 110 and 132 kV alternatively an output of 1,000,000 kVA can be obtained at 22 and 33 kV by operation as an auto transformer with the primary and secondary windings connected in series.

5. The testing station further has:

(*a*) Cells for testing up to 33 kV.

(*b*) Outdoor area for tests from 33 kV to 132 kV.

(*c*) Concrete outdoor observation rooms.

(*d*) Control house containing control gear, electro magnetic and cathode ray oscillographs, and photographic dark rooms.

The electro magnetic oscillograph mentioned under (d) is a 16 element instrument this being unique as hitherto oscillographs having only 9 elements in a single instrument have been used. All the records are produced on a single film, thus eliminating the troubles in co-relating records taken on separate films. The cathode ray oscillograph makes three recordings on a single film, and this oscillograph is developed in order to obtain records of the high frequency transient restriking voltage which occurs at the instant of interruption of the arc.

The symbols have the following interpretation:

EY–B	Applied test voltage (Line Y to line B)		
VR	Red phase voltage.		
VY	Yellow phase voltage.		
VB	Blue phase voltage.		
IR	Red phase current.		
IY	Yellow phase current.		
IB	Blue phase current.		
P_1P_2	Fluid pressure.		
T	Travel time	Ic	Closing coil current.
IT	Trip coil current.	CC	Closing coil.
TC	Trip coil.	S	Shunts.

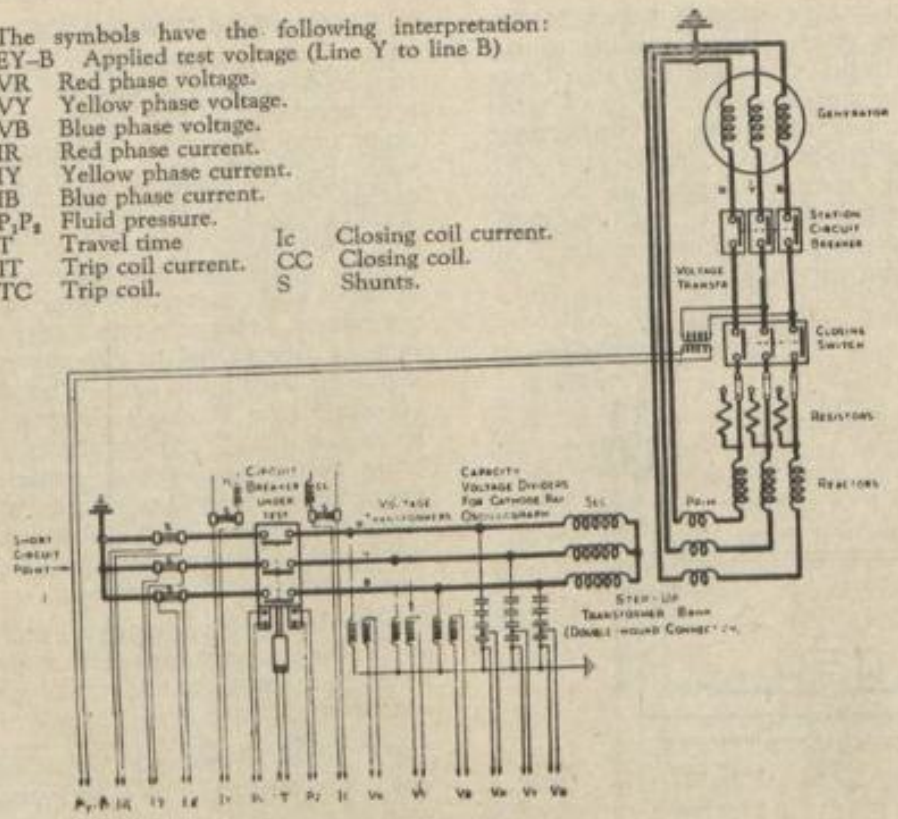


FIG. II.

Figure II shows a typical diagram of test circuit connections when employing the step up transformer unit, the symbols have the same interpretation as for Figure I except that EY–B in this case being the applied primary voltage.

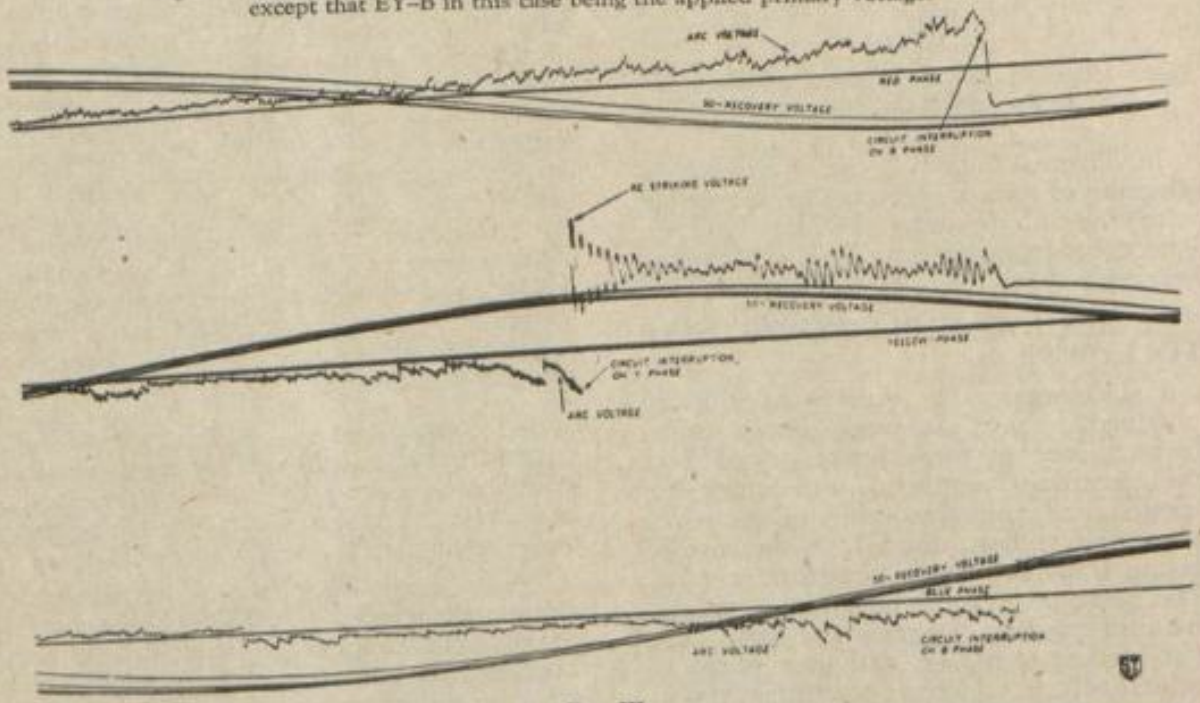
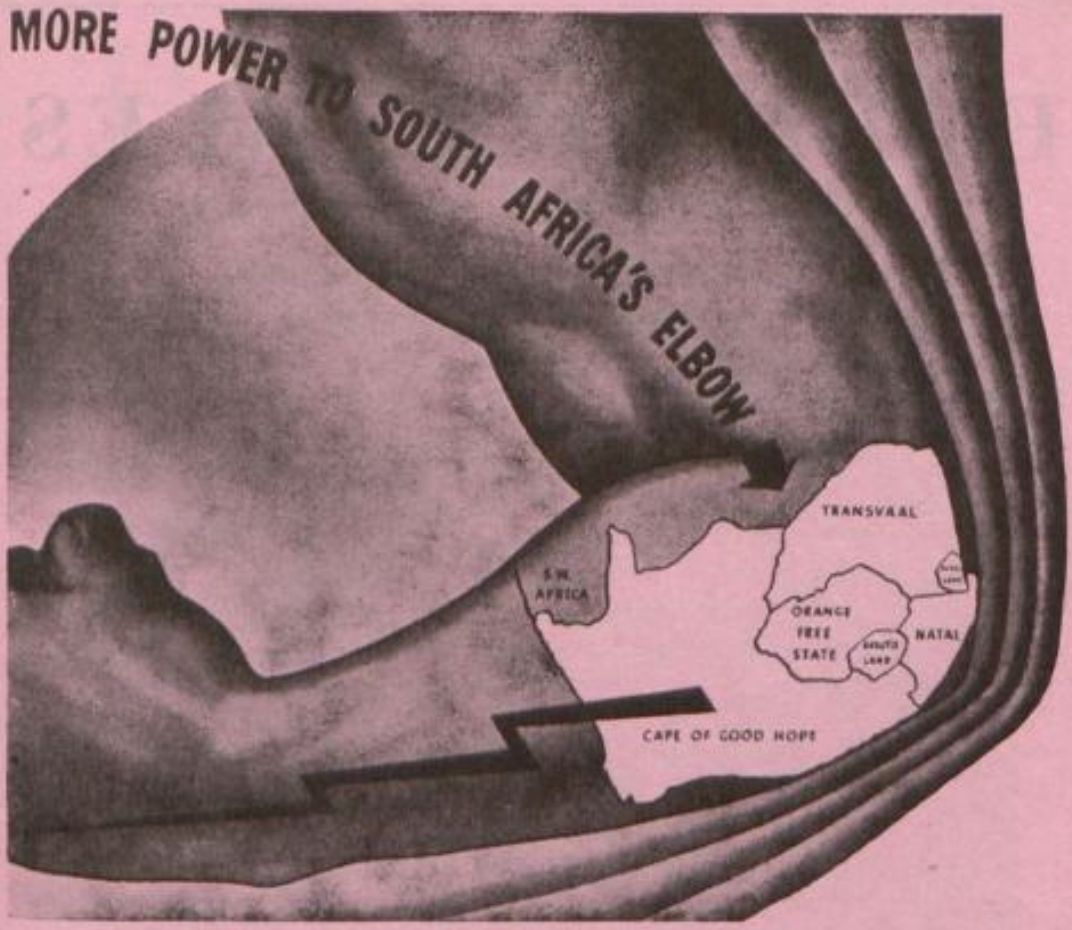


FIG. III

Figure III shows a typical 3 phase oscillogram, taken on the cathode ray oscillograph which records the High frequency transients with particular reference to the restriking voltage.



In times like this it is well to remember that a nation's greatness lies not in its armed strength but in its power to produce. The ever-increasing productive power of South Africa calls for an ever-increasing supply of electric power to the factories and the farms. And this call is being answered, as it has been answered for the past twenty-nine years, by Escom, the national power supply undertaking.

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travel and Breaker contact travel is known, and consequently each step or variation in the record represents a known movement of contacts.

5. Timing Wave: The timing wave provides an accurate measurement of time at any part of the oscillogram and it is obtained by energising an oscillograph Element from a 50 cycle supply. The film rotating in such a way as to give the time on a horizontal axis from left to tight.

All the above quantities are recorded by the electro magnetic oscillograph mentioned under "d". This particular instrument is today considered an indispensable item of the equipment in any factory producing electrical apparatus.

The length of film required for a normal 3 phase test on a circuit-breaker is 12 inches for the electro-magnetic oscillograph, and for such test the following quantities are taken.

a. Generator voltage — line to line.
b. Red phase current.
c. Red phase voltage.
d. Red phase power (arcil kowatts)
e. Yellow phase current.
f. Yellow phase voltage.
g. Yellow phase power (arc kilowatts)
h. Blue phase current.
i. Blue phase voltage.
j. Blue phase power (arc kilowatts).
k. Fluid pressure.
l. Contact time — travel record.
m. Trip coil current.
n. Closing coil current.
o. Timewave (50 cycles per second).

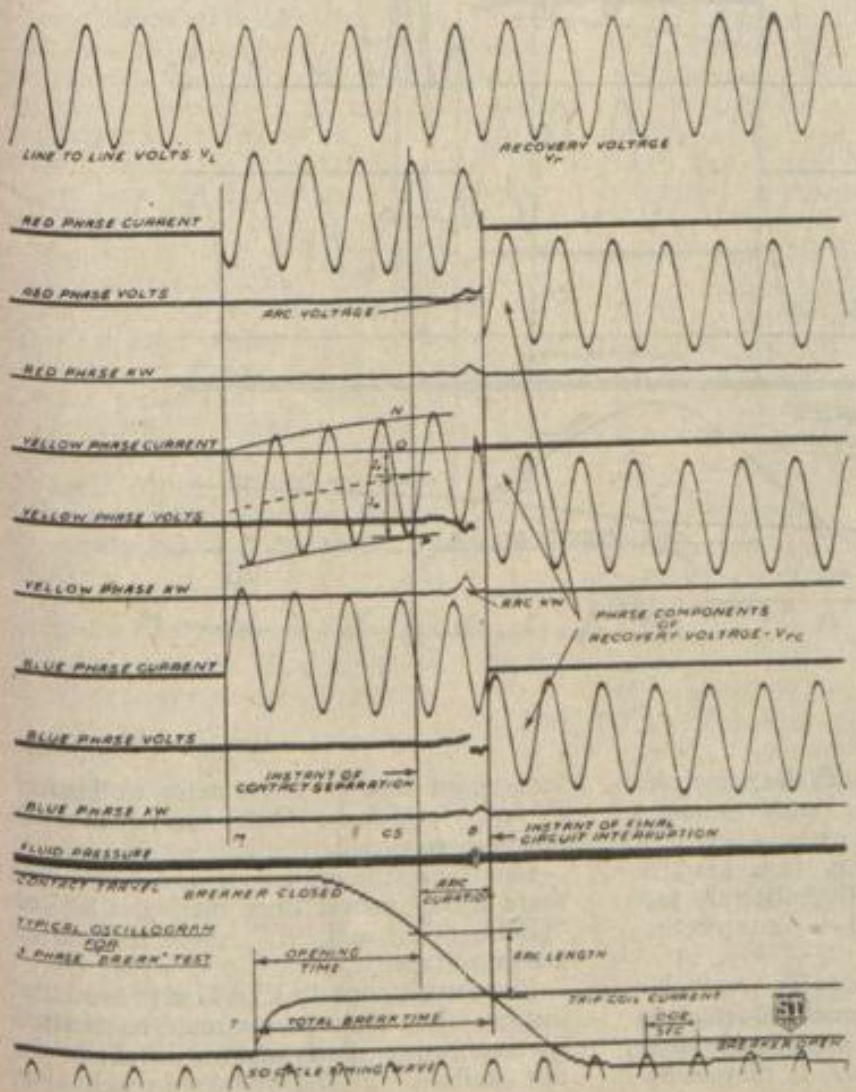

FIG. IV.

Figure IV shows a typical record of a "Break Test". While figure V is a typical record of a make break test. Both records being taken on the electro magnetic oscillograph.

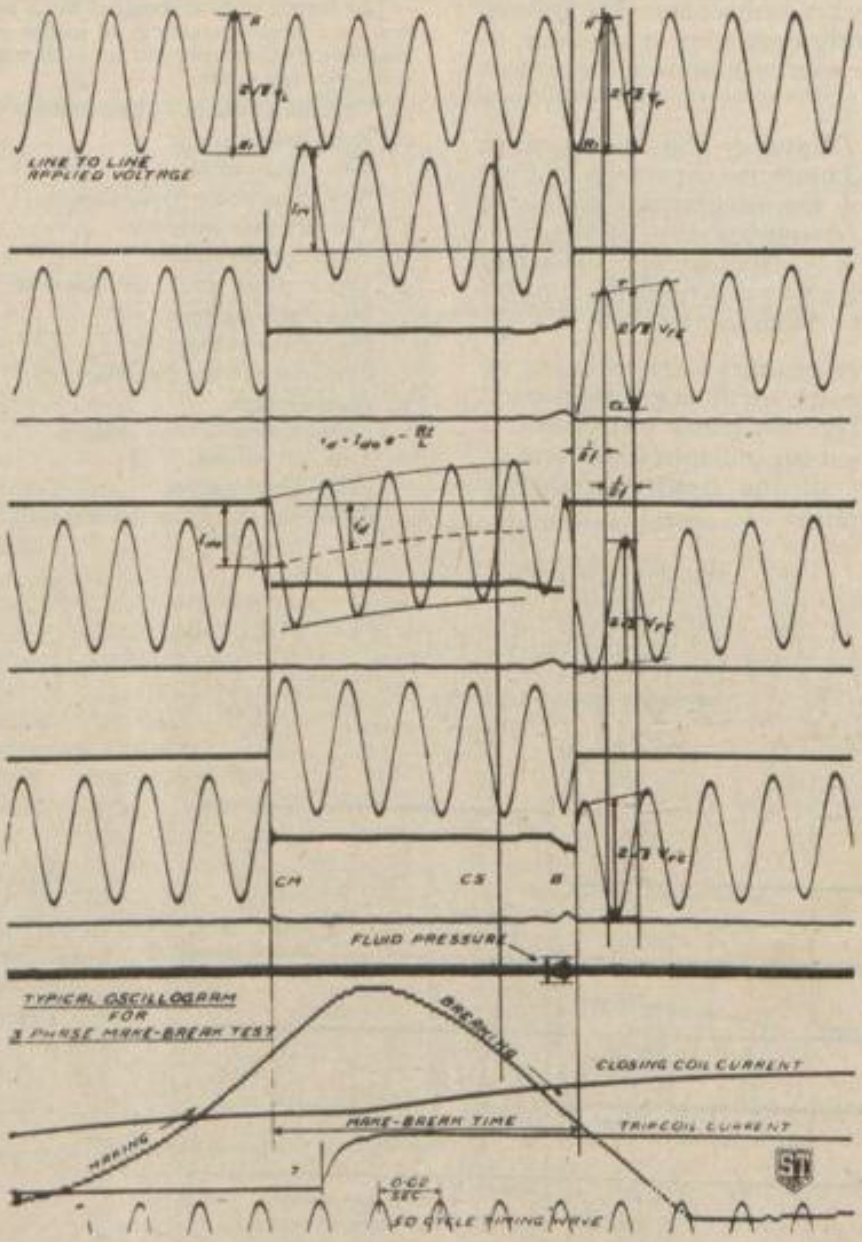

FIG. V.
Make Break Test.

Most of us are familiar with the principles of its construction, but unfortunately, mainly because so many never have occasion to employ it, the majority lack practice in its use and consequently relatively few have any degree of skill in interpreting oscillograms.

Since oscillograms provide valuable evidence of proving tests much information can be gained from an intellegent interpretation of such a record. It may therefore be of interest if we refer to Figures IV and V and make a brief analysis of what has been recorded.

On the oscillograms IV and V we see there three vertical lines marked "M" or "CM", "CS" and "B", these three lines are important.

In a break shot "M" will represent the instant when the short circuit is initiated by the closing of the making switch in the test station. In the "Make break" shot

"CM" will represent the instant of short circuit due to contacts of the breaker under test making contact. The line "CS" indicates contact separation at the instant that the arcing contacts part in "breaking" and is the point at which arcing arises. The line "B" indicates final interruption, at the point at which the current is interrupted. The interval between "CS" and "B" represents the arcing time "VL" represents the line to line voltage and is shown in the uppermost curve. It is measured across the voltage wave immediately before the instant of short circuit "M" or "CM" and it is computed by dividing AA_1 Fig. V (Top wave Trace) by $2 \times \sqrt{2}$.

Making Current Im:

In a "make-break" shot the make test is very difficult because the breaker contacts have to close on to a peak current. The value of this peak current is that of the first major loop of the current wave after the instant of short circuit "CM" Fig. V and is marked Im. Measured between the current zero line and the peak of the wave. It is of interest to note the current wave of the *Red phase* current shows a minor loop immediately after "CM", indicating almost complete asymmetry in the red and yellow phases while the blue phase is very nearly symmetrical. The point "CS" (contact separation) is determined prior to the short circuit test by taking no load oscillograph record with Direct current passing through the contacts. A break in the record indicates the instant of contact separation in relation to the travel record.

The point CM (instant of contact make):

This is determined in a similar manner as CS by no load time travel records.

Breaking Current IB:

This current is measured at the instant of contact separation "CS".

It will be recalled that in certain duty cycles symmetrical values of current are used while in another duty cycle it is the asymmetrical value. In the first instance the current is not considered to be symmetrical if the D.C. component exceeds 20% while in the second case to be asymmetrical the D.C. component in one of the phases must have a value of 50% or more.

In Figures IV and V the D.C. component is shown by Id and the A.C. component by Ia.

The A.C. component $Ia = \frac{OP+ON}{2}$

D.C. component $Id = \frac{OP-ON}{2}$

% D.C. Component $= \frac{Id}{Ia}$

For symmetrical breaking current the R.M.S. symmetrical value is $\frac{Ia}{\sqrt{2}}$

For assymmetrical breaking current the R.M.S. asymmetrical value is

$$\sqrt{\left(\frac{Ia}{\sqrt{2}}\right)^2 + Id^2}$$

Recovery Voltage Vr:

This is measured between lines during the second complete half cycle after final circuit interruption. The value of Vr is obtained by dividing RR_1, Fig. V by $2\sqrt{2}$, *or the line to line* recovery voltage may be obtained from the average value of the phase components Vpr measured in each phase during the second complete half cycle after "B". $Vr = 3 \times Vpr$ for a three phase test.

Vpr is derived by dividing rr_1 by $2 \times \sqrt{2}$.

M.V.A. Interrupted: $= \sqrt{3} \times$ line to line recovery voltage (kV) $\times$ average breaking current in Kilo amps for a three phase test. For a single phase test the M.V.A. Interrupted is obviously recovery voltage in kV $\times$ breaking current in kilo amps.

Arc duration:

This time is measured from the instant of contact separation "CS" to the instant of final circuit interruption "B" this time will be given in terms of half cycles or loops for each phase and also in terms of *arc lengths* in terms of inches. This being determined in conjunction with the travel record. In Figure IV the arc duration and arc length is indicated. The Arc Energy dissipated in the breaker is given under the curve of kW Fig. IV and is stated in kW seconds.

The duration of short circuit is measured from "M" or "CM" to "B".

Travel Record:

This record shows the movement of the breaker moving contacts for both opening and closing the record is of course important as it indicates whether the

breaker closes and opens fully, it also provides the means of determining the speed of closing and opening. The breaking speed is determined at the instant of contact separation "CS" by measuring the contact travel during the first 0·01 seconds after the arcing contacts have parted, the average breaking speed is determined over the full separation distance of the arcing contacts up to the point at which the cushioning devices start to function. The closing speed is determined at the instant the contacts make "CM", by measuring the distance travelled by the contacts in 0·01 seconds immediately before the instant of contact.

Opening Time:

This is measured from the instant at which the trip coil receives its tripping impulse "T" to the instant at which the contacts separate.

Total Break Time:

This is measured from "T" to final interruption "B" and it is the sum on the opening time and arcing time.

Arc Voltage:

On Fig IV this is marked and shows the voltage across the arc between "CS" and "B". This is the voltage which gives some indication of the arcing period as it starts at "CS". This cannot however be regarded as a method for determining "CS" as voltage may quite easily be indicated due to contact chatter before the point "CS".

Trip Coil and Closing Currents:

The tripping impulse is indicated, in Figs. IV and V by the trip coil current trace. In both cases it will be seen that a pause occurs just before maximum current is reached. This pause is due to the resistance encountered by the plunger as it meets the tripping bar. In Figure V the current taken by the closing coil is shown by the curve immediately above the trip coil current trace.

The values of time are obtained from the 50 cycle timery wave at the bottom of the record.

Determination of Power Factor:

In Figure V on the yellow phase current wave references appear from which the *angle of phase difference* may be determined, from the curve of the D.C. component of the asymmetrical current wave between the incidence of short circuit and instant of contact separation by the following method:

First determine the time constant $\frac{L}{R}$ of the D.C. component which has the general form of $id = Ido e^{\frac{-Rt}{L}}$

id being the value of the D.C. component at any instant. Ido is the initial value of the D.C. component L/R is the time constant in seconds of the test circuit "t" is the time interval in seconds between id and Ido. C is the base of the Napierian logarithms.

This is done as follows:—Measure the value of Ido at the instant of short circuit and the value of id at any other time before contact separation. Determine value $e^{\frac{-Rt}{L}}$ by dividing id by Ido. From a table of e^{-x} determine the value of $^{-x}$ corresponding to the ratio id/Ido. The value of e^{-x} can be obtained from a table of Napierian logarithms by taking the reciprocal of the number of which x is the logarithm. The value x represents Rt/L from which R/L can be determined by dividing x by t and consequently L/R is obtained. The angle e is determined from the formula $e = \text{Arc tan } \frac{(WL)}{R}$

W being the actual frequency multiplied by 2π.

REQUIREMENTS OF BRITISH STANDARD SPECIFICATIONS

The greater majority of Electrical Engineers are conversant with the British standard specifications covering switch gear, and it is therefore not intended to go into any details beyond mention being made of the salient factors within the scope of this paper.

B.S.S. 936. This specification covers circuit-breakers intended for service on systems not exceeding 660 volts, where service conditions may not be severe.

B.S.S. 116-1937. Covers circuit-breakers on systems where, under service conditions a very high degree of asymmetry in the short-circuit current can occur and where the restriking conditions may be severe.

There are three main duties which a circuit-breaker is called upon to perform, these are:

a. Breaking.

b. Making.

c. Short time capacity.

The breaking referred to under "*a*" is termed the breaking capacity, and requires that the circuit-breaker must be capable of opening on a fault occuring, and also clearing the fault.

"*b*" Refers to the Making capacity of the circuit-breaker which requires that it must be capable of being closed on a fault and of being latched in the fully closed position until tripped by the action of its protective devices, or tripped by the making current release. This latter device being defined in BSS 116 and 936 as a device to open automatically and without time delay, when the making current exceeds a predetermined value. Such devices are known under different names and are called "Force Trips," "Momentum Trips" or "Inertia Trips."

"*c*" Refers to the capability of a circuit breaker to sustain for a short period, generally about 5 seconds, the fault current while another circuit breaker in series clears the fault.

2. Determination of Rupturing Capacity

It is evident that the safety of every electricity supply system depends upon its circuit breakers performing their function infallibly; and it is essential for manufacturers as well as users to know definitely that every circuit breaker is capable of making and breaking its rated short circuit capacity without suffering mechanical or electrical breakdown and thereafter be still fit to perform its normal duty.

In order to provide unquestionable evidence of this and also to ensure that users will obtain equipment that will afford them the maximum of protection under certain specified conditions, manufacturers subject their equipment to rigorous tests, provide proof of such tests and sell their switchgear with a specific rating.

The ratings are generally stated in kVA or MVA or alternatively in symmetrical or asymmetrical breaking current in kilo-amps (r.m.s.) at a specified voltage. Apart from the above the making current of a circuit breaker is also stated in kilo-amps and is generally qualified as peak kilo-amps.

In order to provide proof of the rating assigned to a particular circuit breaker the test duties prescribed are as follows:—

BSS 116

1. B — 3′ — B — 3′ — B at 10% of rated symmetrical breaking capacity.
2. B — 3′ B — 3′ — B at 30% of the rated symmetrical breaking capacity.
3. B — 3′ — B — 3′ — B at 60% of the rated symmetrical breaking capacity.
4. B — 3′ — MB — 3′ — MB at not less than 100% of the rated symmetrical breaking capacity and not less than a 100% of the rated making capacity.
5. B — 3′ — B — 3′ — B at not less than 100% of the rated asymmetrical breaking capacity.

B.S.S. 936 requires the following:—

1. B — 3′ — MB at 30% of the rated symmetrical breaking capacity and making capacity.
2. B — 3′ — MB at not less than 100% of the rated symmetrical breaking capacity and not less than 100% of the rated making capacity.

After having studied the typical oscillographic records Figs. IV and V of the proving test required under *B.S.S.* 116—1937. It may also be of interest to provide some records of some of the many other tests to which switch gear manufacturers subject their equipment.

Sheets A to G following is a record of a special test not covered by either B.S.S. 116 or B.S.S. 936. This record indicates that the breaker was electrically tripped before the main contacts had touched in the closing operation, and was made for the purpose of proving some special feature.

It may also be helpful to consider some general aspects of these oscillograms, and the explanation following should provide some general idea and assistance to those who are interested in the interpretation of oscillographic records.

(a) Timing Oscillograms (Sheet A)

Four traces are shown on each of the three oscillograms.

All record the quantities in the same order, *viz.*—from top to bottom—contact separation, travel (vertical movement) of contacts, trip-coil current and timing wave.

(i) Contact Separation Trace

Current is passed through the closed contacts of the breaker to an oscillograph element, so that initially the spot is deflected *i.e.*, the top trace, at the left, is above its zero. When the contacts separate, the spot assumes its zero or undeflected position, and remains so during the remainder of the record.

(ii) Travel Trace

The trace is continuously horizontal, until the contacts commence to move. The light spot here is deflected as some current is flowing through the resistor. When the trip coil releases the circuit breaker and the contacts move downwards, the resistor slider also moves downwards. As contact is made with each successive stud, resistance is cut out, and the stepped trace obtained. On the bottom oscillogram the length of each horizontal step corresponds to $\frac{1}{8}$ in. movement of the contacts.

It will be appreciated that the slope of the stepped travel trace is a measure of the speed of contact movement, and the change in slope a measure of acceleration. Initially the speed is slow and gradually increasing, since the forces due to gravity and "throw-off" springs have to overcome the friction between the fixed and moving contacts.

In the case of large circuit-breakers the kinetic energy of the moving parts necessitates cushioning at the end of the stroke. This is commonly effected by the use of air or oil dash-pots. On the bottom record the cushioning will be seen to commence at about point K. After the end of the stroke, marked L, some slight rebound occurs before the moving mass remains finally stationary at M.

The apparent movement some time after the end of stroke on the top oscillogram is due to the fact that at P, the resistor slider was on the point of making contact with a fresh stud. Slight vibration of the circuit breaker framework, combined perhaps with some slackness in the travel recorded coupling was sufficient to cause the slider to oscillate from step to step for about four cycles.

(iii) Trip-Coil Trace

A trip coil is an inductive winding, in which direct current grows according to the law $I=\frac{E}{R}\left(1-e^{\frac{-rt}{L}}\right)$. This occurs from Q to R on the top record. At R, however, the value of ampere-turns is sufficient to attract the plunger through the coil and raise it to its topmost position (S) at which point it has sufficient momentum to knock off the trip bar and release the mechanism. From R to S, therefore, the inductance of the coil circuit is continuously increasing and the current correspondingly decreasing. At S the inductance of the coil is once again constant, and from S to T the exponential law is resumed, the current attaining its final value at T.

On the bottom record it will be seen that there are two current "pips", at Y and Z, respectively. This is accounted for by the fact that at Y the effort to knock off the trip bar completely was sufficient to arrest the momentum of the trip plunger. At Y, therefore, the plunger is stationary at almost the end of its stroke, and between Y and Z the final fraction of an inch is traversed. Between Y and Z the current has attempted to grow according to the exponential law and has been cut down by increase of inductance, in the same way as from X to Y.

(iv) Timing-Wave Trace

This hardly needs any comment beyond the fact that the undeflected position of the light spot was at the bottom edge of the film, as no useful purpose is served by recording the whole of the 50 cycle wave. The time between successive peaks is, of course, 0·02 second.

(b) Short-Circuit Oscillograms: (Sheets B–G)

All the traces on all six oscillograms are positioned and numbered in the same order, their functions being, from top to bottom:—

1. Phase-to-phase volts, Y–B.
2. R phase current.
3. R phase volts-to-neutral.
4. R phase watts.
5. Y phase current.
6. Y phase volts-to-neutral.
7. Y phase watts.
8. B phase current.
9. B phase volts-to-neutral.
10. B phase watts.
11. Fluid pressure.
12. Contact travel.
13. Closing-coil current.
14. Trip-coil current.
15. Timing-wave.

(i) Phase-to-phase Volts Trace (No.) 1

Initially this records the open-circuit phase-to-phase volts at the generator terminals. On Sheet B the open-circuit voltage is marked from P to Q. The short circuit starts at Q and thereafter from Q to R the voltage recorded is reduced by an amount equal to the inductive drop in the generator windings. Virtually the whole of the voltage from Q to T constitutes the drop across the series reactors in circuit. Measurements made along the QR period will show that the voltage is continuously decreasing as the demagnetisation of the generator field proceeds.

At R the short circuit is interrupted and the voltage recorded from R to S is again the generator open-circuit value. Since, however, the restoration of the initial value of the air-gap flux takes time after the demagnetising effect has been removed, it will be seen by measurement along RS that at no point is the voltage equal to the value along PQ, although it is continuously increasing towards the initial value.

The severity of the short circuit can be gauged at a glance after a little practice on any test plant by noting the reduction in generator terminal voltage when the current starts.

(ii) Phase Current Traces (Nos. 2, 5 and 8)

The most noticeable feature of these records is that they are either symmetrically disposed about their zero axes or else asymmetrical or "offset" to a greater or lesser degree.

If an e.m.f. of sinusoidal wave shape were applied to a circuit consisting solely of inductance, and if the circuit were closed at an instant when the voltage was at its peak value, the resulting current would flow, from the commencement, as it would under steady conditions in an inductive circuit, *i.e.*, it would be a sine wave evenly disposed about its axis, and lagging by 90° behind the voltage.

If the circuit were closed at zero voltage, however, the resulting current would rise to a peak value equal to double that in the previous instance, during a half cycle of voltage, and then fall to zero during the next half cycle, and so on, never falling below the zero line. In other words the wave shape would as though caused by the addition of a symmetrically disposed sine wave and a D.C. current of value equal to the peak value of the sine wave.

This is known as the "doubling" effect. Because a practical circuit comprises resistance as well as inductance, the current will only rise to some value less than double the normal and the asymmetry will only be transient, the wave shape gradually becoming symmetrical. In other words the value of the "D.C. component" gradually dies away to zero.

The exact value of the maximum current peak and the time to assume steady conditions will depend upon the relative values of resistance and inductance. For most practical circuits the offset peak does not attain a value higher than 1·8 times the truly symmetrical peak.

For a given set of circuit conditions the degree of asymmetry will also vary between the upper and lower limits for varying values of phase-volts between zero and maximum, at the instant of switching-in.

The foregoing conditions apply to a three-phase short-circuit test. The power-factor is low, and, within practical limits all three phases close at the same instant. It follows, therefore, that there must be some degree of asymmetry in two phases, and probably in three, since there are only six instants of time in a revolution of the phase-voltage vectors when a phase-voltage is at its maximum value.

The associations leading to asymmetry can be seen best from the "make-break" oscillograms B and C. On B, for example, the Y phase volts are nearly a maximum initially, and the Y phase current is only slightly asymmetrical. The R and B phase volts were much below their peak and the current waves were more offset, especially in the B phase. It will be seen that the asymmetry in all three phases has nearly disappeared by the time the breaker contacts separate. The degrees of asymmetry can, of course, be as easily seen on the other oscillograms although no initial phase-volts are recorded for comparison. (Since these are records of "break" tests, *i.e.*, circuit-breaker initially in closed position, there is no phase-voltage across the contacts.)

(iii) Phase-Voltage Traces (Nos. 3, 6 and 9)

On the "make-break" tests, Sheets B and C, full phase-volts are initially across the circuit-breaker contacts. When the current starts, as at Q on sheet B, the voltage falls to zero, being absorbed in the generator windings and the series reactors. Strictly, during the period Q to T, there must have been some resistive and inductive drop across the breaker and the connections to the neutral point, but such drop was too small to be observable on the traces.

At point T the contacts separate and the arc is struck in each phase. The exact determination of the instant of contact separation on the short-circuit oscillograms is obtained by reference to the corresponding no-load oscillograms. For Sheet B, the no-load record is the top one on Sheet A. On this it can be seen that the contacts separate at midway along the second step on the travel trace. On oscillogram B, therefore, the vertical line at T has been drawn to cut the travel trace at a similar point.

Between T and X arcing continues, and during this period an indication of arc-voltage appears on the traces. Since the arc-path is almost purely resistance of value proportional to the arc-length for a given current, the arc-voltage is in phase with the current, and the trace can be seen to reverse either above or below the zero line at each instant when the current changes sign. The value of the arc-voltage progressively increases with each half cycle during the period T to X as the contacts separate further and further.

For the first fraction of a cycle after time T the volt drop across the short arc-path is so small as to be unobservable on the traces. Hence the importance of a contact travel record, which accurately locates the point when the arc is formed. Determination of contact separation from the first indication of arc-volts is always inaccurate, and increasingly so with high voltage circuit-breakers, where the arc-current is relatively small in value.

Examination of all six oscillograms will show that the arc has been extinguished in one phase before the other two. This is always necessarily so, because of the fact that the current in an A.C. arc can only be finally extinguished at or in the neighbourhood of a normal zero point. Since current zero occurs at different instants in the three phases one phase must, therefore, be interrupted first. When this occurs the currents in the other two phases are equal and opposite and the circuit becomes single phase. Both of these currents must be interrupted at the same subsequent current zero, since one phase acts as a return path for the other. Reference to Sheet B shows that phase Y has cleared at point Z, and the remaining two phases 90° later, at point X. The immediate change in phase relationship (at time Z) between phases R and B can also be seen, particularly in the R phase.

At the instant Z when the arc is extinguished in the first phase, it will be seen that the voltage across the arc path rises to a peak value at W, this peak being much greater than the peak value of the open circuit phase value. Actually it may be as much as 1·5 times the open circuit value. This will be understood by considering the conditions obtaining when the first phase has cleared, and with the generator star-connected. Neglecting the voltage drop due to series reactance or to resistance of the arc-path in the remaining two phases, these two phases can be considered as being short-circuited at the generator terminals, and the voltage across the contacts of the phase already cleared is, therefore, equal to the terminal volts between the open-circuited phase and the two short-circuited phases. By drawing the vectors it will be seen that the voltage between the short-circuited terminals and the neutral is half the phase value, thereby giving 1·5 times the phase value between open- and short-circuited terminals.

When the arc is extinguished in the remaining two phases, as at X, the voltage across their arcing paths assumes phase value, and at the same time the voltage across the first arcing path also reverts to phase value. Incidentally the phase voltages recorded on Sheet B have been affected by "neutral swing" during the first cycle or two of recovery.

The rise of voltage across the arc path when any phase clears, occurs over a period of micro-seconds. Further, this voltage rise charges up the capcitance of the circuit, which on discharge, superimposes, on the fundamental 50-cycle wave, a high

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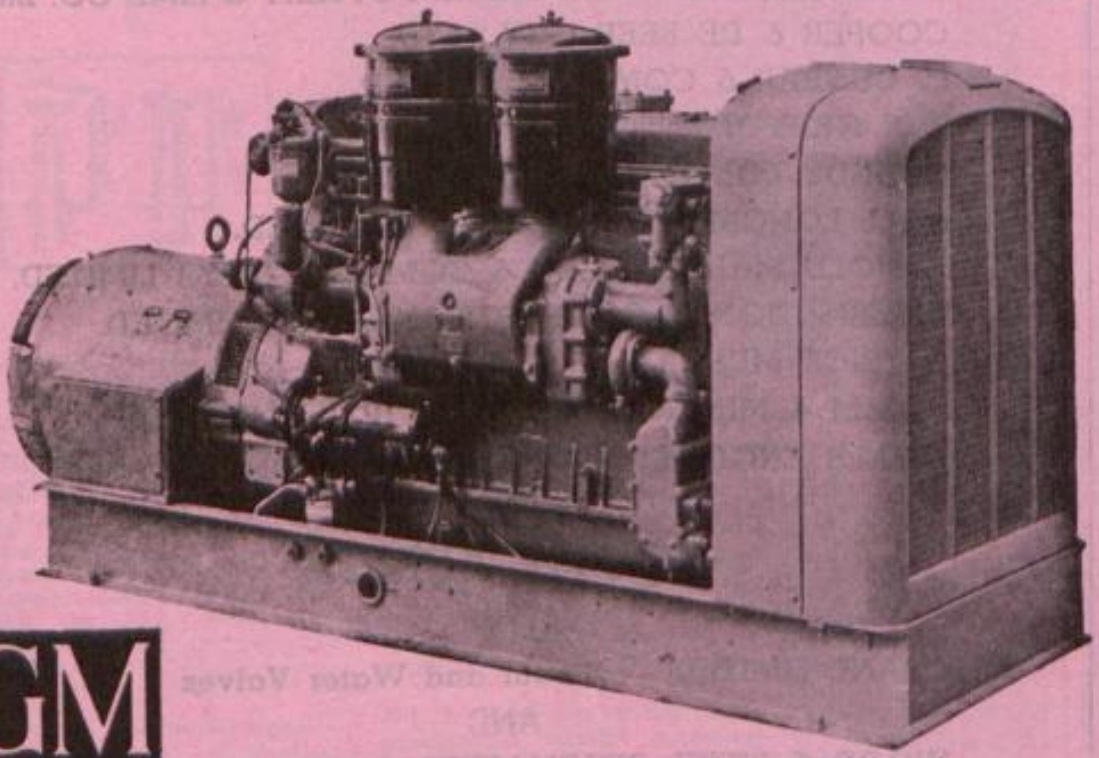

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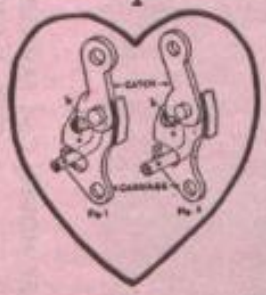

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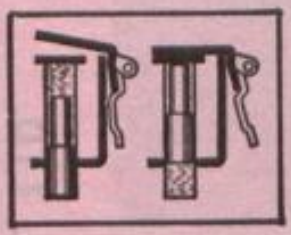

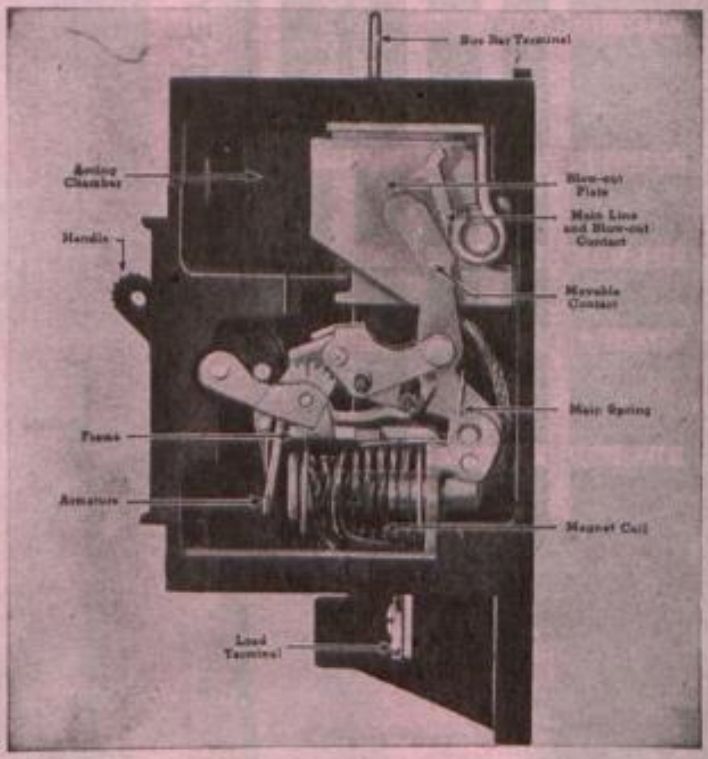

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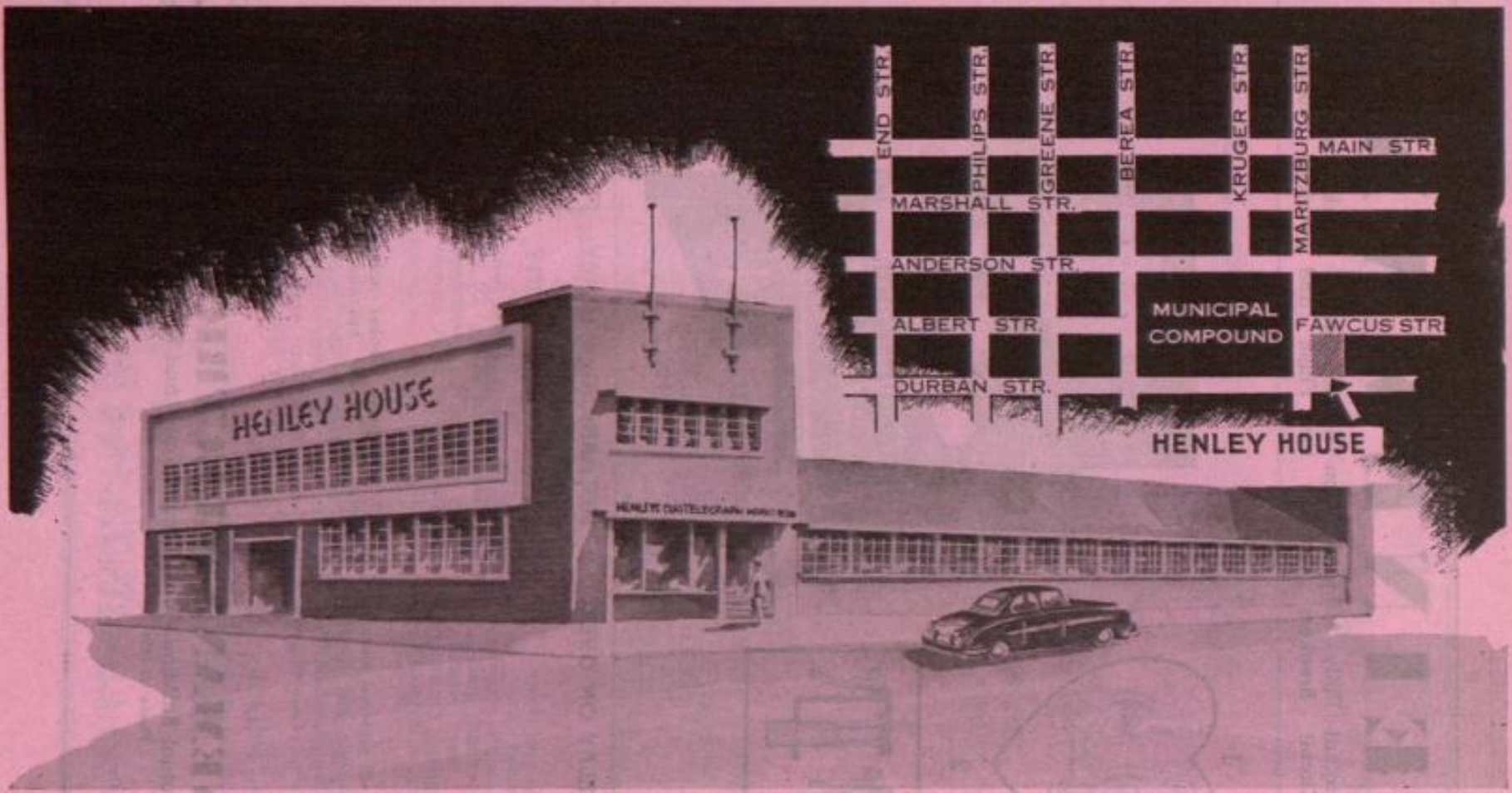

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frequency oscillation (known as the re-striking transient) of a frequency equal to the natural frequency of the circuit. The rate of rise of voltage and the amplitude of the H.F. oscillation are governed by the conditions of circuit constants and the arcing path. Such transient phenomena can hardly be studied, however, on the attached oscillograms, owing to the limitations of the electromagnetic oscillograph and the time scale employed.

The phase voltage traces on the "break" tests, Sheets D, E, F and G, differ from those on the "make-breaks" in that no voltage is recorded prior to the commencement of current flow, since the circuit-breaker under test is initially closed. On Sheets F and G the resistive and inductive drop across the circuit-breaker and its connections prior to contact separation, is clearly recorded as a gentle undulation. This is explainable by the fact that both Sheets F and G are records of heavy current tests.

(iv) Phase Watts Traces (Nos. 4, 7 and 10)

These record the watts absorbed in the arc-path, the deflection of any point being proportional to the instantaneous values of arc-current and volts across the arc. (Strictly, they also include the watts absorbed by resistance of the circuit-breaker conductors and connections). By determining the area of the trace above the zero line the energy consumed can be obtained with the aid of the appropriate kilowatt and time scales. The deflection of the traces is always in the same direction, *i.e.*, above the zero line, as the arc power factor is unity.

(v) Fluid Pressure Trace (No. 11)

The light "spot" for this trace is usually made much longer than any other in order to cater for the increased writing speed to which the spot may be subjected. It may for example, be deflected 1·5 cm. above and then below the zero line in $^1/_{1000}$th sec. as against the same movement of a current or voltage spot in $^1/_{50}$th sec. It should be noted that the pressure scale is given in lbs. per sq. in. per cm. band. This means that to determine the pressure at any given instant the total band (or the sum of the deflection above and below the zero line) must be measured before multiplying by the scale. For example, on Sheet E, the maximum pressure occurs just prior to interruption of the short-circuit, the band being 11·5 mm. From this should be subtracted the width of the spot in its undeflected condition, *i.e.*, 2·5 mm. the pressure then being $0{\cdot}9 \times 100 = 90$ lb. per sq. in. It will be seen that the pressure is of an impulsive nature which quickly dies down to a sustained value of about 20 lb. per sq. in. Close examination of the trace would suggest that some pressure is recorded before the beginning of the short-circuit, but this is explained by the fact that the bridge circuit was initially slightly out of balance, to an extent so small, however, as to be of no consequence for practical purposes.

(vi) Travel Trace (No. 12)

Very little amplification of previous remarks is needed. On Sheets D, E, F and G, which are records of on-load "break" tests, the trace is generally similar to the record on the no-load "break" tests. It is of interest to note however, that the slope of the stepped trace, and therefore the speed of contact movement, may be much higher after contact separation, than on the no-load tests. This is particularly noticeable on Sheets E and G, and is explained by the fact that on power tests the forces due to gravity and accelerating springs are augmented by an electromagnetic force acting on the horizontal contact bar, and by gas pressure acting on the arcing contact surface. The effect of these additional forces varies, of course, with the value of the short-circuit current.

The travel trace on the "make-break" tests shows firstly the closing stroke (K to L on Sheet B), then a horizontal record L to M, representing the fully closed position, and finally the opening stroke M to N when the trip coil operates. The initial fully open position of the circuit breaker may not always be recorded, as on Sheet C, as it is not of particular importance.

(vii) Closing Coil Trace (No. 13)

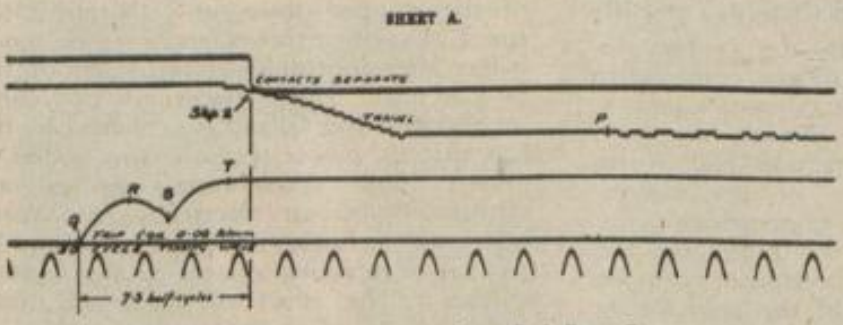
This is only recorded on the make-break tests, where the closing of the circuit-breaker under test initiates the short circuit. The general shape of the trace is similar to that of the trip coil, with an initial rise of current according to the exponential law, followed by a decrease of current as the solenoid plunger is attracted into the coil. It will be seen that the final

current "pip" representing the completion of the plunger stroke, coincides substantially with the completion of the moving contact stroke, as is to be expected. Compare H and L on Sheet B. The current pip H is much less pronounced than the pip J on the trip coil trace owing to the difference in the speed of movement of the trip- and closing-coil plungers, and therefore the difference in change of inductance of the coils. The trip-coil plunger has merely to rise against its own weight, and therefore moves faster than the closing-coil plunger, which is driving the breaker mechanism and contacts.

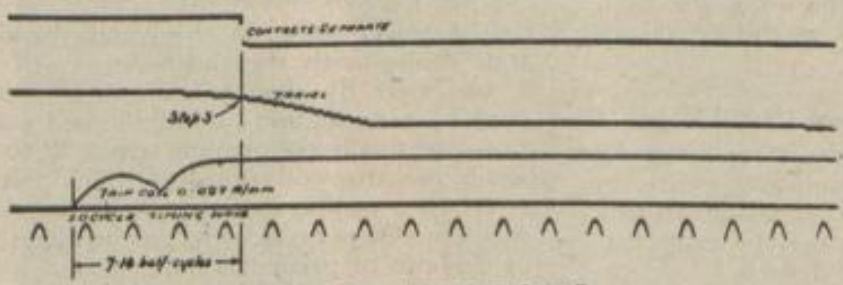
(viii) Trip-Coil Trace (No. 14)

The trip-coil trace on power tests should merely be a reproduction of that shown on the corresponding no-load test. Some discrepancy is noticeable on Sheet F, however. The irregularity of this trace is due to induction as a result of the trip-coil leads being located too close to the main current-carrying connections to the circuit-breaker. It can be seen that the induction is due to a 50-cycle "pick-up", which commences at X and coincides with the beginning of the short-circuit.

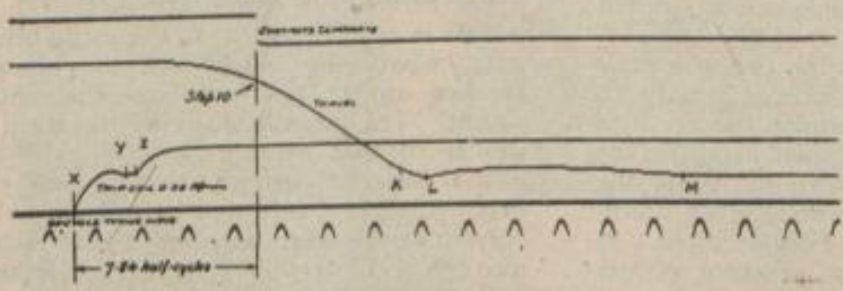
On the "break" tests, Sheets D, E, F and G, it would appear that the trip-coil light spot has remained in its zero position while also giving a deflected record of the trip-coil current. This apparent anomaly is explained by the fact that the light spots for both the closing and trip-coil traces are positioned so that their zero axes coincide, merely to save overall length of the oscillogram. Thus, on break tests, since the closing coil, is not energised, its light spot remains undeflected, and serves to facilitate scaling off the trip-coil deflection.



Timing Record for use with Sheets B, C, D and E.



Timing Record for use with Sheet F.

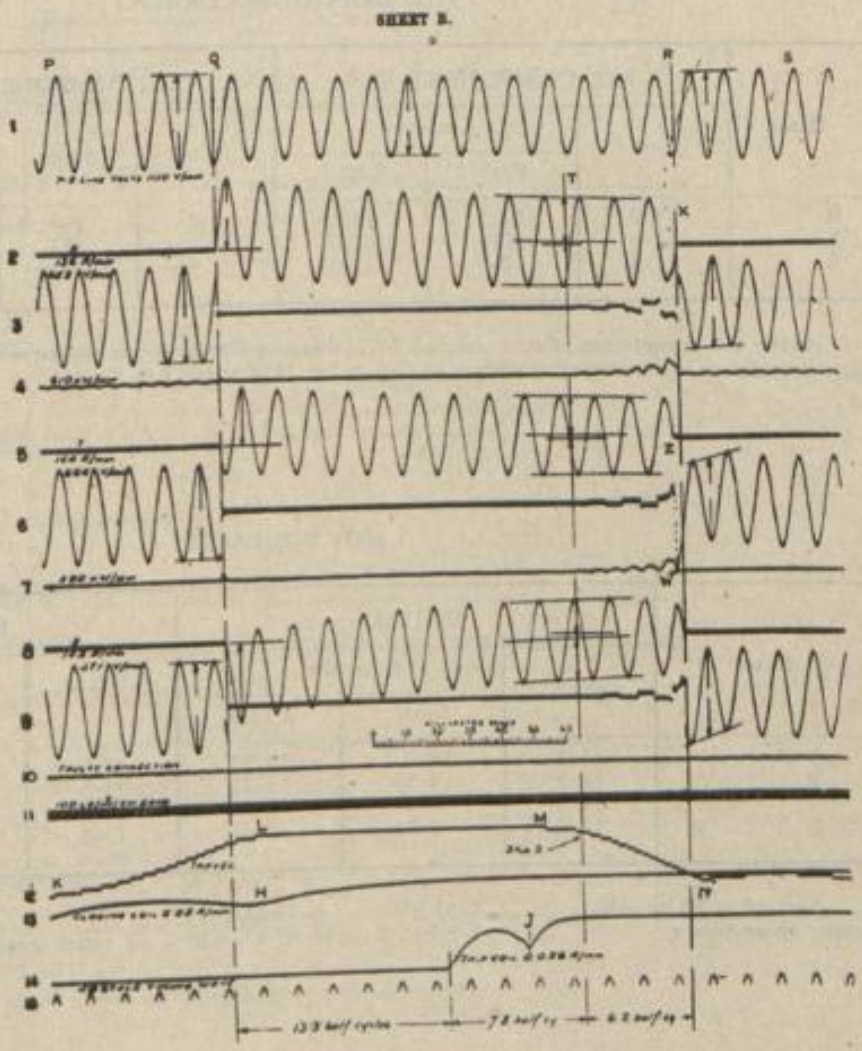


Timing Record for use with Sheet G.

It may also appear anomalous that on Sheets C, E and G, the trip-coil is energised before the short-circuit current starts, a condition which does not obtain in practice, where trip-coil operation results either directly or indirectly from the current flow in the main phase conductors. It should be remembered, however, that in order to subject a circuit-breaker to a desired value of short circuit in a testing station, the trip coil must be capable of separate and variable control. In other words the contacts of the circuit-breaker must be capable of being separated at any point in time after the initial current flow, in order that the required stipulations of the test, such as values of symmetrical component of breaking-current, recovery voltage, and D.C. component, may be met.

(ix) Timing Wave Trace (No. 15)

This differs in no way from the records on the no-load tests, excepting that the scale in mm./cycle may vary in different tests depending upon the expected duration of the short-circuit.



Make Break Test breaking current symmetrical.

FIGURES DERIVED FROM SHEET B.

(I) MAKING CURRENT

Phase	m/m.	Peak Amps.
R	21·5	2930
Y	17·5	2525
B	24·0	3435

The highest figure only is significant, i.e., 3,435 Amps. (peak).

(II) BREAKING CURRENT

Phase	A.C. COMPONENT: X			D.C. COMPONENT: Y			TOTAL R.M.S. Amps per phase.
	m/m	Amperes		m/m	Amps.	% of A.C. (Peak)	
		Peak	R.M.S.				
R	14·0	1903	1350	1·0	136	7·15	1357
Y	12·0	1728	1227	1·2	173	10·0	1240
B	12·3	1760	1245	1·5	214	12·2	1264

As the d.c. component never exceeded 20%, this is evidently a test to prove a "symmetrical" figure. The significant figure is therefore the average of Col. 4, i.e. 1274 amps. r.m.s.

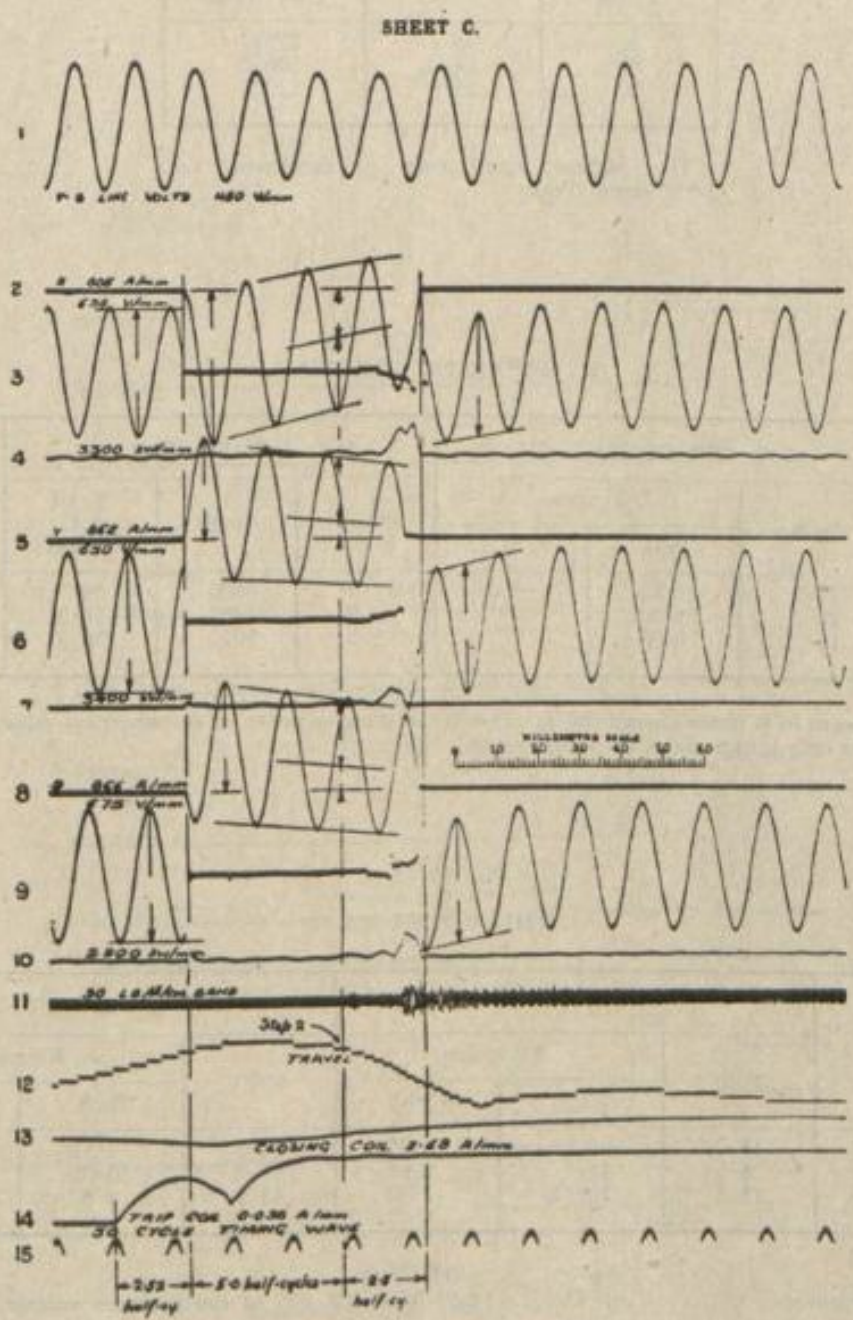
(III) VOLTAGES

Phase	INITIAL			RECOVERY		
	m/m	Kilovolts		m/m	Kilovolts	
		Peak	R.M.S.		Peak	R.M.S.
Y–B	14·4	16·0	11·35	13·5	14·95	10·6
R	14·5	9·55	6·77	13·5	8·9	6·32
Y	14·1	9·37	6·63	12·4	8·23	5·84
B	13·9	9·33	6·61	13·5	9·05	6·41

Average of Ph/E volts ... 6·67 kV 6·29 kV
Equiv. phase/phase ... ... 11·5 kV 10·87 kV = 99% of rated service voltage (i.e. 11 kV)

(IV) TANK PRESSURE

(0·45—0·3) c/m × 100 = 15 lb. per sq. inch.



Make Break Test breaking current asymmetrical.

FIGURES DERIVED FROM SHEET C.

(I) MAKING CURRENT

Phase	m/m.	Peak Amps
R	36·7	29550
Y	24·0	20650
B	25·5	22000

The highest figure only is significant, i.e., 2,550 amps. (Peak).

(II) BREAKING CURRENT

Phase	A.C. COMPONENT: X			D.C. COMPONENT: Y			TOTAL R.M.S. Amps per phase.
	m/m	Amperes		m/m	Amps.	% of A.C. (Peak)	
		Peak	R.M.S.				
R	17·2	13820	9800	11·8	9500	69	13630
Y	15·2	13100		4·0	3450	26·3	
B	16·0	13800		5·8	5020	36·3	

D.C. component in R phase exceeds 50%. Test is therefore to prove an asymmetrical value, and the total current in R phase only is important, i.e. 13,630 amps. r.m.s.

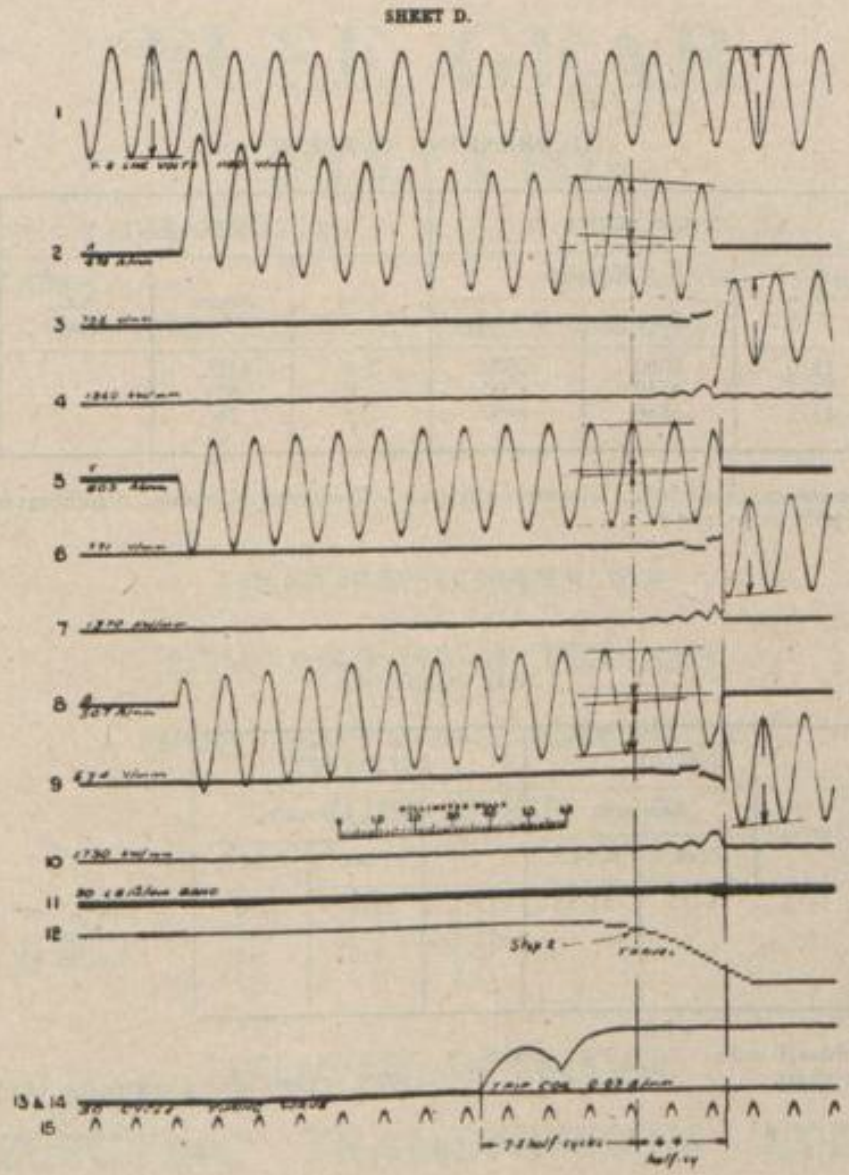
(III) VOLTAGES

Phase	INITIAL			RECOVERY		
	m/m	Kilovolts		m/m	Kilovolts	
		Peak	R.M.S.		Peak	R.M.S.
R	15·0	9·83	6·95	14·5	9·52	6·73
Y	16·5	11·7	8·28	15·5	10·05	7·12
B	15·5	10·45	7·40	14·5	9·80	6·93

Averages ... ... 7·54 6·93
Equiv. phase/phase ... 13·05 kV. 11·95 kV = 108·5% of rated service voltage. (i.e. 11 kV)

(IV) TANK PRESSURE

(0·85—0·25) c/m × 90 = 54 lb. sq. inch.



Break Test

Breaking current symmetrical.

FIGURES DERIVED FROM SHEET D.

(I) MAKING CURRENT

NONE—This is a test for breaking performance only.

(II) BREAKING CURRENT

Phase	A.C. COMPONENT: X			D.C. COMPONENT: Y			TOTAL R.M.S. Amps per phase.
	m/m	Amperes		m/m	Amps.	% of A.C. (Peak)	
		Peak	R.M.S.				
R	15·0	7060	5000	2·8	1315		
Y	13·2	6550	4700	1·0	503		
B	13·5	6850	4850	1·5	760		

No d.c. components exceed 20%. Therefore a test for a "Symmetrical" value. Significant figure is average of column 4, i.e. 4,850 amps. r.m.s.

(III) VOLTAGES

Phase	INITIAL			RECOVERY			
	m/m	Kilovolts		m/m	Kilovolts		
		Peak	R.M.S.		Peak	R.M.S.	
Y–B	14·2	16·75	11·85	13·2	15·6	11·0	= 100% of rated service voltage (i.e. 11 kV.)
R				11·2	8·46	5·98	
Y				12·5	9·62	6·80	
B				13·8	9·3	6·57	

Average of phase/E volts $= 6{\cdot}45$
Equiv. phase/phase $= 11{\cdot}2$ kV. $= 102\%$ of rated service voltage (i.e. 11 kV.)

(IV) TANK PRESSURE

(0·3—0·15) c/m × 90 = 13·5 lb. per sf. inch.

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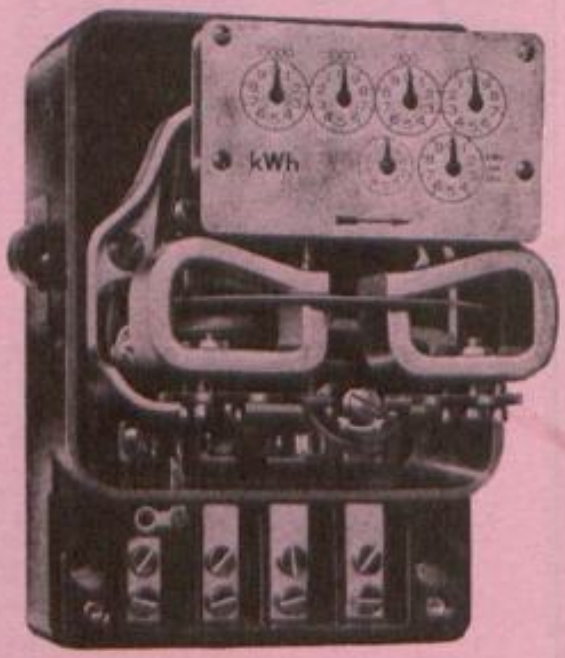

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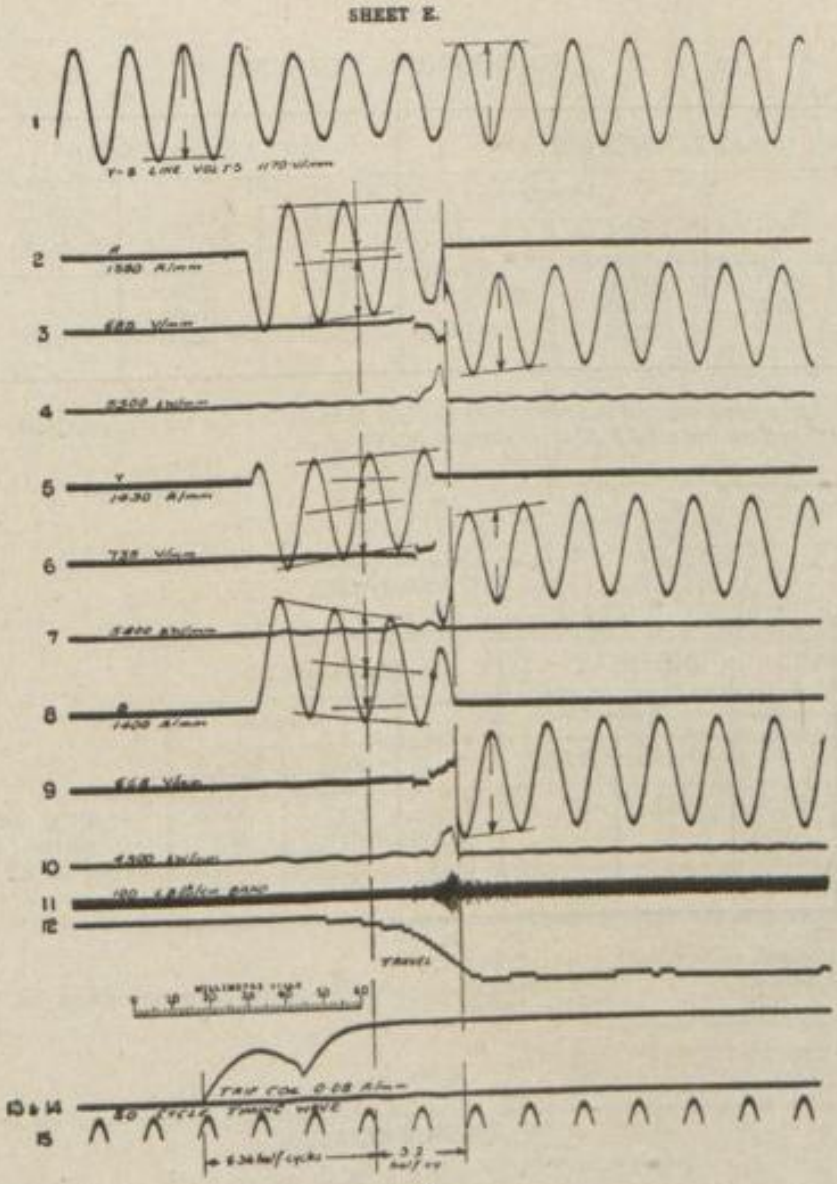


Break Test.
Breaking current assymmetrical.

FIGURES DERIVED FROM SHEET E.

(I) MAKING CURRENT

NOTE—The short circuit was not closed by the test breaker.

(II) BREAKING CURRENT

Phase	A.C. COMPONENT: X			D.C. COMPONENT: Y			TOTAL R.M.S. per phase.
	m/m	Amperes		m/m	Amps.	% of A.C. (Peak)	
		Peak	R.M.S.				
R	15·0	20700		2·6	3600		
Y	13·0	19400		7·0	10400		
B	14·0	19600	13850	10·3	14400	73·7%	20000

In B phase d.c. component exceeds 50% and the test is therefore for an asymmetrical value. The figure of importance is therefore the total R.M.S. current of 20,000 amps.

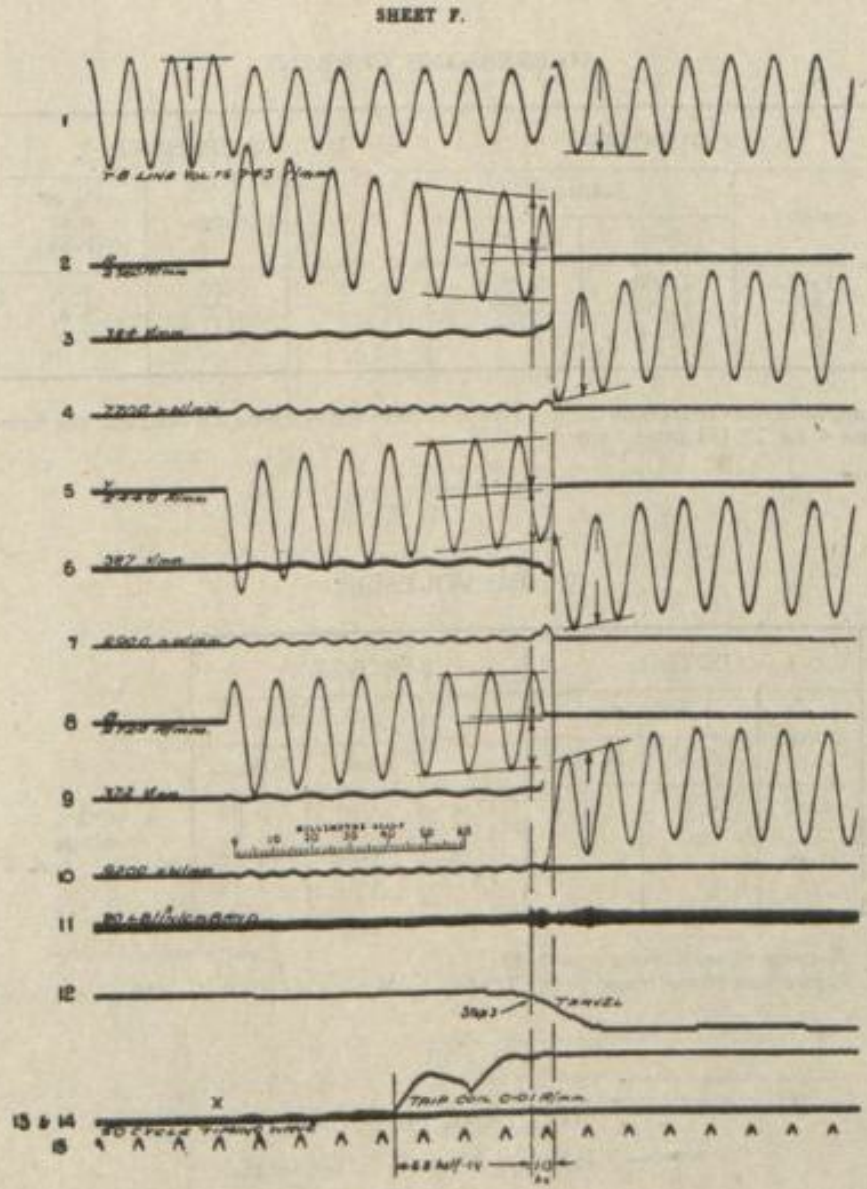
(III) VOLTAGES

Phase	INITIAL			RECOVERY			
	m/m	Kilovolts		m/m	Kilovolts		
		Peak	R.M.S.		Peak	R.M.S.	
Y–B	14·5	17·0	12·03	13·3	15·7	11·10	= 101% of rated service voltage i.e. 11 kV.
R				12·6	8·65	6·12	
Y				12·0	8·85	6·26	
B				13·0	8·70	6·16	

Average of phase/E volts 6·18 kV.
Equiv. phase/phase = 10·7 = 97·3% of rated service voltage (i.e. 11 kV.)

(IV) TANK PRESSURE

(1·15—0·25) c/m × 100 = 90 lb. per sq. inch.



Break Test.
Breaking current symmetrical.

FIGURES DERIVED FROM SHEET F.

(I) MAKING CURRENT

NONE—This was a "break" test.

(II) BREAKING CURRENT

Phase	A.C. COMPONENT: X			D.C. COMPONENT: Y			TOTAL R.M.S. per phase.
	m/m	Amperes		m/m	Amps.	% of A.C. (Peak)	
		Peak	R.M.S.				
R	13·2	33800	23950	2·5	6400	18·9	
Y	13·2	32250	22850	1·3	3170	9·8	
B	12·2	33200	23500	1·0	2720	8·2	

The d.c. component never exceeds 20%. This is therefore a symmetrical test, and the figure desired is the averate of column 4, i.e. 23,433 amps. r.m.s.

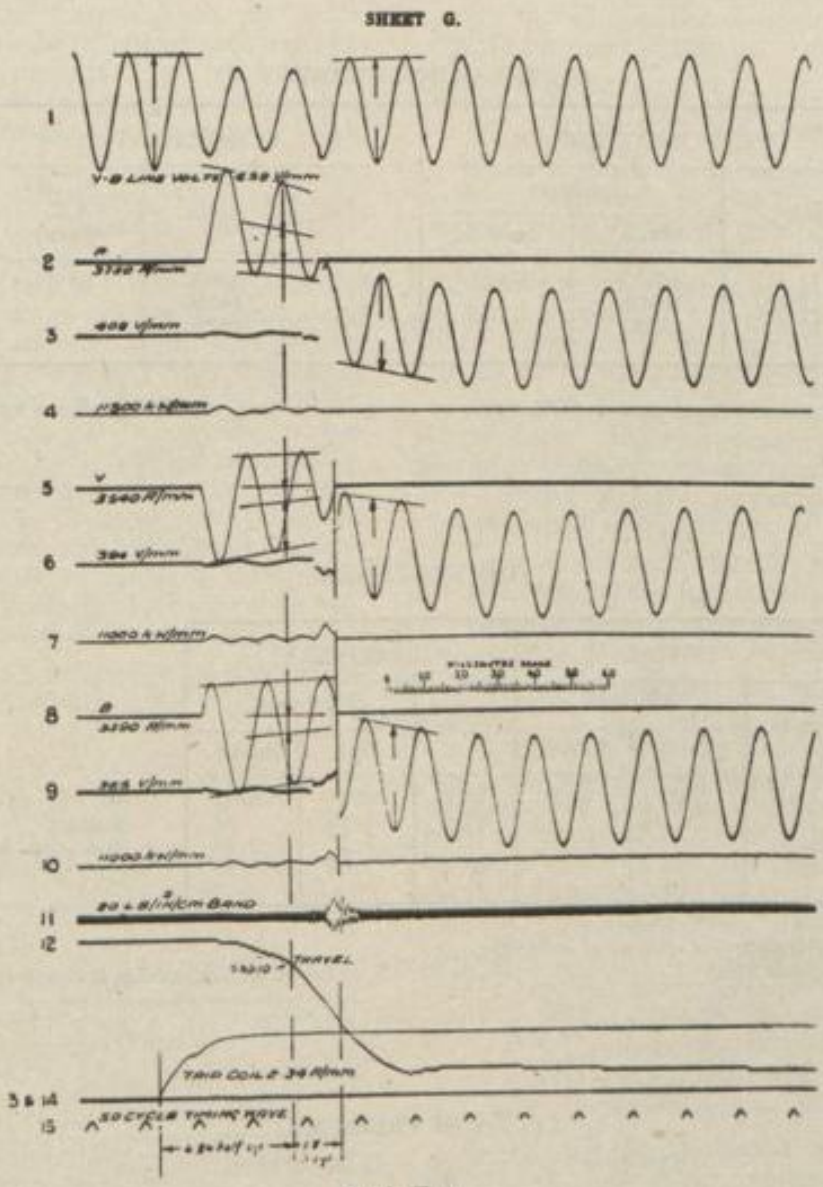
(III) VOLTAGES

Phase	INITIAL			RECOVERY			
	m/m	Kilovolts		m/m	Kilovolts		
		Peak	R.M.S.		Peak	R.M.S.	
Y–B	13·7	10·2	7·22	12·0	8·95	6·34	= 96·2% of rated service voltage (i.e. 6·6 kV.)
R				13·2	5·07	3·58	
Y				13·6	5·26	3·72	
B				13·0	4·82	3·43	

Recovery Voltage } Average phase/E volts = 3·58
Equivalent phase/phase = 6·20 kV. = 94% of rated service voltage (i.e. 6·6 kV.)

(IV) TANK PRESSURE

(0·6—0·2) c/m × 80 = 32 lb. per sq. inch.



Break Test.
Breaking current assymmetrical.

FIGURES DERIVED FROM SHEET G.

(I) MAKING CURRENT

NONE—A "break" test.

(II) BREAKING CURRENT

Phase	A.C. COMPONENT: X			D.C. COMPONENT: Y			TOTAL R.M.S. per phase.
	m/m	Amperes		m/m	Amps.	% of A.C. (Peak)	
		Peak	R.M.S.				
R	12·5	46600	32950	8·2	30600	65·7	44900
Y	12·5	44300		4·2	14850		
B	13·5	45800		4·8	16250		

As R phase d.c. component exceeds 50% this is an asymmetrical test, and the significant figure is therefore 44,900 amps.

(III) VOLTAGES

Phase	INITIAL			RECOVERY			
	m/m	Kilovolts		m/m	Kilovolts		
		Peak	R.M.S.		Peak	R.M.S.	
Y–B	15·0	9·88	6·98	13·7	9·2	6·52	= 98·8% of rated service voltage (i.e. 6·6 kV.)
R				12·6	5·16	3·65	
Y				13·2	5·2	3·68	
B				13·8	5·04	3·56	

Average phase/E volts = 3·63
Equiv. phase/phase volts = 6·28 = 95·3% of rated service voltage (i.e. 6·6 kV.)

(IV) TANK PRESSURE

(1·06—0·15) c/m × 80 = 73 lb. sql inch.

WHAT HAPPENS INSIDE THE CIRCUIT BREAKER AND WHAT FORCES ARE SET UP

When an oil circuit breaker opens, an arc is established at the instant of the contacts parting, the current in this arc is carried by the hydrogen and other gases produced by the intense heat. In order to interrupt a short circuit successfully it would be desirable for the circuit breaker to open at an instant when the wave passes through its zero current value or zero point.

Should this happen the rate of improvement in dielectric strength of conducting medium between contacts is greater than the rate of rise in voltage across them. This rise in voltage is dependent on the value of active recovery voltage and also on the superimposed high frequency oscillations which are determined by the electrical constants of the circuit. These oscillations may have frequencies varying from a few hundred cycles per second when many miles of cable are connected within a small area, to a 100,000 or 200,000 per second under exceptional conditions such as where circuit breakers are connected close to large reactances.

These oscillations have an instantaneous value of twice the peak value of the phase recover voltage and the rate of rise of electric stress may in extreme cases be as high as several thousand volts per micro-second.

In order to see what actually happens inside the circuit breaker it is necessary to examine an oscillogram showing this restriking transient and figure I shows such a record obtained during the test of an O.C.B. on short circuit.

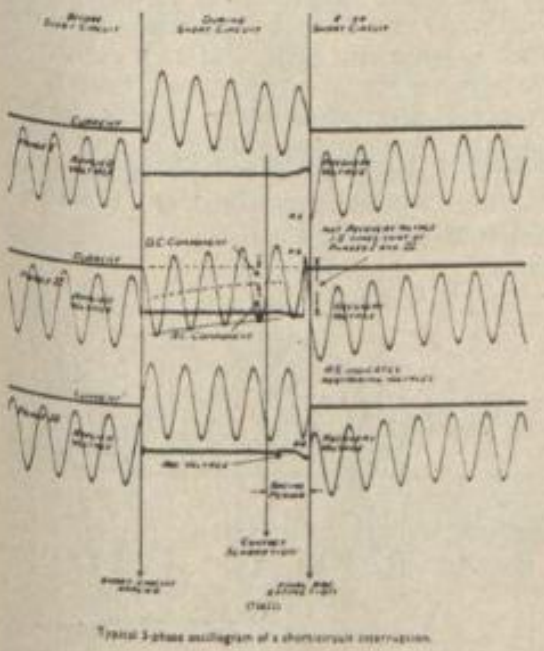


FIG. I

Typical 3-phase oscillogram of a short-circuit interruption.

WHAT HAPPENS WHEN A SHORT CIRCUIT OCCURS

When a short circuit occurs on an a.c. network between any two lines, the initial short circuit current consists, generally of two components, one of which is an a.c. component, the r.m.s. value of which is equal to the r.m.s. voltage between the lines divided by the impedance of the circuit up to the point of faulting.

The other component is a transient d.c. component, the amplitude of which depends upon the instantaneous value of the voltage, and the power factor at the instant when the short circuit commences.

If the short circuit occurs at an instant of zero voltage the initial value of the d.c. component at low power factors is equal to the peak value of the a.c. component.

If it is assumed that the angle of phase difference is 86 degrees (Cos. 0·07) at the instant of applying the short circuit, then, by the end of the first half cycle the value of the d.c. component would have fallen to 80% of its initial value, 64% by the end of the cycle and by a similar proportion each successive half cycle. With higher power factors the d.c. component is more rapidly damped out.

NOTE. In the B.S. specification No. 116-1937 a decrement factor of 80% per half cycle is assumed and is used here where approximate values are given for quantities dependent upon it.

Should the short circuit occur at an instant of maximum voltage the d.c. component is zero, while, if the short circuit starts at an intermediate instant the d.c. component will have an intermediate value.

The graphical illustration fig. II shows the short circuit commencing at zero voltage, and it can be seen that the effect of the d.c. component is to force the a.c. current wave above the zero line.

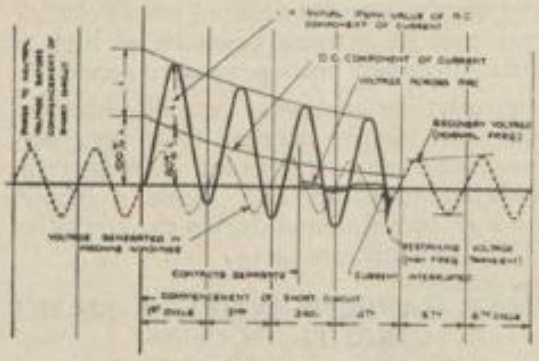


FIG. II

Asymmetrical short-circuit interrupted by circuit breaker.

What are these Components

When the rupturing capacity of circuit breaker is discussed or when specifications are drawn up, it is usual to have the breaking capacity stated in terms of amps, kilo-amps, kVA or MVA and makers are generally asked to state the symmetrical and asymmetrical breaking capacity. The presence of a d.c. component in the current is generally spoken of as asymmetry and the term *asymmetrical* or *total* short circuit current is employed to denote the combined a.c. and d.c. components. When there is a small, or no asymmetry and the a.c. component only is considered, it is referred to as the symmetrical short circuit current.

Amplitude or Value of Asymmetry

In the 3 phases of a 3 phase system there are six instants of zero voltage per cycle, and it follows that in the case of a 3 phase short circuit there will always be considerable asymmetry in at least one phase.

Referring to the graphical illustration, Fig. II, it will be clear, that with full asymmetry, the peak value of the asymmetrical current in the first cycle is 1·8 times the peak value of the a.c. component, indicated by "i" and is therefore $1{\cdot}8 \times \sqrt{2}$ or very nearly 2·55 times the r.m.s. value of the a.c. component.

Further, with the decrement factor of 80% per half cycle the d.c. component will at the end of 5 cycles, or 10 half cycles have fallen to 10% of its initial value. With time the a.c. component also decreases rapidly in amplitude, especially if the short circuit should take place close to the generators or transformers feeding into the fault, and more slowly if the fault occurs some distance away, until it reaches a value which can be maintained by the generators.

The ratio of the r.m.s. value of the asymmetrical current when there is full asymmetry, to that of the symmetrical component, both taken over the first half cycle is:—

$$\frac{\sqrt{\left(\frac{1}{\sqrt{2}}\right)^2 + (0{\cdot}8)^2}}{\frac{1}{\sqrt{2}}}$$

or approximately 1·5, and if the decrease in the a.c. component is disregarded the r.m.s. value of the asymmetrical current at the end of the 5th cycle will be

$$\frac{\sqrt{\left(\frac{1}{\sqrt{2}}\right)^2 + (0{\cdot}1)^2}}{\frac{1}{\sqrt{2}}}$$

or 1·01 times the r.m.s. value of the a.c. component.

NOTE. $(0{\cdot}1)^2$ *in the above expression is approximate only*

$(0{\cdot}8)^{10}$ *(10 half cycles) is approximately equal to* 0·1

It will thus be seen that with the assumed power factor of 0·07 and after a lapse of 5 cycles from the commencement of the short circuit, the initial asymmetry has for all practical purposes disappeared.

When the fault or short circuit occurs close to the apparatus feeding the fault and therefore under low power factor conditions the ratio of reactance to resistance is generally high, and as a result, in the absence of asymmetry, an instant of zero current corresponds closely to an instant of maximum voltage in the same phase. Should there be asymmetry this condition would be modified, and this effect is illustrated in figure III.

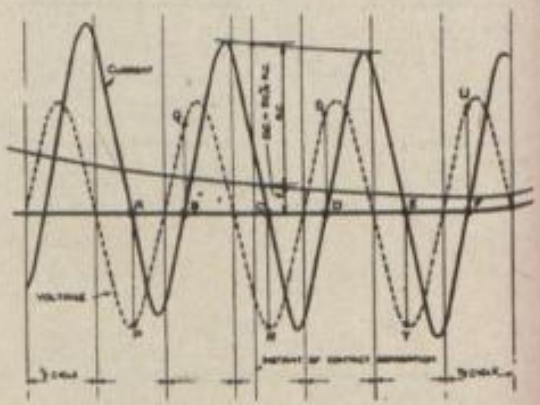
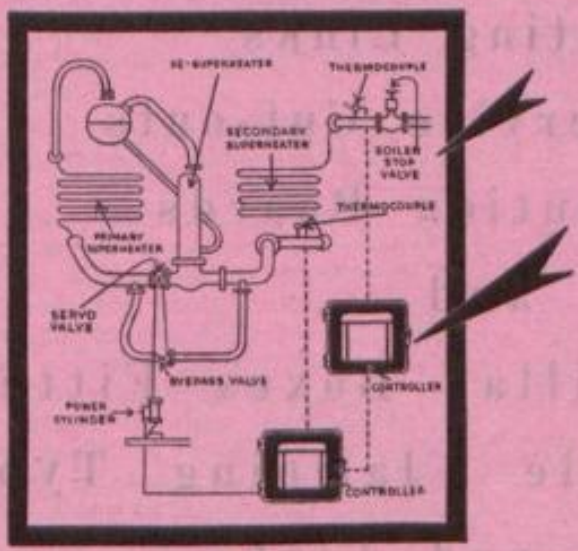


FIG. III

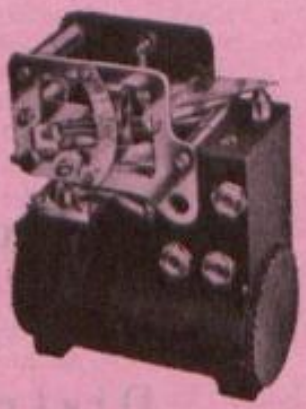
Active value of recovery voltage.

Automatic Control

BY THE NEW KENT MK. 20 AIR OPERATED CONTROLLER



Kent Mk. 20 Controllers give complete automatic control of Steam Pressures: Fuel Feed: Superheat Temperature: Furnace Pressure: Air Flow.



The Diagram shows the latest practice in superheated temperature control, in which a Kent Multelec Mk. 20 Temperature Controller measures the final steam temperature and automatically sets the control point of a second Multelec Mk. 20, which measures and controls the steam temperature at the entrance to the secondary superheater by automatically setting the position of the desuperheater byepass and series valves.

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The voltage is shown leading the current by approximately 81 degrees, corresponding to a power factor of 0·15. At the end of each major current loop viz., at AP CR and ET zero current corresponds very closely to maximum voltage and at the end of each minor current loop viz., BQ DS and FV this correspondence is not so close which is due to the effects of power factor and asymmetry cancelling each other in the first instance, and are accumulative in the second case.

Should the power factor not exceed 0·15 and if the d.c. component is not greater than 20% of the peak value of the a.c. component, then the instantaneous value of the generated voltage at zero current will not be less than 96% of its peak value.

From what has been said it follows that at each instant of zero current under the given conditions the generated voltage will have a high value differing little from its peak value.

If the rate of change of current near the zero value remains fairly constant, the generated voltage is absorbed in overcoming the circuit impedance, but the moment this rate of change is varied abruptly as it is if the current pauses at a zero point, the voltage across the arc rises with extreme rapidity and the result is a series of high frequency oscillation as shown on the oscillographic record fig. III. The frequency of these oscillations as previously explained are determined by the constants of the circuit, and is independent of the frequency of any voltage generated in the circuit, and it is what is generally termed the natural frequency of that circuit.

The voltage in this transient oscillation is called the Restriking voltage" and the generated voltage about which these oscillations take place is known as the "Recovery voltage" and it is this which reappears on the test oscillogram across the contacts of a circuit breaker immediately after the current is interupted in any phase.

The amplitude of the restriking voltage depends on the instantaneous value of the recovery voltage at zero current. This instantaneous value is of importance and is called the *"active recovery VOLTAGE."*

The active recovery voltage depends on three factors viz., power factor, the amount of asymmetry present in the current wave and the peak value of the generated or recovery voltage wave at interruption. Due to armature reaction in the generating plant the terminal voltage often drops considerably by the end of a few cycles after the short circuit has started.

DESIGN OF CIRCUIT BREAKERS

In common with all other plant and equipment a circuit breaker originates on the drawing board, and in order to produce an article that will perform its function infallibly it is essential for manufacturer as well as user to know definitely that every circuit breaker is capable of making and breaking its rated short circuit capacity without suffering electrical or mechanical breakdown and thereafter still be fit to perform its normal required duty.

Among the many factors which designers must therefore consider to provide a maximum of safety the following may be mentioned:—

I. *Actual speed of making and breaking.*
II. Pressure exerted on moving contacts at making and breaking.
III. Arc suppression or control.
IV. Electro magnetic forces opposing closing.
V. Pressure rise within the oil tank.
VI. Head of oil above the contact points.
VII. Shape of and method of securing oil tank.
VIII. Method of supporting and type of contact.

Much can be written about each of the above factors especially since research has constantly brought more and more interesting information to the fore in regard to the behaviour of switch gear under test. It would be outside the scope of this paper to discuss even partially any of the above, and only short reference can therefore be made to these points in so far as they affect the rupturing capacity of switch-gear.

In the past advantage was taken of the fact that in the event of a fault occuring, the value of the fault current would by the time the circuit breaker trip mechanism operates, have fallen to 60% of its value, and the practice was to select a somewhat smaller capacity O.C.B. than what would actually be required to interrupt the full value of the fault current.

With modern high speed circuit breakers this practice is not being considered any longer and the modern circuit breaker generally installed is selected to break the full fault current.

1. Speed of Opening and Closing

The actual speed of opening and closing of the circuit breaker is an important factor as it affects the duty the breaker is called upon to perform when opening on a short circuit. Two aspects may be considered, these being (*a*) whether the breaker is being closed on a fault, and (*b*) whether the fault develops immediately after the breaker is fully closed.

When closing on a fault, and depending on the type of contacts, considerable electro magnetic forces, perhaps of several tons, act on the moving contacts once current commences to flow. Should these forces balance, or very nearly balance the force exerted by the operator on the closing mechanism, there will be an instant before the tripping mechahism is actuated, and before the accelerating springs are fully compressed when enormous currents will have to be carried by the arcing tips. Under such conditions the contacts freeze or weld, unless the overload release, or quick acting relays if fitted, operate very rapidly. From this it will be clear that when closing on a fault the speed of breaking under these conditions may be much less then when the fault developed after the breaker is fully closed.

So far we have dealt with the speed of making and breaking, the pressure exerted on the moving contacts, by the closing mechanism, and the elctro magnetic forces opposing closure. Mention has been made that this opposition may amount to several tons. Since it is the initial peak value of the displaced current wave that determines this repulsive electro magnetic force it follows that such enormous forces may well be present when a circuit breaker is closed on a short circuit.

This peak making current in modern high speed circuit breakers may well have a value of 2·5 times the r.m.s. value of the symmetrical component at the instant the contacts part. However, where circuit breakers are selected to interrupt the full value of the fault, it is often necessary to provide protection to the circuit by fitting definite time relays, should a circuit be thus protected advantage can be taken of the decreased breaking current after the lapse of time and a slightly smaller breaker may with advantage be used.

A further rating, viz: "short time" rating of a circuit breaker is often required, and as an example may be quoted circuit breakers without auto tripping mechanism. In such cases the O.C.B. would be rated to carry for a short period of time, (half a cycle) the full fault value, until the circuit is broken by a master circuit breaker elsewhere. Where circuit breakers are installed having regard to their short-time rating, it must however be borne in mind that the heavy current passed through such circuit breakers imposes a thermal limitation which if exceeded would cause considerable damage to that particular unit.

Arc Suppression and Control

The current in an a.c. arc ceases to flow at every zero point, and the faster the speed of breaking, and the higher the head of oil above the circuit breaker contacts the more effective would be the capacity of the circuit breaker to interrupt a fault successfully, and if circuit breakers could be designed to interrupt a fault exactly at every zero instant ideal conditions in design would be achieved.

In the section dealing with "What happens inside the circuit breaker" mention was made of the oscillations set up, the factors which determine the frequency, and that the transient voltage is termed the restriking voltage. It is this transient voltage which really breaks down the gap between the parting contacts when the rate of increase is in excess of the rate of re-establishing dielectric strength. It is possible for the circuit to possess more than one natural frequency, and the restriking transient may be of a simple oscillatory nature, or it may also have harmonic ripple.

The way in which this arc current is interrupted has a marked influence on the restriking transient voltage in increasing the effect with sudden interruption before the zero of the wave and damping it if the current flows for a few micro seconds after zero.

In order to control to some extent the condition created by the restriking transient "de-ion grids," or "side blast baffle pots"

arc extinction devices are employed. These devices surround the arcing contacts. The "de-ion grid" consists of a series of insulating plates, having interspersed plates of magnetic material, all so dispersed and vented that the arc is moved laterally into oil pockets, where it vapourises the oil. The resulting gases of the arc stream are then forced transversely through the conductive gases of the arc stream to de-ionise them, so extinguishing the arc. This arc extinction takes place before the moving contact is fully withdrawn from the explosion pot. This type of arcing device is known as the "impulse" type.

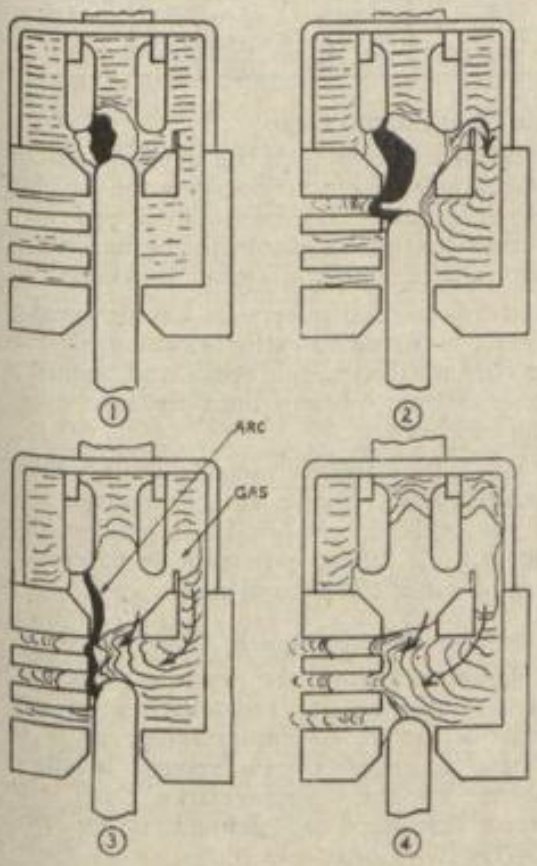


FIG. IV.

Figure 4 shows a typical cross jet pot with 4 stages in its operation.

1. Illustrates the commencement of opening and the arc striking.
2. Shows the gas bubble being forced out through the vents and the arc being forced against the splitters.
3. Illustrates the arc diminishing in magnitude and fresh oil rushing into the spaces between the insulating laminations.
4. Shows the arc completely extinguished before the moving contact leaves the stack, fresh oil, free from ionised particles filling up the spaces evacuated by the gas bubble.

The arc extinguishing side blast baffle pot, or "cross jet" arc extinction device, as it is sometimes called, is illustrated in Figure IV. This device has no magnetic material embodied in it, but the extinction of the arc is obtained by the pressure set up by the arc, forcing oil laterally across the arc, which in turn carries the arc against splitters. In this type of arc extinction device, it is the jet of oil crossing the path of the arc stream that extinguishes the arc. The moving contact is not withdrawn from the explosion pot until the arc is completely extinguished.

As a result of controlling the arc, the length of the arc is reduced and consequently the duration and the pressure which would normally be set up in the oil tank is very considerably reduced due to the arc being trapped within a small and practically isolated chamber, and thereby relieving the mechanical stresses caused by the violent oil turbulence, characteristic of plain break circuit breakers.

SHAPE OF OIL TANK AND METHOD OF SECURING

From what has been said about arc control it follows that without de-ion stacks severe mechanical stress may be imposed upon a circuit breaker especially when closing the breaker on a fault, it is therefore essential to give consideration to the shape of form of the oil tank and the method of securing it. It can readily be appreciated to what extent consideration should be given to this aspect in design, particularly in high voltage circuit breakers, where each phase is mounted in a separate tank in order to make impossible any phase to phase fault under oil thereby limiting the mechanical stresses set up under fault conditions.

This latter consideration in design, and in the light of information made available by modern testing facilities, designers have thus been enabled to consider the production of equipment of less cumbersome dimensions, and as a result low oil volume switch gear was developed.

Low Oil Volume Switch Gear

The head of oil above the contacts of a circuit breaker in order to provide a rapid replacement of di-electric free from ionised

particles to the contacts at instant of parting was gradually reduced with the development of de-ion stacks, and as these explosion pots improved in design and more effective means were developed for controlling the arc, it seems natural that with larger switch-gear, unless some means was developed to reduce the oil volume such units would become very cumbersome and perhaps even uneconomical.

Besides the expense involved in providing large quantities of oil whose di-electric strength, when confined within certain limits must naturally be considerably reduced, consideration had also to be given to fire hazards and the attendent consequences particularly where circuit breakers may be closed on a short circuit.

Low oil volume switch-gear has received particular attention in the high voltage field and an interesting feature in this respect is a circuit breaker built in three separate parts, designed for operation on 132 kV with a total oil content of 250 gallons compared with a 1,000 gallon capacity oil tank in earlier and similar designs.

With the development of l.o.v. circuit breakers it also became necessary to have breakers with closing or breaking speed considerably in excess of the earlier types, these increased make break times being essential to give rapid interruption under fault conditions on an interconnected network, where every precaution should be taken to avoid machines falling out of synchronism and causing a general shut down. To this end designers have produced switch-gear with make break times as low as 0·065 seconds.

These high speed l.o.v. circuit breakers are generaaly pneumatically operated from an air receiver of 150/175 lbs. per square inch pressure, the compressor unit starting up automatically after each operation.

Features worth mentioning regarding these types of circuit breakers are that for the first half cycle the break is very rapid, while during the latter part of the cycle the breaker is slowed down to eliminate any arc drawing.

During this latter period, at a pressure of approximately 200 lbs. per square inch, oil is forced across the break driving the arc across the splitters and extinguishing it.

Without entering into any discussion into the merits and demerits or expressing personal likes and dislikes of this particular type of switch-gear, it may not be out of place to provide some indication of the reduction in oil tank sizes and consequently the reduction of oil, For the purpose of comparison the operating or rated voltages are given.

Rated Voltage	*Size of Vessel*	*Rupturing Capacity MVA*	*Gallons of Oil per 3 Phases*
11 K.V.	8 inches	up to 750	4·5
22 K.V.	10 inches	up to 1000	10·2
33 K.V.	12 inches	up to 1500	15

Air Blast Switch Gear

Simultaneously with the development of low oil volume circuit breakers the air blast circuit breaker has been developed in a further attempt to eliminate the hazards of fire, possible with oil circuit breakers.

In this particular type of circuit breaker the arc is forced to extinction by a blast of air directed on to the break and against a series of arc splitters built up into a fan shaped chute.

While the current in an oil circuit breaker is interrupted finally at the natural zero of the cycle, in the air blast breaker like the H.R.C. fuse the current is forced to zero ahead of the natural cycle.

Selection of Switch-gear

When selecting the various types of circuit breakers for installation in any network, plant or undertaking, it is of course essential to understand what is meant by the "performance" of such circuit breakers, as defined under BSS 116-1937.

This specification demands that the short circuit ratings and test performances of a breaker shall be stated in the following terms.

a. The symmetrical current which could be broken simultaneously on all poles with a given recovery voltage.

b. The asymmetrical current which could be broken on any one pole with that recovery voltage.

c. The peak current through any one pole on to which the breaker could be closed at the rated service voltage.

It is customary to refer to these values in terms of kVA or MVA these values being the product of the symmetrical current and the recovery voltage equal to the rated service voltage.

The current which may flow under short circuit conditions on a system is determined by the total capacity of synchronous plant feeding into the fault and the value of reactance and resistance between such plant and the fault.

When a short circuit occurs on a system the current builds up in the first half cycle to a very high value which may include a high percentage of d.c. component depending on the vectorial position of the voltage wave at the instant of short circuit.

This high value of the current decreases rapidly to a sustained value at a rate depending upon the initial degree of asymmetry, or the proportion of d.c. component, the circuit power factor, and the decreased characteristic of the synchronous plant.

In the past it was general practice to take advantage of this decrease in current value and to select a circuit breaker equal only to the value of this decreased current at the time of the breaker contacts parting, and it was generally accepted that the current value, by the time the contacts parted, had fallen to 60% of its initial value, an average figure obtained from standard curves of decrement based on the average current time characteristic of generating plant.

Modern circuit breakers act much quicker since relay times are reckoned in cycles rather than seconds and little decrease can take place before the contacts part.

This fact, and the possibility that the breaker may be closed on a growing fault have brought about the practice of ignoring any decrease when determining the breaking capacity of a circuit breaker.

The most severe conditions that a circuit breaker can be called upon to withstand under operating conditions is where the circuit, if earthed, is earthed at one point only and not at both the neutral point of supply and fault itself.

The necessity of installing circuit breakers having breaking capacities based on the calculated value of short circuit current at the point of installation is today a recognised necessity, and this is true for high as well as low voltage circuit breakers, but there are certain fundamental differences which should be borne in mind, some of which are often not appreciated.

When dealing with high voltage systems the arc impedance is a negligible factor in so far as limiting the value of the short circuit current is concerned, and, likewise the impedance of connections, except long overhead lines and cable runs, may be ignored.

When calculating the magnitude of a short circuit which may occur on high voltage systems these factors are not taken into account, but on low and medium voltage systems these same factors are of greater importance and play a big part in reducing short circuit current values.

In order to illustrate this let us consider two separate undertakings, one of which generates at 660 volts, transmits at this voltage and transforms down to the required service pressures to consumers, against another undertaking, generating at 6,600 volts, giving a 10 to 1 ratio of voltages. If the base be taken as 10,000 kVA with approximately 0·001 ohms impedance the following percentage values would obtain:—

10,000 kVA at 6·6kV = 875 amps.
0·001 ohms = 0·875 volts drop.
= 0·023% Impedance.

10,000 kVA at 660 volts = 8750 amps.
0·001 ohms = 8·75 volts drop.
= 2·3% Impedance.

Therefore, for the same value of ohmic impedance the percentage impedance at the lower voltage is 100 times greater than for the higher voltage value. This shows that the value of 0·001 ohms impedance, which is quite a normal value for connections between a circuit breaker and apparatus such as a transformer, has indeed a marked effect on the values of short circuit currents on lower voltages.

The determination of the rupturing capacities of low or medium voltage systems depend therefore on the source of supply, and when this is derived from low voltage generating plant the short circuit currents will be low due to the fact that low voltage generators are usually of small kW capacity.

With the present trend of development the small LV power station is rapidly disappearing and the small consumers obtain their power from high power generating plant having capacities of 100 and more times the capacity of the step down transformers. If therefore there is no appreciable external impedance on the HT side the actual plant impedance can can be ignored because the impedance of the transformers will be the true limiting factor.

However, supplies of the nature described above, where consumers take a bulk supply from a supply authority, the transforming plant in the consumers substations are generally fed by cable, and here it is necessary to take into account the impedance of the feeder cables between the supply circuit breaker and the consumer's substations.

Evaluation of Short Circuit Values

With the ever increasing power generated by modern power stations a fault on the system may be fed by such enormous currents that unless instantly interrupted serious consequences may result, such as fire, damage to plant, injury to personnel and serious stoppage of supply.

Knowledge of the values of fault currents which can appear on a network is therefore absolutely essential, and it is only with a knowledge of such quantities that the selection of switch-gear, current transformers, busbars, and associated equipment can be made.

When selecting circuit breakers it is sufficient to base calculations on symmetrical three phase fault conditions.

When determining protective relay settings, it is however, necessary to know line to earth, double line to earth and line to line, or unsymmetrical fault values.

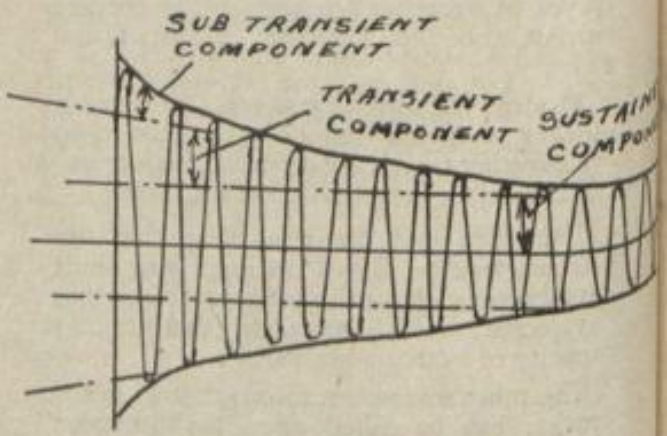
The source from which power may be fed into a network is usually the generating plant connected to the network, but synchronous machines, normally drawing power from such network, are capable of feeding power into the system under fault conditions. Large motors with heavy rotors having considerable flywheel effect may, with a drop in frequency or voltage act as induction generators and feed back will occur. It is therefore necessary that all these factors be taken into consideration in calculation of fault values.

In order therefore to determine any fault values it is essential to know the impedances of the system. This being the vector combination of resistance and reactance, symbolised by the letter Z and evaluated: $Z=\sqrt{R^2+X^2}$

In the case of generators, transformers and reactors the resistance is negligible compared with reactance, and for all practical calculations the percentage reactance method is the one which simplifies calculation, utilising the reactances given by the plant manufacturers.

The reactance of machines as mentioned, is generally expressed as a percentage, and this expression may be simply stated that under short circuit conditions a transformer having a 5% reactance, with normal full load current passing will have a reactive voltage drop of 5% of the line to neutral voltage, the applied voltage then being 5% of the normal applied voltage.

In generators there are three reactance values, the first being a sub-transient reactance which is a rapidly decreasing component, the second a transient reactance being a slowly decreasing component, and third a synchronous reactance which is a sustained component. These components are illustrated below by the diagram showing the symmetrical short circuit current of a typical generator.



These components do not arise in transformers, since these are static apparatus. The reactances of transformers are the leakage reactances of the primary and secondary windings and may be considered as series reactances and added arithmetically.

The reactance values of cables and overhead lines are generally given in ohms per mile or per 1,000 yds. and these values can easily be converted to a percentage value by the formula:

$$\%\text{ Value at given kVA base for ohmic value of X} = \frac{100{,}000 \times \text{kVA Base} \times X}{V \times V}$$

Where X = Value in ohms.
V = Line to line volts.
the value of X may be either resistance, reactance or impedance.

When calculating fault currents it is essential to know the following:—

1. Full details of all the plant that can feed the fault.
2. Details of all the factors that can limit the fault.

Since generators, transformers and reactors are all rated in kVA it is convenient to calculate short circuit values in kVA or MVA and to convert to values of symmetrical breaking current at the final stage.

When selecting circuit breakers it is not necessary to convert the fault values to current, since circuit breakers are rated in kVA or MVA but, it is however essential that this rating should be stated in relation to the voltage, since the voltage determines the current which the circuit breaker can deal with.

It will be appreciated, from the foregoing that a statement 150 MVA means little or nothing, as it cannot be expected that a circuit breaker should have the same rupturing capacity at voltages lower than that voltage on which the rating is based. The plant installed and connected to a network will, by virtue of requirements, naturally have different kVA ratings, and, because of this, when calculating fault values, it is necessary that the percentage reactances of the various plant be converted to a common kVA base. The value of this base is unimportant and may be that of the total plant capacity, the largest machine, or an arbitrary figure generally taken as 100,000 kVA.

In order to illustrate the unimportance of the value chosen for the basic kVA consider a 500 kVA transformer having an impedance of 5%. (Actually the impedance would be nearer 4 or 4·7%).

The fault value would be

$$\frac{500}{0{\cdot}05} = 10{,}000 \text{ kVA or } 10 \text{ MVA.}$$

In this instance the base was taken as the rated capacity of the transformer, from what has been said, when converting the percentage impedance to a common base the result with any other basic kVA would be the same, as follows:—

5% Reactance on 500 kVA would on a 1,000 kVA base be $\frac{1000}{500} \times 5 = 10\%$

and the fault capacity would be

$$\frac{1000}{0{\cdot}1} = 10{,}000 \text{ kVA.}$$

This being the instantaneous symmetrical value.

The simplest short circuit calculation is where a single generator gives supply to a number of feeders. A fault on any one point such as E_1 or E_2 Fig. 1 would mean that either the feeder O.C.B. or the generator O.C.B. must open to clear the fault and the value will be

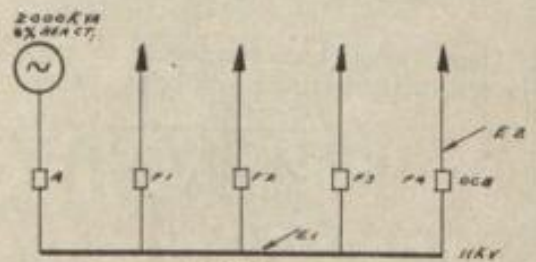


FIG. 1

$$\frac{2000 \times 100}{8} = 25{,}000 \text{ kVA.}$$

again, taking in this instance a kVA base of 100,000 the percentage reactance on this basis would be

$$\frac{100{,}000}{2000} \times 8 = 400\%$$

and the fault capacity would be

$$\frac{100{,}000 \times 100}{400} = 25{,}000 \text{kVA.}$$

The foregoing example might be cited as an average undertaking to which future extensions will be made from time to time, and let it be assumed that two further sets are being added the capacities of these

sets being different. In this instance a common base must be decided on and the combined reactance expressed in terms of this base.

Figure 1·1 indicates this condition.

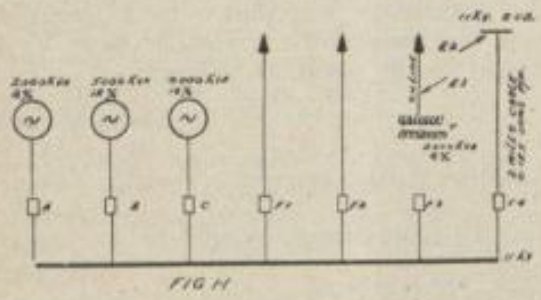


FIG 1

Let the base be taken as 100,000 kVA. Then:—

1. Generator A $= \frac{100{,}000 \times 8}{2000} = 400\%$

2. Generator B $= \frac{100{,}000 \times 12}{5000} = 240\%$

3. Generator C $= \frac{100{,}000 \times 16}{8000} = 200\%$

There being three reactances in parallel the resultant reactances will be the following

$$\frac{1}{\frac{1}{400}+\frac{1}{240}+\frac{1}{200}}$$

$$= \frac{1}{0{\cdot}0025+0{\cdot}0042+{\cdot}005}$$

$$= \frac{1}{0{\cdot}0117} = 85{\cdot}4\%$$

and the symmetrical short circuit kVA will be

$$\frac{100{,}000 \times 100}{85{\cdot}4}$$

$$= 117{,}000 \text{ kVA or } 117 \text{ MVA.}$$

This calculated fault value does not take into account any reactance external to the station, such as cable or overhead line impedances, and in Figure 1 the fault is indicated as occuring close to the station. However, should one of the feeders, say F4 feed a substation 2 miles distant, by cable, having a reactance of 0·125 ohms. per mile, this additional reactance, for the purpose of calculating the fault capacity must be taken into account, should a fault develop at E2.

The first step will now be to convert this ohmic reactance value to a percentage b sis as follows:

$$\frac{100{,}000 \times 100{,}000 \times 0{\cdot}125 \times 2}{11000 \times 11000}$$

$$= 20{\cdot}6\%$$

In this instance we have a further reactance in series with the former, and, since the calculations become somewhat more involved as we advance with additions to the station it would be better, for the purpose of these more involved calculations if impedance diagrams were introduced at this stage.

Returning for a moment to Fig. 1·1 where three reactances were coupled in parallel the resultant impedance diagram would be as in Fig. 1·2.

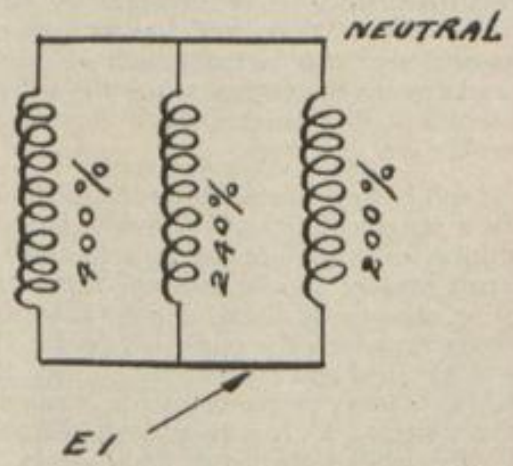


FIG. 1·2

The next step, a feeder cable was added with a reactance calculated by the foregoing formula, of 20·6%. This additional reactance being in series with the previous, the diagram now becomes as in Fig. 1·3.

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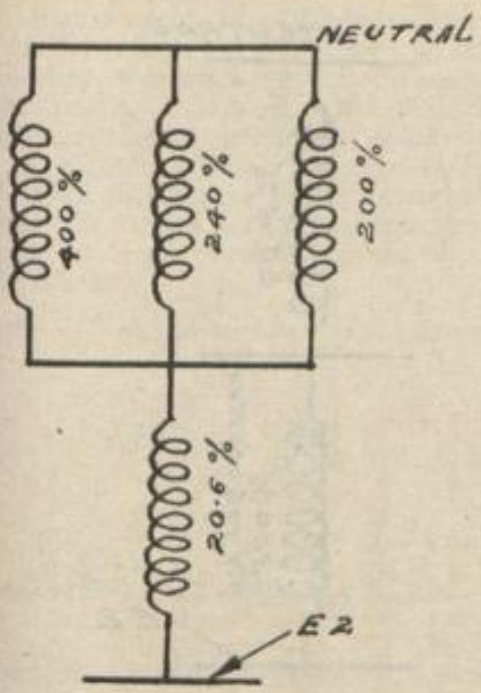


FIG. 1-3

The resultant reactance of the generators have already been calculated to be 85·4% and a more simplified diagram may now be drawn as follows:—

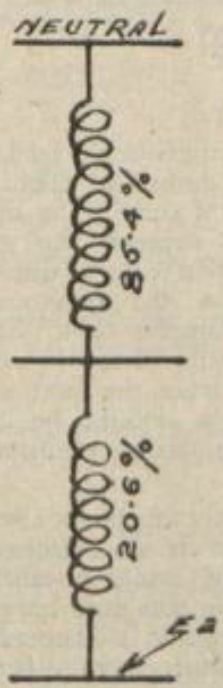


FIG. 1-4

Since reactances in series are added arithmetically the resultant or combined reactance in this instance will be

$$85{\cdot}4+20{\cdot}6$$
$$=106\%$$

and the impedance diagram further simplified to the following:

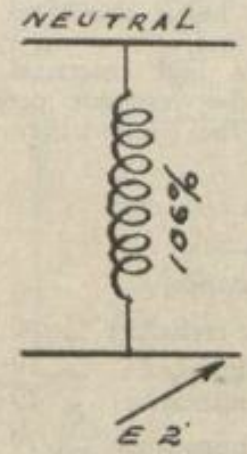


FIG. 1-5

and the instantaneous symmetrical short circuit value will be

$$\frac{100{,}000}{106} \times \frac{1}{100}$$
$$=94{,}339 \text{ kVA}$$

or say 94,400 kVA.

Should the substation however be fed by duplicate feeders the reactance of the second cable must be taken into account, as such type of feeding will increase the fault value, should they be of equal length. A further factor to be taken into account in this type of calculation is the resistance component, and where this component is greater than, or very close to the reactance value, its effect will contribute considerably towards breaking down the initial short circuit capacity.

The cable in the previous example may well have a resistance of 0·179 ohms per mile, giving a total resistance of $0{\cdot}179 \times 2 = 0{\cdot}358$ ohms.

Expressing this resistance in terms of a percentage to the kVA base the following is obtained.

Per cent resitance on kVA base=

$$\frac{100{,}000 \times 100{,}000 \times 0{\cdot}358}{11{,}000 \times 11{,}000} = 29{\cdot}5\% \text{ approx.}$$

The resistance component cannot be added arithmetically to the reactance component as the IR drop represents a component in quadrature with the reactance drop, and must therefore be added vectorially, and, since the vector sum of resistance and reactance is termed impedance the resultant percentage impedance of the combination will be the following:—

1. Generator reactance	85·4%
2. Cable reactance	20·6%
Total reactance	106·0%

i. Generator resistance %	0
ii. Cable resistance %	29·5
Total % resistance	29·5

Total % impedance $= \sqrt{29{\cdot}5^2 + 106^2}$
$= 109\%$ approximately

and the short circuit value under these conditions will be

$$\frac{100{,}000 \times 100}{109}$$

=91,743 kVA.

The foregoing examples have not taken into account the installation of any step up or step down transformers, and the introduction of such transformers does in no way complicate the determination of fault values, if in Fig. 1·1, Feeder F3 feed a substation with a 2,000 kVA transformer having a reactance of 6%, the short circuit value of a fault on the secondary side, close to the transformer at E3 would be enumerated as follws:

1. **Transformer:** 6% reactance on 2,000 kVA will be on 100,000 kVA

$$= \frac{100{,}000 \times 6}{2{,}000}$$

$=300\%$

2. **Generators:** From previous calculations 85·3%.

Constructing a reactance diagram.

The following conditions will obtain.

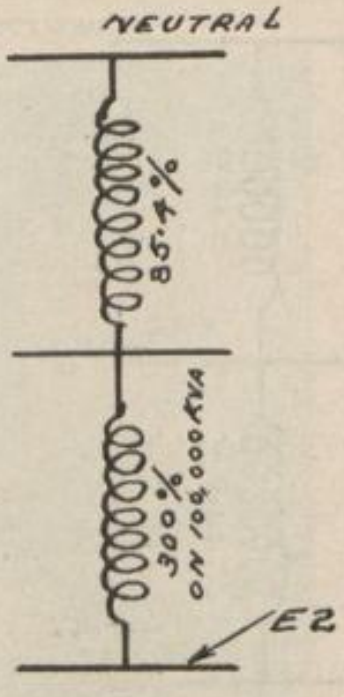


FIG. 1·6

Since it can be seen that these reactances are again in series the resultant reactance will be =85·4+300=385·4%
And again the instantaneous symmetrical 3 phase short circuit value will be

$$\frac{100{,}000 \times 100}{385{\cdot}4}$$

=25,947 kVA.

Should this transformer feed an overhead line, and it is desired to calculate the fault value at a point some miles distant it will then only be necessary to add the line reactance to that of the transformer and proceed as in the previous examples. So far the examples have illustrated conditions suggesting that the power station was planned from the start and that the circuit breakers would be adequate to deal with any fault condition that may arise.

Unfortunately this is not always the case, and extensions are some times added many years after the initial installation. If in such a case the machines happen to be of different voltages it is customary to install coupling transformers between the machines in order to raise or lower the busbar voltage to a common value, in such a case the coupling transformers form very

useful busbar ractances. Where machines of the same voltage but of greater capacity are installed, it is often not convenient to discard existing switch-gear, and if such existing switch-gear is to be employed again, it becomes necessary to sectionalise the Busbars, by inserting busbar reactances between the various sections or machines in order to break down the initial short circuit capacity.

Figure 1·7 shows such an arrangement.

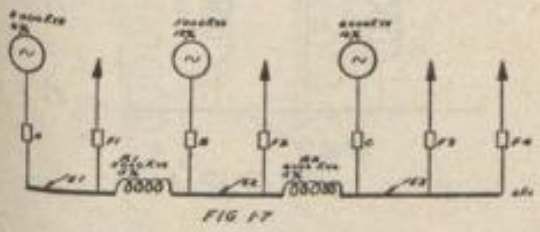


FIG 17

From the previous calculations it was found that, on the basis of 100,000 kVA the generator reactances were:

Generator A 400%

Generator B 240%

Generator C 200%

on the same basis the reactor will have the following percentage values:

R1 $\frac{100{,}000 \times 5}{5000} = 100\%$

R2 $\frac{100{,}000 \times 5}{8000} = 62{\cdot}5\%$

Should a fault develop at E1 the following impedance diagram illustrates the reactances in the sequence which they will have to be evaluated in order to arrive at the fault current value.

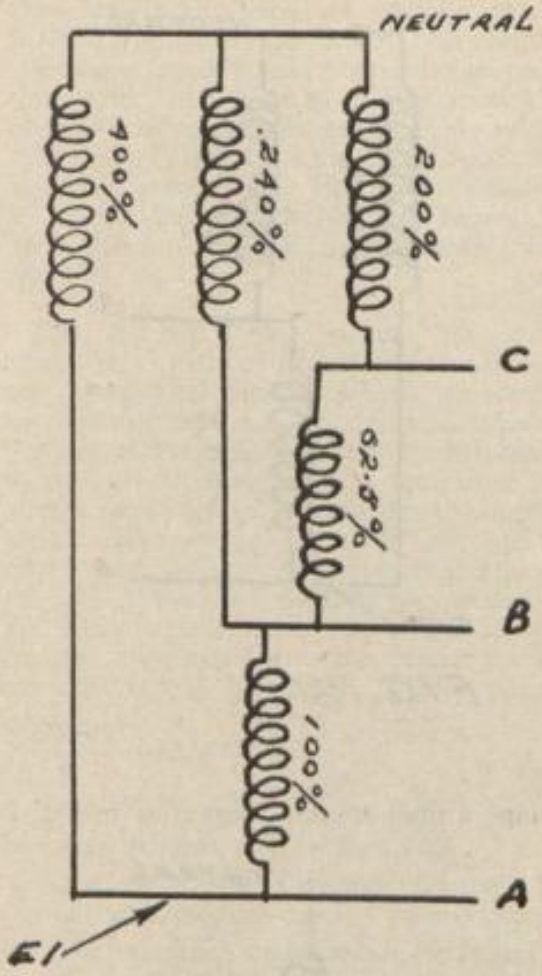


FIG.1·8

These show that parallel reactances 240%, 200% and 62·5% must be first solved as follows:

1. Resultant reactance $\frac{1}{\frac{1}{240}+\frac{1}{200+62{\cdot}5}}$ = 125% approximately.

This then gives an impedance diagram as in Fig. 1·9.

There again we have a parallel combination solved in the same manner as before.

2. Resultant reactance $\frac{1}{\frac{1}{400}+\frac{1}{125+100}}$ = 145%

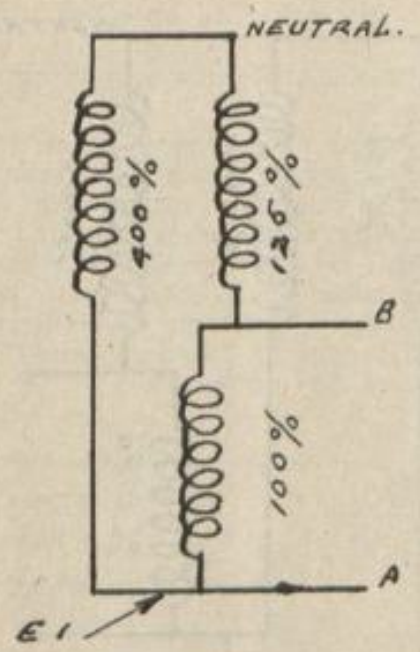


FIG. 1-9

Giving a final simple diagram as in Fig. 2

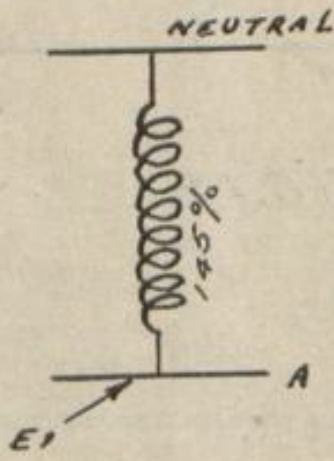


FIG. 2.

for which the final symmetrical short circuit kVA will be

$$\frac{100{,}000 \times 100}{145}$$

$$= 69{,}000 \text{ kVA}$$

A fault at E2 will give the diagram as in Fig. 2·1

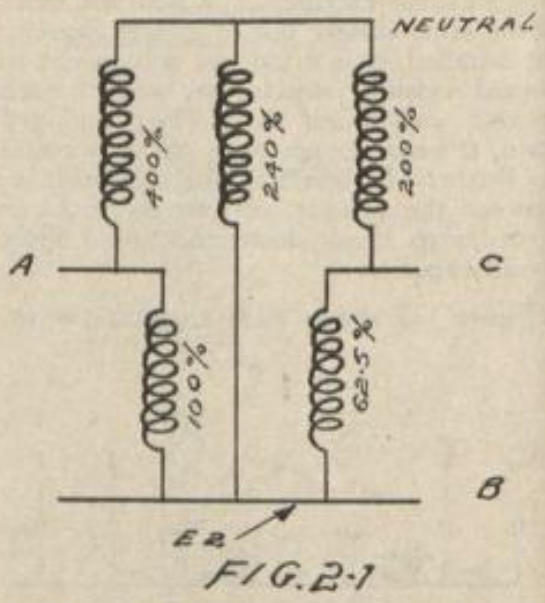


FIG. 2-1

showing the reactances in parallel and providing a simple calculation as below:

3. Resulatant reactance

$$= \frac{1}{\frac{1}{400+100} + \frac{1}{240} + \frac{1}{200+62{\cdot}5}}$$

$$= 100\% \text{ approximately}$$

and the symmetrical short circuit kVA at E2 will be

$$\frac{100{,}000 \times 100}{100}$$

$$= 100{,}000 \text{ kVA}$$

A fault at E3 will have the impedance diagram as in Fig. 2·2.

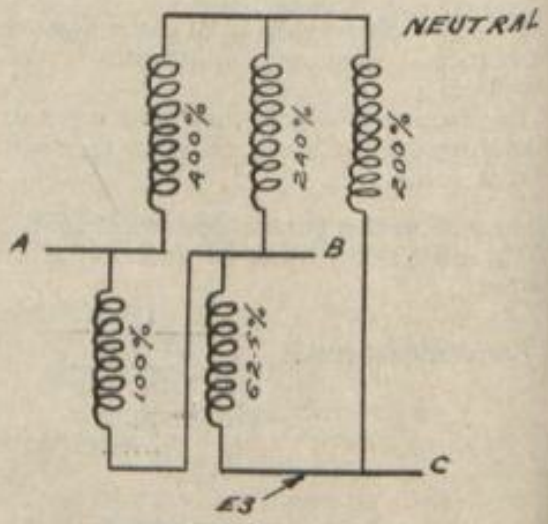


FIG 2-2

Here the 400% and 100% reactances are in parallel with the 240% reactance, giving

4. Resultant reactance $$\frac{1}{\frac{1}{400+100}+\frac{1}{240}}$$

$=161\%$ approximately

this gives a further simplified diagram as in Fig. 2·3.

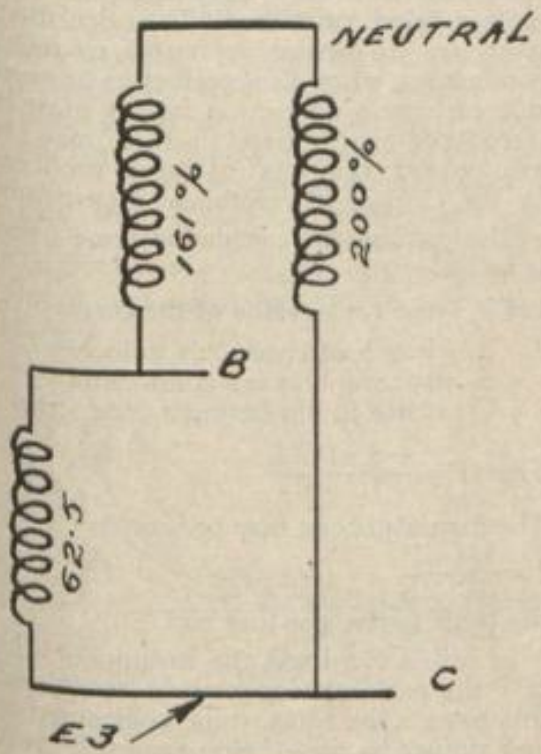


FIG. 2·3

Where it provides a simple solution of two reactances in series, coupled in parallel with a third and solved as follows:

5. Resultant reactances $$\frac{1}{\frac{1}{161+62\cdot5}+\frac{1}{200}}$$

$=106\cdot4\%$

and the short circuit value at E3 is

$$\frac{100{,}000\times100}{106\cdot4}$$

$=94{,}000$ kVA.

The foregoing examples reducing series or series parallel branches of a network to a single reactance is the simplest method of dealing with such problems. There is however, a further method known as the Star-Delta and Delta-Star method which is slightly more complicated. This method is however considered outside the scope of this paper, and, also since this particular method is very comprehensively dealt with by R. T. Lythall in his work *Calculation of fault currents in Electrical Networks*, it would be superfluous to reproduce here this method of dealing with fault currents.

Up till now this paper has dealt exclusively with fault conditions arising on systems fed directly by the generators or transformers i.e. at the transmission voltage, and it may therefore be of interest to provide an example of a consumer fed at 400 volts through a transformer coupled to a high voltage network, through a circuit breaker having a rupturing capacity of 150 MVA the transformer being of 500 kVA capacity with a reactance of 4%. In the simplest form the short circuit capacity would be, at the given voltage,

$$\frac{500\times100}{4}=12{,}500 \text{ kVA}$$

$=12\cdot5$ MVA.

In many systems, two factors, viz:

i. The equivalent reactance of the HV network feeding the LV network and,

ii. The reactance or impedance of the LT connections between the transformer and the switch-gear, can have considerable influence on the fault values and on the type of switch-gear, particularly where existing gear cannot be replaced due to economic reasons.

Considering (i) above, this depends on the size of transformer, and the smaller this is the less will be the effect on the low tension fault, and this may be illustrated by the following examples.

A. Taking the 500 kVA transformer in the previous example

Then:

$$\text{Equivalent HV reactance \%} = \frac{500\times100}{150\times1000}$$

$=0\cdot33\%$

Short circuit kVA on 4% transformer reactance only (at 400 volts.) $$=\frac{500\times100}{4}$$

$=12{,}500$ kVA

Short circuit kVA on transformer reactance + HV reactance (at 400 volts) $= \frac{500 \times 100}{4 \cdot 33}$

$= 11{,}547$ kVA

Indicating a reduction of 953 kVA.

B. Taking a 3000 kVA transformer with a 6% reactance and the same capacity O.C.B. — 150 MVA

Then:

i. Equivalent HV reactance % on 3,000 kVA Base $= \frac{3{,}000 \times 100}{150 \times 1{,}000}$

$= 2\%$

ii. Short circuit kVA on 6% transformer reactance only (at 400 volts.) $= \frac{3{,}000 \times 100}{6}$

$= 50{,}000$ kVA

iii. Short circuit kVA on transformer reactance $= \frac{3{,}000 \times 100}{6+2}$

HV reactance (at 400 volts) $= 37{,}500$ kVA

Indicating a reduction of 12,500 kVA.

Stresses due to Short Circuits

The calculating of short circuit values in an electrical system naturally suggests that the methods for calculating the stresses set up in conductors, more particularly in bus bars, should be given attention.

It is well known that when a current flows in two parallel conductors there is a mechanical force between the conductors, depending upon the direction of the current — attractive when the currents are in the same direction, repulsive when in the opposite direction. When carrying normal currents these forces are of negligible magnitude, but under short circuit conditions, the magnitude of these forces increases considerably and therefore allowance must be made when designing electrical plant, and insulating supports. Clamps and linking apparatus must have adequate strength to withstand these forces even though they may be of momentary duration only.

In so far as these forces affect the design of switch gear it is not proposed to give any calculations in this paper since this particular subject is very comprehensively dealt with by W. Wilson in a publication *Calculation and Design of Electrical apqaratus. Forces on Conductors during short circuit* by W. R. Tripp and, *Electro magnetic forces set up between current carrying conductors during short circuit* — Journal IEE Vol. 75 No. 454, October 1934.

The forces considered will be those occuring on busbars and long lengths of conductor runs only, right angle sets, etc. are not being considered. The calculations given are in general applicable to round conductors, when flat conductors are considered certain correction factors must be introduced and these factors may be readily read from a set of curves produced by the Copper Development Association.

The method for calculating these forces is as follows:

Let I = the r.m.s. value of the current

L = length of conductor in inches

S = spacing between conductors

F = force in lbs. between conductors

Then $F = \frac{4 \cdot 5 \times I^2 \times L}{10^8 \times S}$

The formula above may be written

$F = \frac{5 \cdot 4 \times I^2}{10^7 \times S}$

the force in lbs. per foot run.

In order to obtain the maximum value of F the peak current must be considered, this being $\sqrt{2} \times$ r.m.s. value (a symmetrical and sinusoidal wave being assumed) giving

1. $F = \frac{5 \cdot 4 \times (\sqrt{2}\ I.\ r.m.s.)^2}{10^7 \times S}$ lbs. per foot run.

2. $\frac{10 \cdot 8 \times I.\ r.m.s.^2}{10^7 \times S}$ lbs. per foot run.

Under short circuit conditions, as explained earlier in this paper, at least one phase will be asymmetrical, and that the peak current in a fully asymmetrical current wave may be 2·55 times the r.m.s. value. This being the condition which determines the forces the bus-bar insulators and conductor supports must be able to withstand.

The forces must be calculated on this basis and the formula then becomes.

3. $F = \frac{5 \cdot 4 \times (2 \cdot 55 \times I.\ r.m.s.)^2}{10^7 \times S}$ lbs. per foot run.

4. $F = \frac{35 \cdot 12 \times I.\ r.m.s.^2}{10^7 \times S}$ lbs. per foot run.

When flat conductors are involved the formula becomes

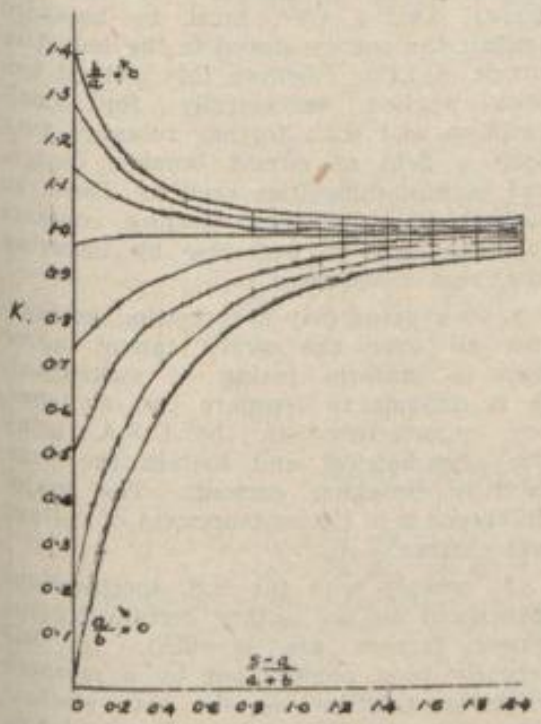
$$\frac{35{\cdot}12 \times \text{I. r.m.s.}^2 \times K}{10^7 \times S}$$

The constant K may be enumerated as follows:

$$K = \frac{s-a}{a+b}$$

where a = width of bar
b = depth of bar
c = centre distance between bars

in evaluating "K" care should be taken as regards the values of "a" and "b" since these values vary depending on whether the bars or conductors are laid flat or on edge. In the case of compounded bus bars with spaces between bus-bars laid side by side on edge the full width of the compound bar is taken and not the sum of the individual bars, likewise where the bars are laid flat.



Shape factor for Rectangualr copper condutors. (By courtesy of the Copper Development Association.

PRESIDENT:

I think you will agree that the paper we have just heard incorporates into one place a mass of most valuable information. The matter is now open for general discussion.

Mr. C. R. HALLE (Pietermaritzburg):

Mr. President and Gentlemen: I am certain we are all thankful for this very fine paper, not only for what it has shown us that we do not know about our own breakers, but also in that it may inspire our Councillors and prove to them that we have, after all, a fairly complicated job to do! Not that I am going to put in for an immediate increase in salary! But I do hope that when we get to the stage that our undertaking has increased in size and we say we must expend a lot more capital, our Councillors will realize that there are scientific reasons for it; that the ordinary old paraffin tin arrangement that we had years ago and were quite happy with and called an oil circuit breaker is not accepted today and that we cannot go on pushing unlimited power through it—we have to ask for a lot of money at times to get the correct thing for safety.

When the job has got beyond a certain limit it may not be economic to go on putting in more and more powerful circuit breakers; it may be better to stick to the one rupturing capacity you have decided on and then look for another point of supply for injecting power into the system through that same standard circuit breaker—a problem we are meeting with at the moment.

I believe that in any discussion on a paper one should try to ask an intelligent question, and in my struggle to find one all I can think of is that this paper indicates all through the good old standard 50 cycle sinewave. With due respect to Mr. Milton, we do not receive that. There was a case where a Scotsman we know was very upset with things that were happening when he put on condensers and certain switches blew up and he got interruptions, and he actually asked Mr. Kinsman to lend him an oscillograph and took various tests and called us in to view what we were putting into his factory, and it looked rather like a dromedary suffering from rheumatism.

What I would like to know is, if these tests are taken in practice with the best type of sinewave that can be given us under commercial conditions, are all these wonderful calculations made to look

ridiculous, and does it increase the danger? Would there be much difference in the result?

Mr. J. L. VAN DER WALT (Krugersdorp):

Mr. President and Gentlemen: The author is to be congratulated upon presenting a paper of such vital importance to distribution engineers. It is perhaps a subject that is being treated too lightly by many. Under the heading "What happens inside a circuit breaker and what forces are set up," the author has touched on one of the most complex problems in electrophysics, i.e., arc interruption phenomena. Prior to the separation of the contacts, there is an electron drift measured as current. This electron drift cannot be expected to be arrested without some form of display of energy. It is this display of energy that is observed as an arc. It has further been proved that it is not only heat that causes ionization, favourable conditions for arcing. It is also assisted by the incidence of light radiation of sufficient short wave length and the application of strong electric fields.

The author mentions that the faster the speed of the breaking the more effective would be the capacity of the circuit breaker to interrupt a fault. There is, however, a critical speed for the best performance. In the arc interruption phenomenon there is eventually reached a re-striking value of voltage higher than the system can supply. This happens at the critical gap length. If this length is reached just after the arc has restarted after zero, then for the next half cycle the arc will burn at a length greater than the critical gap. Thus a greater amount of energy will be released. This critical speed has been proved to be: $V = 100 \times W$, where V = velocity in feet per second, which is the critical gap. This speed is difficult to obtain in practice, especially in high voltage switch gear.

An arc control device not mentioned is the turbulator contact of the plug and socket type.

The author states that it is essential to know system impedances, details of plant that can feed into the fault, and all factors that can limit the fault. Unfortunately,—fortunately I would say for some of us—a large number of undertakings purchase in bulk, and this information is not readily obtainable. The short cut method of Rupturing capacity in

$$\text{KVA} = \frac{\text{KVA rating of transformer} \times 100}{\% \text{ Reactance of supply transformer}}$$

This formula gives a pessimistic value and is therefore safe. It allows for a certain growth in the system, and I think that is about the only formula we can apply, on account of the lack of information as to the system feeding us.

A field yet little explored in circuit breaker design is to reduce the current to zero before the contacts part by providing an alternative path for the arc. This path must therefore be capable of absorbing all the arc energy. This is possible by means of a condenser connected across the contacts. For successful operation, the energy stored in the condenser, i.e., $\frac{1}{2}$ CV^2, must be balanced against the energy stored in the inductive circuit, $\frac{1}{2}$ LI^2. I believe this method has been applied successfully for small switches and with further research may open a field of circuit breaker design, and certain difficulties such as discharge current of condensers welding contacts together may be overcome by inserting discharge resistances.

It is a great pity that testing authorities all over the world cannot agree upon a uniform rating of switchgear. It is difficult to compare two switches, one manufactured in the U.S.A. using the asymmetrical and Britain the symmetrical breaking current. The major difference is in the measurement of voltage and current.

To comply with the B.S. specifications mentioned by the author certain lagging power factors are specified. It has recently been pointed out by a research engineer that in certain test stations this factor is obtained by manipulating circuit elements in parallel, and this reduces the severity of the test as compared with circuit elements in series. This is due to the alteration in the circuit time constant. The author of this statement recommends that all British standards exclude adjustment of power factor by parallel connection of circuit elements.

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Mr. J. W. SWARDT (Bureau of Standards):

Mr. President, Mr. Buchanan and Gentlemen: With reference to what has been said in this Paper regarding safety, and the necessity of realizing that safety is such an important factor in the whole set-up of distribution, I would like just to mention to what extent the development of testing switchgear has gone in South Africa.

Shortly after the Bureau of Standards was established it was realized, with regard to switchgear being manufactured in the Union, that though it was admittedly still on a very small scale, development was taking place at a fairly rapid pace, and consequently we had to bear in mind that in due course requests would be coming forward for the testing of switchgear. As you know, the Bureau of Standards is also an independent test house, and manufacturers or consumers or anybody may request the Bureau to have commodities such as switchgear tested and issue a test certificate.

In 1950 it was one of my duties to investigate this whole issue of switchgear testing overseas. We realized right from the beginning that anything comparable with the A.S.T.A. station in the U.K. would not be practical, nor were we ready for that in South Africa. We had to keep our mind on the aspects that we would have to cater for. In Britain, the U.S.A. and Switzerland I had the privilege of witnessing many of these tests and also the size of the gear involved, and as a result it was decided that in order to strike a happy medium with what was being produced in the Union and the facilities required, we would invest first of all in a small testing set capable of doing the 10,000 amps on a half second rating. That could be stepped up considerably depending on the time rating. That equipment is now practically completely installed, and I thought it might be of interest to you to know the extent of the development of testing gear in South Africa.

With regard to the symmetrical and asymmetrical currents referred to in the discussion, I would like to say that that matter is enjoying the attention of the International Electrical Commission. Although, like many of these international projects, they are extremely slow-moving, I think we all realize that when you get different peoples from Europe and from the United States together it is not always an easy job to get agreement on such basic issues.

PRESIDENT:

Is there any further discussion on this Paper, gentlemen? If not, I will express our appreciation to Mr. Buchanan for the Paper he has prepared for us, and assure him that it will be a valuable addition to our proceedings as a Paper of reference that all members will make considerable use of in the future.

LATE DELIVERY OF ELECTRICAL EQUIPMENT AND PLANT FOR POWER STATIONS

Councillor Billingham of Cape Town now wishes to place before you the question of plant deliveries.

Councillor Major J. W. O. BILLINGHAM (Cape Town):

Mr. President and Gentlemen: The subject I would like to bring to the notice of this Convention is the delay in the delivery of electrical equipment from overseas. I should imagine that most municipalities are in the same position as we find ourselves in Cape Town, that is, we have our headaches in many ways outside of the question of deliveries of electrical equipment that municipalities have already ordered. For instance, we in Cape Town have an additional worry, in the fact that we are now receiving in our coal, fines, for which our older section of the generating plant was never designed. That in itself gives us a reduction in capacity and adds to our headaches. That, of course, is a local matter and must be cleared up with the colliery. Again, we have, as we must have, faults in various types of machinery. We in Cape Town have had developments of faults in rotors quite unexpectedly, and that, combined with fines, reduces our capacity, and now we are shedding loads five days a week. Strange to say, our peak load on Sundays is almost as much as it is on a weekday, bearing in mind the fact that industry is closed on Sunday, so there must be an awful lot of dinners cooked round about 12 to 1

o'clock. These particular matters, of course, are more or less confined to the country we are in, but the growing demands of electricity, I feel sure, have been taken good care of by various municipalities; in other words, I am sure that the councillors will continue to look well ahead in their requirements for the future. We have done that in Cape Town. We have plans ahead that will carry us forward for many many years—new power stations and development to existing stations. Consequently we place our orders years before we are requiring them.

Now, although we are prepared to wait for a reasonable time for the delivery of this equipment, bearing in mind the growing demand for electricity (perhaps due to our own advertising) we cannot wait indefinitely for it or afford to see the delivery dates very much exceeded. Therefore, Mr. President, in as much as the municipalities have taken all steps necessary to get delivery of equipment, I do suggest that we should pass some sort of resolution at this Convention stressing the urgent necessity of our getting this equipment as soon as possible. I suggest the following: that a telegram be sent to the High Commissioners of Rhodesia and the Union of South Africa from this Convention, requesting immediate action in obtaining shipments of electrical equipment ordered by municipalities in the various territories as soon as possible.

PRESIDENT:

Thank you. Councillor Billingham has moved that we send a message to the High Commissioners of the two territories concerned urging compliance with delivery dates. I think that is his greatest concern—the fact that plant is being delivered far later than the initial delivery dates. We are all aware of many of the problems associated with that, but there can be no harm in urging yet again the vital importance of electrical plant to both territories with which this Convention is concerned. Would someone second that resolution?

Mr. D. A. BRADLEY (Port Elizabeth):

Mr. President: In seconding Councillor Billingham's proposal, may I say that we are all conscious of the late delivery of all types of apparatus and machinery affecting our undertakings and we all suffer thereby; and I think you have put the matter correctly, Mr. President, when you stress the urgent need for electrical plant in both territories. We have done all that we can do, and now I hope that this resolution may bring about something we have been hoping for for a long time, namely, that machinery may be made available at the time the contractor concerned has stated it will be available.

Mr. W. H. MILTON (Escom, Johannesburg):

I think, Mr. President, it would be advisable to add the Commission's name to those of the municipalities, in view of the fact that many municipalities are now entirely dependent on us, for example, Port Elizabeth is dependent on us for the extension of supply.

PRESIDENT:

May I take it that it is agreed that that message be sent?

(Agreed.)

SHORTAGE OF COPPER

The next matter is one of growing concern to all of us: the shortage of copper. As a result of what might almost be called a black market in copper and lead, many of you in the Union and some of us in Rhodesia have suffered, not only from a copper shortage arising from late deliveries of copper but from a rather subtle abstraction of copper from those resources already available to us. I think it would be good for the question to be ventilated, so that all concerned will hear of the very serious situation that is occurring as a result of this shortage of copper.

In recent months we have seen deliveries of cable, which previously one could get within a matter of three or four months, extended to periods of 12 months and more, and we are told that the reason is mainly the copper shortage.

Now, we know that world conditions are responsible for this state of affairs, but it is a fact that, whenever there is a shortage of anything, it is necessary for those whose need is greatest to express that need in no uncertain terms; and I

submit that the power supply industry, whether municipal or any other, is the most important consumer of copper in South African territories; and the availability of copper supplies, in whatever form required, should engage the attention of all governments before anything else. Further, I do feel that the utmost steps should be taken by the authorities concerned to ensure the rigid enforcement of the ordinary criminal code against those persons found quilty of stealing copper. I have heard of affairs in the Union that almost beggar description in the cleverness of those who are responsible for contributing to this particular black market, and we are beginning to have the same experience in Rhodesia. It takes two days for Johannesburg's cold weather to reach Bulawayo and the transit of criminal practices has been equally rapid. I am not suggesting now that Johannesburg was the originator of this idea, in fact, it seemed to happen so quickly that it might have been the other way round, but I would like to impress on all authorities, particularly those administering the criminal law of our country, the seriousness of the copper shortage and the necessity to take strong measures when the theft of copper, particularly from power undertakings, occurs. There may be some of you who would like to discuss this point, and I would like to refer also to certain proposals that have been received by most of us from cable manufacturing companies which have sometimes been a little difficult to handle in view of the current Council procedure. It has been suggested that any copper that may arise in the form of scrap from municipal undertakings should be made available to cable manufacturing companies in order to produce at least an equivalent amount of new product for the use of the Council or other authorities concerned. That cuts across the normal Council procedure which I expect applies to most of you—that all scrap materials, of whatever sort, arising in the course of municipal administration, shall be sold either to the highest bidder or at an auction market or something of that sort. The diversion of any form of scrap to a particular manufacturer raises questions of principle that have concerned Councils all over the country; they certainly concern my own Council. There are various suggestions of ways and means of achieving what we want, that is, to ensure that any copper scrap that does arise can be used for the benefit of the electricity industry of the place where it arises. It has been suggested that cable tenders might be invited with clauses providing for the taking over by the contractor of whatever scrap copper or lead may be available, the pricing of this to be one of the items on the bill. That is one way in which it might be overcome. But the whole question is one of such great importance to us at the present time that I feel we might usefully spend a few minutes discussing it, and it may be that some of you have had experiences that will help other Councillors to make up their minds on this important matter.

Mr. J. C. DOWNEY (Springs):

The problem of copper in the Union has now reached serious proportions with many of us, particularly in the Witwatersrand area—and I include the mines in this—and serious thefts have taken place from our undertakings. In one case a fence was cut and a complete drum of cable rolled out and whisked away. In another case, in our own undertaking, a line was made dead during the night and the whole of the line was removed. In another case, where a new township had just been completed and one house supplied from the new network, they waited till the people went to bed and then dug up and removed the cable. That is going on not only at one end of the Reef but all over, including the mines.

My own Council have realized the seriousness of the position and have now implemented the local government ordinance and introduced by-laws governing the sale and re-sale of scrap copper. These laws were taken originally from the Scrap Metal Act in Great Britain, which was brought into force there in 1912. The position, as I have said, is a serious one. I have not all the facts, but I know we have received an allocation of copper in the Union and deliveries for cable now are going up to two years. Some of our undertakings now have to resort to under-sized lines on account of the shortage of copper. I think this matter should receive our serious con-

sideration. I am very much against any method of disposing of scrap in the form of copper to scrap metal merchants. I feel it is in our own interests that we dispose of our copper to the people who will process it and pass it back to us. I submit these points for the consideration of members.

Mr. W. ROSSLER (Kroonstad):

We have also had experience in this regard. We have taken steps to superimpose a completely new distribution system on our existing one, and by this means have been able to recover some of our copper. In fact, it has been an economical proposition to recover some of the old sections of cable. These were stored in the power station yard, together with any scrap copper that we could lay hands on coming from the undertaking. I think on five occasions the fence round the power station yard has been cut. In each case the Police were informed, but in no case were they able to trace the culprits. All they were able to tell me was that it is an "organized gang operating from Johannesburg," which was of comparatively little use or comfort to us. All we are after is an effective result. Whilst it is difficult to estimate the exact quantity of copper we lose, it must be in the neighbourhood of several tons so far. In one case a quantity of copper cable had been stored outside a substation under construction, and when we arrived there the next day it was gone. That, too, was reported to the Police, without effect. Therefore, Mr. President, I do agree that it would be helpful if legal measures could be taken. On the practical side, we have sent recovered copper to cable manufacturers, thereby getting at least the equivalent weight of the scrap copper in new cable.

Mr. J. C. DOWNEY (Springs):

For Mr. Rossler's benefit, I might mention that the gang may have operated from Springs!

Mr. G. J. MULLER (Bloemfontein):

Mr. President and Gentlemen: On the subject of sale of scrap, I am going to tell you about a means of overcoming the difficulty of Municipal regulations in connection with the sale to manufacturers. After the matter was brought to the notice of our Council they passed a resolution calling for tenders and making available to the accepted tenderer an amount of copper equivalent to requirements. That does not involve any breach of Municipal regulations or ordinances, because the scrap is not sold, it is used for Municipal purposes by agents of the Municipality, the tenderers in this case.

The theft of copper, I agree, is becoming serious. We have had minor occurrences. I think the total value of copper stolen is about £300, which is bad enough, but not so much in comparison with some places. Something should be done about this quickly. As long as copper is in the hands of dealers in metals we shall have this sort of thing, because control is extremely difficult.

I would suggest that this Convention approaches the South African and Rhodesian Governments—and I say both Governments because if one Government does not cover it all the copper will arrive there. We should ask both Governments to make illegal the possession of copper by anybody who is not a user or a manufacturer of copper products, and within a period of three months all copper in the hands of non-users and non-manufacturers must be sold to manufacturers, after which date all copper should pass only between manufacturers and users.

Mr. J. E. MITCHELL (Salisbury):

Mr. President and Gentlemen: Following on what Mr. Muller has just said, I can tell him that the actual export of copper from Southern Rhodesia is prohibited already. It was found that quite a lot of copper was being collected and was on its way or practically on its way to the Union, when the Southern Rhodesian Government stepped in and stopped all export of scrap or any kind of copper to the Union, except that we did get a dispensation for sending any copper to the Union which was to be re-processed and sent back in equal quantities to Southern Rhodesia as cable or copper wire.

Whenever there is a shortage of anything there is a "black market," and it is very difficult to stop a black market

by legal methods; people always find some underhand way of getting out of it.

At the Washington conference last year every country was given a certain quota of copper, and I think I am right in saying that the Union of South Africa's allocation was put at something like 70 per cent of the normal quota. I think there are two methods open to us, one of which definitely concerns us and the other the country as a whole. If representations could be successfully made to get the quota back to normal, the black market would go, because we should all have the copper we require. The other suggestion is that high level representations be made to get at least the quota of copper for electricity undertakings back to normal, giving them priority, giving those with prior claims, say, 90 per cent of their quota, and balancing this by cutting users of small priority to something like 50 per cent. I think if we were to make representations along those lines we might get somewhere.

PRESIDENT:

We have now ventilated this subject, and I think it was only right that we should do so. I do not propose to put any resolution before you at this stage, although we might produce one later in the Convention. The matter will be discussed by the Executive before the end of the Convention. We will now adjourn until 9.30 tomorrow morning.

Convention **adjourned** at 12.30 p.m.

WEDNESDAY, 7th MAY, 1952

PRESIDENT:

The Paper given yesterday by Mr. Buchanan is still open for discussion if any members would like to contribute later on, and there will, I trust, be discussion of Mr. Redman's Paper which he is to contribute this morning, and arrangements will be made for the authors' replies to the discussion to be given tomorrow morning.

It is now my pleasure to call upon Mr. R. H. Redman, to deliver his Paper.

THE DEVELOPMENT OF THE BULAWAYO ELECTRICITY UNDERTAKING

By

R. H. REDMAN, B.Sc.(Eng.), A.M.I.E.E., M.Inst.F., A.M.(S.A.)I.E.E

Deputy City Electrical Engineer

Mr. R. H. REDMAN (Bulawayo):

INTRODUCTION

The Association is holding its meeting in Bulawayo again after a lapse of seven years. At the two previous occasions that this city has been honoured as the venue for the Annual Conference, papers have been presented on the development of the Bulawayo Electricity Undertaking. On both these occasions the papers were presented by the then Assistant Electrical Engineers, namely Mr. J. W. Phillips who gave a comprehensive and interesting survey up to 1934 and Mr. A. R. Sibson who, in 1945, filled in the story for the intervening period between those dates with an excellent paper which, I may say, is still used as a reference book and guide by the department.

Mr. Phillips, as you are aware, became Chief of the Undertaking in 1936 and remained so until 1945 when he left us to utilise his profound engineering knowledge in a wider sphere of the Colony's economic life. Mr. Sibson succeeded him in that year and he is our President today.

I have been given the privilege of reading a paper to the Association at this Conference, and I cannot help feeling that I should be breaking what has now become a time honoured custom if I were to choose any subject other than the Development of the Bulawayo Electricity Undertaking. I may say, however, that I have not made my choice without a certain amount of trepidation, in view of the very high standard already set by my predecessors, and if I should fall short of this criterion I must ask your indulgence.

It is my intention to consider the Undertaking under six main headings, *viz.*, Introduction, Generation, Distribution, Financial, Administration and Technical, and Conclusion.

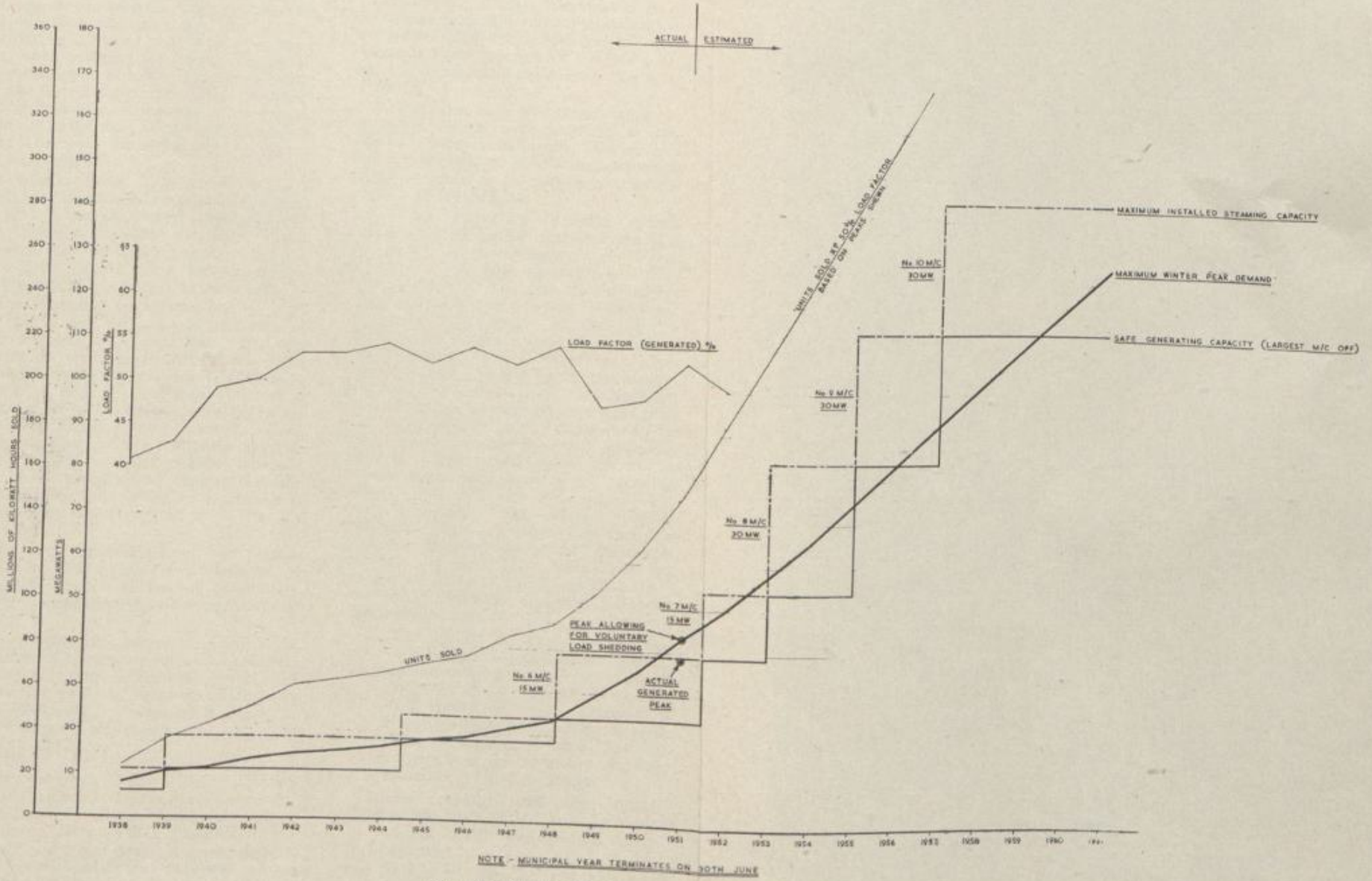
The story of the Development of the Undertaking since 1945 is a story of almost superhuman effort on the part of the staff to keep pace with the electrical demands of a community whose rate of growth has far outstripped the resources of its utilities.

How does one assess the rate of growth of a city? By the increase in population? By the increase in its Civic Expenditure or Revenue? By computation of its increase in building? Or by the increase in Water and Electricity demands?

TABLE 1

GENERAL STATISTICS RELATING TO BULAWAYO DISTRICT

	1945	1946	1947	1948	1949	1950	1951	% Increase 1945–51	REMARKS
Aggregate Annual Civic Revenue ...	£562,997	£600,205	£713,907	£785,110	£881,930	£1,002,880	£1,258,666	123·6%	
Population (estimated) *Bulawayo district (employed)*									
European ...		17,544					32,500	85·2%	
Coloured ...		976					1,530	56·7%	% Increase from 1946–1951 only.
Asiatic ...		895					1,330	48·6%	
Native ...		33,322					56,000	68·1%	
Total		52,737					91,360	73·2%	
Number of passengers carried by omnibus service ...	—	—	—	—	2,243,446	3,323,456	3,939,897	75·6%	The figures shown relate to the three years of operation by a private company and the % increase is from 1949–1951 only.
Water consumption gallons ...	731,289,000	755,378,000	944,374,000	822,575,000	1,059,077,000	1,010,017,300	1,356,000,000	85·4%	
Annual value of building plans passed	£416,166	£552,977	£832,599	£1,117,428	£2,021,342	£1,910,956	£4,068,067	878%	
% Annual increase in petrol sales in Bulawayo over each preceding year ...	—	48·7%	35·8%	15·5%	23·0%	22·4%	3·9%	264·9%	



NOTE - MUNICIPAL YEAR TERMINATES ON 30TH JUNE

No 1 ACTUAL AND PROJECTED GROWTH OF UNDERTAKING

There are many ways such as these by which the growth of a community can be assessed, but to my mind no single factor can give the true picture. Only by collective consideration can anything like a true picture be achieved, and it is important that when assessing the growth of such an Undertaking as our own, one should have as a background a picture of the growth of the community which we serve since, without it, the story of our own expansion could become one sided and perhaps a little meaningless.

Consider Table I which shows the expansion that has taken place from 1945 to 1951 in various spheres connected with the City and adjoining districts. It will be seen that the Civic Revenue has risen by 123·6% in six years, representing an average rise of just over 20% per annum.

The European population has risen by 85·2% in five years, or at the rate of approximately 17% per year. Had the figures for 1945 been available it is thought that the increase might have been even more striking. Perhaps the most interesting figure of all is the fantastic increase in the value of building plans passed. Even assuming that building cost three times as much in 1951 as it did in 1945, it would not be unreasonable to assume that the amount of building going on at present is almost three times as great as it was six years ago.

We see, therefore, from the picture shown in Table I that our Undertaking is being called upon to serve a community which is expanding at a very considerable rate.

Our Department has, as a consequence, been forced to step up its own expansion to keep pace with this rate of growth, and the measure of the success with which it has achieved this will be shown, subsequently, in later sections of this paper.

GENERATION

The position in 1945 was that Bulawayo and the adjacent district was served by one source of power—Lobengula Street Station of 28·5 MW., Turbo-alternator capacity and steam raising capacity slightly less. A peak load of 18·2 MW was carried in June of that year which was just below the safe capacity of the Station at that time. Planning of the new 150 MW 13th Avenue Power Station has been in progress for some time and orders had been placed for the 15 MW machine in the preceeding May.

Considerable thought had been given to the operating conditions of the new station, and it has finally been decided to settle on an operating steam pressure of 635/600 p.s.i., and a nominal operating steam temperature of 850/825°F.

At that time, only two other stations in Southern Africa were working at this pressure, but it later became adopted as a standard for units of 30 MW capacity which might be taken as an endorsement of the wisdom of the decision.

Another important decision which necessitated prolonged consideration was the choice of generating voltage. There appeared to be three possibilities—33kV, 22kV and 11kV. For some time it had become apparent that it would be necessary to increase the voltage of the primary transmission system in the Urban area and the outside districts as there were signs that the network would, in the near future, become heavily overloaded. This problem was, of course, very closely connected with the choice of generation voltage. At one time, it had appeared that the new transmission voltage would be 22 kV, but it became apparent, in view of the probable growth of load in the area, that 33 kV would be the wiser choice and this, coupled with the fact that 22 kV is non-standard as a generator voltage, ruled out the inter-mediate voltage. The choice thus lay between 33 kV and 11 kV, and the latter was finally selected for the following principle reasons:—

(*a*) The 33 kV primary network was only being contemplated at the time, and it would be several years before it could be in use. Eleven kV generation would, therefore, represent a lower first cost and a saving of Loan Charges until it became desirable to purchase the necessary coupling transformers and switchgear.

(*b*) The operating staff were already familiar with 11 kV as a generation voltage which was deemed advantageous.

(*c*) Eleven kV was an old and tried generation voltage in the manufacturing world. Generation at 33 kV was a newer departure, although not an innovation, and at the time had not

been altogether satisfactory in some cases. Situated, as we were, at a considerable distance from manufacturing centres it was deemed prudent to choose the lower voltage.

(*d*) The breaking capacity of the switchgear would be lower.

The work of preparation of the site commenced in June 1945, and soon after this steelwork for the plant started to arrive.

The first section of the initial installation to be completed was the 900,000 g.p.h. No. 2 Cooling Tower on 1st December, 1946.

At the beginning of 1947, the writer witnessed the turbo-alternator undergoing its tests at Rugby. Shipment was made later in the year and work of erection of the set on site commenced.

In the meantime, the demand on the Undertaking had been growing, as will be seen from Table 2, and Drawing (1), showing the progress of the Undertaking.

In April, 1948, the second installation for the 13th Avenue Power Station was ordered. This was an exact duplicate of the first, comprising one 15 MW turbo-alternator and two 80 klb/hr. water tube boilers, feed pump and ancillary equipment.

On the 2nd and 3rd November, 1948, fires were lit in numbers 1 and 2 boilers, and commissioning tests commenced on the first 15 MW installation.

On the 19th of that month, the official opening of the Station was performed by His Excellency, the Governor of Southern Rhodesia, Sir John Nobel Kennedy, in the presence of the Mayor of Bulawayo, Councillor H. A. Holmes, M.P., and Councillors. From this time, the set has been on load almost continuously except for brief periods at weekends and public holidays for essential overhaul and maintenance.

It would not be permissible to leave the year 1948 without mentioning two other events which occured in that year, the repercussions of which were not without effect on the Department. During March and early April there had been rumours of the possibilities of Native unrest. From the 10th April onwards, the situation appeared to worsen, and in the early hours of Wednesday, the 14th April, the strike commenced.

The biggest problem was keeping the boilers supplied with coal, which invloved moving roughly 170 tons of coal a day from the storage pile along a cocopan track 150 yards long—work normally carried out by Natives. The solution was achieved by the use of volunteer European labour recruited from the Distribution sub-department (the activities of which had been seriously curtailed as a result of the strike), from other Municipal offices, and from amongst the general public including Technical School boys.

The removal of the ash from the basement was carried out by volunteer labour supplied by the Coloured community. Three eight-hour shifts during the 24 hours were arranged, and women members of our own office arranged a day and night canteen service, hot meals being available at noon and in the evening, and tea, coffee and sandwiches, etc., as required.

As a result of the general effects of the strike, the load on the Power Station was reduced to some extent, the actual demand being of the order of 13 MW against a normal demand of 19 MW at that time, the peak occuring in the mornings.

On the morning of Friday the 16th, most of the 8 a.m. Native shift returned to duty, and throughout that day there was a gradual return of the remainder of the Department's Native staff. By night fall the position was nearly normal.

No load shedding was necessary during the emergency, and as a result of the willing and whole hearted co-operation of the staff, and all sections of the community, supply was maintained normally throughout the period.

The second happening in 1948 which was of major interest to us was the termination of the Coal Price Agreement that had been in force for the past ten years. The effect on generation costs was considerable, and this is dealt with under the Financial section of this paper.

The year 1949 showed a sharp increase in the rate of growth of the Undertaking as will be seen from Table II. The winter peak rose by 35·1% and the units sent out by 17·13%. In September of that year orders were placed for the third installation in the 13th Avenue Power Station comprising a 30 MW Turbo-alternator, two 160 klb/hr boilers with the necessary pipework, feed pumps amd ancillary equipment.

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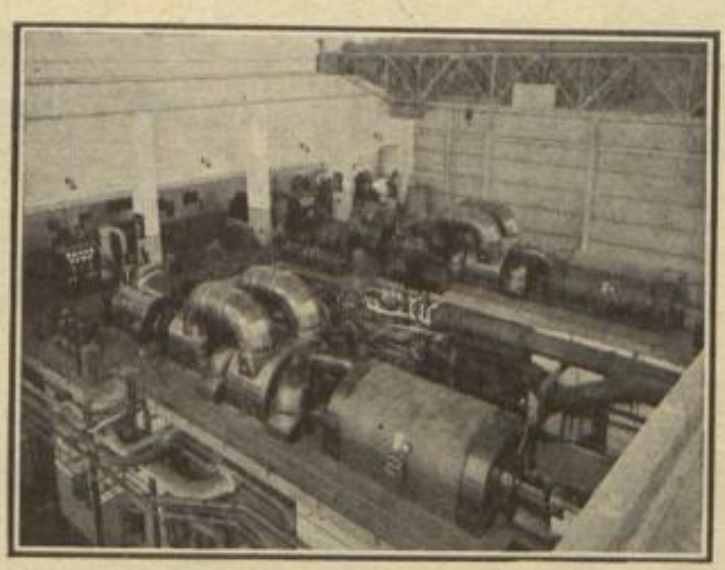

Two three-cylinder Turbo Alternators installed in an Australian Power Station. Seven machines of a similar type have been ordered by the Electricity Supply Commission of South Africa for the new Taaibos Power Station in the O.F.S.

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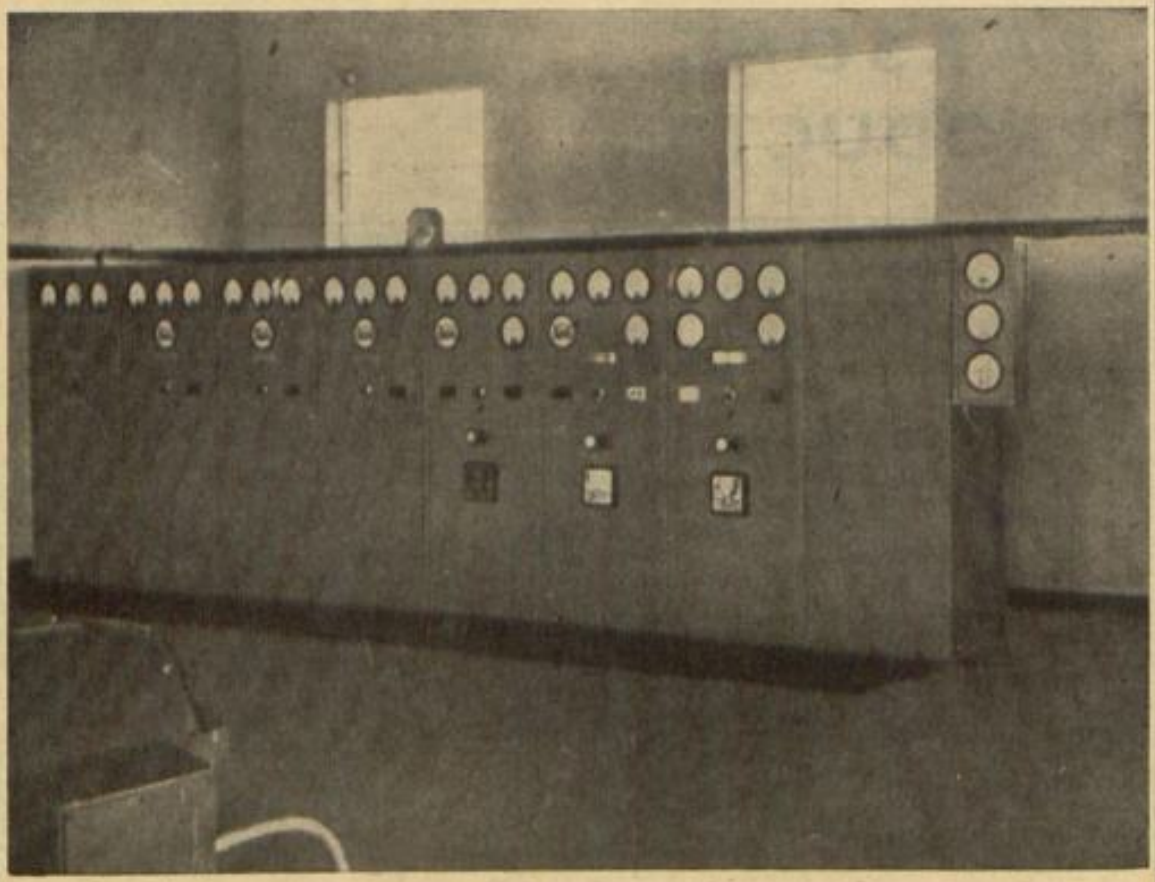

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TABLE 2

GENERATION STATISTICS — BULAWAYO

Year Ending 30th June	Total Installed M/C Capacity (MW)	Total Safe Capacity (MW)	Maximum Demand (kW) (MW)	% Increase over previous year	Yearly Load Factor	Units Generated	Units Sent Out	% Increase over previous year. Units Sent Out
1945	28·5	18·5	18·2	——	52·6	83,857,100	77,739,429	——
1946	28·5	18·5	June 1946 18·5	1·65	54·45	88,174,637	81,088,273	4·32
1947	28·5	18·5	June 1947 21·6	16·75	52·7	99,612,300	91,908,322	13·34
1948	28·5	18·5	June 1948 21·9	1·37	54·9	105,497,200	97,748,940	6·36
1949	43·5	24	June 1949 29·6	35·1	48·01	124,490,300	114,494,290	17·13
1950	43·5	24	May 1950 34·0	14·85	48·87	145,551,600	133,458,660	16·55
1951	43·5	24	June 1951 38·4	12·95	53·22	179,023,300	165,639,700	24·11

Additionally, the first bank of 33 kV switchgear comprising a nine panel 750 MVA indoor board type was ordered. This was to serve the proposed primary transmission system which would shortly replace the existing 11 kV net work as the backbone of the distribution system.

Two 15 MVA coupling transformers were provided to link the 33 kV system with the existing 11 kV main board which was energised by the generators in Lobengula Street Power Station, and the first 15 MW set in 13th Avenue. Later on, when commissioned, the second 15 MW set would also be connected to this Board. Both 15 MW machines were provided with generator reactors.

To house the third installation, plans were put in hand to extend the building sufficiently, not only to house this extension, but also the next one which it was proposed would be similar in capacity and arrangement.

At this time, the cooling arrangement for both stations consisted of spray ponds giving a capacity of approximately 22 MW under summer conditions, and one 900,000 gallon/hour Mouchel hyperbolic type cooling tower for the first installation in 13th Avenue. A second 900,000 gallon/hour tower was in the course of construction but would not be ready for commissioning until the following year.

Following the original planning of the new station, which embodied the replacement of the spray ponds with cooling towers, orders were placed for the construction of two further towers of 1,250,000 gallon/hour capacity for the 30 MW installation which was scheduled for completion in 1953, and to replace the existing spray ponds.

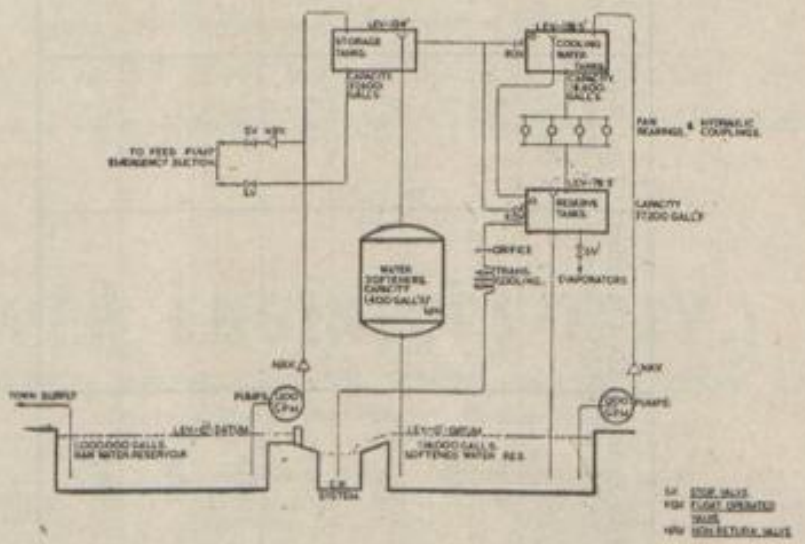
The final arrangements for water supplies generally are shown on Drawing (2). It will be seen that raw and soft water reservoirs are provided which will eventually, occupy space now being taken up by cooling ponds. Water will be pumped up to raw water storage tanks and soft water storage tanks situated on the Power Station roof, which will ensure the continuous availability of a gravity head for supply to the equipment for which the water is needed.

From the cooling water tanks, the water is taken out through a bus main to the various fan bearings and hydraulic couplings, returning to reserve tanks at a level forty feet below the main tanks. From there it passes out to the evaporators, and to the 33/11 kV generator transformers on the first subsequent 30 MW installations, which are water cooled, returning to the water cooling system via the suction duct.

The raw water storage tanks connect with the water softeners which feed the soft water reservoir, and also with the emergency suction main to provide a stand-by supply for the feed pump suction.

The primary purpose of the arrangement shown is to guard against failure of water supplies from outside sources.

Another feature in station design, which has necessitated considerable thought, is the



No. 2 ARRANGEMENT OF WATER SYSTEM 13TH AVENUE POWER STATION

method of coal and ash handling. At present, a certain dependence on Native labour exists in both stations and this, at one time, was an economy but it is doubtful whether it is so today.

Also, Native labour is becoming scarcer as time passes, the attraction of easy and more congenial work in Industries being the primary factor which causes the shortage.

Recently, contracts have been placed amounting to approximately £32,000 for mechanisation of the coal handling in Lobengula Street. This will, briefly, consist of a telfer grab unloading from trucks on to a stock pile, whence it can be conveyed to the main hopper and from there to a hopper immediately outside the boiler house by a reclamation belt conveyor and thence, by means of drag link conveyors to the individual boiler hoppers.

An ash handling scheme for 13th Avenue Power Station has been put out to enquiry, and by the time this paper is published it should be on order.

Also, a coal handling scheme for 13th Avenue is under consideration. This on the score of expense will probably take a temporary form in the shape of belt stackers and mechanical grab conveyors to a stock pile, and thence to the main conveyor hopper. The main belt conveyor, capable of handling 120 tons per hour has, of course, been in existence since the inception of the Station.

Reverting again to Table 2, it will be seen that there was no appreciable slackening in the demand for electricity as time progressed, and this continuous and rapid increase began in 1950 to affect not only ourselves, but the Electricity Supply Commission, particularly, in their Gwanda district.

In order to provide assistance, arrangements were put in hand by them to extend the existing 33 kV transmission from the N'Cema Pumping Station for a distance of 23 miles to join up with the Filabusi network, and Bulawayo Power Stations relieved the Gwanda Power Station of the load in this district amounting to 1·7 MW during the day which was their most difficult time. In May, however, our own demand increased to such an extent that the arrangement had to be discontinued.

The second 15 MW installation, originally promised for April of 1951, was not even completely on site and with the winter peaks imminent, and a boiler maintenance programme severely handicapped through lack of staff, it became necessary to plan for the first time a load shedding scheme.

The area was divided into three zones, each zone representing a reduction of about four megawatts. The plan was to shed the zones alternately twice each week during the hours of daylight. The evening curtailment was to be met by means of a voluntary reduction by Industry. Actually, the plan was only implemented on one Public holiday week-end in order to carry out some most urgent maintenance work, but the winter period of last year placed a very severe strain on both the plant and the operating staff, probably the most severe that either has ever experienced. This is brought home to one when it is realised that during the evening of every weekday, excluding Saturdays, from the commencement of June to the beginning of August, the Power Stations were called upon to carry loads within two MW of their total combined capacity.

The peak for the Municipal year ending 30th June, 1951, occurred at 6.20 p.m. on 12th June, and it amounted to 38·4 MW, an increase of 12·95% over the preceding year.

TABLE 3

ANALYSIS OF UNITS SOLD AND PEAK LOAD — BULAWAYO UNDERTAKING YEAR ENDING 30.6.51

Class of Consumption	Proportion of Units Sold	Proportion of Highest Peak Load
Electricity Supply Commission ...	30·90%	14·00%
Heavy Industry ...	11·05%	10·32%
Light Industry ...	14·85%	5·82%
Railways	3·22%	2·19%
Domestic and Commercial ...	37·45%	58·05%
Municipal Supplies including Street Lighting	2·53%	3·84%
Power Station Auxiliaries	—	5·78%
	100·00%	100·00%

The total units sold for the year ending 30th June, 1951, amounted to 152,255,509 units and analysis of this figure, together with an analysis of the peak load for the year is shown in Table III.

In examining this, it must not be forgotten that this peak load of 38·4 MW is lower than it would have been, due to the voluntary co-operation of all consumers at the time. It has already been pointed out that the load curtailment was dealt with during the winter months of this year by asking domestic and commercial consumers to restrict, during the morning peak in the hours of daylight, and industry in the evening. Had there been no curtailment it is estimated that the peak would have amounted to 43 MW, an increase of 136·2% over the peak of 1945.

It is very difficult to estimate the effects of load curtailment on the units sold figure but this, of course, would certainly have been greater. However, taking the actual figures recorded the increase over the 1945 figure of 72,017,770 is111·4% which represents the growth of the Undertaking in six years.

It will be interesting to compare Table 3 with the Table given by Mr. Sibson in 1945. The Air Force Camps which were primarliy war time innovations have fallen away, and the only one remaining has been placed under the heading "Commercial", which also includes supplies to certain Government buildings and special contracts.

It will be seen that the proportion of output sold to the Electricity Supply Commission at the busbars has risen considerably. Part of this is made up by the Council's own pumping load at N'Cema which amounts, at present, to about 1,500 kVA.

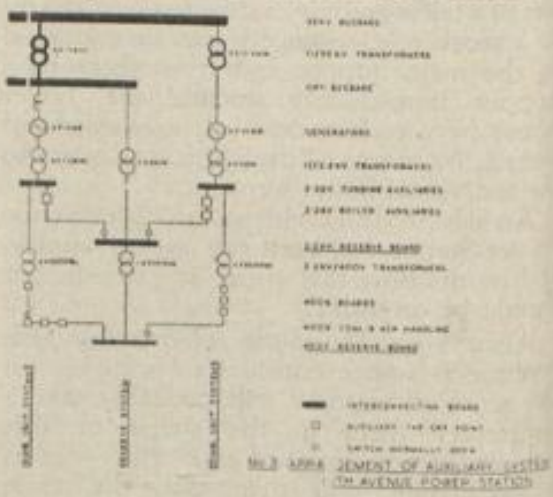
Industry has been segregated under "Heavy" and "Light" and the sum of these shows a slight increase on the Industrial figure shown in the earlier table.

Regarding the Municipal supplies, the pumping load at the Khami pumping station has been taken into account, but not the load at N'Cema which is supplied by the Electricity Supply Commission in bulk from their 33kV line to our own switchboard.

On 8th July, 1951, orders were placed for the second 30 MW installation. Generally, the equipment was to be similar to the first 30 MW installation, with switching on the 33 kV board, two 160 klb/hr boilers with feed pumps, steam piping and the necessary auxiliaries.

Nine skeleton panels were ordered for the 33 kV board to enable its erection to be finally completed, and to allow for the expansion of the 33 kV primary network in the foreseeable future.

At this stage, it became possible to finalise the auxiliary supply arrangements in the 13th Avenue Station, and one feature that may be of interest is brought out in Drawing (3) which shows the schematic



arrangement. From this it will be seen that each set has its individual unit transformer which feeds a 2·2 kV board. Interconnection of these boards is possible through another known as the Reserve Board which is energised from the 11 kV board, to which is connected not only the two 15 MW sets in 13th Abenue Power Station, but the generators in Lobengula Street Power Station. Normally, the interconnector switches on the reserve board are open, but synchronising arrangements are provided and use could be made of the board with its alternative source of auxiliary power in the case of failure of any of the normal sources. An additional economy is achieved by using the interconnecting cables as ring mains to the points where auxiliary power is required.

During the winter of 1951, history was made in the Department by reason of the fact that for the first time the Bulawayo Power Stations were run in parallel with another Power Station. The Bushtick Mine, a gold producing property situated about 28 miles from Bulawayo, had been served for many years partly by the

Electricity Supply Commission and partly by their own small Power Station of installed capacity two MW situated on their site. It had been decided to close this Mine down, and African Associated Mines, Ltd., who controlled it, knowing our pressing needs as a result of the delayed commissioning of the second installation, offered to keep the Power Station running until the 1st October to feed into our network via the 33 KV line to N'Cema. This very generous and co-operative offer was promptly accepted, and the arrangement implemented from 17th June.

In January of this year, an arrangement was entered into with the Electricity Supply Commission whereby their Gwanda Power Station ran in parallel with our own during our evening peak. By this means supplies to the Filabusi area could be made available again from Bulawayo since we could now cope with the demand in the morning while Gwanda could take it over in the evening.

The necessity for laying off boiler and generator plant for maintenance became more and more pressing as the year progressed, and the delay in commissioning the 15 MW set became more protracted. All work that could be done at nights, weekends and on Public holidays was done but the burden on the staff was considerable.

Eventually it became necessary to put into operation a load shedding programme for a few weeks, and this enabled boiler maintenance to be carried out in both stations. At the time of writing, the deliveries of the 15 MW set have, at last, been completed and the contractors, by using a double shift period on erection, have every hope of commissioning by the end of March. This will, at least, give the Department a measure of respite from the pressure of its growing demand, however temporary.

DISTRIBUTION

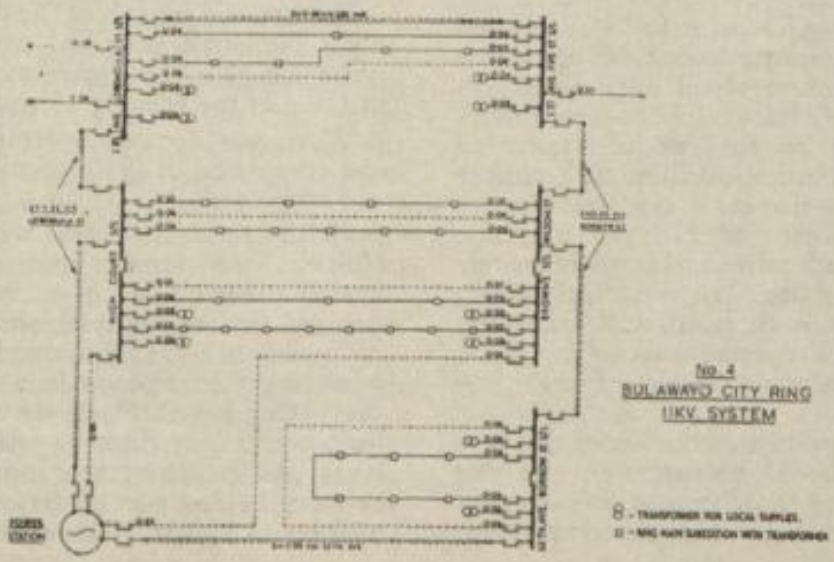
This section, probably more than any other section, had suffered from the depletion of staff during the war. Of the 17 members who were on active service, 14 were members of this section which represented about one-third of the total strength.

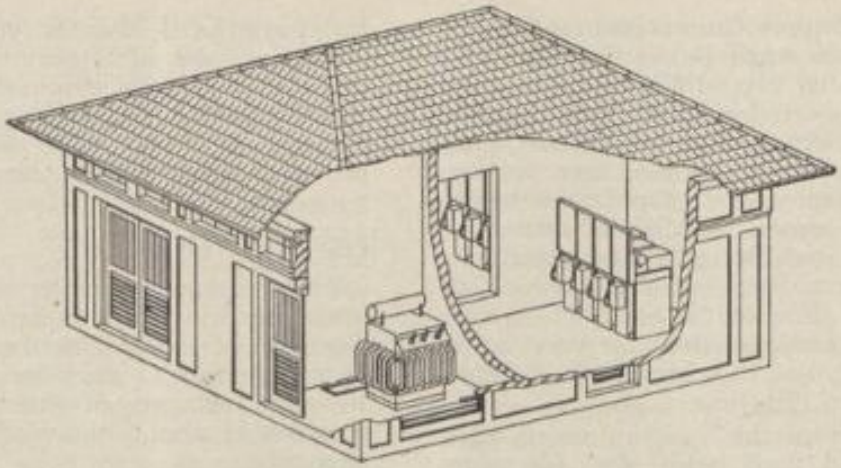
The cessation of hostilities brought with it a rush of work, both inside and outside the City. It also brought with it problems due to protracted delivery of materials.

It had already become apparent that the old ·06 square inch 11 kV City ring was no longer capable of dealing with the load in the centre of the Urban area, let alone the load in those outer areas which were fed from this backbone.

Work on a new duplicate ·25 square inch ring was commenced with a grid system of interconnection, as shown in Drawing (4) which should be compared with the schematic diagram in Mr. Sibson's paper (1945 Convention). The modified arrangement was designed for a safe capacity of 20 MVA which, it was felt, would be a reasonable guess for the loading in the centre of the City in the foreseeable future.

Solkor protection and earth leakage was proposed for the ring itself, with over





No. 5 TYPICAL ARRANGEMENT OF A 500KVA SUBSTATION

current and earth leakage protection on the interconnectors.

Two-hundred and fifty MVA switchgear was installed in all Ring Sub-stations while the Underground Sub-stations on the original ring have been progressively replaced by brick buildings with asbestos pantile roofs, supported on steel trusses. Drawing (5) shows a typical Sub-station suitable for 500 KVA installed capacity.

At present, only two of the original Sub-stations remain on the system.

Considerable care has been exercised in the design of the Sub-stations within the rateable area, not only from the technical angle, but also from the aesthetic angle to ensure that no disharmony was apparent architecturally with their immediate surroundings.

Mr. Sibson, in his paper in 1945, referred to the trouble experienced at that time through the failure of oil filled sleeves in 11 kV joints. This trouble has been overcome entirely by the use of plasticised styrene as a jointing medium with copper sleeves. This increases the cost by an approximate figure of £10 per joint for a ·25 square inch cable, and proportionately less for smaller sizes, but there is no doubt whatever that it is an overall economy, bearing in mind the maintenance costs and loss of revenue due to failure of the older type of joint.

Another advantage of the use of this type of joint on the 11 kV network was that jointers became familiar with its construction and were thus in a better position to handle the jointing on the future 33 kV network, which it was decided should be of this type.

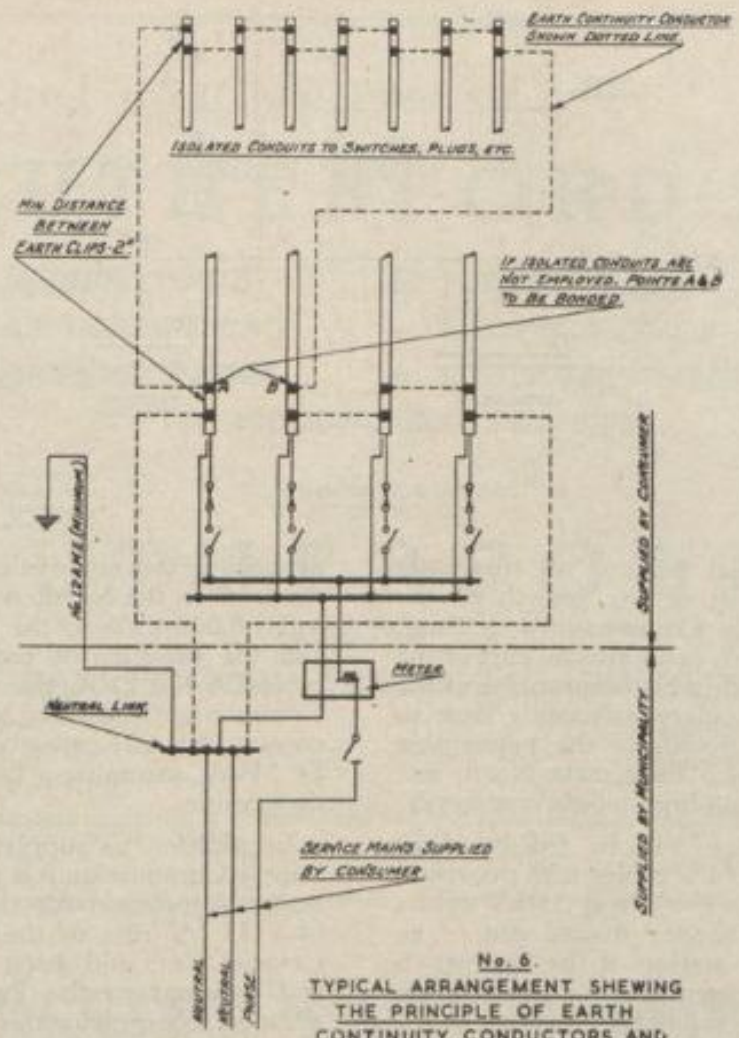
The load growth was apparent, not only in the central City area, but also in the Light and Heavy Industrial areas, and in the latter a noteworthy increase was the installation in 1945 by the Rhodesian Iron and Steel Commission of a 1,600 kVA automatic arc furnace at their Bulawayo site.

With the plant additions at the Power Station it became necessary as a result of increased short circuit capacity to change all the switchgear on the existing ·25 square inch Heavy Industrial site ring from 150 to 250 MVA class. This was completed in 1946.

Further, the growth of the demand in the Light Industrial sites had necessitated the provision of a ·25 square inch ring feeder in place of the existing ·1 square inch ring.

Work was commenced on this in 1947 and completed in 1950. Solkor protection was employed.

Of the residential areas within the City, Hillside, the largest and most heavily loaded which had been recently incorporated into the Municipality, was served by means of a 2·2 kV overhead line network supplied from a line approximately two miles long. Plans for reinforcement had been on the drawing board for several years, and in 1946, it was found possible to convert the first part of the overhead transmission to 11 kV. The complete network



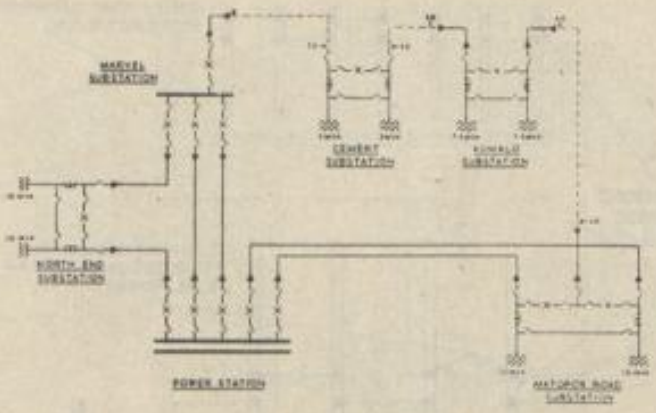
No. 6.
TYPICAL ARRANGEMENT SHEWING THE PRINCIPLE OF EARTH CONTINUITY CONDUCTORS AND CIRCUIT ARRANGEMENT

was eventually changed over two years later, but is now being being steadily replaced by underground 11 kV cables.

It will be recalled that in Mr. Sibson's paper in 1945 he described a type of 11 kV construction. It was, at that time, being tried out. This embodied two lightning guard wires above the line with a split neutral below which was also used as an earthing guard. This construction has now been adopted as standard in the Department and has proved very satisfactory.

The idea of the split neutral was extended later to service connections with a view to overcoming earthing difficulties due to high soil resistance. The twin neutrals are now used throughout on new L. T. lines whether below H. T. or separate. Two service neutrals are brought in to the house and connected to a link which is, itself, if possible, earthed to a water main or other satisfactory earth. The conduit is earthed to this link by two conductors at the Service Board and at some point near the extremity of the run it is joined by continuity conductors. Additionally, two bare copper conductors connect this point to the earthing link so that in effect ring main earthing is achieved. The general schematic arrangement is shown on Drawing (6). The years 1948 and 1949 showed an even greater increase in growth than previous years, and it became apparent that it would be necessary to take more drastic steps to deal with the demands made on the distribution than the simple increase in copper sizes of the main Transmission.

The implementation of the previously planned 33 kV network became necessary. Schematically, this is shown on Drawing (7).



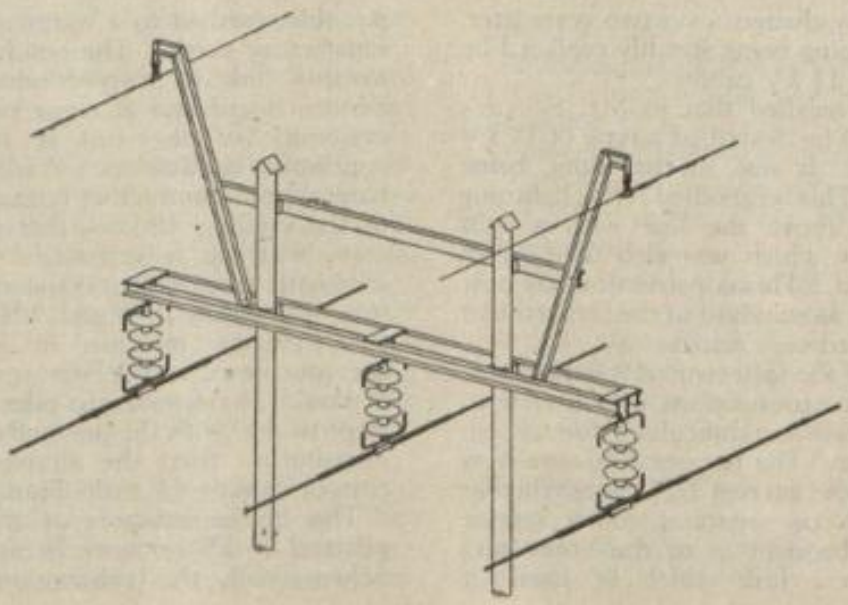
No 7 SCHEMATIC ARRANGEMENT OF 33KV PRIMARY SYSTEM

The matter had become all the more urgent as a result of the growth of the Electricity Supply Commission's demand, and it was decided, as an integral part of the scheme, to provide a Sub-station site at the Commonage Boundary sufficiently large to cater for their growth in the perceivable future, from which their main North and South transmission lines would commence.

This Sub-station will be fed by three ·2 square inch 33 kV cables with provision for a fourth. One of these 33 kV cables will initially be looped in and out of an intermediate Sub-station of the one switch type in the Northern area for the purpose of injection into the heavily loaded 11 kV network at this end of the City. Assuming the load on the Northern areas Sub-station to be 8,000 kVA in the immediate future, and the capacity of each of the 33 the cables 16,400 kVA, the Sub-station at kV Commonage Boundary would thus have a conservative safe capacity of approximately 24 MVA, assuming a fault in any one of these cable.

In addition to supplying the Electricity Supply Commission it is planned to use this major Sub-station for the commencement of a 33 kV ring to the Premier Portland Cement Co., and back through Famona and Belmont to the Power Station. In addition to supplying the Cement Company

No 8 STANDARD CONSTRUCTION FOR 33kV OVERHEAD LINES



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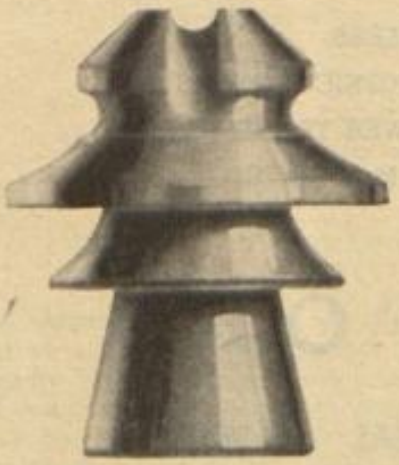

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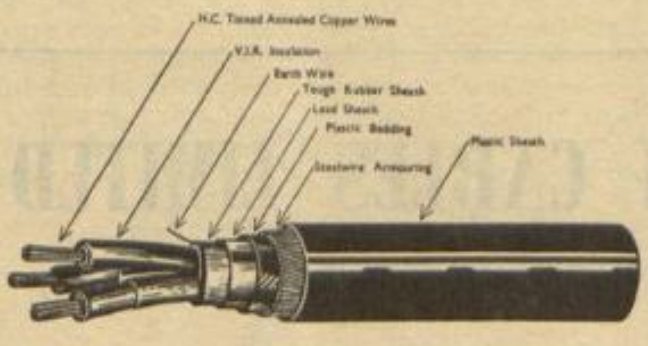

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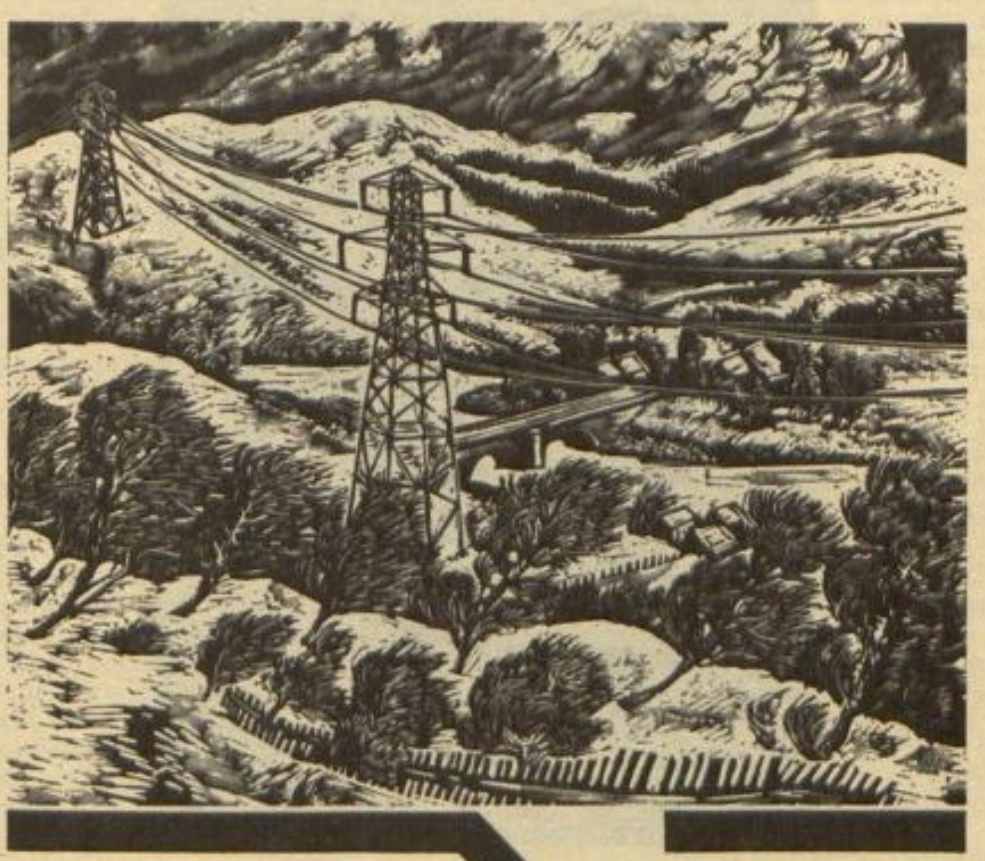

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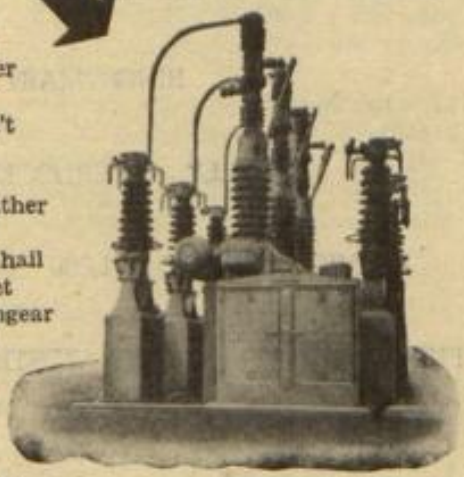

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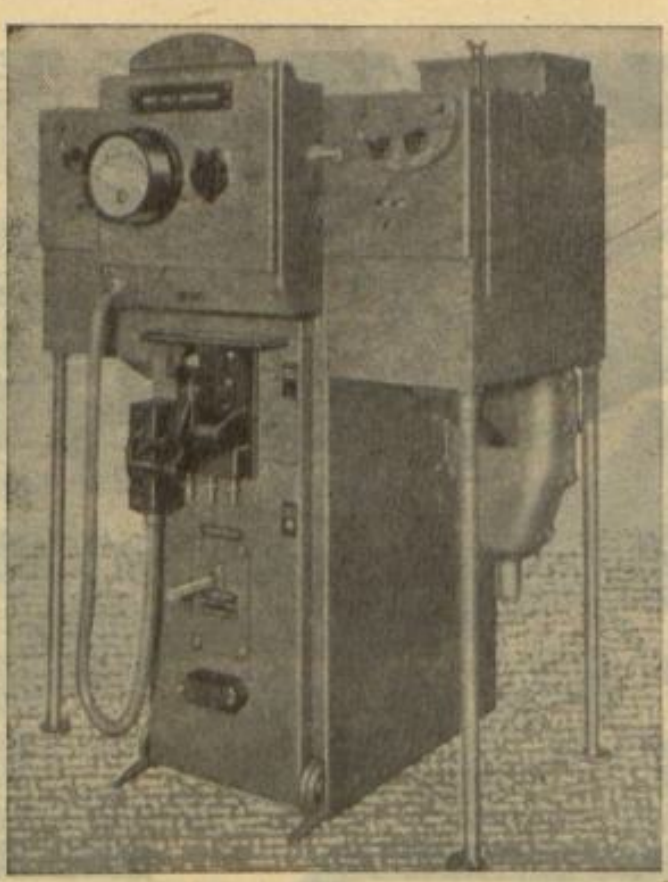

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two further Sub-stations en route will be used for injection into the residential networks and in the case of Famona/Belmont into the adjacent Light Industrial network as well.

Drawing (8) shows the construction used for the Premier Portland Cement line which will replace the heavily overloaded 11 kV feeder at present in use.

One of the heaviest calls on the Distribution Sub-Department was the provision of power to the National Housing Board sites. The largest of these, commenced in 1948, was the Queens Park Residential area consisting of 744 bungalows and 45 blocks of flats.

Tests in this area during the winter months have shown an average loading per dwelling house of 2·4 kVA.

Connection to this area and a further Housing Board area comprising 540 stands was, of course, only one portion of the many calls on the Sub-Department. A further large area within the Commonage has recently been opened up on the Southern side of the City in which eventually 498 stands will be available. Also, in the past five years Famona/Malindela area lying on the South side of the City between what was the old Town Management area of Hillside (now part of Bulawayo) comprising 801 stands has been completely reticulated.

Additionally, the water supply to the City from the 4,012,000,000 gallon dam at N'Cema has been augmented by the laying of a 30 inch main to replace the existing 15 inch one. This has entailed the provision of additional pumping plant to the five existing 350 h.p. Worthington Simpson Pumps at N'Cema. The scheme embodies the provision of two 600 h.p. Sulzer Pumps for the 15 inch main and six 480 h.p. Sulzer Pumps for the 30 inch main. The 30 inch main will be broken at an intermediate pumping station at Fernhill. Supply to both N'Cema and Fernhill will be taken from the Electricity Supply Commission's 66 kV transmission stepped down to 6·6 which is the motor voltage. All the work of provision of this supply from the Electricity Supply Commission busbars was carried out by our own Sub-Department.

Further, the work of cabling and wiring in the Power Station for the various plant extensions in progress is part of the work of the Distribution Sub-Department. This has placed a heavy burden on its own Test Branch which has, in the last few years, been greatly expanded. Facilities are now available for the simultaneous tests of 34 polyphase meters and 53 single-phase meters.

A capacity bridge and a high tension bridge, made by the Department are available.

In addition, primary and secondary injection testing equipment has been designed and can be used for the testing of switchgear. Arrangements are in hand to build up a mobile test van incorporating the existing equipment for the location of cable faults.

As has been indicated, the burden of the growth of the City fell very heavily on the Distribution Sub-Department, and it was almost inevitable that a back-log of work would accumulate in one or other of its sections.

Provision of street lighting improvements in the older areas, and provision of street lighting in the newer districts has been regarded as of lesser priority than the maintenance of supplies during the past

TABLE 4

DISTRIBUTION STATISTICS — BULAWAYO

Year	Units Sold	Consumers	Cables		Overhead Lines	
			H.T. Miles	L.T. Miles	H.T. Miles	L.T. Miles
1945	72,017,770	4,777	37·0	18·0	65·0	191
1946	75,873,543	4,906	39·0	20·0	70·0	200
1947	85,938,851	5,266	43·0	21·0	78·0	205
1948	91,481,199	6,061	44·0	22·3	85·0	230
1949	106,597,732	7,388	55·0	26·0	98·5	265
1950	125,663,038	8,360	63·4	33·0	115·0	293
1951	152,255,509	9,107	89·4	50·2	120·0	303

five years, in which time the City has approximately doubled its size. It would seem that this is one of the payments that must be made for progress. However, plans are on hand to remedy this, and it is hoped, in the not too distant future, to give considerable attention to these matters.

Reference to Table 4 gives an idea of the growth of the Distribution side of the Department, and the annual output of work; from this it will be seen that in the six years under review, the number of consumers connected has increased by approximately 91% and the units sold by 111·1%.

Table 5 gives the annual capital expenditure for the Undertaking for the year 1945. This should be looked at in conjunction with Table I, which is illustrative of the growth of the general community served by this Undertaking. It will be seen that the two are complementary and that the annual capital expenditure has increased from £58,075 in the earlier year, to a figure just over 12 times greater in 1951. It is estimated that it will be 20 times greater this year than in 1945.

It has become necessary to carry more and more of this capital expenditure by raising loans, instead of adopting the former policy of financing it from revenue, since without prohibitive tariff increases the revenue was insufficient for this purpose. In 1951 it will be seen that 90% of the capital work was carried out by means of loans.

Table 6 shows the annual Income and Expenditure figures. It will be seen that as from 1948 onwards, a definite sum was allocated from the surplus towards Distribution depreciation, and it has since been included as a capital charge. Prior to this, as Mr. Sibson pointed out in his paper in 1945, it has been the practice to allocate approximately 8% of the capital value of the Distribution system to reserve for Capital Works. This, until recent years, was sufficient to finance all Distribution extensions. As the system grew, however, it proved impossible to continue this practice entirely, and it was necessary to go to Loan for the larger Distribution capital expenditure items, but allocation to Distribution depreciation continued and this has proved of considerable assistance in reducing the amount of money that it became increasingly necessary to raise by loan as the demands on the system became greater.

It will be seen that the Revenue has increased by approximately two and a quarter times in six years from 1945–1951. This has, of course, been partly brought about by the increase in tariffs in 1949, while a further increase just introduced results in a general rise of approxi-

FINANCIAL

TABLE 5

BULAWAYO ELECTRICITY DEPARTMENT

Annual Capital Expenditure — 1945-52

YEAR	CAPITAL EXPENDITURE			% Increase of Capital Expenditure over preceding year	% of Total annual Capital Expenditure from Loan Funds
	Total	From Loans	From Surplus		
1945	58,075	16,065	42,010	—	27·6%
1946	152,070	111,328	40,742	161·8%	73·2%
1947	196,967	147,997	48,970	29·5%	75·1%
1948	283,420	202,554	80,866	43·8%	71·5%
1949	301,302	230,269	71,033	6·32%	76·4%
1950	439,749	375,503	64,246	46·0%	85·0%
1951	700,064	633,137	66,927	59·2%	90·4%
*1952	1,184,230	1,081,575	102,655	69·2%	91·4%

* Figures estimated for this year.

TABLE 6

BULAWAYO ELECTRICITY DEPARTMENT — ANNUAL INCOME AND EXPENDITURE

Year	Revenue from all Sources	%Total Revenue Increase over Preceding Year	Operating Expenditure	Capital Charges	Total Expenditure	Surplus	ALLOCATION OF SURPLUS		REMARKS
							Contbr. in Aid of Rates	Contbr. to reserve for Capital Works	
1945	£206,317	—	116,915	53,172	170,087	36,230	5,000	31,230	—
1946	£221,693	7·44%	126,664	53,604	180,268	41,425	5,000	36,426	—
1947	£251,135	13·3%	138,399	61,111	199,510	51,625	5,000	36,625	—
1948	£297,963	18·65%	159,377	85,508	244,885	53,078	5,000	48,078	Contribution of £19,806 to Distribution Depreciation included in Capital Charges
1949	£336,477	12·93%	179,700	114,106	293,806	42,671	5,000	37,671	Contribution of £24,031 to Distribution Depreciation included in Capital Charges
1950	£398,515	18·45%	220,809	128,536	349,345	49,170	5,000	44,170	Contribution of £28,909 to Distribution Depreciation included in Capital Charges
1951	£478,801	20·1%	271,758	165,551	437,309	41,492	5,000	36,492	Contribution of £30,148 to Distribution Depreciation included in Capital Charges
*1952	£544,527	13·73%	316,438	219,687	536,125	8,402	5,000	3,402	Contribution of £33,047 to Distribution Depreciation included in Capital Charges

* Figures estimated for this year

mately 20%. A copy of our current Tariffs is attached, and it will be interesting to compare them with the, then, current Tariffs included in Mr. Sibson's paper.

This new increase was largely necessitated by a rise in coal costs brought about by the termination of the Colliery agreement in September 30th, 1948. After this date until March 1st, 1950, the price had been 10s. per ton f.o.r. Wankie, and then it was raised to 12s. These increases had the effect of increasing our own electricity costs by £20,000 or ·0346d. per unit sold, at the time. As from 1st February this year, another increase has been made and the price now stands at 14s. 3d. per ton f.o.r. Wankie. The railage is still 7s. 2d. but likely to be increased in the near future.

Further, also affecting the need for a tariff increase was the increase in European wages which has occured as a result of the rise in the cost-of-living index.

Also, in 1949 the Native labour award was implemented. This had the effect of raising the average wage of the 530 Natives employed at the time by an amount which represented an annual Departmental increase in cost of approximately £1,600.

The rapid rise in plant and equipment cost is also a potent factor in growing costs of production. Table 7 shows the increase in plant prices over the last few years, expressed in pounds per kW. It will be seen that the probable increase from 1945 to 1957 is nearly 100%, and this may be a conservative figure if basic material prices rise more sharply than is at present anticipated.

It should be noted, however, that the figure of £41·3 per kW which was the cost of the initial installation in the 13th Avenue Power Station includes certain buildings costs and plant costs, such as coal handling equipment, which is applicable not only to the primary installation but also to subsequent installations. This accounts for the higher figure in 1948.

On the subject of plant, considerable thought has been given during the last few years to conditions of contract with a view to easing the position for manufacturers overseas who, like ourselves, have to carry the burden of increased costs in materials and labour for a period before the finished product brings in a financial return.

With a view to lightening this burden, a scheme of progressive payments has been introduced, and these are embodied in condition of contract, standardised for all types of contract, either with or without erection and above and below certain rates.

This had the effect of greatly simplifying and thus speeding up the issue of enquiries by cutting down the amount of work involved for each class of enquiry.

One other effort towards standardisation by the Department is noteworthy, and that is the present method of assessing rural area connection fees and minimum charges. A formula has been evolved by the City Electrical Engineer for this purpose and it is:—

$$C=(6\cdot5\sqrt{A}+10\cdot3)\quad(1+\cdot01M)$$

C = Connection fee in £. (Approximately equal to labour and transport costs).

A = Area in acres.

M = Distance of the centre of the plot from the City Hall.

TABLE 7

COST OF GENERATION PLANT 1945-1951 — BULAWAYO POWER STATIONS

Power Station	Lobengula Street Power Station	13th Avenue Power Station				Average Estimated Cost of 13th Avenue Power Station to 1957
Year erection completed or completion promised	1945	1948	1952	1955	1957	
Size of extension ...	10 MW	15 MW	15 MW	30 MW	30 MW	
Cost per KW ...	£27	£41·3	£37·3	£46·7*	£53*	£46·3

* Figures Estimated

This formula was derived from consideration of a number of plots in various areas and gives, it is thought, an equitable and uniform method of assessing connection fees, which represents the irrecoverable labour costs in making service connections to the mains.

The minimum charge which gives the return on the Capital laid out in the form of material is derived from the connection fee as follows:—

$$\text{Monthly minimum} = \frac{1}{12}(3C) \times \frac{23}{100}$$

C = Connection fee.

From the study of a number of service connections, it has been ascertained that the irrecoverable labour and transport charges involved represent on an average one quarter of the total cost, and the material represents the other three quarters. The average material cost is, therefore, 3C and the figure of 23% is designed to cover the capital charges on the extension and all other costs of giving a supply of the equivalent value to the minimum charge.

Consider a plot ten acres in extent—six miles from the City Hall. The connection fee would then be:—

$(6 \cdot 5\sqrt{10} + 10 \cdot 3)$ $\quad$ $(1 + \cdot 01 \times 6)$

$= £32 \cdot 8$ $\quad$ $= £32$ 16s. 0d.

The monthly minimum charge would be assessed at:—

$$\frac{1}{12} \times (3 \times 32 \cdot 8) \times \frac{23}{100}$$

$= £1 \cdot 89.$

This would be rounded off in practice to £1 17s. 6d.

This formula is designed primarily, not so much to relate individual charges to the cost of connecting a particular consumer but to relate charges to the increase in costs of the distribution in a particular area due to land occupied by that individual consumer.

The use of the formula has now become firmly established, resulting in a considerable saving of time in the assessment of fees in the rural area, and what is more important a uniformity in that assessment.

ADMINISTRATION AND TECHNICAL

If it is reasonable to compare an Electricity Undertaking to a wheel, in which the Distribution and Generation Sections are two of the spokes, then it is reasonable to compare the Administration Section to the hub of that wheel.

In passing it might be commented, regarding this comparison, that it would be a very odd wheel with only two spokes. In Bulawayo the third spoke is the Techinical Section which handles all development work, the technical side of contracts and a part of the financial side. The Drawing Office also forms part of this Branch.

This particular section has expanded considerably since 1945 and it will be interesting to relate this to the increase in loan charges which is roughly representative of the increase in the amount of contract work on hand since that time. This was dealt with in the previous section.

The work of the Technical Section has from 1949 onwards been alleviated to some extent by the appointment of Messrs. Merz & McLellan as advisory Consulting Engineers. Situated as we are away from the technical and industrial centres of the World this step had appeared desirable for some time. Their wide knowledge and facilities have proved of the greatest benefit and assistance to the Department in coping with the problem arising from the rapid expansion of the Undertaking.

The Department had of course employed the services of Messrs. Kanthack & Partners as Civil Consultants in connection with the Power Station building programme for some considerable time and in the early days mechanical and electrical consultants had been called in from time to time so that the step was not quite the innovation it would appear at first sight.

In recent years in addition to our two major Consultants, local Civil Consultants, Messrs. Haviland & Marshall have been commissioned in connection with the building of 33 kV Sub-stations.

There is a point of view in existence amongst Power Supply Engineers which advocates the necessity of a fourth spoke in the wheel, namely an Efficiency Section. This section is usually controlled by an Efficiency Engineer whose job is to act as a check on the output and operation of the other sections. Of necessaity, the Engineer in charge of such a section would require to have had a very wide training embracing electrical and mechanical testing, chemical

engineering and administration. In other words, for such a branch to be a success it would need to be handled by a paragon of engineering and such men are rare. Generally, it is felt that the advantages that might accrue are not worth the risk of the disadvantages, although it is known that some Undertakings have utilised such a section with great success.

Reverting again to our simile of the hub and the wheel, it has always been a bone of long standing contention in Power Supply circles as to the correct size of the Administrative hub in relation to the rest of the wheel.

At least one attempt has been made to assess this proportion and, also, the size of the whole staff wheel in general terms of concrete quantities such as Revenue, Expenditure, Units Sold, etc., relevant to Power Undertakings, basing the assessment on data from several established and efficient organisations.

This approach has been applied to the Bulawayo Undertaking very successfully. The writer would, however, express the view that such assessments are very difficult if not almost impossible, to achieve even as the roughest general guide. Each Undertaking has its own particular problems which, to be solved, needs its own special application, and even if some golden rule could be found acceptable to those in the Industry, it would be very hard to convince those outside it of its utility because of lack of intimate knowledge of Undertakings other than the one with which they are acquainted. This point, can in certain circumstances, be one of importance.

It is felt that the only direct way of assessing the amount of staff needed for a specific purpose, assuming a reasonable standard of efficiency and keenness to exist, is to watch the amount of overtime worked by that section. If an excessive amount is worked regularly, then more staff is needed. If occassional overtime is worked, the staff position is probably correct, but if none is ever worked, then the Section is overstaffed. This applies, of course, most particularly to the office staff but it is also applicable to all sections, and it is based on the assumption that work is dealt with promptly and none is shelved, and that there is a normal amount of efficiency and keenness.

The general present staff arrangement is as shown on Drawing (9), and Table 8 shows the annual staff increase since 1945.

NUMERICAL SCHEDULE OF STAFF— BULAWAYO ELECTRICITY DEPARTMENT 1945-51

TABLE 8

Year	No. of European Staff	REMARKS
1945	91	17 on Active Service
1946	94	All staff returned from Active Service
1947	94	
1948	128	
1949	149	
1950	185	
1951	177	Many vacancies on establishment remaining unfilled

In Bulawayo a Clerical Assistant is in charge of the Office section of the Administration with a male Records Clerk responsible to him for the general office establishment, which at present consists of six women clerks and six shorthand typists.

The Department has always been greatly concerned to encourage apprentices, with a view to building up an efficient and keen supply, not only for itself, but for the whole Colony.

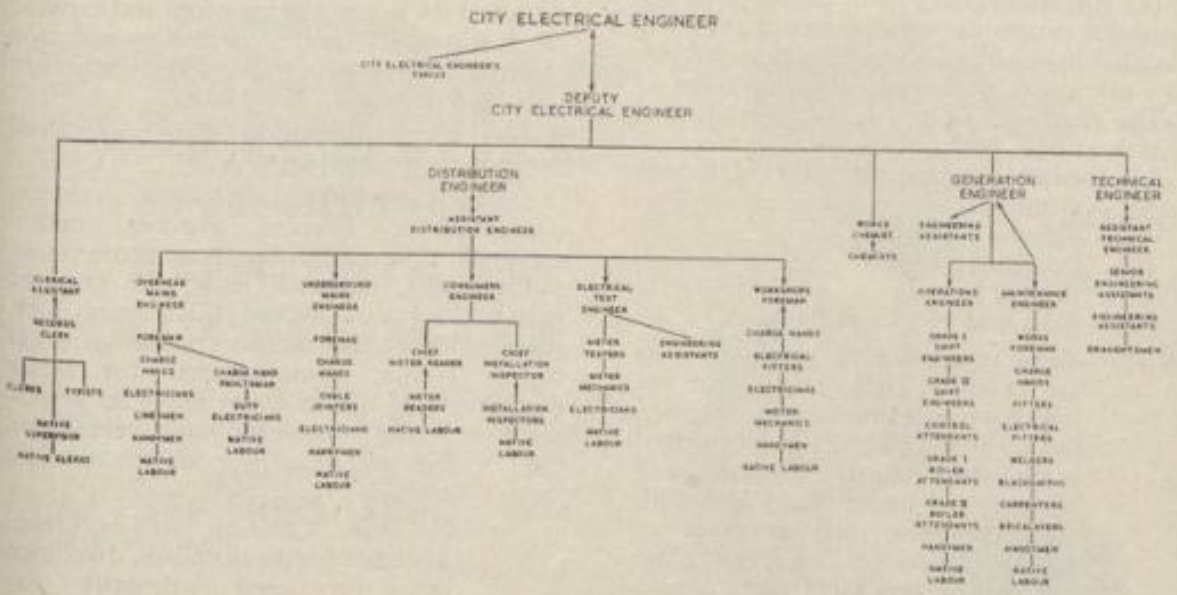
With a view to this end, it has recently introduced regulations whereby an apprentice, subject to having passed National Technical Certificate (3), can undergo a trade test and, if he passes, he is at once put on Improvers rate which means a difference of 14s. 5d. per day in the case of a fourth year man.

It is hoped that this may prove a great incentive to encourage apprentices to take techinical study seriously.

CONCLUSION

The future of the Undertaking is thought to be one of ever increasing output. An attempt has been made in Drawing (1) to provide a forecast of the peak demand and the units sold. From this it will be seen that a winter demand of 130 MW is anti-

No. 9.
STAFF DIAGRAM OF BULAWAYO ELECTRICITY DEPARTMENT



cipated in 1961. Whether this will be reached depends on many factors outside the scope of this paper such as immigration, the general world ecomonic position and, above all, the International situation at the time.

Whatever the future holds, however, it is felt that it will be at least as interesting and stimulating as the past, and one can, after all, ask of life little more than this.

In conclusion, it is desired to apologise for the fact that it has not been possible, owing to extreme pressure of work, to devote more time to the preparation of the paper. It is hoped, however, that the attempt to present a picture of the Undertaking over the past few years will provide a modicum of interest for, at least, a few of the members.

It is desired to acknowledge assistance in the form of criticism and advice in the preparation of this paper from:—

The City Electrical Engineer, Mr. A. R. Sibson, A.M.I.E.E., A.M.I.(Mech.)E., M.(S.A.)I.E.E.

The Deputy Town Clerk, Mr. E. S. White, A.I.T.C., A.C.I.S., A.I.A.C., F.I.P.A.

The City Treasurer, Mr. C. C. Wigg, A.S.A.A., C.A.(S.R.).

And assistance in the provision of statistical data and drawings from:—

The Technical Engineer, Mr. J. N. Jones, B.E., A.M.I.E.E.

The Distribution Engineer, Mr. H. E. Summers, B.Sc.(Eng.), M.I.E.E.

TARIFF OF CHARGES AND CONDITIONS FOR THE SUPPLY OF ELECTRICITY

1. WITHIN THE COMMONAGE BOUNDARY

SCALE 1—LIGHTING TARIFF

(a) General

Electrical energy for lighting purposes in all classes of premises, except as otherwise provided for, will be supplied on the following sliding scale, subject to a minimum charge of 5s. per month:—

The first 500 units per month at 7½ per unit.

The next 500 units per month at 3¾ per unit.

All units in excess of 1,000 units per month at 1¾d. per unit.

(b) Athletic and Sporting Clubs

Electrical energy for lighting purposes will be supplied to approved Athletic and Sporting Clubs at a flat rate of 2½ per unit, subject to a minimum charge of 5s. per month.

SCALE 2—DOMESTIC SUPPLY

(*a*) Electrical energy will be supplied for domestic purposes to the classes of premises detailed below at the following rate, subject to a minimum charge of 5s. per month:—

The first four units per living room per month at 8½d. per unit.

All further consumption during month at ¾d. per unit.

(i) Private houses.
(ii) Boarding houses.
(iii) Private hotels.
(iv) Flats and blocks of flats.

(N.B Where supplies to blocks of flats are given in bulk, energy for the lighting of common corridors, etc., in that portion of the building used solely for domestic purposes will be supplied under Scale 2. With this exception, all supplies to blocks of flats will be given under the appropriate tariff rates applicable to the class of consumption.)

(v) Hostels and residential institutions, excluding Government School hostels.
(vi) Homes run by charitable institutions.
(vii) Private nursing homes and maternity hospitals.

(*b*) On written application to the City Electrical Engineer, the secondary rate of ¾d. above will be reduced to ⅝d. in respect of each installation with one or more approved electric water heaters in use (of not less than 10 gallons total capacity). To obtain this reduction the water heaters must have been installed to the satisfaction of the Council's Installation Inspector, and the reduction will only be maintained while the water heaters are connected to the Council's mains and are working satisfactorily.

(N.B. Except where electric water heaters as defined above are installed in each and every flat of a block of flats, or where a central system for the whole building with electrically heated water is installed and maintained, the reduced secondary rate will not be applicable to blocks of flats taking supply in bulk.)

Definition of Living Room

For the purpose of assessing the number of "living rooms", a "living room" shall be defined as:

Any room and/or compartment in a residence, or in an out-building thereof, designed for use as a living room and capable of being inhabited, whether wired for electrical energy or not and whether occupied or not.

The above definition, however, shall exclude the following:—

Kitchens, pantires, bathrooms, passages, conveniences, sleeping porches, native servants' quarters, garages, storerooms in outbuildings, entrance halls, the area of which does not exceed 70 square feet, provided that the temporary use of such rooms and/or compartments for other purposes will render them liable to assessment as living rooms for such periods as the City Electrical Engineer may determine.

(N.B. Where a separate service is given by the Council to buildings associated with domestic dwellings but not used primarily for European habitation, the Council reserves the right to regard any rooms and/or compartments as living rooms for the purposes of this tariff Scale 2, notwithstanding the above exceptions, provided that the quota of higher priced units will, in this event, be only two units per room in respect of such rooms and/or compartments as would otherwise be excluded from assessment.)

A "sleeping porch" shall mean a portion of a verandah or building exclusively used as an open-air sleeping apartment. So-called sleeping porches which are permanently enclosed by masonry or wooden partitions with windows and doors and used as living rooms shall not come under the definition of a sleeping porch for the purposes of this tariff.

A room, dormitory, ward or combined dining and sitting-room, when in excess of 300 square feet in area, shall comprise for the purposes of this tariff one living room for every 300 square feet, or portion thereof, of enclosed floor area.

For private houses the maximum number of living rooms chargeable under the tariff will be seven for each single dwelling. This provision will be strictly confined to private houses, and will exclude all other consumers taking supply under the room tariff.

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The minimum number of living rooms applicable to each separate consumer under this tariff will be two.

Where a portion of a residence is occupied by paying guests, such residence will only be classed as a pirvate residence where the total number of rooms, as defined above does not exceed seven.

Any dispute as to the number of living rooms contained in any premises to which this tariff is applicable shall be referred to the Council whose decision shall be final and binding.

SCALE 3—SHOP WINDOW LIGHTING

Electrical energy for outside electric signs, external floodlights, and lighting of shop windows in all business premises, blocks of buildings, etc., (with the exception of bioscopes and theatres), when in the opinion of the City Electrical Engineer such lighting will augment the lighting of public thoroughfares, will be metered on a separate meter and charged at the under-mentioned rate, subject of a minimum charge of 5s. per month:—

The first 40 units consumed per month at 4½d. per unit.

All further consumption during month at 2½d. per unit.

Electrical energy for the operation and lighting of Petrol Pumps will also be supplied in terms of the above tariff.

SCALE 4—COOKING, HEATING, WATER HEATING, REFRIGERATION AND AIR CONDITIONING (Separate Metering).

(*a*) Electrical energy when separately metered will be supplied to all classes of premises for cooking, heating, water and air conditioning purposes, and for the use in all types of refrigerators, except refrigarators operated by motors in excess of ½ h.p. rating, at a flat rate of 1d. per unit, subject to a minimum charge of 5s. per month.

(*b*) For the exclusive purpose of demonstrating electrical appliances which are capable of taking supply from the Municipal mains, electrical energy will be supplied through a separate meter at a flat rate of ½d. per unit, subject to a minimum charge of 5s. per month.

(*c*) Large water heaters of capacities exceeding five kW may be supplied with electrical energy at a flat rate of ½d. per unit, provided such heaters are separately wired and equipped with a magnetically operated contactor for connection to a time-switch which will be provided by the Council. It will be a condition of supply under this tariff that the power will be switched off not more than twice daily at such times and for such periods as the City Electrical Engineer shall from time to time determine, provided that the total period of disconnection in any one day shall not exceed four hours.

SCALE 5—INDUSTRIAL POWER (Sliding Scale)

Electrical energy is supplied for power and for industrial processess in business establishments, not elsewhere provided for herein, at the following rates:—

The first 1,000 units per month at 1½ per unit.

The next 1,000 units per month at 1·2d. per unit.

All further consumption per month at ·9d. per unit.

(**N.B.** This scale is subject to a minimum charge of 5s. per month for the first two h.p. and 2s. 6d. for each additional h.p. or part thereof up to a total of 60 h.p. where lighting is separately metered and charged for. Appliances rated in kW shall be subject to the minimum stated above on the equivalent h.p. basis, which shall not be less than 5s. in any month. Where lighting is charged for at industrial power rates, in accordance with the provisions of Notes 2 and 3 herein, the minimum charge will be £12 10s. per month.)

SCALE 6—INDUSTRIAL POWER (Maximum Demand Scale)

Supplies of electricity will be given under the following standard two-part rates:—

For extra high-tension supplies 11,000 volts, 3-phase	For 400/230 volts, 3-phase 4-wire
A demand charge of 8/1d. per month per kVA of maximum demand, plus An energy charge of ·345d. per unit supplied.	A demand charge of 9/2d. per month, per kVA of maximum demand, plus An energy charge of ·375d. per unit supplied.

Such supply rates to be subject to the following conditions:—

(i) The amount payable in any month in respect of maximum demand shall not be less than 70% of the amount payable in respect of the previous highest demand recorded during the period of 12 months immediately preceding.

(ii) A minimum payment of £600 per annum shall be made in respect of demand and energy charges taken together.

(iii) The energy charge to be based upon coal cost of 15s. 8d. per short ton delivered at Power Station Siding. Should the cost of coal be greater or less than this amount, the energy charge shall be increased or decreased according to a coal adjustment formula to be attached to the contract documents.

(iv) Before electrical energy can be supplied at this rate a contract for supply for two years will be entered into.

(v) Each consumer taking supply of E.H.T. electrical energy under this tariff shall provide, free of charge, accommodation to the approval of the Council for the housing of the Council's transformers and switchgear.

The Council reserves the right to use any of its equipment so installed for supplying adjacent networks, in addition to the consumer's own requirements.

Notes applicable to Scales 5 and 6

1. The Council reserves the right of decision as to the voltage at which a supply would be given, but should it be necessary, for technical reasons, for the Council to meter supplies at low Tension, where all the conditions enumerated in the foregoing paragrpahs (i) to (v) above have been compiled with by the consumer, then the tariff laid down for E.H.T. supplies shall be applicable, provided that the registration of the energy meter shall be subject to a 5% increase to cover transformation losses.

2. In the case of industrial consumers whose installed capacity of industrial plant is 100 h.p. or more and where supply is brought by the Council to the consumer's premises at extra-high tension and where the consumer has provided at the request of the Council, and free of charge an approved sub-station for the sole use of the Council principally for the purpose of housing the Council's switchgear and transformers, lighting supplies may be included at industrial power rates. (The term "approved sub-station" shall include approved access way for the Council's cables to the consumer's boundary, and it shall be a condition that the Council may use such sub-station for the supply of other consumers should it so desire.

"Approved" shall mean approved by the City Electrical Engineer).

3. In the case of industrial consumers whose installed capacity of industrial plant is 100 h.p. or more, and where for technical reasons the supply is at any time brought by the Council to the consumer's premises at low tension, the consumer may be given lighting supplies at industrial power rates without being required to provide an approved sub-station, provided that an agreement is entered into whereby the consumer undertakes inter alia to provide an approved sub-station, as defined in Note 2 above, within three months of the receipt by the consumer of a request by the Council so to do, and whereby the consumer pays the sum of £100 to the Council in addition to any other fees that may be payable, which sum of £100 shall be refunded to the consumer if he is required to provide an approved sub-station within three years from the date of the payment of this amount. In cases where an approved sub-station is not required by the Council within the period of three years mentioned, no refund will be made of the £100 referred to above, but the liability to provide an approved sub-station, if required by the Council at any time in the future will remain with the consumer.

SCALE 7—LICENSED HOTELS

Electrical energy is supplied to licensed hotels for all purposes at the following inclusive maximum demand scale.

A demand charge of 20s. 5d. per month per kVA of maximum demand.

An energy charge of ·45d per unit supplied.

Such supply rates shall be subject to the following conditions:—

(i) The amount payable in any month in respect of maximum demand shall not be less than the amount payable in respect of the previous

highest demand recorded during the period of 12 months immediately preceding.

(ii) The conditions enumerated in subclauses (i) to (v) inclusive under the provisions applicable to Scale 6 herein.

TEMPORARY TARIFFS FOR GOVERNMENT SUPPLIES

Where bulk supplies are to be given to Government Institutions other than purely Industrial undertakings, the tariff will be based on Scales 1(*a*) and 4(*a*) with 25% of the consumption allocated to the former scale, the application of such tariff to any new Institution being dependent upon its substitution for existing tariffs for such supplies already being given to the Government.

This tariff is a temporary experimental tariff and may later be superseded by a similar bulk scale, the exact details of which will depend upon the information derived during the working period of this temporary tariff.

2. TO ALL AREAS OUTSIDE THE COMMONAGE BOUNDARY

Supplies will be given under all the foregoing tariff scales, subject to a surcharge of 30% with the exception of Scale 3 which is applicable only to the area within the Commonage Boundary.

PRESIDENT:

It has always been my view that, at every Convention of this Association, wherever possible, a Paper on the undertaking of the town in which the Convention is held should be give, for such a Paper assists delegates and visitors to understand something of the undertaking of the town to which they have come and to appreciate its problems, in addition to making any visits that they may pay to that undertaking the more interesting. It also serves the purpose of putting down at reasonable intervals the various procedures that have come to be adopted in that particular undertaking in the intervening years, and enables a general check-up to take place with the rest of our colleagues on the usefulness or otherwise of the various ideas and proposals that have been put into effect; and so it would be of very great value to have as full as possible a discussion on this Paper. As Mr. Redman has indicated, we shall be delighted to hear any criticisms, any comments showing how you may have tackled similar problems in your own undertakings. I now throw this Paper open for discussion.

Mr. R. W. KANE (Johannesburg):

Mr. President: Mr. Redman's Paper or contribution to the proceedings of the Association is, to my mind, particularly valuable. I consider that a Paper of this description, dealing as it does with the variety of problems that can arise in any undertaking, quite often gives a solution or at least some guidance towards the solution of similar problems that may be very much nearer home in our own undertakings. I have learnt of recent years that an immediately apparent solution is not necessarily the ideal one and a little time for thought and research into the reasons for present practice in many cases uncovers facts that may also be pertinent. After all, our predecessors were no fools and invariably laid a solid foundation for their successors to work on; and by predecessors I include Heads of Departments, Councillors and Provincial Administrations.

Perhaps Mr. Redman may be considered lucky in at least having the opportunity of following his predecessors in the pattern of his Paper. On the other hand, as Scots are not confined to north of the Tweed, but are found straddling the Vaal and Limpopo, etc., perhaps Bulawayo really desires to ensure a series of papers dealing with the history of the undertaking at the Association's expense.

However, Mr. Redman's Paper gives me great pleasure and I am only sorry that I was not permitted to keep my copy longer before handing it on to another prospective contributor.

Dealing with the Paper, may I be permitted to pass the following comments and to raise a few queries?

I note the use of circuit breakers in place of the consumer's service fuse, and, although at least one large city in the Union adopted this practice many years ago, I wonder if the local officials have any comments to make on their experience with these—I appreciate that service complaints may be reduced but I am more

interested in their behaviour under severe storm conditions and whether any particular maintenance problems have arisen, as compared with the rather less expensive fuse.

I would also like Mr. Redman to tell us the reason for the high yearly load factor.

Then, again, it is not quite clear why it should be necessary to split the neutral conductor of the L.T. system into two wires when not used below H.T. wires. If used below H.T. wires the split neutral will understandably provide an earthing guard, but used otherwise, apart from better contacts to earth, there appears to be little advantage to outweigh the higher installation cost. Perhaps this could be elucidated. It would be interesting to know wheher, as a result of using this multiple earthing system, any complaints have been received from the Postmaster-General in regard to telephone interference due to stray currents. Also it would be interesting to know whether, as a result of a fault, any dangerously high voltages have been experienced on the poles or consumers' installations.

With regard to your tariffs, the only comment offered is that it might have been possible to include a business tariff which would include for both lighting and industrial processing in business establishments, and thus dispense with one meter. Lighting in industry could be included in the industrial tariff, once again dispensing with an addtional meter. There would then be little necessity for Scale No. 1.

The formulae evolved for connection fees and minimum charges for rural areas are of considerable interest and would doubtless have provided a subject for a lengthy discussion had the means of their derivation been detailed. However, it is probably beyond the scope or intention of the meeting to deal with the intimate technicalities of the subject, though it must be interesting to many to know that a basically long-winded calculation can be boiled down to two simple formulae.

Turning to the assessment of the size of the administrative section of the department, it is agreed that a golden rule would be most difficult to apply generally and that each undertaking has its own particular problems which require special attention and provisions. It is submitted, however, that the method of assessing staff positions by the amount of overtime worked, on the basis suggested, is open to a certain amount of criticism. In an office solely concerned with routine work, the principle could possibly be applied, but most offices have additional work to do which by the nature of it would normally be shelved in preference to overtime working, particularly if unremunerative. It is therefore felt that this method of assessing staff should be applied with considerable caution and that such things as leave, sickness, change of staff as well as the proportion of non-routine work should perhaps be given equal consideration. To say that an office which works no overtime is overstaffed may be an injustice to a section which is highly effiecient.

I noticed in this morning's paper that at least one ratepayer is not satisfied with the street lighting in his area. I was going to raise the matter of street lighting in any case. The good people who have been entertaining us this week have not given us much opportunity really to see what goes on in this town, but I have been impressed with the street lighting of your central area. My general impression may be wrong, and whether the wide streets have not a lot to do with the general effect I do not know, but I think it is very nice indeed. In fact, there is a noticeable lack of overhead mains, and where there are some they have been discreetly camouflaged. But, on the whole, in my opinion, the central area is outstanding.

Mr. A. F. TURNBULL (Vereeniging):

Mr. President and Gentlemen: I too have been struck by the general lack of street lighting. I noticed in the outlying areas—what little we have seen of them—that the reticulation is carried down the back of the houses evidently right through the stands, and I was wondering what type of street lighting would be put up, whether you would adopt the general practice in the central area of having lights only at intersections, or whether it is proposed to erect separate poles and do the street lighting that way; and in that case would the street lighting

consist of overhead wires or underground cables. I feel that, since you have gone to the trouble of hiding your reticulation generally, it would be rather a pity to spoil it by the erection of overhead wires down the streets.

PRESIDENT:

Are there any other contributions to the discussion? (There was no response.) Well, you have not had much time to study this Paper. I am sure, however, that there are a number of controversial points raised in it which in the ordinary way would arouse quite heated discussions. I will therefore postpone the discussion at this stage, and there will be a further opportunity later on, as I have already indicated, to discuss this and Mr. Buchanan's Paper. Before we turn to the next matter, is there anyone who would like to make a contribution to the discussion on Mr. Buchanan's Paper at this stage? (There was no response.) In that case, gentlemen, I will deal with two matters of business.

At our Annual Meeting on Monday we did not complete the allocation of members to various sub-committees and to represent us on various other bodies. It has been the normal procedure of the Executive to do this, and I now announce the following.

The South African Standards Institution having fallen away, there is no need for any further representation by us.

South African Bureau of Standards. It is suggested that the representation remain as at present; that is, Mr. J. L. van der Walt, with Mr. J. C. Downey as alternative, with power to co-opt any other member to any other sub-committee of the Bureau.

Safety Precautions Committee. Mr. J. C. Downey, with Mr. J. C. Fraser as alternate. It has been agreed that, in view of the many absences of Mr. Fraser from office, if he is absent his place may be taken by Mr. Kane.

Coal Supplies. The position here, as I think was mentioned the other day, is that we were approached by the United Municipal Executive to suggest someone to represent the municipalities on the Coal Priorities Committee. It is suggested that Mr. C. G. Downie should be the person, with Mr. J. C. Fraser as alternate. In addition, it is felt that we should maintain in existence our own Coal Supplies Sub-Committee, with Mr. C. G. Downie as convenor, and Mr. D. A. Bradley and Mr. J. C. Fraser and Mr. Hugo.

The Import Control Committee has fallen away because there is no longer, I believe, any Import Control, or, if there is, it is unimportant as far as this Association is concerned, so it will not be necessary to re-appoint representatives on that sub-committee.

There will, however, be a sub-committee to deal with the control of the copper situation, and that will consist of Mr. J. C. Downey, Mr. J. L. van der Walt and Mr. J. C. Fraser.

On the World Power Conference we have Mr. J. C. Fraser, and it is proposed that that representation should continue.

Mr. Fraser has also been our represensentative on the Electrical Wiremen's Registration Board, and it is proposed that that should continue.

The Executive has also decided, in connection with the presentation of Papers at future conventions, to appoint a Papers Sub-Committee, with a view to encouraging the presentation of Papers and obtaining early delivery of any Papers that may be presented, apart from generally looking after the question of Papers at Conference. That will consist of the President, the Vice-President and Mr. Kinsman.

I have mentioned the sub-committee to look after the copper situation, and as a wind-up to the discussion that took place yesterday, I will ask Mr. J. C. Downey to finalize that discussion.

Mr. J. C. DOWNEY (Springs):

Mr. President: As I mentioned yesterday, my Council has introduced regulations under the local government ordinance for the control of scrap copper. I have a copy of the proposed regulations with me, and should any member wish to see them I shall be glad to show them to him.

As you know, there has been a Government Notice in regard to the control of copper. Your Executive appointed a sub-committee to watch the copper position. We contacted the Controller of

Copper to find out how allocations would be made, and I feel it is only fitting that you should be advised of the reply we received from the Controller in regard to the allocation of copper. Some of you may not have yet had any difficulties in the matter, but I can tell you that the Controller of Copper is with us, and when you place your next order you will probably find some delay before you can get an allocation. I will give you a list of the details, so that you will know what the requirements are when you next make your application for an allocation. You have to supply the Controller with "(a) the total quantity of copper used during each of the years 1950 and 1951, specifying the various firms and distinguishing between quantities required for (1) maintenance and repairs and (2) new development work." It will also be necessary to give full details stating from what source supplies were obtained in the past. Then (b) says: "With regard to the present supplies required, full details must be given as to the quantities necessary and for what purpose it is required, again distinguishing between (1) general maintenance, (2) new development work. Particulars must also be submitted indicating what steps have been taken up to now to obtain these supplies through normal trade channels." There is an additional paragraph in this letter which says: "If any municipality is finding itself in difficulties there will be no objection if they submit their case to this office" — that is, the Controller of Non-Ferrous Materials, Armadale House, Bree Street, Johannesburg — "but in doing so it will be necessary for them to submit" — and then it mentions the details I have previously given. That will give you some indication of what is required by the Controller of Copper before you get an allocation.

I do not want to reiterate what I said earlier in the Convention, that we should endeavour—particularly those of us who have suffered great losses of copper—to prevent copper going back into the hands of scrap dealers in copper. As you know, copper can be re-fined and suitably drawn for use in the manufacture of cable, so that the desire is really to get it back to the manufacturers. I think it is the general opinion of the Executive that we should all try to divert our scrap copper into channels which will bring it back to the manufacturers, rather than to the scrap dealers. This will assure you of quicker deliveries. Some of you probably have very large quantities of copper, and if you can get these supplies back to the manufacturers you will find that your deliveries of cable will be greatly speeded up.

Mr. G. J. MULLER (Bloemfontein):

Mr. President: I would like to ask Mr. Downey whether, in his dealings with the Copper Controller, any indication has been given as to the proportion that will be allocated. If we could have that information it would be most useful in advising our Councils as to what proportion of new townships we can reticulate. You will know that housing is extremely short and Councils are doing their best to make things easier, as is the National Housing Commission, but unless we know what copper is available we may not be in a position, when the time comes, to reticulate these areas, and you may find large areas unreticulated, to the great dissatisfaction of the people who are expected to live there.

Mr. J. C. DOWNEY (Springs):

Mr. President: In reply to Mr. Muller, I think our letter to the Controller was rather early, in that he had not had an opportunity to decide how the allocation should be made. We asked direct questions, and in view of his reply we had to conclude that he was not in a position to tell us, and your sub-committee considered that no good purpose would be served at that particular moment by continuing until we had more information from undertakings that were running into difficulties with their copper allocation. Perhaps in the next few months we may receive a lot of valuable information on the subject, but at the present moment we have very little, and up to now we have not heard of any undertaking having difficulty in obtaining copper. The President has suggested that if any of you have any difficulty with copper you should communicate with us, and we shall be able to investigate the matter. If you send a letter direct to me, I think that will expedite matters.

PRESIDENT:

I think Mr. Downey has adequately wound up that discussion. I will just add one point in connection with the handling of scrap copper. It is suggested that means can be found for handling it in a manner not inimical to existing municipal regulations. It is possible to include, in tender documents for new supplies of cable, clauses that enable the tenderers, whoever they may be, to make offers for any scrap that may be available, and for those offers to be considered as part and parcel of the tender and given due consideration. The correct approach to that depends upon the various Councils' methods of handling such matters, but I do think it is possible for something along those lines to be done and to meet the difficulties of all concerned.

(**Adjourned** for tea.)

I now want to deal with the proposed amendment to the factory legislation on the subject of the earthing of roofs and downpipes. The regulations, as they exist in the Union at the moment, require a state of affairs which is practically impossible to fulfil: they require that before any installation is reconnected, after being disconnected for any reason whatever, even non-payment of accounts, a thorough inspection should be made of the premises so as to ensure that the earth and downpipes have been adequately earthed. This regulation is in the process of being amended, and Mr. Smit has agreed that this proposed amendment should be made available to you, and I will now read it.

This proposed amendment to Regulation 76(2) of the Regulations under the Factories, Machinery and Building Work Act, 1941, is:-

"(a) Before connecting electric current to a building:-

(i) To which electric current is to be supplied for the first time.

(ii) From which electric current was cut off by the supplier on account of a fault on the consumer's electrical installation.

A supplier shall satisfy himself that all metal roofs, gutters and downpipes of such building have been adequately earthed.

"(b) When a supplier tests any alteration or addition to the electrical installation in a building, he shall require the owner or occupier of such building to cause all roofs, gutters and downpipes to be adequately earthed to his (the supplier's) satisfaction, unless this has already been done.

Should the owner or occupier fail to do this within a period fixed by the supplier (which period shall not exceed 30 days) the supplier shall disconnect the supply to such building and shall not reconnect the same until the earthing has been carried out to his satisfaction.

"(c) The supplier shall be deemed to have satisfied himself that all metal roofs, gutters and downpipes have been earthed in respect of premises on which machinery is situated on production by the supplier of a certificate signed by the person appointed in terms of paragraphs (a), (b), (c) or (d) of Regulation 31(1) to the effect that all metal roofs, gutters and downpipes on such premises have been adequately earthed.

"(d) Any person appointed in terms of paragraphs (a), (b), (c) and (d) of Regulation 31(1) shall at all times ensure that all metal roofs, gutters and downpipes of premises on which machinery is situated and of which machinery he is in general charge have been adequately earthed."

Those are the proposed amendments.

Before proceeding to any further business on the A.G.M. agenda, some of you may have thought of some points you may wish to contribute in the discussion of Mr. Redman's Paper delivered this morning. I would like to emphasise that the fact that anyone who takes part in the verbal discussion this morning need not by any means feel that this limits the extent of his contribution. Should he wish to submit a written contribution that will be very acceptable, and any points he contributes now need not embrace the whole of what he may subsequently wish to say in written contribution. So I would welcome any small point that any member may wish to raise on this Paper.

Mr. W. H. MILTON (Escom, Johannesburg):

Mr. President, Mr. Redman, Gentlemen: Unfortunately the paper under discussion

was not available for a sufficient length of time prior to the Convention to enable me to present the type of discussion which the paper merits. Mr. Redman is to be congratulated on the preparation of a paper of such great value particularly as it follows upon two previous papers on the same subject and, therefore, maintains a continuity of data in relation to the progress of Bulawayo which is, to my knowledge, exceptional in the annals of this Association.

There are a number of salient points which I would like to deal with at the present time.

My remarks will follow closely the sequence of presentation adopted by the author.

The problem set by the author relative to the assessment of the rate of growth of a city is an interesting one and it must be agreed that no single factor can give the true picture. It would have been interesting if the author had referred to the rate of expansion of electricity sales under the classifications of industrial development and "other" development. In Southern Africa we are so young that there is considerable unbalance between these two rates of development when single towns and cities are concerned. It is not illogical that towns develop in the first instance on the basis of domestic activities until there is established sufficiently effective civic amenities to encourage development of an industry with its accompanying labour force. This is not always true because, for example, a mine may be established after the discovery of large mineral wealth in a particular area and then the industrial activity precedes the development of the balanced community associated with complete social requirements. A history of the development of Bulawayo in this respect would probably be indicated by the development of sales of electricity to the two different types of community making up the whole.

In his paper the author has presented in the form of a graph the rate of development of the electricity department since 1938 on the basis of the maximum winter peak demand and the total units sold, extending the plot of the actual figures by a linear function to indicate the probable maximum demand in 1961 and units sold up to approximately 1957. The units sold for future years have been estimated on the basis of a 50 per cent load factor based on the maximum winter peak demand.

The form of the graph from 1938 to 1951 indicates to me that the rate of development common to the majority of electricity undertakings in Southern Africa has been experienced, i.e. the increase is compounded and not linear. From 1939 to 1948 the rate of growth may be represented by a development of 9 per cent per annum. If the period is extended and the peak in 1951 is taken into account on the basis of the higher demand shown on the curve, the average rate of development would be 12 per cent per annum. It would seem, however, that from 1948 to 1951 there was an abnormal expansion in the demands of the electricity department and this may be attributed to some change in the way of life of the population or to the acquisition of some relatively large industrial load or loads.

The general experience is that the demands on electricity supply have been increasing for some years past at an average of approximately 10 per cent per annum. In some communities this rate of increase has been considerably exceeded, but in very few has the rate of increase been appreciably less than this figure.

In my opinion there is no indication that the requirements of the communities in Southern Africa are reaching saturation and, therefore, we should expect a continuation of the compound rate of development for some time to come. There are, of course, exceptions where large industries are involved, such as for example the mining industry, where the life of mines may be known to be limited.

In all these circumstances I feel that the author should have estimated the future requirements on the basis of a compounded development and not on the basis of an equal increment of megawatts for each succeeding year.

It is interesting to note from the graph that the rate of development between 1948 and 1951 has been exceptionally large particularly when regard is had to the peak which it is expected would have occurred had there been no volun-

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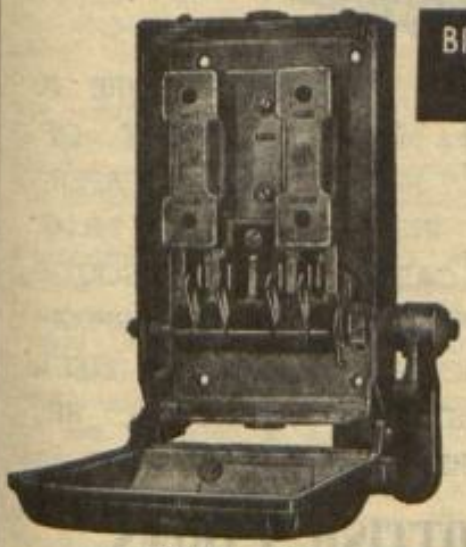

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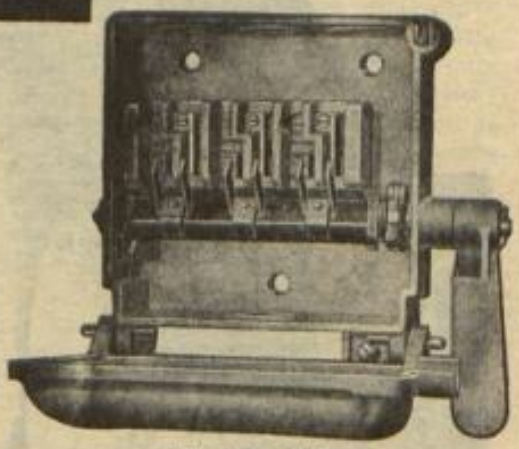

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tary load shedding. As between the years 1950 and 1951 the increment in load exceeded 20 per cent (based on the estimated peak). By adopting the method of presentation used in the paper, the author has provided for a rate of growth per annum on a percentage basis decreasing from the figure of the order of approximately 16 per cent to a figure of the order of 7 per cent in the region of 1960. It would therefore seem that the author has in mind a continuation of conditions similar to those that prevailed in recent years for the next few years and that, thereafter, the rate of growth will diminish.

The effect of overestimating the rate of growth of load over a long period in its incidence on present day planning is, in my opinion, preferable to the effect of under-estimation of load growth for the reason that it is not an easy matter to rectify the shortcomings of an inadequate system whereas the effect on the economics of a department brought about by the initiation of a scheme to cope with greater loads than will arise, are negligible. It is quite a simple matter to extend the dates on which additional plant and equipment are required but not so simple to bring forward those dates.

In the section of the paper devoted to generation, the author deals with the reasons for selecting boiler pressure and temperature and the voltage of generation. I feel that too much stress cannot be placed on the author's remark that it was prudent to bear in mind always that we are "situated at a considerable distance from manufacturing centres." All too often engineers in this country are criticised for not adopting the latest practice of overseas countries. Our critics lose sight of the fact that these latest advances have behind them the manufacturing organization close at hand to deal with troubles as they arise and to effect replacements and modifications with a minimum of delay.

On the subject of the distribution system, the author mentions that one of the heaviest calls on the distribution sub-department was the provision of supply to the National Housing Board sites and states that tests in this area during the winter months have shown an average loading per dwelling house of 2·4 kVA. Presumably this figure is 2·4 kilowatts per dwelling on the distribution network in the vicinity of the dwellings. If the figure is intended to express the view that it is a high average of peak on the substation itself, I would express the view that is is a high average for a residential area although it is to be observed that there are 45 blocks of flats in the district mentioned. For some time past a figure of the order of 1 to 1·8 kilowatts has been regarded as reasonably normal for residential areas. Further amplification by the author in connection with these loading figures should prove very valuable to the Members of the Association.

Coming to the financial side, it is pleasing to note that the revenue surpluses have been kept to reasonably low proportions in relation to the expenditure. It seems to me that it is quite probable that the rapid rate of growth of the electricity department in Bulawayo may be attributed largely to the wise policy in this connection.

It must also be pleasing to the electricity department that a considerable proportion of the surpluses each year have been set aside as reserves for capital works. Such reserves enable improvements to be undertaken as and when they arise without the fear of the incidence of the capital costs of such improvements on the annual costs of operating the network. Coming to the question of the tariffs—perhaps a dangerous subject for comment in these days—the author amplified his paper this morning by, I believe, stating that the off-peak demands of a consumer, if they exceed the on-peak demands, were charged for at half the maximum demand rates. I presume that the half rate is charged in respect of the number of kVA by which the off-peak demand exceeds the on-peak demand and that it is not applied to the whole of the off-peak demand.

Proposals for raising special charges in respect of peak loads which are created outside a specified period of time may, when applied, lead to considerable difficulty in the effective management of the undertaking as time progresses. In my opinion any such special rates should be strictly at the option of a supply authority; in other words no consumer should have the right at any time to demand that he receive supply on these

special rates. If this strict option is not retained by the supply authority, it is quite easy to visualize that an off-peak period may change completely in its position in the 24 hours. For example, if the restriction is imposed from say, 5 p.m. till 9 p.m. as being the peak period, sufficient encouragement might be given to industrialists to establish loads responsible for very serious peaks on the generating plant at some other time than the restricted period. That is, the peak period would change from an evening peak to, say, a morning or afternoon peak.

This would then necessitate the definition of the peak period at some new time and the supply authority would be faced with considerable opposition if consumers responsible for that peak had been encouraged to establish themselves on the basis of reduced tariffs and were then faced with being called upon to pay full tariff rates. Encouragement of industry to develop on the basis of off-peak tariff rates such as is suggested, must never neglect the fact that any particular consumer or group of consumers receiving this encouragement would have a very strong case against the supply authority if it endeavoured to remove those special facilities due to the shift in the period of peak. In such circumstances it might be necessary for the supply authority to continue to supply such consumers at preferential rates for a long time after the necessity for removing such special rates at such times has arisen.

When dealing with these off-peak special rates, the supply authority must never lose sight of the fact that he must cover his distribution expenses and that he can only forego contributions towards the generation overheads. It seems to me that this has been carefully taken care of in this particular case because a charge at half the on-peak rate would appear to be adequate to cover the appropriate contribution towards the cost of the distribution network including the feeders.

PRESIDENT:

Mr. Milton has raised a point that does require an immediate answer—an error in the way the Paper has been put together by the printers.

Mr. R. H. REDMAN (Bulawayo):

Mr. President, Mr. Milton, Gentlemen: The point Mr. Milton has raised concerning the 30 per cent surcharge in rural areas is a very understandable one in view of the way it appeared in the Paper. It was mentioned in my resume that this schedule of tariffs should have been in the form of an addendum and something additional to the Paper. This 30 per cent has nothing to do with the next paragraph, which deals with an increase. The 30 per cent surcharge is one that is made on the town tariffs to apply to rural areas and has been in existence for several years, and bears no relation to the next paragraph, dealing with the increase in coal costs. I am afraid this misunderstanding has arisen by reason of the way it has appeared in the Paper, and I trust I have now made it clear.

Mr. W. H. MILTON (Johannesburg):

Thank you.

Mr. F. STEVENS (Ladysmith):

In congratulating Mr. Redman on his Paper I agree with the President's suggestion that there should be such a Paper at each Convention, but I am of the opinion that it would be a mistake to restrict them to the undertaking at which town the Convention is held. It is a pity Mr. Redman's Paper was not made available earlier, for I am sure that most engineers found it quite impossible to study it closely, as most of us had a busy time preparing to get away to the conference.

Two points in the Paper in which I was particularly interested are the split multiple earth neutral and the tariffs. While I favour phase, neutral and an earth wire, as against phase and twin neutral service, for various reasons, I would be pleased to know the cost to Bulawayo of their service and whether both neutrals are insulated.

With regard to the tariff, it appears to me to be somewhat involved. In this connection I would like to know whether any thought has been given to a common minimum charge for all domestic consumers.

One other point is the cost of substation buildings, and whether Bulawayo con-

siders there is always justification for partition walls or cubicles as shown. Perhaps this is not the practice for all their substations.

Finally, I am sure many would like to know how you deal with the charges for extended services, that is, long service lines.

Mr. J. E. MITCHELL (Salisbury):

Mr. President, Mr. Redman: There is a song in "Annie Get Your Gun" which is very often used both by Salisbury and Bulawayo: it is, "Anything You can do I can do Better"! As this time I am the guest of Bulawayo I feel I have to be very careful indeed. There seems to be also some sort of conspiracy afoot in regard to this Paper, for my copy only arrived by post this morning at my Hotel, and I felt that possibly I got myself in hot water at last year's Convention and they were determined I should not do so again. But believe me, gentlemen, I have had so little time to look at the Paper—they make certain you have no spare time unoccupied once you come to Bulawayo—and so I shall be very cautious and not pick on anything that I know nothing about; I shall confine myself to the things I do understand—which are very little! Peculiarly enough, Mr. Milton has already dealt with the only point I was really going to speak on, except that I would have gone the opposite way. He was quite surprised, apparently, to see the figure of 2·4 kilowatts per domestic consumer, and he assumed that that was the actual demand on the substation. I think he will find, when the author replies, that that is the A.D.D. at the power station. In Salisbury our figure is 3·7. These figures for Rhodesia are really amazing, mainly, of course, because we have so many all-electric houses. I have not got the figure for Bulawayo but the figure for Salisbury is that a domestic consumer uses on the average 10,000 units per annum. That is the averave for the domestic consumer in Salisbury. If you work that out you will find that on the usual load factor you have something between 3 and 4 as the A.D.D. Perhaps that will help to convince Mr. Milton.

I did not mean to touch on this point as it has really nothing to do with the Paper, but possibly engineers might be interested to know that we have now got that 3·7 down to 2·7 in Salisbury, with our new ripple control installation. But do not take those figures as final yet because we have not been through the winter, and it is very difficult to give any real final figures.

As I said before, I shall be very cautious and not speak on the Paper at all, really. The only other point is that I do feel that Mr. Redman, in using the word "fantastic" for the growth of Bulawayo, has left me rather in a vacuum, because I am going to be in great trouble some day in finding another word for Salisbury. Finally, I feel Mr. Redman must be a great asset to Bulawayo, and possibly his two years in Salisbury, learning where demands really increase, have been of great value to him!

Mr. J. L. VAN DER WALT (Krugersdorp):

Mr. President: Most of the points I intended to speak on have already been covered. I just want to point out a few that have been drawn to my notice in the Paper. First of all, Mr. Redman's elucidation of the marvellous achievement of the citizens of Bulawayo, I can assure him, really came through in the cold printed words, quite apart rom his verbal account of the events. He need not have had any doubts on that score. I think the citizens of Bulawayo should be congratulated on their achievement in keeping the power supplies going during the Native Strike of 1948.

As far as the high proportion of the peak load contributed to the domestic consumers is concerned, I would like to know whether the Native population of Bulawayo contribute to that, and is that perhaps a cause?—are the Natives in Bulawayo electricity-conscious?

The split neutral, of course, invites comment. I personally do not see the necessity for a split neutral, as we have found that earthing the neutral—running the neutral on an earth pin and earthing every fifth pole or even more, depending on the soil resistance—has given very good results, even in very high soil resistant areas.

As far as the H.T. line is concerned, the two earth wires running above the lines, has it been proved that that has had

any effect or any influence in the reduction of outages due to lighting storms? There are many diverse opinions on this matter. Some authorities claim there is no improvement whatsoever. If that is the case, is the additional expenditure warranted?

Mr. Milton touched on the subject of the proportion of excess revenue over expenditure. What struck me on that side is the contribution to relief of rates, and I think Bulawayo should be congratulated on its wise policy there. In most other parts of the country the Electricity Department is more or less a "Relief of Rates" Department and not an Electricity Department at all.

On the subject of the tariffs, I am also of the opinion that they could be very much simplified. The tariffs are there for the benefit of the consumer and the simpler and the fewer the tariffs you have the better they can be understood by the consumer, and the better the goodwill existing between the Department and the consumer. I am of the opinion that three basic tariffs are required, and no more: domestic, business and industrial.

With regard to the special tariff for cooking and heating, I wonder whether that is necessary. If your domestic supply is attractive enough it will look after that side of it, because your cooking appliances and your water heaters (Mr. Milton also touched on the point, I think) are in most towns today, at any rate along the Reef, in many cases the cause of your peak load, rather than your industries. It is only now that the industrial load is creeping up that your peak load caused by cooking and heating is becoming more apparent. To my mind your special tariff is needed specifically to fill in the "valleys" or gaps of your load curve. But with cooking and heating I think it has the opposite effect, and should not be given at a reduced tariff during your highest peak.

As far as domestic supply is concerned, Bulawayo is on the room basis. The argument in favour of this is that it takes care of the maximum demand proportion of your tariff. I have not seen the proof of it yet; it has only been said. I contend that there is no difference between the room tariff and your sliding scale or simplified tariff as far as the maximum demand proportion is concerned. I would still like to see it proved that the room basis is a more scientific tariff. I would ask, why go to all that trouble, that cumbersome tariff, keeping a check on rooms, areas of rooms and so forth, if you can derive the same revenue by a very much simpler tariff.

Coming to Rhodesia by road, I noticed that you have a very extensive rural distribution network. From what I can understand, you supply, in conjunction with the Electricity Supply Commission, many small mines in the rural area, but is there any indication that, except for the mines, the rural distribution in this area is payable, because I feel that rural distribution will be the future development of most undertakings after they have satisfied their internal needs, and most undertakings will have to look to their rural areas for development.

Mr. A. FODEN (East London):

I would like to add my mead of praise to Mr. Redman for a very interesting Paper. It was a pity that we had not an earlier opportunity of going through this Paper, which is very interesting indeed. I have only one comment to make on the Paper and that is in regard to capital expenditure. I notice on page 12 you have a typical arrangement of a 500 kVA sub-station. It occurred to me, when perusing the Paper, that that must be a very costly structure for a 500 kVA sub-station, and I would like to know whether it is your definite policy in Bulawayo to carry on with this type of sub-station rather than to go in for steel kiosks, for instance. We in East London use only brick structures for switch houses; for sub-stations, wherever possible, we use steel kiosks, which are made to the Department's special design. You might think this arrangement would be troublesome from the atmospheric point of view, but we find that frequent painting keeps them in reasonably good condition, and the capital cost of such a sub-station as compared with one of brick is small. I should like to hear Mr. Redman's views on this matter. I for my part do feel that the use of steel kiosks represents a considerable economy. They can be erected by your own staff in a short time, saving the labour costs of skilled brick-

layers, overcoming the cement difficulty, and so on.

Mr. C. R. BURTON (Kimberley):

Mr. President, Mr. Redman: With regard to the national houses and the load taken by them, I am of the opinion that the Sunday morning peak in the medium income group that we get in the national houses is in the region of 3·7 kVA, which is something to think about, whereas during the week at peak time it is only about 2·5. Perhaps Mr. Redman could tell us the time of day that this was taken on.

Mr. G. J. MULLER (Bloemfontein):

Mr. President: As has been said, the Paper was circulated rather late, and I did not intend to speak; I was going to contribute in writing; but I feel prompted by a few of the remarks already made to say a few words at this stage. On the subject of demand, I think I agree with Mr. Redman and disagree with Mr. Milton. In designing our sub-stations we worked on a figure similar to that suggested by Mr. Milton, and within a year we found we were doubling up on our transformers, with the result that the space available in the sub-stations was rather cramped.

On the subject of the split neutral in areas where earthing is difficult, we have quite an extensive rural system and we have found the use of earth leakage circuit breakers very satisfactory; they are a complete protection. The only trouble we have had is with severe lightning in our area, and the test circuit, strangely enough, is always a target for lightning. We are now experimenting with lightning protection of a type recently put on the market, and if it can overcome our difficulties it will be the answer, and quite a cheap answer.

With regard to miniature circuit breakers in place of fuses, I personally prefer them, and in my previous undertaking, where Mr. van der Walt is now, we standardized on it before the war. During the war they could not be obtained. Today, as far as we are concerned, the availability is problematical, and it is most difficult to go on to an article when you are not sure of its continuous supply.

Another subject not touched on in the Paper as far as I could see was that of space heating. I do not know how other undertakings are affected, but the centre of our town is gradually being rebuilt, the older buildings are making way for new on a considerable scale, and in almost every single case all space heating is done electrically.

The load imposed by this space heating is not the type of load one would like to see too much of; it lasts for three months and is extremely heavy. I was thinking of one building in passing where they have about 150 kilowatts space heating, involving us in generation and distribution costs of the order of £15,000. I wonder whether, if the owners of the building had spent £15,000 on some other central system, it would not have been better for both parties.

Mr. W. H. MILTON (Escom, Johannesburg):

I hope I shall be forgiven for speaking a second time, but Mr. Muller seems to have accused me of designing his substation, though I do not think he meant to do that; I think he meant he had used a similar figure to the one I had previously mentioned, of the order of 1·8 to 2. When dealing with a small town the substation loading is relatively low per capita, but you do get exceptional cases; where, for example, you have a suburb the residents in which are all employed in a particular form of industry you will often get some very high figures for the average loading per capita. There have been cases, and there are cases now on the Reef, where a whole town is occupied by almost entirely by, shall we say, miners, and those miners work exactly the same shifts. In such cases you will get 4 to 5 kilowatts per capita at substations feeding such communities. But where you have a more general community the loading is lower, owing to the diversity of employment.

Mr. G. J. MULLER (Bloemfontein):

I plead not guilty to the design of my substations by the Commission. The figure we had assumed was based on pre-war experience, and just after the war years, when loading was less than it is today. During the war years appliances were impossible to get, and pre-war electricity was not so generally used as it

is today. I might go so far as to say that in a housing scheme fostered by my Council there is not a single chimney. All heating, space heating, cooking, hot water and everything is done by electricity. With the national housing it is exactly the same. In the private buildings in a wholly private enterprise township called Dan Pienaar I do not think you will find 5 per cent of the houses not using electricity.

PRESIDENT:

There will be a final opportunity later for discussion, before we have the authors' replies. Before passing on, however, is there any other member who wishes to contribute any views on Mr. Buchanan's Paper? (There was no response.)

In that case, I will revert to yesterday's discussion on the meter test code. It was decided, you will remember, not to take a resolution yesterday on the matter but to leave it open for further thought on the part of members. The Executive have had a further opportunity of discussing it, and I will now ask Mr. Kinsman to refer to that matter.

Mr. C. KINSMAN (Durban):

Mr. President and Gentlemen: You will recall that when the general discussion was adjourned the position we had reached was that there was a proposition by Mr. Smith, seconded by Mr. Turnbull, the purport of which was that we should defer any further action in the matter of the meter testing code for another 12 months.

Subject to Mr. Smith and his seconder, Mr. Turnbull, agreeing to withdraw their resolution, I would like, on behalf of the Executive, to put one before you, the effect of which will be the same as that proposed by Mr. Smith, but its wording will be such as to include within itself the reasons for deferring the subject, if that is the wish of the Convention. After reading it I will ask Mr. Smith and Mr. Turnbull if they agree to withdraw their resolution. The one that I wish to put forward on behalf of the Executive reads:-

> "Although this Association is convinced of the desirability of a compulsory meter testing code, it cannot agree to the promulgation of a code until such time as the Association's constituent local authorities have had an opportunity of considering the code in its final form and its possible financial implications."

Will Mr. Smith and Mr. Turnbull now agree to withdraw their proposition, subject to the acceptance of the withdrawal by the meeting?

Mr. E. L. SMITH (Boksburg):

Mr. President and Gentlemen: Mr. Turnbull and I have already discussed this matter with Mr. Kinsman and we are prepared to withdraw our proposition, providing that the one just read is adopted. I have much pleasure in seconding the resolution put forward by Mr. Kinsman.

Mr. C. KINSMAN:

I do not want to take up time unduly, but I think it is due to Mr. Mullins and Mr. Swardt that we should give some reasons for the proposition. I think it is with some feeling of disappointment that we feel that we would not be entitled to put forward an expression of opinion in the direction of urging the early promulgation of the meter testing code. We are grateful to Mr. Mullins and to Mr. Swardt for the information they have given us. We have already expressed and re-expressed our acceptance of the principle of a meter testing code, and as a purely technical matter I think we could quite happily take a decision. But, while we were told that in the case of a municipality undertaking to do its own certification of meters there would be no cost, the figure of 3d. was mentioned last year and this year 1s. 9d. was mentioned, and then there was a reference to the possibility of the establishment of stations around the country which, if that policy were pursued, would prove costly. Whilst on a purely technical aspect, we would be justified in taking a decision, where there are possible financial implications I do not think we should be justified in doing so unless our respective councils had first been given the opportunity to consider those financial implications and to express their willingness or otherwise to accept those financial liabilities. We all agree that it would be competent for the authorities formally to promulgate

this, with or without our consent, but in the spirit in which this whole subject has been introduced and pursued, I think we are justified in asking their indulgence to the extent of giving our member councils an opportunity to consider the code in its final form. We have been given to understand that, as a result of the year's trial, there are comments which have been sent forward, and they will be considered and probably incorporatd in the final form. So with that explanation, and with apologies to Mr. Mullins and Mr. Swardt, I leave the resolution with you.

PRESIDENT:

Is there any further discussion on that resolution? If not, may I take it that it is agreed?

(Agreed.)

RIGHT OF SUPPLY

An item on the agenda which requires to be finalised is the Right of Supply, and I will ask Mr. Downey to deal with that, explaining what it is, what it means, and the satisfactory conclusion to the discussions on that subject.

Mr. J. C. Downey (Springs):

Mr. President, Gentlemen: You will remember, at the Cape Town Convention Springs had this item on the agenda, and after discussing it in Committee in Cape Town it was withdrawn. The matter was referred to the Electricity Control Board, and we subsequently made an application to the Electricity Supply Commission requesting them to amend their licence. We have now received intimation from the Commission, and I will read you the paragraph with which you are mainly concerned, and you will notice from it that the reply is satisfactory. We contended that we had the right of supply in our own area, but due to the licence granted to the old V.F. and Transvaal Power Company, they had the right of supplying any consumer whose demand would exceed 50 kilowatts for motive power. The Commission have now advised us as follows: "The Commission is taking steps to amend its licences so that it will not be compelled to supply power to consumers for industrial purposes whose demand for power exceeds 50 kilowatts, where the industrial undertakings of such consumers are situated within a municipal area and the supply can conveniently be given by the municipality." You will understand that that actually satisfies our requirements. I understand the licence is now in process of amendment.

Mr. C. MULLINS (Electricity Control Board):

Mr. President, Gentlemen: With regard to the complications in this matter, it was really due to the Germiston area being supplied by the old V.F.P., which is gradually going away on the starting of their own municipality. Probably you are not aware that the 50 kilowatt Rand extension will be entirely deleted. It will come to finality on Monday next.

PRESIDENT:

I think that winds up that particular point, which was first dealt with at the Cape Town Convention last year.

CONFERENCES—FREQUENCY OF

Now, your Executive have a rather knotty problem on which they would like guidance from the general membership before going into it in any great detail. It has been suggested from several quarters that the increase in the general number of conferences being held by municipal officials is reaching such proportions that some councillors who happen to serve on more than one committee are seldom at home—they are always attending a conference of one sort or another—and it is undoubtedly a fact that in the last few years the growth of new conferences has been quite phenomenal. Some of us feel that some of the new bodies formed are strictly speaking purely technical bodies and bear the same relation to ourselves as, say, the South African Institution of Electrical Engineers does, to which we would never dream of asking our Councils to send representatives. But, whatever that position may be, it is a fact that Councils are now facing an increasing number of requests to send delegates to conferences, and it has had the inevitable result of making Councils re-examine the whole situation and begin to wonder whether any conferences should be supported in the way they have been in the past. It has been suggested for our consideration that we

might consider whether, instead of holding our conferences every year, we should hold them every two years. We have not actually discussed this question in the Executive yet, and we feel we would be glad to have some views from all the membership before doing so.

If I might give just a slight lead, I would myself suggest that our own conference is somewhat different from many of the other municipal conferences that take place: firstly because our membership consists not merely of the technical people concerned but is in fact an association of councils; it is an association of undertakings in which the engineer is no more important than the council with which he is employed, and which is entitled to send a councillor representative with equal voting powers. So our Association is somewhat different from most of the others, if not all of the others. It is a truly municipal conference, and not by any means a purely technical one. It is also a fact that we deal with a matter which is probably subject to greater change, greater rate of change, than most of the matters dealt with by other conferences. A wait of two years between conferences might well allow all sorts of changes to take place without due note having been taken of them by our membership. It would also impose a very heavy burden, I assure you, on the officers and the executive committee, who would be required presumably to serve for two years instead of one; and I assure you it is quite a big enough job to get through 12 months of office in any capacity on your Executive.

I now throw this matter open for discussion, and I would be glad if councillors would also take the opportunity of saying what they feel about this matter, because they are the ones chiefly involved. We do want to do the right thing for all the people concerned, and I think we must approach this not from the point of view of the desirability of our getting away every 12 months for a convention but on the basis of a proper consideration of the real facts of the case.

Mr. C. KINSMAN (Durban):

Mr. President and Gentlemen: In your introductory remarks you have covered the ground as we see it at the moment very fully, but to my mind, before this matter is opened for general discussion, I think there is one point that should be emphasised. Particularly in recent years there have been so many emergencies in connection with supplies and other matters germane to our job that it has been necessary to hold at least one executive meeting during the 12 months intervening between two successive conventions; and in more than one year it has been necessary to call a further informal meeting of the executive, generally of those members nearest Johannesburg who can meet there.

During the past two years the question of the expenses of officials and councillors attending executive meetings has been raised in at least one quarter, and there is something to be said for the attitude of the particular council that raised it. Their attitude, I think, may be fairly expressed in this way. As the councillor said, we do not mind sending our delegates to the annual convention because every other local authority which is a member of this association does the same thing; but, because our engineer happens to be elected to the executive, why should we then not only allow him to devote his time and experience in the interests of the Association but be further penalised by paying his expenses to do it? There is something to be said for that view. The attitude is that as they work in the general interests of the whole of the Association and its constituent members, all the costs, travelling and subsistence allowances, etc., relating to Executive meetings should be distributed over all the constituent members through the general income. If there were to be brought about a new system whereby conventions were only held every two years, then I think it would be essential to have two, if not three, executive meetings during those two years. The very nature of the business we conduct makes it impossible for us to wait two years. These matters must be dealt with as they arise, as you can see from the number of committees we have. Members of those committees have served and are serving this Association and its interests at some considerable sacrifice in time and energy to themselves, and it is not fair to place on those small sub-committees the whole responsibility. There must be a full meeting of the Executive at intervals of not more than six to seven months whereby the Executive

can jointly take the responsibility for actions which must be taken in the interests of the Association. So, in considering it this other question will arise: that if Executive members are called to Executive meetings three times in those two years, then I think the point of view expressed by that one councillor may be expressed by more councils whose engineers and councillors are members of the Executive; that in turn would mean that the Association's income would have to stand the expenditure entailed in the travelling and subsistence money of the Executive members attending those Executive meetings. I think we now have the whole picture before us.

Councillor L. M. WIENER (Johannesburg):

Mr. President, Gentlemen: I want at once to say that I was not the councillor who brought this matter up on the Executive. But this is certainly, Mr. President, a very contentious subject that has been worrying my Council recently. This is now the fifth conference that I have attended, and it is a very highly technical one. If I remember rightly, two years ago I suggested that councillor members be asked to submit papers which would create a certain amount of interest for councillors. We as councillors are commonly termed "City Fathers"; in other words, we do not depend on the allowance we get as Councillors for our living. This is no secret: certain of my colleagues have stated again and again that some of our officials are away on conferences for more than half of the year, and only recently this question of conferences was debated fully, arising out of which certain action has been taken by the Johannesburg City Council, namely, that while in the past it has been the policy of my Council at least to send two delegates to conferences, from the beginning of this year it has been reduced to one. I was given the honour of representing Johannesburg at this conference, but I think I would be failing in my duty if I did not clarify the position from the Councillors' point of view. I am a very busy man, and believe me, if it had not been for the fact that I wanted to see the Victoria Falls I would have had to give the matter very serious consideration before accepting the invitation to come to this conference. I would also like to say that in my opinion, from what I have noted at this and other conferences of a technical nature our senior officials can manage the administration of conferences quite satisfactorily without the assistance of councillor members.

Now, my good friend Mr. Kinsman, with all respect to him, has stated that officials should receive their expenses from the funds of this Association; but I do not think that is quite the position, and I want to give this assurance, speaking on behalf of my colleagues as well as myself: that if this Convention today were to agree to meet only once every two years, and the Executive three or four times during that period, my Council would see to it that our representative on the Executive attended every meeting and that expenses would be paid.

As I have already stated, the work entailed at these conventions is of a highly technical nature, and while the councillors (I am speaking for myself now but I have heard the comments of other councillors) do enjoy the social side of these conventions, I do humbly say that meetings of such a highly technical nature do not instil any knowledge into a councillor. He listens to people talking about KV's and MV's and neutral joints—incidentally I shall have more to say this afternoon about neutral joints when discussing the coal situation. So that, Mr. President, whilst at the present moment I have an open mind on the matter, I do want to warn this Convention that the Johannesburg City Council is giving very serious consideration to the advisability of curtailing conferences of a similar nature to this one. Indeed, I had to battle hard with my colleagues to persuade them that we ought to be represented at this Convention this year. It was only when I impressed on them that there was a very good reason for my attendance here, namely, to invite the Convention to meet in Johannesburg in 1953, that they finally agreed to my coming here. In all probability you will find that next year the Johannesburg City Council will submit a resolution on the lines of the remarks I have made, deploring the growth in the number of conferences and urging that they be curtailed and held less frequently; because, as I have said, this is a highly technical con-

ference, and there is not much that can be learnt by the councillor member, for that reason. It is the intention of the Johannesburg City Council (this was discussed in the General Purposes Committee two or three months ago) to throw out feelers to the various associations and institutions, etc., so as to curtail, if possible, the number of conferences held annually. I hope members will give some consideration to the points I have made.

PRESIDENT:

Councillor Wiener is already on the Executive and we have had an opportunity of knowing his views. I hope some other councillor members will give us the benefit of their views on the matter.

Councillor J. Schlapo (Roodepoort):

I am very sorry that I cannot agree with Councillor Wiener of Johannesburg as far as the technical side of this Convention is concerned. I am only a layman, but I want to learn, and the only way I learn—and I have had quite a few years' experience on the Council in my area—is through conventions of this sort. Whenever I have returned from a Convention I have always brought back to my Council ideas which I have picked up there, not necessarily on electricity but on all sorts of matters of interest to us. I am also going to the Falls, but I can honestly say that that was not my excuse for coming here! With regard to sending delegates to these Conventions, it is not necessary to send a whole quorum, like Johannesburg. A council can always send a particular councillor who is interested in the work of the Association and its bearing on his own local authority. As you know, most councillors, within a few months of election, become experts in every department, so that when the head of a department puts up a scheme of some importance he is inclined to be confronted with these experts who may not be in agreement with him, and it is then that he really needs the support of a councillor who really does know something about the subject. Now, if the councillor has attended conventions like this he can give that support, and that is very important.

I can give you one instance. In 1941 we went on to the room basis on the suggestion of a tariff that had been worked out by Mr. Milton at that time. After years of experience we have found that it does not work out 100 per cent, because you must have staff, and you have to depend on another department to give you the necessary information, and so on. I have an open door very near to the offices, and people come in to me with accounts and say, "What's this account all about?" and I have to ask them how many rooms they have, and work it out for them. My engineer felt the sliding scale would be the best, and I had learned something about it and agreed with him, but the administration turned it down. However, one is always able to learn something at these conventions, and that is one reason why I feel they should be held annually. Last year the town clerks decided to meet bi-annually, but now they have reconsidered it and are going to meet yearly again, because so many items crop up. Progress is so rapid these days that I think the amount of time and money spent on these conventions is well worth it, and I do suggest that we carry on as before.

Councillor L. DUBB (Port Elizabeth):

Mr. President: My Council, too, is very perturbed about the multiplicity of conventions and conferences now being held, and I have just jotted down at least 17 while the debate was going on—and I am sure I have left some out. But this is my first attendance at one of these conventions of this Association, and whilst I appreciate that it is of a highly technical nature and that other councillors, like myself, are not able to take part in discussions, nevertheless I agree with the last speaker that it is highly desirable, and I think essential, that councillors should accompany their chiefs on conventions of this nature, because, as mentioned by the last speaker, the engineer may require some support in committee.

Before coming here I might have been inclined to the view that this convention could well be held every two years, but having come here—and I must say that my committee insisted that I should come here to gain experience, as I have—I do realise now that the nature of your work is such as to require constant attention and is by no means of purely academic interest. There are some conferences held where the discussion is concerned with what one might describe as luxury items—how best

to make rockeries, the best aloes to plant, and so on; others discuss the best types of runways, and so on, in anticipation of jet planes. Those are very interesting, no doubt, but could, I think, very well be left over for discussion by the experts who in the final analysis are responsible for their construction or erection. But I do feel that this convention—and I say it as a result of my experience here—is one that should be held frequently, because the problems that have to be solved are those which affect the every-day life of every member of the community. I do hope that council members will emphasise this in their respective committees and influence their fellow councillors to support the holding of this Convention annually.

Councillor G. P. BLAKE (Stellenbosch):

Mnr. die President en Here: Ek stem saam met die vorige spreker dat dit absoluut noodsaaklik is om jaarliks 'n kongres te hou.

Ek betreur dit dat die Stad van Johannesburg, die magtigste stad in ons land, dit nie kan bekostig om iedere jaar die Kongres van Munisipale Elektriese Ondernemings kan bywoon nie. Is elektriese dienste nie die dienste wat die grootste en vinnigste vordering maak van al die dienste wat 'n munisipaliteit verskaf nie? Het elektrisiteit ook nie van die grootste noodsaaklikheid, veral in die groot stede, geword nie? Kan elektrisiteit ook nie die gevaarlikste dienste wees as daar nie behoorlik van gebruik gemaak word nie?

Mnr. die President, hoe kan 'n raadslid voorsitter wees van 'n komitee waarvan hy niks weet nie. Is die Kongres nie die plek waar jy jou kan bekwaam, nie net met wat in die Kongres bespreek word nie, maar deur onderlinge bespreking deur raadslede en bespreking met ander elektriese ingenieurs om sodoende jou moeilikhede te oorkom nie?

Vir my is die kongres altyd 'n leerskool. As die Munisipaliteit van Stellenbosch dit nie meer kan bekostig om my onkoste na die kongres te betaal nie, en ek nog die verantwoordelikheid van 'n komitee moet behartig, sal dit vir my 'n plesier wees om die koste uit my eie sak te betaal.

Mnr. die President en Here, ek was nie van plan om na die Victoria Valle te gaan nie, maar die inspirasie by hierdie kongres was so groot dat ek besluit het om na afhandeling van hierdie kongres wel die Valle te besoek.

Councillor P. URBANI (Springs):

Mr. President: I think we all ought to cry for Johannesburg first. They seem to be the biggest city in South Africa but they seem to be in such a state that they cannot even at this stage send more than one councillor. At Springs we have always encouraged councillors to attend these conventions, because we fell that if a councillor is conscientious in his duties as such he can be of great value to the council. I would, however, suggest that a lot of councillors spoil these opportunities by talking about the lovely time they have had rather than about what they have learned at the conference; instead of submitting a useful report on the proceedings they tell people what a good evening they had at such and such a place. Like Councillor Wiener, I am calling a spade a spade.

Councillor L. M. Wiener (Johannesburg):

Are we not entitled to a break?

Councillor P. URBANI (Springs):

Yes, they have a break at the expense of the Council and then come back and brag about it. Then they wonder why they get it in the neck!

I have been attending conventions of one sort and another for the last 12 or 14 years, and I have learnt very much from them. I can also bear out what the last speakers said—that you are then a great asset to your council and to your community, and in particular to the engineer or department associated with the conference. I do suggest that, whether it is finance or any other matter, councillors should take a keen interest in the proceedings and report back to their fellow councillors what they have learnt. If you do that I can promise you that you will always get support when the question of representation comes up. Naturally, when there is a deficit and any trimming to be done, it is those who have not taken an interest in the proceedings who find that they are unable to justify further representation. If, on the other hand, you attend and give a useful report on what you have learnt, your fellow councillors will feel that they are getting some value out of attendance

at the convention, and support you accordingly. Finally, I say, "Do not change the policy of having an annual Convention."

PRESIDENT:

It is now time to adjourn. There will be a further opportunity after lunch for any councillors—or engineers for that matter—to contribute to this discussion.

(*Adjourned* from 12.30 to 2.30 p.m.)

PRESIDENT:

It is always a very great pleasure to us to welcome as visitors—I might say as more than visitors: as almost permanent members—those delegates who represent bodies that are associated with the work that our own Association is doing. It is a very great pleasure to me, therefore, to welcome Mr. Swardt, as representing the South African Bureau of Standards, not only to our Association meetings but to our meeting this afternoon in particular, and to say to him that the paper he is about to read to us on the control of domestic equipment is one that is of very considerable interest to us. We are all, I am sure, looking forward very much to what Mr. Swardt has to say.

Mr. J. D. SWARDT (S.A. Bureau of Standards):

Mr. President, Gentlemen: Before reading the paper I would like to say how much the Bureau of Standards appreciates the opportunity of presenting this issue to this Convention. The Bureau could think of no better qualified collection of technical men to deal with this matter of principle then we find gathered at these conventions, and for that reason we consider it desirable that we appeal to you in assisting us with this important issue.

PROPOSED COMPULSORY SAFETY SPECIFICATIONS FOR ELECTRICAL APPLIANCES

By

J. W. SWARDT,

Principal Technical Officer, S.A. Bureau of Standards.

B.Sc.(Eng.), A.M.I.(Mech.)E., M.I.P.E., A.M.I.(S.A.)Mech.E.

At each of the annual conventions during the last few years, your representatives on the South African Bureau of Standards Committees have reported that it is the intention to recommend to the Minister of Economic Affairs that safety specifications for electrical appliances and equipment be made compulsory by such legal measures as would render it illegal to sell non-complying appliances and equipment. In fact, a preliminary notice to this effect was actually published in December, 1950, in the Union Government Gazette in respect of "Portable Electric Appliances for Heating Liquids" because certain very dangerous types of appliances for heating liquids appeared on the market and action was immediately necessary. The time has now arrived to give serious consideration to this whole matter of compulsory safety specifications, and in this connection the guidance and assistance of this Convention is considered to be of great importance. It is common knowledge that from time to time accidents occur with electrical appliances and equipment, resulting in death or injury to persons or fire damage to a greater or lesser extent. Investigations have revealed that in many instances these accidents are due to the lack of adequate safety standards or faulty connections. Since such equipment is generally portable and does not fall within the purview of the Mines and Works Act or the jurisdiction of the local supply authority administering the Standard Wiring Regulations, there is no control exercised over its sale because it is usually plugged in or attached to a lampholder and is invariably bought over the counter by the individual or householder who has no proper means of assessing the actual value of the article. Furthermore, as far as the retailer is concerned, it is often the question of price that is more important than the safety of the user. It is for these main reasons that the original Electrical Committee of the Bureau of Standards recommended that South Africa, like several other countries, should publish minimum safety precautions with the object of their becoming effective in due course by some means of legislation.

Before dealing with the major implications of this whole issue it may be

appropriate to outline briefly the scope of these safety specifications.

A general specification has been prepared which will be applicable to all appliances and equipment other than those for which specific specifications have been published. The expression "appliances and equipment" is defined as covering all portable machines, tools, devices or instruments designed to be operated by electricity for the purpose of doing mechanical work, or of providing heat, light, sound or motion, or in which electrical energy is modified in character or pressure or converted into another form of energy. It shall have a current rating not exceeding 15 amperes, shall be of such construction that it is readily movable, and designed for connection to a source of electricity supply by means of a flexible cord. The main features of these safety precautions are that adequate insulation resistance should be provided, generally one megohm under test of 500 volts D.C., dielectric strength should be such that no puncture of insulation or arcing over takes place when applying 500 volts (rms) in case of rated voltages under and including 40 volts and 1,000 volts (rms) in case of rated voltages over 40 and up to and including 250 volts; leakage currents between live and earthed parts are limited to 5 milliamperes at 230 volts and the resistance between the earthing-contact or terminal and earthed parts must not exceed 0·1 ohm. Maximum temperatures are prescribed for various types of insulation materials and the design of the appliance is only permissible if it does not create a fire hazard. In the case of toasters and radiators, a piece of filter paper should not be charred when the appliance is placed over or adjacent to the paper, depending on the type of appliance. In the case of radiators, the protective guard should be sufficiently far away from the heating element to prevent scorching of a given piece of flannelette in a given time. Furthermore, the guard should be robust and not permit of ready contact with the element or live terminals. Suitable means have been devised to test for these requirements. Electrode type liquid heaters (i.e. bare current-carrying elements in contact with water) are entirely prohibited owing to the fact that the water in the container could be raised to a dangerous potential. (A popular type tested at the Bureau gave a potential of 180 volts between the earth and the outside of the unit, depending on the manner of connection between the lampholder and lampholder-adaptor supplied.) One cannot but be impressed by the number of fatal accidents that have been found to have been caused through improperly or incorrectly connected electrical equipment. For this reason all electrical appliances with exposed metal parts are required to be wired for earth continuity connections and all flexible cords for such appliances to have at least three cores with the insulation of the earth continuity conductor coloured green. Furthermore, it is required that all terminals, including those in plug tops, should be indelibly marked as to which are the line and the neutral terminals respectively and the earth continuity terminal shall be identified by green marking, e.g. green spot adjacent to the terminal. In the case of plugs and socket provision is made for the limitiing of the fingers making contact with the live contacts when inserting the plug into a live socket (the standard test finger being the criterion). Cord anchorages are prescribed on plugs, apparatus connectors and the terminals of appliances and a proof load applied to the cord is prescribed. Where a switch is incorporated in a portable appliance it shall be of the multipole type if the flexible cord is connected at the appliance by means of a removable reversible apparatus connecter. If the flexible cord is permanently connected to the appliance by means of terminals, or connected by means of a non-reversible removable apparatus connector, the switch may be single pole. Single pole switches and overcurrent protective devices shall be connected so as to control the live or phase conductor of the circuit.

These are but general outlines of the basic provisions of the safety specifications. It has been found that the majority of appliances made by reputable manufacturers would generally comply. On the other hand a large number of appliances of doubtful origin are shockingly wanting in many respects. In view of the increasing number of countries adopting effective measures to control the sale of

unsafe or inferior articles, one wonders if South Africa is not becoming the dumping ground for low-priced inferior electrical apparatus.

It is obvious that whatever legislative steps are taken, they can only be in respect of new equipment offered for sale, for hire or on loan. It is also clear that a reasonable time should be allowed for commerce to dispose of stocks on hand not complying with safety standards. Furthermore, since certain appliances are imported in larger quantities and disposed of at a slower rate or disposed of seasonally, longer periods of grace should be permitted in such cases. The following is a list of safety specifications recommended to be made compulsory together with the recommended periods of grace.

One year's grace after date of final notice in the Government Gazette:-

SV 100—General Requirements for Electrical Material and Equipment.

SV 102—Portable Electric Immersion Heaters.

SV 104—Flexible Cords for Power and Lighting Purposes.

SV 105—Fixed Electric Water Heaters.

SV 111—Replacement Type Heating Units.

SV 112—Electric Handlamps.

SV 113—Electric Toasters.

SV 114—Electric Irons.

SV 115—Electric Soldering Irons.

SV 118—Small Extra-low Voltage Transformers.

SV 119—Lampholders and Adaptors.

SV 121—Apparatus Connectors for Portable Domestic Appliances.

SV 123—Portable Electric Reading Lamps.

Two years' grace after date of final notice in the Government Gazette:-

SV 103—Electric Radiators.

SV 108—Domestic Electric Washing Machines.

SV 117—Electric Stoves and Hotplates.

Since SV 107—Portable Electrical Appliances for Heating Liquids has already been published in the Government Gazette the period of grace need not be more than six months.

It is admitted that the range of specifications is by no means complete and will no doubt be augmented in due course as occasion demands; nevertheless, it is considered that it is sufficiently comprehensive to give serious consideration now to the implementation of the recommendations of the committees, viz. legal enforcement of these safety specifications.

In giving the matter serious consideration one must not only be guided by the statistical records of accidents available at official offices, such as those of the Inspector of Machinery, Insurance Companies, the Workmen's Compensation Commissioner, etc., for these records merely reflect the incidence of very serious or fatal accidents and/or serious damage. There are incidents daily in which injury and suffering to personnel or damage to property occur that never reach the statistical records. I could relate innumerable examples that might be interesting information to the less informed but I considered that a gathering such as this is, by and large, sufficiently informed on the matter and therefore would not warrant the time spent thereon.

At this stage it may also be appropriate to refer briefly to the measures adopted in other countries.

United States of America. Here the well-known Underwriters' Laboratories approval scheme is in use. This body was founded nearly sixty years ago under the sponsorship of the National Board of Fire Underwriters. Later when the American Standards Association was established it adopted many of the Underwriters' Laboratories' standards as national standards. The Underwriters' Laboratories grant approval through various labelling systems and approvals lists. This approval scheme is largely voluntary but high insurance premiums on non-approved equipment have virtually brought about the general adoption of the scheme.

Canada. Similar measures as in the United States of America were introduced in the province of Ontario as far back as 1919. Today much more comprehensive measures in the form of the Canadian Electrical Codes, Parts I and II, amongst which some 75 to 80 safety specifications

feature, are administered by seven of the nine provinces and by all the larger cities in the remaining two provinces. In Canada insurance organisations likewise attach considerable importance to safety standards of electrical equipment, both in respect to permanent and portable installations and virtually indirectly compel the use of the Canadian Electrical Code wherever it is not otherwise compulsory.

Australia. Here the position varies considerable between various State Governments. In New South Wales, the Electricity Advisory Committee approves certain types of electrical appliances (e.g. toasters, grillers, radiators, irons, kettles, etc.). The sale, hire or offer of such appliances is prohibited unless approved. Specimens submitted are retained as patterns, and adherence thereto is rigidly enforced. In Victoria a similar system rules, but N.S.W. approvals are accepted automatically, although not conversely. Elsewhere control is either voluntary, exercised by the Wiring Rules Sub-Committee of the Australian Standards Board, or the specifications of the Australian Standards Association are cited as compulsory requirements for electrical apparatus.

Great Britain. There is no compulsory standards or approvals except in certain applications which are controlled statutorily:-

1. In firey mines equipment must be tested and certified.
2. In shipping for Board of Trade and Lloyds approvals.
3. Electricity metering. The Electricity Meters Act of 1936 requires the testing and approval of electricity meters.

The need for statutory control of safety requirements for electrical apparatus has been raised in Great Britain both through the Institution of Electrical Engineers and the British Standards Institution. It would appear that no unanimity could be reached in regard to a scheme that emphasised safety requirements in contrast to a scheme that embraced both safety and quality requirements. In the meantime unofficial approval was given to domestic apparatus by the Good Housekeeping Institute—a body with journalistic affiliations operating in conjunction with the Electrical Development Association and similar professional and trade bodies.

It shuold be pointed out, however, that certain British standards exist in respect of domestic apparatus, e.g. electric radiators, kettles, vacuum cleaners, etc., but these are merely advisory documents without legal effect except where introduced into a trade contract as such.

Europe. In most European countries (i.e. Germany, Holland, Belgium, Sweden and Switzerland) schemes of approval marks and lists have been developed. Such approval is generally in respect of safety requirements together with certain quality features, varying from country to country. Generally speaking, manufacturers are highly appreciative of the recognition provided by such approval and, in consequence, little emphasis is needed in regard to compulsory approval although compliance is obligatory in most of the countries cited above.

South Africa. From the brief descriptions of the measures adopted in other parts of the world it is seen that safety specifications have been utilised in varying degrees of compulsion, depending on the administrative machinery of each country. In the Union of South Africa there are two courses that may be followed in order to introduce compulsory adoption of safety standards.

(a) Whereas in Canada provincial administrations introduced compulsory safety standards, in the Union such action would have to be undertaken by individual authorities. If local authorities introduced by-laws whereby certain appliances and equipment were compelled to bear a safety approvals mark of the Bureau of Standards, then it would be incumbent upon the manufacturers to obtain this safety approvals mark for their products. The administration of testing and inspection would be carried out by the Bureau and the costs connected therewith would then be borne by the manufacturers through payment for the approvals mark tags or labels. The only weakness in this course lies in the fact that it is extremely doubtful whether uniformity of action would be taken by local authorities. Lack of a concerted effort would cause the

whole scheme to break down as no control could be exercised over unapproved equipment purchased in a neighbouring town and brought into a prohibited area. Furthermore, administration of approved equipment imported from overseas would be almost impossible.

(b) The Minister of Economic Affairs could, in terms of the Standards Act of 1945, declare the safety specifications compulsory throughout the whole of the Union of South Africa. This would apply irrespective of the declaration of a safety approvals mark as distinct from the quality approvals mark. Again the Bureau, in collaboration with the Department of Customs and Excise, could administer such provision, *but,* according to the legal advisers, no financial assistance could be claimed from the manufacturers or importers and the government would have to provide the necessary funds. It is estimated that the cost involved in testing, inspecting and general administration would probably be of the order of £4,000 to £5,000 per year. At a time when large-scale economy is being urged throughout the Union it is extremely doubtful whether the Minister would give much consideration to so expensive a measure. The national importance of such a measure would be greatly emphasised if the Minister could be assured by all concerned of its vital necessity. While commerce as a whole has not yet been approached, certain approaches have been made and the reaction has been favourable as it is felt that unfair trading would largely be eliminated. In giving consideration to the proposed declaration of compulsion, the Minister would most probably attach great importance to the attitude of this convention towards the whole matter. In fact, I believe that, to a very large measure, the success of introducing compulsory safety standards for portable electrical appliances in the Union of South Africa depends on the support of this convention.

PRESIDENT:

Thank you very much, Mr. Swardt. The matters that you have raised are of the utmost importance to all of us. Perhaps I can best emphasise it by giving you one example of something that happened here during the last six months; and this point may be of some interest to the Bureau of Standards as well, because the things that they propose to cover in the safety specifications, I imagine, may not legally include the article to which I am about to refer.

It was some time just before Christmas that members of my staff, quite by accident, noticed on sale in a certain shopwindow toy electric stoves. These things were for sale at about £6, and these members of my staff were naturally interested and went in to have a look at the "toy". They brought a sample of the device back to the office for us to have a look at it. I must say that the hair on the heads of all my technical staff quite literally stood on end when they examined the appliance in question. This toy electric stove consisted of a small device of continental origin operated at 230 volts with a plug-in connection in which the two pins were the live portions—the two pins, not the sockets, were the live portions. It contained an element, suspended almost in air, inside. It had in addition a hot water cylinder. The general construction of the thing was such that there could be no doubt that in a matter of days a fault to earth was bound to occur. It was not actually a hot water cylinder but a water cylinder with a tap on the front, which ensured that in almost all circumstances of use the ground in the vicinity of the "toy" was bound to be wet; and yet this article was offered for sale to fond parents during Christmas week for the delectation of their children!

It was very fortunate indeed that my staff discovered this "toy", and I must say that the dealer in question, the moment the matter was brought to his attention, immediately took all such things away from his shelves, and at some considerable inconvenience and loss to himself withdrew them from sale to the general public.

I do not know that the specifications proposed by the South African Bureau of Standards include toys, but it is a point that I would draw to your attention. This particular incident shook us very considerably and drew our attention in no uncertain manner to the extreme danger of having for sale in the ordinary general dealer's premises apparatus which can be of an extremely lethal character.

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I now propose to throw open for discussion this very interesting Paper by Mr. Swardt, and after we have heard whatever views members wish to contribute we may carry the matter further with a resolution.

Mr. J. F. LATEGAN (Heidelburg):

There is one point that Mr. Swardt has not raised (I do not know whether it falls under the Safety Precautions Committee or the Department of Labour), and that is the fact that there are 3,000 amateurs in the country playing with a very dangerous toy. If you have a transmitter up to 100 watts the lowest voltage applicable would be 1,000 volts rectified D.C., and I feel that this body should do something about putting forward some regulations with regard to these radio amateurs. We are all concerned with the safety of persons in houses, and if we send a man to a substation he has to have gloves on and a stick to pull out the 500 volt link switches, yet here we have these amateurs playing about with 500 to 1,000 volts, very little earthing, and subject to very great dangers of electrocution and burning.

I would like to thank Mr. Swardt for the Paper he has given, and may I assure him that we do appreciate the efforts they are making to ensure safety.

Mr. R. W. KANE (Johannesburg):

I take it that Mr. Swardt's suggestion here really is that if we support any proposal of this sort the Minister would, in terms of the Standards Act, make these specifications compulsory? I am not too sure whether there is another suggestion here—that the Bureau would come into the picture. Perhaps Mr. Swardt could mention that now.

Mr. J. W. SWARDT (S.A.B.S.):

Mr. President, Mr. Kane: Obviously you will have noticed how carefully I have worded my reference to what the Minister can do and might do and is likely to do and so on; for the simple reason that nobody, including the Bureau, could commit the Minister to anything; so that for that reason this Convention could only be considered as having looked into this whole matter in principle, together with all the technical implications, and in that way support the committee on which as you know, you were represented and which has made these recommendations that the matter be taken up with the Minister. The whole point is that if the Convention, having discussed and given consideration to this matter should decide to support the recommendation, it would no doubt carry some weight with the Minister, but, as I say, the Minister cannot be committed in any way, just as the electrical engineers were cautious in committing their councils to anything.

Mr. R. W. KANE:

You referred to the possibilities of the local authorities handling this sort of thing, and my thoughts went back to an unofficial campaign that took place with a view to the local authorities taking action against radio interference, when really there was another body that should be doing the job. All our regulations, wiremen's regulations, Wiremen's Act, and everything that ties us up in a glorious knot is designed to cover safety, and this is another move in the right direction really for the sake of the public. But I do think that, whatever takes place, whatever we decide here, it should be definitely stressed that this should be on a national basis, and that the municipalities should be left out of it as far as the police side of it is concerned. It is not the municipalities' job to act as policemen.

Another point I want to ask Mr. Swardt about—perhaps he will deal with it later on—is whether it is possible at all to leave the door open for reputable appliances that are manufactured in America, Britain and Continental countries. We have most of us already accepted stoves and other appliances conforming with British Standards specifications and with the Underwriters' mark, and I am curious to know how some South African mark is to be applied to these articles. I think it would be a very great pity if we took any step which would bring about a monopoly for purely and simply South African goods.

Mr. R. N. F. SMIT (Pretoria):

Mr. President and Gentlemen: I should like to thank Mr. Swardt very much indeed for the Paper he has just read, and to compliment him on its excellence. I happen to be a member of the committee

on the general requirements of electrical apparatus, and I can assure you the Bureau are doing a jolly good job of work.

If I may be permitted to digress a few minutes from the actual subject of standards, standards alone will not solve the problem of electrical accidents. The major proportion of electrical accidents are caused through ignorance on the part of the public, or at any rate a very large number of them, particularly ignorance on the part of house-holders. There was the housewife, for instance, who attempted to repair an electric iron adaptor while the adaptor was plugged into the socket; and, moreover, she attempted to do it with a pair of scissors. You can imagine the result! The Wiremen's Registration Act is due for amendment and the Board are strongly considering the licensing of appliance mechanics. They are at present not licensed and some of the work put out is not by any means of a high standard and is sometimes actually unsafe.

Once more I wish to compliment Mr. Swardt on his very excellent Paper.

Mr. D. D. BROWN (Roodepoort-Maraisburg):

The aspect of this matter which causes particular concern to me is the inadequate guards which are provided for electric fires and radiators. Mr. Swardt did not mention in his Paper that legislation is presently being enacted in Britain to enforce the provision of suitable guards over not only electric fires but gas fires as well. In my area I must admit that I have been horrified at some of the appliances which are being installed, and I have lived in two or three flats over the past couple of years and in each case I have noticed that the guard over the electric fire has been purely decorative. Children find them a very great attraction, and they usually make a habit of grabbing an element and trying to pull it out of the fire. These fires are actually lethal appliances, especially when one considers that if the element of the fire happens to have a break in the circuit it is quite possible that that element, although not burning, may be alive; and with our earthing regulations, of course, the casing of the heater would require to be earthed, which means that any child touching that element and touching the casing would be instantly electrocuted. The same thing applies if we have amateur repairs carried out to the fire and the neutral wire is taken through the switch instead of the live wire, which means that your element is continuously alive although the fire is switched off. I have known several such cases. That is one aspect that concerns me very particularly. In our area we have not worried whether we have a legal basis for action: we just do not permit that type of fire to be used. Unfortunately, there appears to be no type of fire on the market with an adequate safeguard.

The other point concerns the question of plugs and cores. Mr. Swardt mentioned in his Paper that the earthing lead on the core would be coloured green and that the earthing pin in the plug would also be identified. As we all know, it is largely the laymen who do the connecting up of these plugs, and, for instance, an identifying "E" on the earth pin and an earth core coloured green would have no meaning for the layman at all, so I do submit that if we are to mark the earth core and earth pin at all those markings must be identical; that is, if the earth core is green, the earthing pin should have the green identification spot. Alternatively, if the earthing pin is marked with an "E", then the earthing core should be marked "Earth" or "E"; in other words the identification must be similar in both cases, otherwise the layman will not understand it and it will not make any difference to him what he is connecting up.

I feel that Mr. Swardt and the Bureau are doing a wonderful job of work in this connection, and we are certainly looking forward to having all these difficulties removed and the dangers that we now face eliminated.

Mr. G. A. DALTON—Associate—COMMUNICATED

At the outset I would like to congratulate Mr. Swardt on bringing this most important matter so logically and—in a sense—so forcefully before the Convention. His introductory remarks suggest that the years of complacency, during which no definite recommendation was made to the Minister of Economic Affairs, should now

be replaced by giving "serious consideration to the whole matter of compulsory safety specifications."

The Author, in order to lend emphasis to his subject, enlarges upon the frequency of accidents occurring with appliances lacking in adequate safety standards resulting in death of injury; want of control exercised over the sale of such appliances; and the fact that they are readily purchasable over the counter by innocents who little realise that for their hard earned cash they have now acquired for their home a lethal weapon of some pretensions.

Mr. Swardt states that the original Electrical Committee of the Bureau of Standards recommended the publication of minimum safety specifications enforceable by Law. As the Standards Act was passed in 1945, it can be assumed that this recommendation was made approximately six years ago. One can sense the passing of a great deal of time without anything substantial being done to resolve so important a matter. The South African Standards Institution of the day considered this very subject of Safety to be of such great importance that they represented it in Memorandum to the responsible Minister at that time (Mr. Waterson). It was on this representation that the Minister, realising existent dangers and the want of legislation, appointed the committee under the Chairmanship of Professor Stanley, which Committee drafted the Bill, and from which there ultimately emerged the Bureau of Standards. I was privileged to serve on this Committee.

The preparation of the Memorandum submitted to the Minister was brought about by a Memorandum prepared by the late Mr. Cyril T. Cocks, at that time Assistant General Manager of the Johannesburg Municipal Electricity Undertaking, and myself, as Chief Electrical Engineer of the South African Railways and Harbours, with the assistance of Mr. R. Leishman, the Test and Research Engineer of the Johannesburg Municipal Electrical Undertaking, and Mr. T. H. D. Page, the Test and Research Engineer of the South African Railways Electrical Department. This document was presented to the Electrical Committee of the South African Standards Institution, which committee in turn appointed Mr. Arthur Rodwell, a Past President of the A.M.E.U., and at that time General Manager of the Johannesburg Municipal Electricity Undertaking, to present and sponsor it before the Main Committee of the South African Standards Institution, from whence it found its way to the Minister. It may be asked, what prompted the late Mr. Cocks and his associates to take such action, and spend much time and thought in its preparation? A fatality, a near fatality, and two fires, in close proximity to each other in point of time, were traced, after investigation, to faulty appliances and fittings "of doubtful origin and shockingly wanting in many respects". These articles, it was established, were purchased over the counter in a general merchandise emporium, so it will be apparent that the same influences were at work then as those which prompted Mr. Swardt to write his paper. Judging by results, this country has for a long time been the dumping ground for low priced inferior electrical apparatus, and immediate steps should be taken to rid it of this menace to life, limb, and manifestly unfair trading.

It is encouraging to know that the Association of Chambers of Commerce of South Africa is displaying an active interest in this vital matter of "intrinsically safe electrical apparatus".

The question of safety and its promotion in the electrical industry, with special reference to installations and apparatus, formed the theme of Mr. R. W. Kane's most interesting and valuable Presidential address presented recently to the Institution of Certificated Engineers. Surely this address, coupled with Mr. Swardt's paper, and the thoughts which they will undoubtedly engender in the minds of Electrical Engineers, will prove to be the incentive for corrective action to be taken without further delay. Mr. Swardt is to be commended for outlining his conception of corrective measures which could be readily acceptable as the basis on which to build the protective structure. This, taken in conjunction with Mr. Kane's suggestion that the Insurance Companies institute testing of installations and appliances, together with the substitution of the simple renewable fuse, so "readily tampered with", by hermetically sealed magnetic type miniature circuit breakers, would certainly make for rarity in the type

of accident under review. Is all this possible of achievement? Some may say it sounds good but further discussions will be necessary before it can all be licked into legislative shape. It is, therefore, my opinion that the A.M.E.U. should give their wholehearted and immediate support, and that Clause (b) on page 5 of Mr. Swardt's paper, with the addition of the recommendation from Clause (a) that appliances and equipment be compelled to bear the safety approval mark of the Bureau of Standards, form the substance of a Memorandum to the Minister of Economic Affairs to declare the safety specifications compulsory throughout the Union, and that all appliances and apparatus for sale must bear the Safety approvals mark.

PRESIDENT:

If there are no further contributions I will ask Mr. Swardt to reply to the discussion.

Mr. J. W. SWARDT (S.A.B.S.):

Mr. President, Gentlemen: I would like first of all to reply to the point raised by the President in regard to that "nice" Christmas present some of the parents thought they would give their kiddies last Christmas. You may remember the definition I read out, namely, an appliance is anything that converts electrical energy into heat, sound or motion or any other form of energy and supplied with a flexible cord taking not more than 15 amps, which therefore includes the toy stove. The problem regarding the "toy" stove is that there are two aspects one has to consider: first of all, as an electrical stove. There is no special specification for "toy" stoves, so that it must fall within the purview of the general requirements for appliances specification. Assuming it is so well constructed that it does comply with all the electrical requirements for such a gadget, there is still the other aspect: Is it safe for children to play around with such a toy that is operated or energised by electricity at the normal voltage? In regard to such a matter of safety it is quite easy to take it to the electrical co-ordinating committee who handle all these safety specifications, and they could then through the Council of the Bureau make a recommendation to the Minister that such a "toy", whether it complies with the electrical safety specifications or not, is considered an unsafe thing and should not be for sale at any time. So that that type of gadget is covered in two ways: either because it is entirely unsafe for children to play with, or because it is safe for children to play with in so far as it complies with the specification, but is regarded as dangerous in view of the fact that it is going to be used by children. Electric trains, for instance, fall within the purview of the safety specifications, and you may have noticed that we specifically refer to extra low voltage transformers, which is intended to cover toy transformers. As a matter of interest, the specification for toy transformers prescribes separate windings and auto-transformers are not considered safe and satisfactory.

Coming to Mr. Lategan's remarks, I would like to reassure him that radio and electronic apparatus, if fed by means of a flexible cord and drawing less than 15 amperes, falls within the purview of general requirements. In addition to that, there is a safety specification being drawn up especially for radio and electronic devices. This specification has been pending now for three years, because there were certain fundamental differences of approach between America and the Continental countries, so that the whole matter was referred to the I.C.E., who have now brought out their standard, which should be used as an international standard for the safe requirements of radio and electronic apparatus. So in due course we hope to introduce this safety specification for radio and electronic apparatus as a specific safety specification as in addition to the others we have already enumerated.

Dealing with the radio amateur, of course, you cannot stop a man indulging in his hobby, and if he must play with something dangerous then it is his responsibility. He is exposing *himself* to danger; it is not the same as exposing people to unnecessary danger as when they operate electrical appliances in the household every day. Our protection scheme is meant to protect the man who innocently and in good faith operates an electrical appliance and finds himself exposed to danger; but where a radio amateur fools around with electrical equipment that is highly dangerous, that is his concern, and I fail to see how any sort of legislation or regulations could be introduced to cover that aspect.

In regard to Mr. Kane's remarks on radio interference, whilst it hardly falls within the scope of our discussion, I think the principle he raised is a very important one. This matter of the control of radio interference equipment was extensively investigated by the Bureau in regard to what other countries do. The matter was in hot pursuit when it became known that the Radio Act was in course of enactment. The Bureau then made contact with the Department of Posts and Telegraphs and conveyed its views on the whole matter, based on the investigations that had taken place at the Bureau and it then appeared that the Postmaster General would have powers to make regulations in connection with the prohibition of equipment causing radio interference. The Bureau then put up a scheme to the Postmaster General whereby such interference could be controlled to a very large degree; and the reply was that as soon as the Act had passed through Parliament a committee would be set up to formulate regulations under that Act, and it was indicated that the Bureau would be asked to contribute and assist in the formulation of those regulations. Briefly, I would indicate that the idea is to introduce specifications for equipment to be really interference-free, and that is really the crux of the whole issue. I feel, however, that the matter is fairly well under control and would relieve the local authorities from searching for faulty equipment, which I think is an almost impossible job.

With regard to the query as to what happens to reputable manufacturers and whether the door can be left open for them, we are very sorry, but you cannot make a law for some and not for others. The reputable manufacturer in any case is the one who will have least worries. These specifications, if they do become compulsory, will apply to all and sundry, whether the equipment is made in South Africa or overseas. A large portion of the equipment that these specifications would be covering would be equipment made overseas—such as hair dryers and shavers, for instance. Permanent waving machines and all those things will be coming into the same grouping, and they are all made outside the Union. So we need have no fears that some will be controlled and others not.

In connection with Mr. Smit's reference to appliance mechanics, I would merely like to mention to him that the Bureau have investigated rather extensively the whole issue of appliance mechanics. We all have knowledge of cases where things have gone to an appliance mechanic for repair and have come back in a more dangerous condition. The Bureau has a large amount of information and would be glad to pass on all the information required.

Mr. Brown's point on electric fires was very interesting. We will probably appreciate that reference was made to the gaurd and that there is very strict control over the protection of the element. The committee actually spent about two-and-a-half years finalising this whole issue, and the electric radiator problem was one of the stickiest jobs of all. There are many criteria throughout the world as to how to judge whether or not an electric radiator is suitably protected and guarded. Some countries have extremely strict requirements, particularly Sweden. In Sweden it is so strict that they lay down that the test finger, which is 10 mm. in diameter, should not be able to pass through the mesh of the guard to the element or to any live part. That is merely an indication of how tight they are on that issue. We want the guard to be so placed away from the element that when a specified piece of flannelette is placed over the guard is should not scorch within a given time. The test is identical with the test that has been developed by the British Standards Institution, except that the time in which the scorching may take place is a little shorter in the case of the South African Standard than the British. Actually we were in line with each other, and then the British changed theirs again, but there is so little difference between the two that we do not think another change is warranted. When the Bureau handles issues of this sort it invariably makes a large number of tests on appliances on the market, and by then collating these results and noting the effectiveness of the measures, the issue is put before the committee, which is then in a much sounder position to judge whether the measures are acceptable and reasonable.

I would like to amplify it by saying that, whilst it may sound as if our requirements are strict, they are not the strictest in the world. I have already mentioned Sweden in regard to the guard. I now want to mention

the Canadians. They prescribe that if a heater should fall over it must turn on its back, so that if it should inadvertently fall over it will not be a hazard and set fire to a carpet, the floor or any papers that may be about. We have not got that requirement; we felt it was not quite so important, and in any case, radiators are subjected to a stability test.

In regard to the identification of the earth, mentioned also by Mr. Brown, that has been fully covered, and we do not mind whether the manufacturer puts one form of identification or another, so long as they have a green spot next to the terminal so as to correspond with the green earth continuity conductor, so that obviously green spot and the green conductor should line up. It does not prohibit the manufacturers from putting on any other form of identification in addition to that green spot

I would be also interested to hear some time from Mr. Brown what was the criterion or standard for the control that he was exercising in his area with regard to these radiators. It strikes me that he might be able to use the Bureau safety specification, or maybe he has a better one, in which case we might learn something.

The contribution to the discussion from Mr. Dalton refers to the earlier history of the need for protecting the public against unsafe appliances. The information given by him is most interesting and it goes to show that the urge to obtain some protection for the public existed before the Standards Act of 1945. I may add that after the establishment of the Bureau in 1946, the South African Institute of Electrical Engineers as well as the National Industrial Council for the Electrical Industries of South Africa both approaced the Bureau to investigate the need for safety specifications for electrical equipment. It was these approaches that set the ball rolling and as a result of which the Bureau committee originally investigated the whole matter, as stated in my paper.

With regard to the reference to Mr. Kane's suggestion in his recent Presidential address delivered to the Institution of Certificated Engineers, I might mention that the matter was discussed with certain insurance companies and the impression gained was that while insurance companies would welcome this introduction of safety specifications, they were not prepared to institute testing of installations and appliances. This may be partly due to the fact that permanent installations are either under the jurisdiction of the factory inspector or the electrical department of the local authority.

In conclusion, I would like to thank the contributors for their very kind remarks, and may I also thank you for yours, Mr. President. I can assure you that it is our object to serve the community at large and assist your Association in itself at all times.

PRESIDENT:

Immediately after the tea interval I shall ask Mr. van der Walt to deal with a resolution you may care to pass in connection with this Paper. Mr. Swardt has asked me to announce that either he or Mr. Durr will be happy to give any member specimen copies of safety specifications to give an indication to members of the sort of specification they are drafting. After tea I will call upon Mr. van der Walt to propose a resolution in connection with this matter.

(Tea interval.)

Mr. J. L. VAN DER WALT:

Mr. President, Gentlemen: Safety specifications have been occupying the mind of your Association for quite a while. Your Association has been represented on all committees concerned with the drafting of safety specifications. As Mr. Swardt mentioned, the stage has now been reached when some action ought to be taken, otherwise all that labour and time will have been for nothing. I can assure you that these committee meetings of the safety specifications committee are very interesting to attend. Sometimes we get on very amicably, sometimes hairs fly, but we never become bad friends, and it is wonderful how some of the manufacturers can be persuaded to co-operate as far as the safety of the public is concerned. That there is a dire need for the promulgation of the safety specifications I think nobody will doubt. Many of us have been approached in the street by the general public, as municipal engineers—why they connect us with it I do not know—asking us why we permit unsafe material of inferior quality as far as safety is concerned to be sold in the bazaars and anywhere.

The answer has always been this: We hope that one day some legislation will be formed to stop this. That stage has now been reached and I think it is going to be a very important step, a most important step for this country to take. There will certainly be complaints, but as remarked before, I think we need shed no tears for those people who are going to complain. It will be the unscrupulous dealer or manufacturer who raises the dust, and I do not think we should take much notice of it. The conscientious man, the scrupulous dealer, the type we have met on the committees representing associations and businesses, are all 100 per cent in favour of the promulgation of the safety specifications. I would just like to give you some figures to show you why I think the promulgation of safety specifications in the very near future is necessary. These figures are of accidents in South Africa, and they are provided by the Department of Labour and kindly given to me by the Bureau of Standards. In 1949 the total number of accidents coming to the notice of the Department was 57, of which 32 were fatal; and I presume there may have been many more which did not come to the notice of the Department. The number of fatal accidents due to domestic electric appliances was 18, and the number due to electrical tools and appliances 15. In 1950 the total number of accidents reported was 60, with 28 of them fatal. Electrical domestic appliances were responsible for 18, and electrical tools and appliances were responsible for 10 fatal accidents. Although the numbers may not appear large, I maintain that these lives were lost unnecessarily. I do not suggest that the safety specifications can eliminate all of these, but they can reduce the number, definitely, and eliminate a large amount of risk.

I would therefore put the following motion before this Convention:

> The Association of Municipal Electricity Undertakings of Southern Africa, in conference assembled, resolves that:—
>
> In view of the number of fatal and serious accidents arising from the use of domestic electrical appliances of unsatisfactory design and/or construction, the Minister of Economic Affairs be respectfully requested to consider the promulgation of the electrical safety specifications on a national basis under the powers vested in him by the Standards Act of 1945, and so reduce the danger to life and limb of the public.

Mr. J. C. DOWNEY (Springs):

Mr. President: In rising to second this proposition put to you by Mr. van der Walt, it gives me very great pleasure because I have been associated, as you know, with safety specifications from the early days. One point has been very interesting to me this afternoon and that is the one mentioned by Mr. Smit. The original committee considered the question of the safety specifications but considered there was one hole that was still not plugged in the dyke—that is the control of the appliance mechanic. Now I understand the Wiremen's Registration Board are considering the licensing of appliance mechanics. Thay may considerably help and support the safety specifications. I do not wish to add anything further. You have heard the safety specification question come up year after year, and I have great pleasure in seconding Mr. van der Walt's motion.

PRESIDENT:

Is there any discussion on that resolution?

Mr. C. R. HALLE (Pietermaritzburg):

Sir, no one can disagree with the general idea behind this very serious side of our work, but we must realise that it is now becoming dangerous to live. I think that another danger we do not seem to foresee is that bands of enthusiasts all over the place will be getting together and forming so many rules and regulations that we shall not be able to continue to live very long. There is the road safety business and all these other things, continually penalising the many for the folly of the few, and I think it is going a little too far. I think figures given by Mr. van der Walt speak for themselves and really prove the wonderful safety of electricity. When one considers the millions and millions of times electrical apparatus must have been handled during the period mentioned, I think it is almost impossible to expect to be able to reduce the figures to any appreciable extent. Therefore, whilst supporting the principle

that we should have standards—our civilisation is built on standards—we must, I think, put in some rider about their application. In the commercial world it is very unsafe to have financial dealings with certain people, and we know of that splendid institution the Dunn's Gazette. I think the way to look at this matter is that there are standards, and any apparatus found not to conform should be black-listed. I do not know how that would be applied, but I know the bigger firms who comply to the standards laid down overseas should not be in question at all. I remember a little travelling electric iron which was a beautiful little death-trap, and that was whipped off the market by the municipality, but if this Standards Bureau had been in operation then we would have sent it to Pretoria and the firm would have been black-listed and warned that if they did it again they would be penalised. So that, whilst I want to see this put into effect, I do hope that we shall not be tied up with more bureaucracy and control and returns, and so on, so that another Union building will have to be put up to house the staff to deal with it.

Mr. R. N. F. SMIT (Pretoria):

With regard to Mr. Halle's suggestion of blacklisting certain appliances, it is a very good one if it can be carried out, but it will be exceedingly difficult to do it. There are many articles in common use which are positively dangerous and the plug with the flex entering at the back, a two-pin plug with the two wires merely twisted round two split-pins inside, and that type of plug can give very very serious hand burns. If a short occurs inside it blows clean through the back into the palm of the hand.

Mr. J. W. SWARDT:

I would like to add one or two words to the points raised by Mr. Halle. I can assure him that the Bureau is not looking for work. We have more than we can actually handle now. However, supposing the whole scheme of compulsory safety specifications goes through and the Minister is agreeable to provide the £4,000 or £5,000 per year for the administration, it will involve setting up a means of control to insure compliance with the legalised safety specifications. I am sure Mr. Halle will believe me when I say that we shall not be looking for the black sheep; they will eventually sort themselves out. Mr. Halle's approach sounds very good until the legal adviser gets hold of it, and his attitude is always that you cannot have negative legislation, just as you cannot say that, because a man has been convicted as a bad driver, he must be put on a list to be carried by the traffic cops. Negative legislation in principle is never permitted. The primary aspect is that once all and sundry know that there are safety specifications with which they must comply it is their business to find out what those provisions are. We have broadly framed out the scheme of administration which will include lists of approved appliances. Every model and type of appliance must be submitted to the Bureau when it is first put on the market, and if satisfactory will be listed on approved lists. This will make it easy for the people who are to administer it, such as inspectors who may from time to time purchase appliances from various shops to check whether these appliances are complying with the compulsory specification.

As far as the manufacturer who operates conscientiously to the safety specification is concerned, he has nothing to fear and will not be entangled with any paper work or periodic returns; there will be no administrative work or anything to clutter up his business.

Mr. E. L. SMITH (Boksburg):

Mr. President, Gentlemen: Every year we see ourselves getting deeper and deeper into the morass, and it looks as though we shall have a hard job in the very near future. I feel we are tackling this problem from the wrong end. We have this business of safety precautions because of our system of supply. We have the whole headache of earthing, which is growing and growing every year. Finally the cost of earthing a house will be more than the installation. We face more and more difficulties as time goes on. Do you not think, Mr. President, we should tackle it from a different angle and alter our system of supply to make it safe for people to use electricity without all these laws and regulations to be applied? I think we ought to give serious consideration to this aspect, and also to our system of supply. For one thing, I think we should do away with this wonderful earth neutral and go back to the three phase 220 supply. I recommend that.

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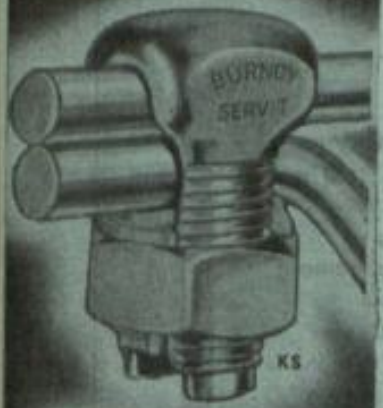

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is of general knowledge to the community but something which we alone are held to have the requisite knowledge to decide. We are, as I said just now, the guardians of the community's life and limb in this matter. Now, do those who have sounded a note of warning feel sufficiently strongly on the matter to make this proposal not a unanimous one, or would they like to call for a vote, or would they be prepared to accept the resolution? Mr. Halle, how do you feel?

Mr. C. R. HALLE:

I have been shot down in flames!

PRESIDENT:

Mr. Smith?

Mr. E. L. SMITH (Boksburg):

Yes, agreed.

PRESIDENT:

Mr. van der Walt would prefer it to be a unanimous resolution. May I take it as agreed?

(Agreed unanimously.)

CONFERENCES—FREQUENCY OF

Now, at the tea interval this morning we had to interrupt a very interesting discussion on which our Councillor friends were becoming quite eloquent—the frequency of conferences—and as there are one or two who were not present then and others who are still bursting to speak, I will throw open the subject for discussion again.

Councillor, Col. H. O. SAYER (Ladysmith):

I am not bursting to speak, Mr. President, and I promise to be very short. From my remarks it will be inferred that I am a Councillor and not an expert. I hope that the larger authorities are not going to get away with this. I think the suggestion that we should hold these conventions every two years is wrong. I am speaking from the point of view of smaller authorities. I think it is essential that we should have these conventions every year. I can understand the point of view of the larger authorities, but from the smaller authority angle it must be realised that Councillors would not have the benefit of continuity. You would have one Councillor who was Chairman of the Electricity Committee coming to one Conference, and by the third year he might be out of office and the Councillors do, I think, learn a great deal at these conventions. It was mentioned this morning that it was so technical that it was above our heads. I do not think that is so. There are quite a lot of things that we learn, and we do not want the engineers to think we do not learn. We have learnt a great deal of useful information about phasing which we can take back with us. I can understand that the engineers of the larger authorities have not the same difficulty. But I do not want to be called what I have heard one engineer call the chairman of his committee—his ball and chain. I would rather be spoken of as the spark over the gap.

Councillor ROSS THOMSON (East London):

In the first World War I was a two-ringer in the Merchant Navy, and in the last World War I was an Acting Lance Bombardier in a coast battery. Now I find, on my return to Bulawayo, I have been promoted to Colonel! I wish to correct that. Several of the delegates have addressed me as Colonel and I am afraid I could not substantiate it.

Mr. President, in connection with the frequency of conferences, there is much to be said for and against it. At the Town Clerk's conference in Johannesburg last year a resolution was put before the meeting that an approach should be made to the Municipal Executive that all municipal conferences should be held biennially. The Town Clerks felt that as the chief executive officers this should come from them. However, it was not agreed to.

On the good that a councillor member can derive from these conferences, I think sometimes we do not realise the knowledge that we gain from them. This was brought home to me very forcibly last year at the Town Clerks' conference. Councillor Niel Boyd of Durban wrote a paper on a recent trip that he made to America as the guest of the United States Government, and during the course of the paper he gave us the highlights of American transport and said that the double-decker bus had gone out of vogue, and the longer type of single-decker bus with the under-slung engine was the answer to the transport manager's prayer. That immediately went home to

me because our own transport manager in East London had been trying to convince us councillors that our double-decker bus was not the answer to the transport manager's prayer. So when the question of placing orders for buses this year came up I was able to quote from Councillor Boyd's paper and I am very happy to say that the East London City Council decided to go in for the longer single-decker type. I mention that as an example. We were faced with an expenditure of some £60,000 or £70,000 on about 12 or 14 buses, and I am sure we would not have bought the correct type of bus had it not been for the information contained in that paper.

I am sorry if I have digressed, but with regard to the frequency of conferences my own personal opinion—not my council's—is that I verily believe that the major departments, the City Engineer's Department, the City Electrical Engineer's Department, the Town Clerk's Department, the Medical Officer of Health's Department and the City Treasurer's Department, should hold their conferences annually. But when it comes to the minor departments such as Parks, Traffic Officers, Nursery Schools and many new ones which are springing up from year to year. I do feel that a halt should be called, and that these minor departments could quite well conduct their affairs satisfactorily if they held their conferences biennially.

This expression of opinion is my own, and possibly many here will not agree with it, but I give it for what it is worth.

PRESIDENT:

Gentlemen: I must thank you for the contributions you have made. They will be of great assistance to your Executive in considering this matter. I am particularly glad to have had Councillor Sayer's comments, because he brought forward a point not previously thought of, that is, that the smaller undertakings, by the very nature of things, find conferences of more value than the larger ones, in that the councillors in the larger towns are in fact from day to day in contact with the people that the smaller undertakings come to conferences to meet, and in that sense it is possible that the representatives of the larger centres would tend to adopt a view that was somewhat different from that of the smaller ones.

COAL SUPPLIES

Now, we had a discussion on the question of Coal Supplies which was left in abeyance in the Executive meetings pending information that Mr. Kane, representing us on the Coal Priorities Committee, was awaiting. I understand that that information has now arrived, so I would ask him if he would be good enough to wind up the question of Coal Supplies.

Mr. R. W. KANE (Johannesburg):

Mr. President, Gentlemen: I received the minutes of the meeting held on Friday last and I have had a quick look through them, and though there are several points which have been discussed, I do not see any important decisions apart from what I have stated earlier on—the assurance of 100 per cent to railways and power stations. I notice it was decided that it would not be desirable to issue a press statement at this juncture. I have nothing further to add.

Mr. D. A. BRADLEY (Port Elizabeth):

Mr. President: In a letter I have received from Mr. Chris Downie, of Cape Town, Convenor of the Coal Supply Committee, he asks that those who burn coal in their stations, should let him have a weekly schedule recording the daily quantities of coal received and the time taken for that coal to get from the colliery to the power station concerned.

Mr. Downie has sent out a schedule or a table of which Mr. Ivey has some copies, and I would, through you, ask those who use coal to get a copy of this schedule from Mr. Ivey and forthwith use it in the interests of our Association by filling it up weekly and forwarding it direct to Mr. Downie for his immediate observation and use on the new Coal allocations Committee of which he is a member.

Councillor L. M. WIENER (Johannesburg):

Mr. President, it is not my intention to say very much on this matter, but I would like to make some suggestions to the Coal Supplies Sub-Committee of the Association. I do feel that I speak with some authority as far as coal is concerned. The Johannesburg undertaking uses no less than an average of 2,400 tons of coal per day; in other words, 50 to 60 trucks of coal have to come into our yards daily. We use approximately 864,000 tons per annum and

it will not be very long before we shall be using 1,000,000 tons of coal per annum.

I would like to suggest that the Coal Supplies Committee keep an eye on the Transvaal Coalowners Association. In July last year the railway magazine *Railway News* issued a lengthy statement on the question of the haulage of coal, and although I do not intend to go into the merits of their case, basically they put the blame on to the collieries. I am not interested in the Transvaal Coalowners' Association or in the Railways; I am only interested in my undertaking and in all undertakings represented here this afternoon, and in whether or not they get their supplies of coal.

It may interest members to know that the Transvaal Coalowners' Association consists of the majority of the collieries, but there is a minority of non-members, and it appears to me that we are suffering through some argument that is going on between these two sections. The Coalowners' Association sent an open letter to all customers on 31st July, last year pointing out that the whole blame must be attached to the Railways. With all due respect, I for one could not accept that that was the actual position. The argument going on between the two sections is roughly this. The Association states that their exports of coal only amount to 7½ per cent of their output, whereas the non-members export no less than 25 per cent of their output; and I cannot help feeling that that is one of the major reasons why coal that is supposed to come to members here in their undertakings is diverted for export purposes; therefore I would like to suggest to the Coal Supplies Committee that, bearing these facts in mind, they should make a point of impressing on the Transvaal Coalowners' Association the necessity of keeping our power stations supplied with the necessary requirements.

While we were on the way to Bulawayo we had to get in touch with the Association and tell them that we had to have 2,000 tons of coal immediately. Well, within 24 hours our request for that amount of coal was granted, put on the way and delivered on Saturday evening, and a further 3,000 tons was, I understand, railed on the Sunday; so that I do not think it is fair to attach the *whole blame* to the Railways. I do submit that a certain portion of the blame must be put on the shoulders of the Association. They must be made to realise that it is in the interests of the country that power stations should not be in jeopardy of having to close down or decrease output. We should not have to spend sleepless nights because of it. Last year I was appealed to by my general manager to use my influence in certain quarters in connection with supplies of coal. I do not think that should be necessary. The laws of the country provide that the first priority is the South African Railways and the Army. That we can understand. The second priority is power stations, therefore legally we have the right to priority, and I say with all the emphasis I can command that this Convention through its Coal Supplies Committee should exercise that right and see that the collieries despatch the coal as we require it. If they do that, perhaps some of us will be able to pass undisturbed nights, without having to worry about where the next truck of coal is coming from.

MR. E. L. BUCHANAN (Louis Trichardt):

Mr. President, Councillor Wiener has remarked that it is unlikely that the South African Railways alone are to blame for the delays in coal supplies. I should like to differ with him on that point. Only yesterday afternoon I had a telegram telling me that my station was running short of coal—this after I had made provision for a decent stockpile which, owing to the non-delivery of coal, I had to climb into and start firing off the stockpile. At the same time there was on the way 200 tons of coal from Witbank, which the colliery notified me had been despatched on a certain date in so many trucks. This load of 200 tons of coal was despatched not later than 5th February, and up to this afternoon it had not arrived! The distance is only about 280 miles as the railway crawls. I recently saw in the paper a complaint from a certain association of farmers that they had despatched some cattle by train, and these cattle had been transported at about 1·5 miles a day until they reached their destination some 200 miles away! Here for over 90 days this coal has travelled a distance of 3·3 miles per day! So I think our friends here must be congratulated on receiving their coal. It must have come by jet plane. If the railways would only deliver these trucks

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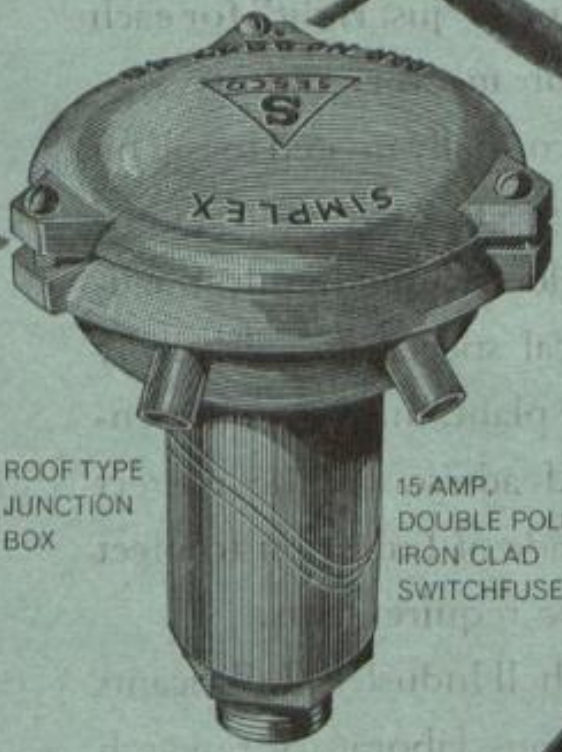

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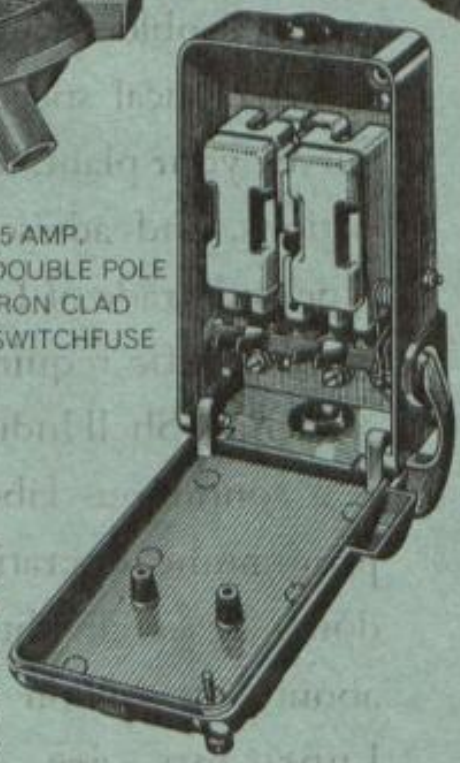

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in reasonable time they could be back in circulation again rapidly and be used for delivering coal elsewhere.

MR. W. H. MILTON (Escom, Johannesburg):

Mr. President, Gentlemen. This is a topic which is very near to my heart and has caused many grey hairs. It is my unfortunate lot to deal with the purchase of coal by the Commission for all the Commission's stations in distant parts, so I think I can claim to know something of the problem. I think we should face facts. There is no point at this stage in endeavouring to attach blame to either the railways or the coal suppliers for the present position. I think the Government has been very careful in referring this problem to each of the committees and commissions it has formed to enquire into matters, to deal with the future rather than delve into the past. I think we all realise that the Railway system is very much over-burdened in relation to its carrying capacity. The reason for that over-burdening is again something which is not a matter for this Association to discuss, but it is a matter which is surely exercising the minds of the Railway officials whose responsibility it is to see that the goods offered for transport are moved.

If I may deal first with the position as regards the delivery of coal, we do get trucks of coal which take a phenomenal period to reach their destinations. That may be due to defects in the trucks arising in transit; but the average time taken, during certain bad periods, for trucks to travel from Witbank to the Cape was up to 21 days. At the present time the Railways have so improved the transit of those trucks that our average time within the last two weeks has dropped to between seven and nine days.

I listened to the denunciation of the T.C.O.A. but what so many people fail to realise is that it is a very simple matter for the T.C.O.A. to supply any one of its given customers with all and more than they require, and I rather suspect that that 2,000 tons which went through to Johannesburg so quickly was more than likely intended for Cape Town—robbing Peter to pay Paul. From the figures I have seen—which I have no reason to doubt—the collieries are apparently not receiving the full allocation of trucks which they require to meet all their needs. We do know that power stations and railways requirements are No. 1 priorities—the railways of necessity—because they must transport goods as well as the coal—the power stations of necessity because electricity is the life-blood of the country. But other goods, in addition to coal for other purposes, are not reaching their destinations at the required rate.

When you reduce the total output of coal from a colliery it means that coal of all grades goes down, and in order to meet the power station requirements the Transvaal people have equipped two collieries for crushing coal, and on 19th May they hope to bring into service a third colliery also crushing coal. We have been warned that all power stations will, in course of time, be required to accept the product of crushing. The product of crushing comes from the round coal, in other words, the best quality coal.

This leads to the question raised by Mr. Bradley of the crushing of coal at power stations. I believe a questionaire went out asking *inter alia* whether or not power stations were prepared to crush coal, but I do not think that questionaire was sufficiently well conceived, because it is admitted by the colliery people that the right place to crush coal for power station use is at the collieries. It is for that reason that the Transvaal Coal Owners have provided crushing capacity for power station coal. It is also significant to learn that the Natal Associated Collieries are also crushing coal. The crushing of coal will introduce a further difficulty in the operation of stations—the question of burning "fines". I do not think segregation of the "fines" to the top of the fuel bed will provide a solution to the problem which will face the smaller power stations. The laying of "fines" on top of the larger sizes is principally to solve the problem of ignition rather than that of complete burning. As soon as you segregate "fines" from the larger sizes there is a very grave risk of the "fines" being carried over by draught and causing trouble in the draught plant, if not elsewhere.

I think that power stations should only regard the provision of local crushers as a matter for emergency use and not permanent use, because there will be times, say as a

result of derailments and things of that sort, when the only coal available may be rather too large to put straight into the boiler bunkers.

In this connection, too, the question of calorific value is in my opinion of considerable importance, because on longer hauls any loss in power station efficiency due to the use of the coals with the excessive quantities of "fines", lower calorific values involves greater quantities of coal. The haulage of more trucks over these long distances, involves not only the down trip but the return, and again means we are further limiting the capacity of the railway system to serve the remainder of the country's needs.

If this Convention were to send off a resolution condemning the coal owners or coal suppliers I do not think it would do very much good, from the point of view that it would merely anger people who seem to be endeavouring to do the best they can for us in very difficult circumstances. In the same way, to criticise the Railways at a time like this would probably have the same effect, because I am convinced that they also are doing their best to serve us.

PRESIDENT:

Thank you. It is not intended to pass any resolution on this matter, and I think we have now fully ventilated this question.

We will now adjourn until 9.30 tomorrow morning.

Convention adjourned at 5 p.m.

FOURTH DAY
THURSDAY, 8th MAY, 1952

PRESIDENT:

Are there any additional contributions to the discussion on Mr. Redman's Paper? If there are no other contributions, I will ask Mr. Redman to reply.

MR. R. H. REDMAN'S REPLY TO COMMENTS ON HIS PAPER — (COMMUNICATED)

Mr. R. H. REDMAN (Bulawayo):

I feel particularly indebted to Mr. Kane for his contribution and for the nice things he has said about my paper.

I agree with him, very strongly, that the immediate apparent solution to a problem is not necessarily the ideal one and a little time for thought and research into the reasons is generally most desirable.

He may consider that I am lucky in having the opportunity of following my predecessors' pattern for my paper: I would suggest, however, that this luck may be a somewhat mixed blessing, as was indicated in the introduction to my paper.

A very high criterion has been achieved in the past; such a criterion may be difficult to live up to.

Regarding the possibilities of providing the history of our Undertaking and of the Association's expenses, I will admit this is a point I had not considered. It has, however, distinct possibilities and if the Association feels that the history of our Undertaking is worth perpetuating, I will certainly look into the matter.

With regard to the immediate present, however, I would point out that in my resumé, I was specific in my reasons for giving the paper and to re-iterate these, they were primarily to learn from those more fortunately situated in the cultural centres of the world what I could of power undertaking practice. Only by the presentation of such papers would one provoke argument and criticism and obtain ideas from other people's practice which one could consider and apply, if applicable, to one's own Undertaking with the consequent benefit.

Regarding the use of circuit-breakers in place of consumers' service fuses, we find them of inestimable benefit. The service fuse was always vulnerable, although it was sealed. The circuit-breaker is a definite method of protection and cannot be tampered with. Since its adoption here it has proved generally satisfactory, and I feel that it has come to stay. The question of its vulnerability to lightning is one which gave us considerable thought when we first employed it and, in certain types, our fears were justified. There were other types, however, which were highly satisfactory.

Regarding the high Yearly Load Factor: this is mainly due to that section of Industry which runs during twenty-four hours on a shift basis, and Mining.

With reference to Mr. Kane's comments on the split neutral conductor for the low tension system, the primary reason for its adoption was the provision of an added safeguard to overcome the consequences of our high soil resistance in this part of the world. In all areas where the provision has been made consumers are required to earth their installations to this system because of the absence of a water system and the difficulty of obtaining an alternative. The provision of one extra wire doubles the factor of safety against those pressure rises referred to by Mr. Kane, in return for very little extra expenditure, bearing in mind that each wire is half the area of the phase wires. No trouble has, to date, been experienced due to pressure rises as a result of faults, and we have had no complaints from the Postmaster as a result of the use of the split neutral system.

It should be noted that multiple earthing has been employed in Bulawayo for very many years, having originally been introduced before the split neutral earth was initiated, to guard against broken neutrals and the consequent dangerous rise in pressure of "earthed" portions of installations. It is maintained today to give the greatest possible conductivity to earth from the neutral system and to ensure that poles and stay-wires are also adequately earthed.

Regarding the comment on Tariffs, I would point out that we have an Industrial Tariff which provides for both lighting and power sections in Industrial establishments. Where consumers provide a Sub-station and where the installed capacity is over 100 h.p., both lighting and power are supplied under the one scale. This is shewn under the section dealing with Tariffs.

Regarding the question of the formulae evolved for the connection fees and minimum charges for rural areas, the application is largely empiric, and very many cases were examined to establish the correctness of the constants. The calculation was, mathmetically, very simple but the process in achieving the constants was somewhat involved.

With reference to my point in assessing the size of the administration section of the Department, I would point out that I did emphasize that there should be normal efficiency and keenness, and under such circumstances work would not be shelved in preference to overtime work whether remunerative or non-remunerative. In any Administration the term "work" would entail consideration of both the routine and non-routine, and one would obviously have to assess the whole process with due regard to leave, sickness, and change of staff. By no means would I have it understood that such computation would be made without due regard to these factors. Regard would also have to be given to the amount of overtime and whether this was continual or intermittent. I would agree that any office which works no overtime may be highly efficient but I would suggest such a state of things is very rare. The general run, however, in the rough and tumble of power supply is, I feel, that most offices are called on for a modicum of overtime, however small, even if correctly staffed. Those who get away without it are luckier than the majority it has been my experience to work with in twenty-two years of public supply.

Regarding street lighting, I felt that this point would be raised by at least one of the delegates. It is something of a sore point with the staff of this Department. Owing to extreme pressure of work due to the necessity of providing essential supplies we have not been able to give the attention that we desire to street lighting work. We have, however, the matter very much in our minds and we hope, within the next twelve months, to make a radical change in the whole position. This point was mentioned in my paper.

With regard to Mr. Turnbull's remarks, the question of the lack of street lighting has already been dealt with in my reply to Mr. Kane. The types we are considering for provision in the City are fluorescent, cold cathode and mercury vapour, but the question still requires some thought before finalisation.

The street lighting mains are carried out in underground cable throughout the central area. In other areas, overhead mains are used, except where street configuration is complicated and the overhead mains are supported for the greater part on the poles that carry the street lighting brackets. It is not felt that the expense of hiding street lighting mains from public view is warranted in the purely domestic areas.

The form of the load growth curve in Bulawayo has given us a lot of thought and Mr. Milton may be correct in suggesting the use of an exponential curve in preference to a straight line. In my view, the factors that affect load in this City, such as rate of immigration, unexpected growth of Industry, unpredictable weather, are so uncertain that any exponential index that may be chosen might alter annually and completely vitiate the principle underlying this method. One can only make a considered guess at probabilities and trust that one achieves a figure which proves reasonable. We are, at present, in the course of carrying out a further survey of probable future expansion in conjunction with our commitments and when this has been concluded we shall, perhaps, be in a better position to make a positive statement.

Regarding the point about the "off peak" industrial tariff, the provision is that the demand imposed by the consumer during such nightly periods as shall be prescribed from time to time by the City Electrical Engineer and totalling not less than 8 hours daily is appreciably in excess of the monthly Demand at the times. Under these circumstances the consumer will be charged at half rates for the total demands during the prescribed periods and not for the excess demand over the peak demand. As the periods for "off peak" reduction are laid down as nightly periods in the Tariff and as they are to be as prescribed from time to time by the Engineer, they will obviously be after the normal evening peak. It is felt, however, that there is very little chance of a second major peak occuring in the small hours of the morning as only a minority of industries will be equipped to take advantage of the Tariff. It is felt, however, that it may result in a levelling up of the demand and a further improvement of Load Factor.

Regarding the formula for connection fees, this was derived from the study of the costs of many rural service connections and the results achieved are, of necessity, average ones. It has proved very effective here and, it is thought, could be applied anywhere with the application of different constants. The figure of 23% represents 23% on the costs of material. The point about the 30% surcharge has already been dealt with.

In reply to Mr. Stevens' remarks, our twin neutrals are earthed at every pole. As indicated in my reply to Mr. Kane, we have not had any difficulties with the Post Office as a result of this policy of multiple earthing, and it has been a standard practice for many years here.

Regarding the question of a common minimum charge this, of course, exists throughout the Municipal area, but it is thought that this would not be justified everywhere owing to the unduly divergent costs of supply to various consumers in other areas and to the revenue return from such consumers. It has always been our policy to base our connection fees and minimum charges on the cost of the work involved in each rural connection.

Regarding partition walls in Sub-stations, these are felt to be a most essential safeguard against fire risks, particularly in view of the present high cost of equipment. Also they ensure an added safeguard for operating personnel.

Regarding the cost of services, the average in the City is £16. The split neutral, or rather the extra wire of the arrangement, represents about £4 of this figure.

Both neutrals are bare wires, but they are fixed on the roof by means of insulators. This, however, is solely for convenience as they are connected to the twin main line neutrals which are also bare and earthed at every pole.

As already indicated, connection fees are related to the actual cost of making the connections, except in the Municipal area where a general average is struck for all domestic connections, and this answers Mr. Stevens' point about extended service lines.

I was very interested to hear Mr. Mitchell's remarks on loading per dwelling house, and to learn that in general he agreed with our figure. It certainly goes to show that Salisbury is developing as well as Bulawayo.

Now on the subject of Salisbury and Bulawayo, I feel sure that we all have skeletons in our cupboards, the doors of which are normally kept closed. Mr. Mitchell has, however, opened my cupboard door. I must confess that I did work in Salisbury for a short time some years ago, but I was young then and had not heard of Bulawayo. However,

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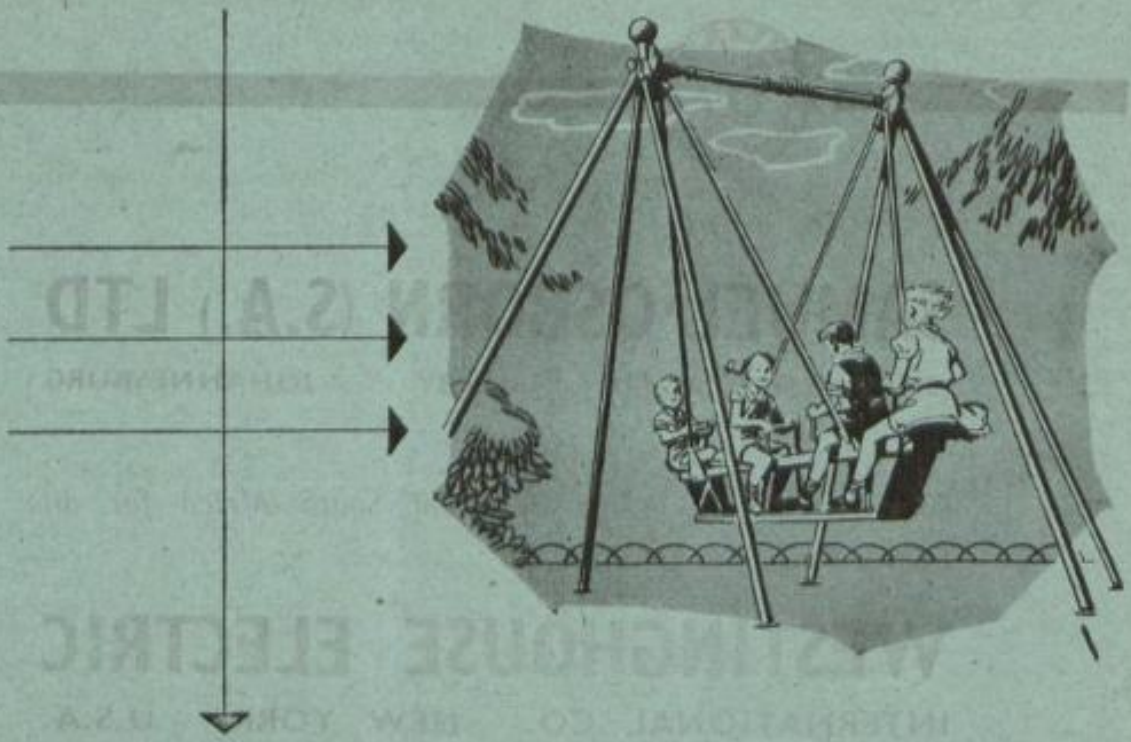

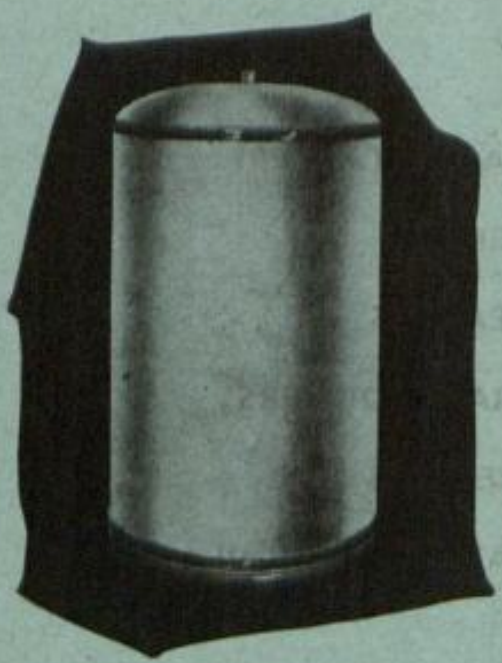

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joking apart, I would like to thank Mr. Mitchell very much indeed for his remarks about my paper; coming from him they are doubly appreciated.

I would like to thank Mr. van der Walt for his kind remarks about my paper.

The demand of the Native population was included in the peak analysis under the heading "Municipal Supplies". The Natives in Bulawayo are becoming electricity conscious and under the latest Native Housing Schemes provisions are being made to have rather more facilities than exist at present, namely lights and one ironing plug per house.

The twin earth wires above an E.H.T. line have, in our view, proved efficacious against outages due to lighting.

Regarding our Cooking and Heating Tariff, this is normally applied to such establishments as restaurants, cafes, etc. which are not large enough to take the licensed Hotel Tariff, in addition, of course, to all business establishments for space heating, etc. The water heater section is of use in building up our off peak load and helps to provide that load factor referred to by another speaker. Regarding our room Tariff, we do not find it cumbersome to administer checks, as additions are kept quite easily by our Meter Readers and by inspection of the Building Section of the City Engineer's Department.

Three basic tariffs would be ideal and I must admit greatly simplify accounting, but with our complex and diverse types of load administration of them might prove difficult. However, Mr. van der Walt's remarks have certainly provided food for thought. Rural distribution may or may not pay in the first instance, but we have found that when distributors appear in new areas those areas very soon become built up and yield a satisfactory return.

With regard to Mr. Foden's remarks, the Sub-station shown is actually a switching station, and this is the type we normally employ for a major type of Sub-station housing transformers, E.H.T. switchgear and L.T. switchgear. The cost of the building is of the order of £800.

We have found some difficulty with steel kiosks here owing to ventilation problems. Small brick kiosks, of the size and pattern of the steel kiosks, however, are used in urban areas where the major Sub-stations are not warrented, and these cost about £450 plus the cost of switchgear and transformer.

I am sorry I have no figures readily available for comparative costs of steel kiosks as it is a long time since we imported any.

In reply to Mr. Burton's remarks, the figure of 2·4 kVA per dwelling house was an average figure obtained by taking readings at morning and evening peak periods. The evening peak in winter is somewhat higher, approaching 3 kVA per dwelling house, but is of very short duration and would be uneconomic if used as a basis for transformer or cable capacity, particularly with the lower ambient temperatures of winter.

I was very glad to note that Mr. Milton did not design Mr. Muller's Sub-stations, and it was interesting to see that Mr. Muller agreed with our average loading figure per dwelling house. The figure was actually derived by ascertaining the loading on the feeders at several Sub-stations in the domestic areas at peak periods and averaging the results. As has already been pointed out by our Mayor, electricity is very widely used in Bulawayo.

I note that Mr. Muller has derived satisfactory results from the use of miniature circuit-breakers, and this has been our experience generally here, as indicated to Mr. Kane.

If by "space heating" Mr. Muller means some form of central heating or air-conditioning, this is a form of load which, so far, has not been experienced appreciably in Bualwayo. I can well believe it could be very undesirable from the Electricity Supply angle, and I feel that if supply were required for such a demand here it would appear necessary to put forward a special tariff.

Due to the high capital cost of such equipment and its very limited application in Bulawayo, it is, however, unlikely to develop into much of a problem, though I can imagine it doing so in Bloemfontein.

PRESIDENT:

I would like to take the opportunity of saying for the benefit of Mr. Milton, who was quite justifiably concerned about

this off-peak tariff. The position is that this half maximum demand charge for off-peak load relates only to a maximum of eight hours per day, and those hours would never be outside of the hours of darkness. At the moment they start roughly about 9 p.m., finishing round about 6 a.m. There will never be any chance of that tariff being applied during any hours of daylight at all, and I think it is extremely improbable that during my lifetime we shall ever reach the stage where our peak loads occur at 2 a.m., so I think we are fairly safe in adopting that traiff and in not interfering materially with its hours of application in the future. We might move it an hour forward or back, but not more.

I would like to thank you, on Mr. Redman's behalf, for your contributions to the discussion on his paper, and I want on your behalf to express our thanks to Mr. Redman for the work he has done in preparing this paper—and I know better than anybody what it has meant in these times of stress.

Now, are there any further contributions to the discussion on Mr. Buchanan's paper?

Mr. J. C. DOWNEY (Springs):

Mr. President, Gentlemen: I think that Rhodesia's traditional complaint—from which we have all suffered again this time—is that they do not give you enough time to sleep, and I think many of us could by this time go to sleep standing up. Unfortunately, I did not have the opportunity of seeing either Mr. Redman's or Mr. Buchanan's paper before arriving here, and since arriving I have only been able to glance at them. Perhaps I may be allowed to contribute in writing to the discussion on Mr. Redman's Paper.

I would like, however, at this stage to make one or two points on Mr. Buchanan's Paper. I think as far as switchgear is concerned some of us have been living in a fool's paradise, and I should like to congratulate Mr. Buchanan on bringing forward a subject that is so vital and will become more vital to the small undertakings as they begin to grow. You start off with a small plant and your rupturing capacity is exceedingly low. As your system grows you find your cables unable to meet the demands of bulk supply and your old system requires to be re-designed. We have increased the size of our feeder cables, and re-designed and re-orientated the whole of our system. Even so, we have still some problems that we do not know how to overcome, because we are trying to avoid replacing cables with larger sizes.

There are a few questions I would like to put to Mr. Buchanan, not necessarily to be answered now. I would like to know the reason for the inherent tendencies revealed in the tests with the breakers; the reason for the tendency for the exclusion of oil from circuit breaker tanks. I think a chart depicting this would be useful as an addition to the paper. I should also like an explanation of the graph from A to G. I think that would help members who do not specialise in this sort of thing.

Not having had time to study this paper, one is at a great disadvantage in understanding it. However, it will give us much food for thought when we can get down to a study of the paper. It is a subject which we cannot overlook; it is becoming more important to all of us every day.

PRESIDENT:

Are there any other contributions before I call on Mr. Buchanan to reply. Whatever verbal replies are given will be amplified in written form, after further written contributions have been made.

MR. E. L. BUCHANAN'S REPLIES TO COMMENTS ON HIS PAPER

(Communicated)

In reply to Mr. Halle, Pietermaritzburg.

1. Effect of Wave Form

Although it may not be possible, or at least extremely difficult to eliminate, Harmonics of any magnitude should not be countenanced on any system, and that is the reason why, during tests on switch gear, harmonics is eliminated to an extent where the tolerance between a sinusoidal wave and that of a displaced or distorted wave due to Harmonic influence is extremely close, so that if any Harmonics would be present the effect of such would be negligible.

Third harmonic circulates wattless power through a delta winding causing unnecessary losses and heating, whilst a fifth harmonic introduces a peaked wave reducing the factor of safety on insulation, and frequently

causes trouble of interference on telephone lines running parallel to power lines.

The question raised as to the effect on switch gear, when Harmonics is present, is an extremely difficult one to answer with any degree of accuracy, and the only explanation must therefore be of a general nature, by considering broadly (*a*) a Superimposed third Harmonic and (*b*) a superimposed fifth Harmonic. As already stated, all tests taken by manufacturers at their works are made with a wave form, as close as possible to the fundamental in order to obtain true comparisons of performance.

If Harmonics were to be imposed for the purpose of testing, tests would have to be frequently repeated with different magnitudes of Harmonic, since the form of the fundamental will be distorted in different ways depending on whether the imposed harmonic is in opposition, in phase or out of phase.

It is well known that a third Harmonic in opposition produces a peaked wave, a third Harmonic in phase produces a more or less symmetrical flat topped wave, while a third Harmonic out of phase gives a considerably distorted wave, and the type of wave described by Mr. Hallé would appear, from the description, if one could conjure up a picture of a dromedary with rheumatism, the story the picture would tell should, I think bring one to the conclusion that the wave contained both odd and even Harmonics.

(*a*) If now a possible third Harmonic is considered, this will have the effect of increasing the initial rate of rise of recovery voltage, compared with the true sine wave, but here the peak value is reduced, and this will result in imposing a more arduous condition during breaking, but on making, the maximum asymetrical value would be somewhat less than that obtained without Harmonics.

(*b*) With a negative third Harmonic, that is, with the third Harmonic out of phase by half a third Harmonic cycle, the above conditions are reversed in as much as that the rate of rise of recovery voltage is much lower at the commencement, but if the circuit is not interrupted early it will assume a high rate later in the cycle, but, on the other hand there is a longer period when the current is near zero, and this under a condition of rupturing under in phase conditions would ease the duty of the circuit breaker.

(*c*) Under conditions of a fifth harmonic the same argument will hold good.

The initial rate of rise of recovery voltage is greater, but this eases off rather quickly, although the peak value of restriking voltage remains higher, and there may, therefore, be the danger of prolonging restriking if the breaker is operating at or near its upper limit.

As was pointed out in the paper, the performance of a circuit breaker is largely determined by the rate of rise of recovery voltage and by the speed of breaking, and that the rate of rise of recovery voltage is determined by the circuit characteristics viz L. R. and C. of the circuit to be interrupted, the explanation given, although being a rather broad one will indicate that with the presence of Harmonic the severity of duty imposed on a breaker imposes a definite degree of danger.

However, considering the conditions on distribution systems which increase the dangers on circuit breaker performance, much can be said for the thoroughness in design and testing of modern high speed circuit breakers, since, notwithstanding all the severity imposed, the circuit breaker of today, if wisely chosen for the duty they are expected to perform, undoubtedly possess a very high factor of safety.

In reply to Mr. van der Walt (Krugersdorp)

From this discussion two points arise which, although not calling for clarification, I consider worth giving a broad outline of, these are:—

1. Difference Between British and Continental practice:

In assessing the breaking duty that may be imposed on a circuit breaker it is universal practice to base this duty on the calculated R.M.S. value of the initial symmetrical short circuit current at the point in the system where the breaker is to be located.

British and continental practice, in determining the capacity of a circuit breaker differ.

This difference is shown clearly in the methods used for computing the imposed breaking duty from the Oscillograms obtained during short circuit test.

The continental designers argue that because the duty in service is determined in terms of the symmetrical short circuit current, ignoring asymmetry, the breaking capacity should similarly be based on the value of the symmetrical current alone as given by the test oscillogram and that the d.c. component present in the actual current broken should be ignored. The argument appears sound, but loses its force when it is appreciated that up till now it has been continental practice to use time-delay relays so as to take advantage of current decrease and so make use of a smaller breaker. Consequently their circuit breakers have not been called upon in service to interrupt short circuit currents in which there was any asymmetry.

When testing there is often appreciable asymmetry in the current broken. British practice rely on the contention that the capacity of a breaker to interrupt a given R.M.S. current at a certain voltage does not depend upon whether the current in question is symmetrical or asymmetrical, but solely on its R.M.S. as a measure of distress. If in practice a breaker open only after say 5 cycles, has to deal with current in which asymmetry has disappeared it is of no significance to ignore asymmetry under such conditions. The R.M.S. value alone has significance in this connection providing the R.M.S. value is not so great as to reduce materially the value of the active recovery voltage. Hitherto continental engineers have ignored the d.c. component, while British practice takes full account of the asymmetrical current successfully broken. Continental manufacturers contend that British ratings are fictitiously high compared with continental ratings. It is often suggested by continental manufacturers that the British 3 phase rating capacities would be 50% high because this is the ratio between the R.M.S. asymmetrical and symmetrical currents during the first half cycle in a fully off set phase. Full asymmetry can only occur in one phase whilst the A.C. component falls rapidly with time.

In pratical testing the performance value derived in accordance with BSS 116-1929 would not be in excess of 10/15% higher than continental rules. Continental test practice deliberately eliminates the d.c. component before contact separation.

2. The Turbulator Arc Control Device:

This type of arc control device consists chiefly of an insulated chamber with a series of slot ventilation apertures .

The number of plates comprising this built up arc control pot, is chiefly dependent on the system voltge, and the number and area of the vents is proportioned to the fault current to be controlled.

At the instant of the contacts parting the arc is drawn, or trapped in what amounts to an almost closed chamber, resulting in part of the oil in the chamber being vapourised and pressure set up.

In the downward motion of the contacts arcing takes place in front of the vents, and by virtue of magnetic inserts the arc is drawn downwards in the turbulator against the vents and sealing the enclosure during the period of arcing.

The gases generated are ejected through the arc path at high velocity, followed by cooler gas which turbulently cools and de-ionises the arc path.

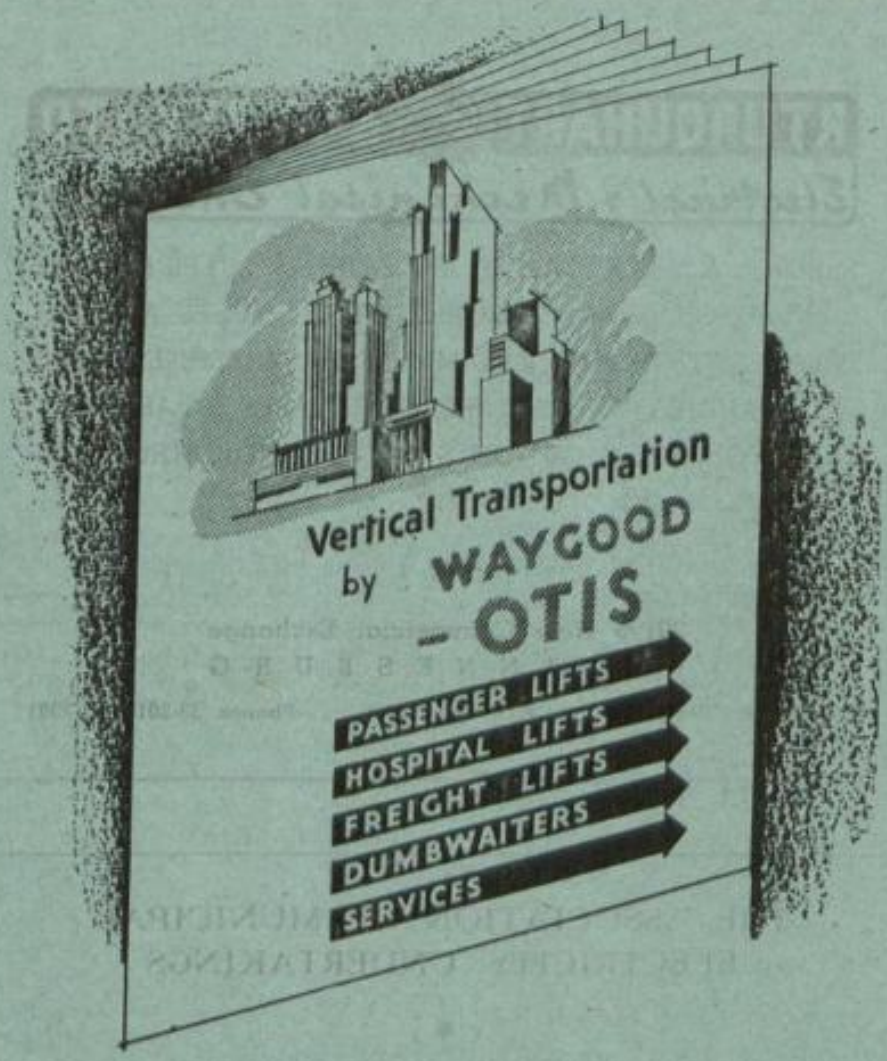
A repetition of this ejection which takes place at each current zero finally extinguishes the arc before the moving electrode clears the Turbulator.

3. Speed of Breaking:

The fact that faster speed of breaking was mentioned in order to increase the effectiveness of a circuit breaker to deal with fault conditions, was not intended to convey that ever increased speeds should be aimed at in design.

The remarks made on arc suppression and control regarding the restriking of the arc is pertinent to this. On page 26 of the paper under Low oil volume Switch gear it was mentioned that during the first half cycle the breaking action is rapid while during the latter part of the cycle the breaker is slowed down to eliminate arc drawing.

What was therefore intended to be conveyed but not specifically stated, was, that the faster the breaker could be made to function at the instant of faulting, e.g. if mechanical friction and other resisting forces could be reduced so as to eliminate



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to a greater extent the inherent time lag of a circuit breaker, the more effective would be its capacity of interrupting a fault.

4. Arc Interruption Phenomena:

The point raised on this, regarding electro physics is a very complex one, and any reply or discussion would mean going into a matter on which much research is still to be done before agreement on all the factors involved is reached.

Similarly, the application of capacity across the contacts of a circuit breaker in order to reduce the current to zero prior to the contacts parting is still in the stages of investigation. This method has found application on light current switch gear, but on the larger types it becomes difficult to provide accommodation for condensers and discharge resistances, and increases costs considerably. Much research will still be necessary before this type of switching can be applied to the larger type of Breakers. It is considered that capacity and resistance switching has advantages such as reducing the rate of rise of recovery voltage on the smaller current ranges.

It is possible by its application to use larger vent apertures to relieve the internal pressure rises, and thereby increasing the short circuit current rating of the circuit breaker.

There is also the possibility of reducing current chopping voltages, and the severity of restrikes, although not eliminated, can be reduced when switching long unloaded transmission lines. Against these advantages may be mentioned the disadvantages:—

The difficulties of accommodating the resistors and condensers, the hazard of the resistors failing, the need for provision of increased clearances for the resistor break, and on short lines, the sharp rise in pressure in the circuit breaker tank instead of in the arc control pots, and in addition there is the increased cost.

When applied to air blast switch gear this type of switching may be of greater value, but it is considered that there is an upper limit, dominated by the rate of rise of recovery voltage.

Modern high speed high voltage circuit breakers are today so well designed and thoroughly tested that all normal demands on systems can be met by a non capacity, or non resistance switched circuit breaker.

In reply to Mr. Downey (Springs)

1. Exclusion of Oil from Switch Gear:

It might be said that there are several reasons for the tendency to exclude oil from switch gear, and amongst the reasons advanced are, Fire hazard, costs, and the reduction in overall size and weight of switch gear.

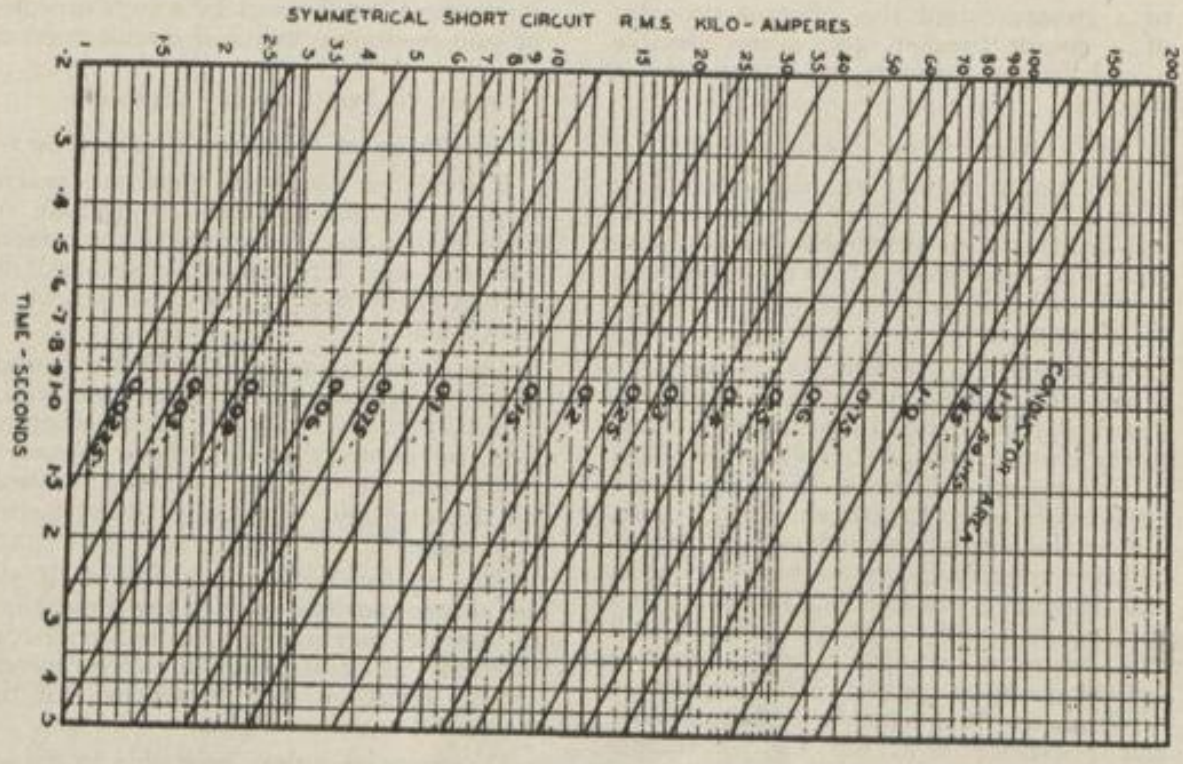
The development of the "De-ion" Stack which really is a scientific name given to the various types of Baffle pots or arc suppression or control devices, have played a major part in the consideration towards oil decrease and elimination from Switch gear tanks.

The almost universal adoption of the arc control pot has enabled the dimensions of circuit breakers to be reduced considerably, as the total volume of oil has no serious effect on the performance of the individual arc control pots.

Designers have thus been able to reduce the overall dimensions of the oil containers and this reduction has consequently led to the development of the Low oil column Switch gear, and has contributed much towards air blast Switch gear.

In order to provide short arcing times—and at the same time smooth current interruption at a natural current zero, the British Electrical Research Association developed and patented an explosion pot on the side blast baffle principle which produced better controlled arcing on each set of arcing electrodes. The operation of this side blast baffle pot is shown more fully on Fig. 4. Subsequently many English and many foreign Circuit Breaker designers have utilised this patent, and have further developed their own modifications to this to suit their particular designs and requirements. The explosion pot consists principally of an arcing chamber not in direct hydraulic communication with the main volume of oil, and below this a stack of hard fibre plates arranged to direct jets of non-ionized gas or oil across the arc column, thus providing a high degree of turbulence and a greater de-ionising force at current zero.

In the case of 3-phase, double break oil circuit breakers, six arcs are actually



produced at each circuit interruption, and one of the most important effects of the use of this side blast baffle pot is to control each arc individually, and to prevent the interaction of forces created by the various arcs on each other, which occurs particularly in the single tank 3-phase, plain break oil circuit breaker.

A comparable development, originally by the American Westinghouse Company, utilises the principle of the explosion pot, but in this case the hard fibre plates stack is entirely open on one side and incorporates magnetic material which, in acting on the arc inside the narrow slot in the stack, produces greater turbulence and tends to force non-ionised gas into the arc column at current zero. It must be emphasized that in both the above arc control devices, it is important that the arc is extinguished before the moving electrode passes outside the pot as otherwise, the action would become comparable to the plain break oil circuit breaker and arcing inter-action, higher pressure rises, and consequent possible failure of the circuit breaker would arise.

With correctly proportioned arc control pots very consistent operating results are obtained with short arc lengths and times, and reduction in the peak pressure wave on the circuit breaker tank. Steady hydrostatic pressures in the smaller oil tanks on arc control pot circuit breakers are comparable to the steady hydrostatic pressure experienced by plain break circuit breakers of similar capacity, but the instantaneous peak pressure on the arc control pot tank is generally lower.

It follows that without arc control pots the mechanical stress imposed upon the circuit breaker structure is greater when opening on maximum fault conditions. A peak pressure wave is transmitted from the open arc in a plain break oil circuit breaker direct to the tank walls. This pressure wave is attenuated throughout its transmission from the arc column to the tank walls, but it is nevertheless of sufficiently high value, particularly in view of the high rate of rise, that very great care has to be taken in designing the shape of the oil tank and its method of securing to the circuit breaker top plate.

In the plain break oil circuit breaker it has been found necessary to provide a minimum head of oil above the break in order to provide a sufficient static pressure

on the arc column, and to reduce to some extent the violent oil disturbance which occurs under arcing conditions. With the arc control pot design where no external arcing occurs, the function of oil in the container is largely to provide replacement oil for that cracked during arcing, and also to provide the necessary insulation between exposed metal parts on different phases.

Theoretically it is possible to produce a circuit breaker with no other oil required than that contained inside the arc control pot and, in fact, designs have been produced which took maximum advantage of this principle, and only provided a very small additional quantity of make-up oil. Circuit breakers of this type are generally known as "live tank oil circuit breakers" as the small oil container is carried on the phase insulator and obviously cannot be earthed. Its use is largely for higher voltage outdoor installations, but as there are other difficulties found principally in connection with the accommodation of current transformers, it has not found universal acceptance. The fact that well designed arc control pots do not require additional oil for their operation does, however, ensure that these can be accommodated in an oil tank, the dimensions of which are slightly limited by the necessity for clearance between live metal and an earthed container. The consequent reduction in the overall dimensions of the oil circuit breaker has enabled switchgear units of smaller dimensions to be produced. It has also been considered that the reduced oil container has had a consequent reduction in the fire risk but this is a doubtful advantage, as a properly designed and tested oil circuit breaker should not fail with sufficient violence to become a fire hazard. Analising all fires created by switchgear failures shows quite clearly that with modern tested switchgear, the fire hazard from the oil container in the switchgear is less than the fire hazard from the explosive violence of circuit breaker failure, whether the circuit breaker is oil filled or air insulated.

It is perhaps significant to point out that the greatest pressure for the exclusion of oil from Switchgear emanates from those countries where testing facilities of the type referred to earlier in this paper, are not commonly available to manufacturers.

With the development of low oil volume circuit breakers incorporating arc control pots, the more consistent short arcing times in conjunction with the high speed protective gear have enabled rapid interruption under fault conditions to be provided. This rapid interruption provides considerable reduction in the system disturbance of interconnected networks and avoids synchronous machinery falling out of step.

With the greater amount of research and the results obtained in the phenomena occurring at arc extinction, attention was focussed on other means of providing non-ionised gas into the arc column at current zero. This led to the development of a circuit breaker which provided a blast of non-ionised dry air across or through the arc column, and is known generally as an "air blast circuit breaker." The additional pneumatic equipment on compressors, air vessels, air valves etc., together with its particular performance, have made this development only really suitable for higher voltage operation with higher fault powers.

It may be added that air blast circuit breakers have an inherent tendency to produce high restriking voltages and switching transients. This is due to the short arcing time and quick recovery of Electric strength. Arcing times of one half cycle or less being obtained.

Elsewhere in the paper it was pointed out that this transient is determined by the circuit characteristic but this transient can also be modified by the circuit breaker itself. These over voltages by a circuit breaker are very similar to that of the H.R.C. fuse in which "cut off" occurs, that is current interruption at a point other than the natural zero pauses. This is known as current chopping and is evidenced where an air blast circuit breaker deals with low values of current such as Transformer Magnetising currents and line charging currents. Current chopping can only be taken care of in the design of the circuit breaker, but the sensitiveness to restriking voltage can be modified by the use of resistance switching, this involves the use of external resistances connected to shunt the main contact gap and are automatically connected in the circuit by the arc transferring to a probe.

Resistance switching is not employed on all air blast circuit breakers. In the

design known as axial blast it is employed but in the cross blast it is less frequently employed.

The main difference between these two types is that in the axial Blast circuit breaker the air stream is in line with the arc and envelopes the moving contact as it parts from the fixed contact.

In the cross blast circuit breaker the air stream is at right angles to the arc, and by means of the arc chute is lengthened and cut into a series of short arcs.

2. The explanation desired on the oscillograms sheets A to G is fully given in an addition to the paper together with an analysis of the oscillograms figs. IV and V, as well as a full explanation on the method of recording.

I would therefore ask Mr. Downey to refer to the corrected paper where these explanations will be found.

3. Fault Capacity of Cables:

In the paper it was stressed that consideration must be given to the effect of cable impedance on limiting fault values, since this plays an important part in determining the rupturing capacity of switch gear required for a specific duty.

However, when selecting cables, it is by no means sufficient to determine on safe current carrying capacity alone the cross-sectional area required.

Having determined the fault MVA which might result with a certain plant capacity capable of feeding the fault, it is essential to consider whether the cable chosen is capable of sustaining the full fault current for the period within which the protective relays will function.

After having computed the fault value, having taken account of all factors capable of limiting the fault, there are other considerations of vital importance, these are, temperature rise, electro magnetic stresses between conductors, Mechanical stress due to rapid expansion and contraction, carrying capacity of lead sheath and type of armouring.

The general accepted temperature rise for cables is 50° cent., this rise is considered to be above an ambient temperature of 70° cent., and cable manufacturers give a safe current carrying capacity at some definite temperature, and state the limits of thermal rise within which the capacity of a stated current will not be impaired.

At higher temperature rises correction factors are employed to give the corresponding current carrying capacity.

Electro Magnetic stress which acts on the conductors, particularly when phase to phase faults develop, tends to distort the conductor and attractive or repulsive forces either bruises insulation or burst the cable apart, consequently the application of the lead sheath and the armouring play a vital part not only as a protective measure but also has a marked effect on the carrying capacity, and on the mechanical strength of the cable against whipping and torsion.

The carrying capacity of the lead sheath is mainly considered in earth fault current, and often it may be necessary to give serious consideration to this aspect, since earth faults may well be the dominating factor, particularly since in practice this latter type of fault is the most common.

The fault capacity of cables may thus be defined as the largest current the cable is capable of carrying under fault conditions for a short period, and the short period is the time lag from the instant of faulting, until the circuit breaker clears the fault, hence the necessity of employing protective relays, not only for circuit breaker protection, but for the protection of the interconnected cables as well.

Just as the Rupturing capacity of switch gear must be seriously considered if continuity of supply is to be maintained, so too is it absolutely essential to consider the fault capacity of cables, as the adequacy of such capacity plays as vital a part in any system as the plant feeding it.

Under fault conditions it is therefore essential to determine the current in amperes that will flow, and to know the time lags between faulting and interruption of the circuit, and from graphs prepared and issued by cable manufacturers and testing authorities the size of cable may be determined for a given duty.

A graph showing fault currents in R.M.S. Kilo amps against time in seconds, for a particular cross-sectional area is given on page 152.

PRESIDENT:

I would like to endorse the remarks of other speakers in expressing your thanks to Mr. Buchanan for this extremely valuable Paper—valuable more, I think, in retrospect than in the actual hearing of it. The information this Paper contains is all available in various places if we have the time to look for it, but this is the first time that so much important information about this subject has been correlated, put together in one place ready for our easy reference, and we are all indebted to Mr. Buchanan for it.

(Tea Interval.)

PRESIDENT:

There are one or two remaining items of business before we wind-up. One of them is the appointment of auditors.

Mr. BRADLEY:

Mr. President: It is my privilege and pleasure to nominate that the present Auditors be commissioned again for the incoming year. (*Duly seconded and agreed to.*)

PRESIDENT:

I announced that the representative on the Coal Priorities Committee would be Mr. C. G. Downie, Cape Town, with Mr. J. C. Fraser as alternate. Mr. Fraser may be away a good deal, so it is suggested that Mr. Hugo act as alternate in his place. (*Agreed.*)

You will remember that the Cape Town Convention Sub-Committee for the Promulgation of Electrical Wiring Regulations was nominated with representation by each Province and Rhodesia, and consisted of Mr. G. J. Muller, Mr. C. Kinsman, Mr. J. C. Fraser, Mr. J. C. Downey as Convenor and Mr. C. G. Downie and myself. The Executive suggests that that same committee should carry on in the next year on the subject of the promulgation of the Electrical Wiring Regulations. Concerning the promulgation of regulations, you will be aware that there is some delay in getting this done. The re-drafted regulations were available to us at our Cape Town Convention—or a few copies were—dated May 1951, but they have not yet been made available for promulgation owing to the fact that the Afrikaans section has not yet been published. The action suggested by your Executive to expedite this matter is that the representatives in each Province follow up with their Provincial Administrations the approach which has been made and we hope will be made by the Institution of Electrical Engineers to those Provincial Administrations to have the Afrikaans translation which has been done by the South African Bureau of Standards accepted universally throughout the country. As soon as that has been done the Afrikaans version can then be published, and it will be possible for the regulations *in toto* to be promulgated by anyone who wishes to do so; and, as you know, there is a considerable economy in effecting what is called group promulgation of such regulations. The gentlemen whose names I read out will take responsibility in their Provinces for seeing that this matter is expedited and will acquaint members with the progress that is made in that connection.

As far as Rhodesia is concerned, we are busy in this country drafting what we hope will be uniform wiring regulations which will be acceptable to all municipalities, and I am glad to say the Electricity Supply Commission as well, and probably the Public Works Department of this country. That work is proceeding, and we have discussed the extent to which the regulations in Southern Rhodesia can be made uniform with those promulgated later in the Union, and that matter is being actively pursued. Mr. Mitchell in Salisbury has done a lot of work in preparing the regulations to be used in this country, and he and I and other representatives of Southern Rhodesia municipalities will be getting together to see to what extent we can bring the two together and avoid variations where such variations are not necessary or not very important. So that is the position as it stands in regard to both territories represented here. It is hoped that in the Union the position will have been ironed out by the time the next Convention is held, and I think there is a reasonable chance that in Rhodesia we may achieve uniformity by the same time. Does anybody wish to make any remarks on the subject of the promulgation of wiring regulations?

Mr. F. STEVENS (Ladysmith):

Mr. President: It is not on the promulgation that I wish to speak but in connection

with the standard wiring regulations themselves. In connection with the Regulation No. 303 of the second edition of the Wiring Regulations, could we have an expression of opinion from the A.M.E.U. on the temperature limitation of 115° F. for VRI and PVC cable, as it is known that this temperature is exceeded in the roof space beneath corrugated iron, at any rate in Natal.

PRESIDENT:

Could Mr. Perrow answer that question?

Mr. E. V. PERROW (Chairman of the Safety Precautions Committee)

The regulation was copied from the regulations of the Institution of Electrical Engineers, London, and has not yet been modified to suit local conditions. Probably there will be an amendment to it when the next edition of the regulations is printed.

Mr. R. W. KANE (Johannesburg):

I think it is only fair to point out that the first edition refers to a temperature condition of 115° and I do not think there were any complaints about it, and the only alteration in the second edition is, I think, to include the PVC and conditions where the temperature is the same as the VRI.

REGISTRATION OF ELECTRICAL CONTRACTORS

PRESIDENT:

Now, another point to which I want to draw your attention is the proposals for the registration of electrical contractors, and I will ask Mr. Ivey to say a few words on that subject.

Mr. E. G. IVEY (Cape Town):

I would like to say at the outset, Mr. President, that I am here under somewhat false pretences. Mr. Chris Downie, the City Electrical Engineer of Cape Town, would normally have been here, but, as you know, we are having a spot of bother with load-shedding, and troubles in Cape Town generally, and he felt he could not get away, so I take this opportunity of expressing his apologies and his disappointment at not being here.

In regard to the registration of electrical wiring contractors, the following resolution was adopted by the Executive Committee at its meeting on 16th November, 1951: "That Mr. Downie be requested to submit a draft set of regulations pertaining to the registration of electrical wiring contractors, together with a memorandum incorporating the views on this matter submitted by various members of the Executive, and that a copy thereof be forwarded to each member of the Executive". This draft regulation has been prepared by Mr. Downie and has been submitted to the Executive, and our comments have been incorporated in a further memorandum on the subject which is available for circulation, and which I think has been circulated. Perhaps members would be good enough to make such comments as they wish in regard to this regulation and let the secretary have them before the next Executive meeting.

COAL SUPPLIES

While I am on my feet I would like to deal with another matter Mr. Downie asked me to bring up and to which Mr. Bradley has already made reference. As you know, Mr. Downie has been nominated the United Municipal Executive representative to represent power stations on the Coal Allocations Priority Committee, and he would like to receive from all members who operate coal-burning stations sufficient data to enable him to make an adequate representation on their behalf when attending meetings of this committee. The particulars which would prove most useful are: the type of boilers used, the type of coal received—that is the grading and calorific value—whether the coal received can be burnt efficiently; and particulars of the time taken for the transit of coal from the mine to the power station. In Cape Town we utilise standard log sheets and it is thought it would be helpful if copies of these log sheets are circulated to all concerned, with the suggestion that the information required by Mr. Downie should be submitted in some standard form. I have copies of these log sheets here and can make them available to any body interested, and will be only too pleased to transmit them as required.

PRESIDENT:

I think it is Mr. Downie's intention actually to write to each of the municipalities

with coal burning power stations, sending them one copy of this form and suggesting they make use of it, if they wish, in the form of weekly returns, keeping Mr. Downie acquainted with the position. That is Mr. Downie's intention, I believe?

Mr. IVEY:

Yes.

OVERHEAD LINES—CODE OF PRACTICE

PRESIDENT:

Now, the question of codes of practice for overhead lines, and the divergences between them and the Factories Act, has been discussed by the Executive, and I will ask Mr. Kane to make some comments on it.

Mr. R. W. KANE (Johannesburg):

Mr. President, and Gentlemen: Your Executive considered this morning a request from the Rand Municipal Electrical Engineers concerning certain difficulties in the regulations on overhead lines. You will all recollect that there was a code of practice introduced by the South African Institute of Electrical Engineers, and this code varies in certain aspects from the regulations published under the Factories Act. We should like to hear Mr. Smit's views on the possibilities of local inspectors accepting the code in so far as they could grant exemptions to the regulations of the Factories Act, or alternatively whether any thought could be given to amending the regulations of the Factories Act to bring them into line with the code of practice.

Mr. R. N. F. SMIT (Pretoria):

Mr. President and Gentlemen: I can promise you that your complaint will be fully investigated as soon as I get back to Pretoria, and also that whenever the regulations are amended due consideration will be given to the point of bringing the regulations into line with the code of practice.

SALARY SCALES

PRESIDENT:

You will recall that at a Convention some years ago, as a result of representations made by certain of the smaller councils, this conference drew up a schedule concerning the salaries of engineers to enable them to be in possession of information where they sought the guidance of this Association. That was some years ago, and the Executive has been considering this matter again, and I would ask Mr. van der Walt to make a statement.

Mr. J. L. VAN DER WALT (Krugersdorp):

Mr. President, Ladies and Gentlemen: It was as early as 1944 at Johannesburg that the subject of salary scales was first introduced. The opinion was expressed at that Convention that although your Association was an Association of undertakings and not a professional engineers' Association, it was quite in order to lay down a scale of salaries for engineers of electrical undertakings as a recommendation and a guide to councils. This was welcomed by both councillor members and engineer members. The sub-committee considered the old scale that was recommended at Durban and accepted, and it is felt that some change is necessary.

SALARY SCALES

At Bulawayo a statement was made to the effect that the report of the sub-committee on the salary scales recommended at Durban in 1947, would be printed in the proceedings. The sub-committee wishes to report as follows:—

It was as early as 1944 at Johannesburg that the subject of salary scales was first introduced. The opinion was expressed at that convention, that, although your Association was an Association of Undertakings and not a professional Engineers Association, it was quite in order to lay down a scale of salaries for Engineers of Electrical Undertakings *as a recommendation and guide to Councils.* This was welcomed by both Councillor Members and Engineer Members.

A recommended scale was adopted at the Durban Convention in 1947.

Your Executive Council is of the opinion that the recommended schedule is out of date and needs revision for the following reasons:—

(1) Since 1947, a large number of Municipalities have had a regrading scheme, raising salaries of all officials.

(2) Increased legislation has added considerable extra responsibilities to the Chief Engineer.

(3) Heavy industrialisation throughout the country is a large contributing factor of added responsibilities to the Chief Engineer, requiring high technical skill.

(4) The possibility of Councils taking this out of date schedule as a guide to determine the salaries.

A sub-committee consisting of Messrs. J. C. Fraser, D. J. Hugo and J. L. v. d. Walt was formed to review the 1947 recommendation. After careful consideration, the sub-committee came to the conclusion that the method of fixing the salary could not be improved upon, but that the schedule should be amended, and further, it should be reviewed annually to keep trend with prevailing conditions.

The recommended scale of salaries is as follows:—

1. *Interpretation*

The following expressions have the meaning assigned to them:—

(*a*) "Supply Authority" means a municipal, borough, town or village council, village management board, town board, local board or health board, constituted in accordance with any law and authorised to supply electricity.

(*b*) "Chief Electrical Engineer" means an engineer employed by a supply authority as defined in sub-clause (*a*) hereof, and responsible to this authority for the management of the electricity undertaking and the direction and control of the technical and all other staff of the undertaking.

(*c*) "Chief Electrical Engineer" may also be known in so far as municipal electricity supply undertakings are concerned as City Electrical Engineer, Borough Electrical Engineer, Manager of Electricity Department, Town Electrical Engineer, Municipal Electrical Engineer.

2. *Salaries to be Determined by Schedule*

The salary of a Chief Electrical Engineer, excluding all allowances, should not be less than the relevant salary shown on the Schedule annexed, subject to the provisions hereinafter appearing.

3. *Definition of Unit Assessment*

"Unit Assessment" means the total number of units sold per annum less 25 per cent of any units purchased in bulk by the supply authority.

4. *Increments by Stages*

Where on the coming into operation of this schedule of salaries payment of a salary in accordance with the schedule hereto involves an increase (hereinafter called the "initial increase") of more than one hundred pounds per annum upon the salary paid immediately prior to the coming into operation of this agreement the undertaker should have the option of paying the initial increase by annual increments which should not be less than one hundred pounds per annum except in relation to any final increment which may not amount to one hundred pounds per annum.

Provided that this clause should have no application to a variation of salary which may be due in respect of each annual ascertainment of the unit assessment, the intention being that the initial increase only should be subject to this clause.

5. *New Appointments*

On the appointment of a Chief Electrical Engineer, the undertaker should have the option of paying a salary of 85 per cent of the scheduled salary for one year, 92 per cent of the scheduled salary for one year and at the commencement of the third year the full salary should be paid.

6. *Protection of Present Holders*

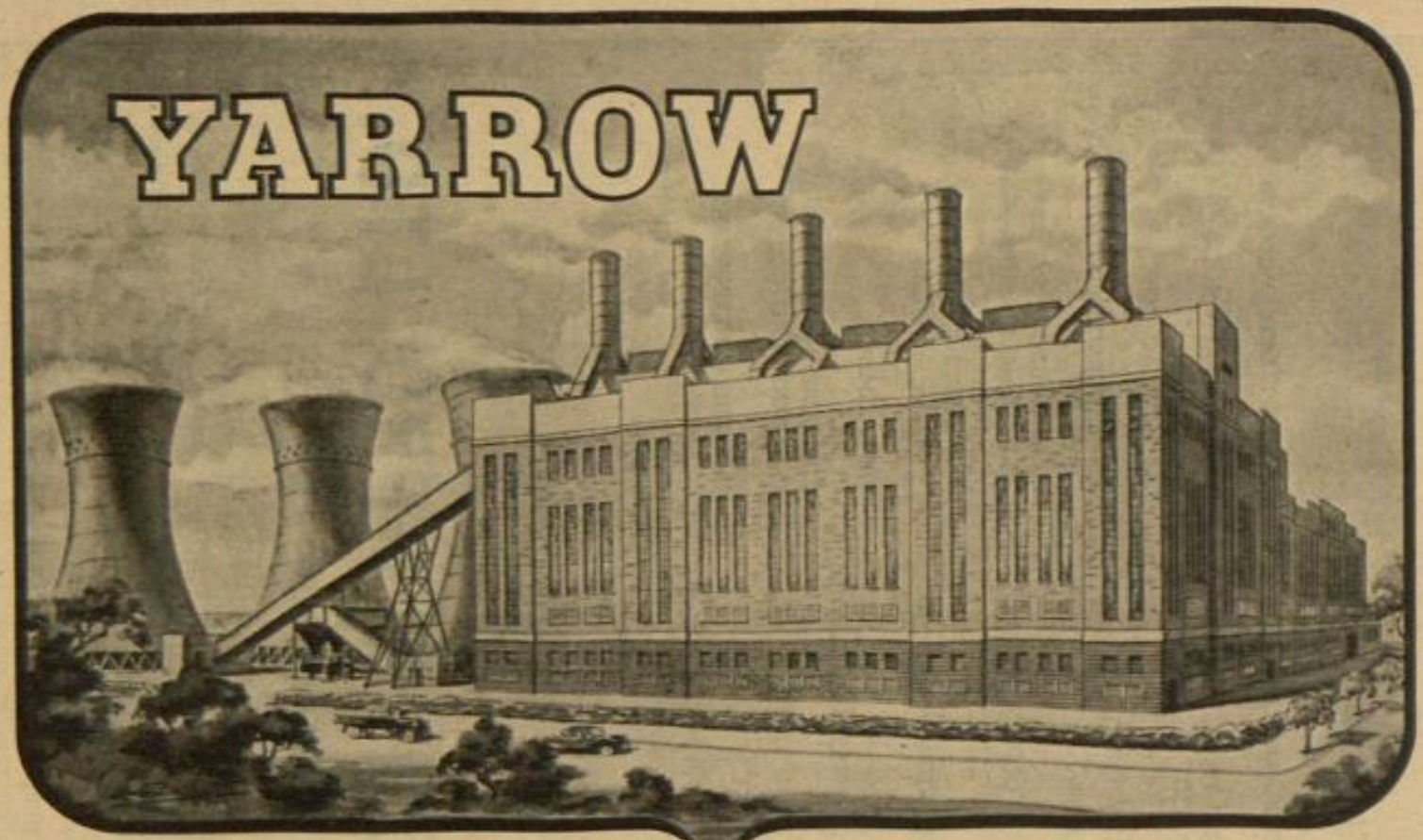
Where the existing salary of any Chief Electrical Engineer is in excess of the salary payable under this scheme no alteration should be made for the existing holder of the position until the salary payable under this scheme is in excess of the present salary.

7. *Date for Adjustments*

Adjustment of salary should date from the first day of each financial year of the undertaking and should be based on the statistics of the financial year immediately preceding.

8. *Exceptions*

(*a*) Where the Chief Engineer is in full charge of other municipal departments



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and activities, the scheduled salary should be increased by an amount considered appropriate in accordance with the increased responsibilities.

The following revised schedule is therefore recommended as a guide to all Councils:—

SCHEDULE

Unit Assessment (Millions)	Minimum Salary Exclusive of all Allowances (1947)	Revised Minimum Salary Exclusive of all Allowances (1952)
Under ½	£600	£700
Over ½. Under 2	£700	£800
Over 2. Under 3	£800	£950
Over 3. Under 5	£900	£1,050
Over 5. Under 10	£1,000	£1,150
Over 10. Under 25	£1,250	£1,450
Over 25. Under 50	£1,500	£1,750
Over 50. Under 100	£1,750	£2,000

RULES AND CONSTITUTION

PRESIDENT:

Thank you. There is one other item before we come to "General". It will probably be obvious to most of you that the constitution of the Association is a rather loosely worded document. Right at the beginning we had a query as to whether associates had the right to vote. We have decided to recommend, therefore, that during the next year the Executive should look in to the question of a general revision of the constitution and present certain proposals to the next Convention. In the meantime the Executive would greatly welcome any suggestions from any members in regard to this matter—any ideas any of you have got that might be useful in helping the Executive in deciding on what amendments to make. I shall be glad if you will remember that and forward any comments you may have to the secretary.

We now come to "General". We have a few more minutes before it is necessary to take the step of winding up this Convention. I would remind you that the Executive have decided to have a meeting immediately after the Convention closes. Are there any remarks under "General".

PROTECTION OF ELECTRICAL ENGINEERS

Mr. E. L. SMITH (Boksburg):

Mr. President: During the war the Provincial Local Government Ordinance was amended. The section amended dealt with the dismissal of officials, and you will remember that the Town Clerks, Town Treasurers, Medical Officers of Health and Town Engineers were to some degree protected in so far as dismissal was concerned. An amendment has now provided for the inclusion of Electrical Engineers, and I feel that this is a matter for congratulation; therefore, on behalf of the engineers and town clerks, I wish to thank the Association for what they have done in this matter, and for the great measure of success they have attained. I only hope that now the Free State and Natal will fall into line, and I would recommend at this stage that the Association press these matters before the Provincial authorities of Natal and the Orange Free State.

STANDARD WIRING REGULATIONS

Mr. E. V. PERROW:

Mr. President: I was a little hasty in my reply to Mr. Stevens' question. I think he will find, if he reads the regulations carefully, that where the temperatures are likely to exceed those laid down in the regulations, the engineer has power to insist on a lower current rating for the conductor.

CONCLUSION

Mr. E. V. PERROW:

I now bring you fraternal greetings and felicitations from the South African Institute of Electrical Engineers. Our President, Mr. J. T. Allen, has asked me particularly to express his regret at not being present today, especially in view of the fact that you are this year's Honorary Vice-President. Circumstances have prevented him being with us.

I would also like to express the appreciation of the Safety Precautions Committee at the excellent services your representatives have rendered on that committee. We are very deeply indebted to the representatives of your Association, because their assistance has been invaluable.

Now may I personally congratulate you, Mr. President, on your accession to office, and congratulate you also on the very successful Convention which you have held here in Bulawayo. Having attended quite a

few conventions, I can say that in my opinion the organisation of the Convention and of the social activities at this Convention have been outstanding.

PRESIDENT:

Thank you. If there are no other items under "General", I will call upon Councillor Dubb to make some remarks.

Councillor L. DUBB (Port Elizabeth):

Mr. President, Mr. Mayor, Ladies and Gentlemen: In Port Elizabeth we are very proud of our developments as an industrial city. We are also conscious of our unique position, geographically, in relation to the rest of Southern Africa. We also point to our housing schemes as a model for other cities to follow. But above all we have endeavoured to establish the reputation of being the friendly city of Southern Africa. Mr. President, from our experience here, from the manner in which we have been entertained and from the hospitality that has been so generously showered on us, I see in Bulawayo a very serious rival to that reputation!

Mr. Downey said this morning, "They don't give us time to sleep." That was not really a complaint, of course; it was merely an excuse, and I think you must accept it in that spirit. I felt particularly at home when I read this morning's paper and the report of the Chairman of the Finance Committee, because I felt it could very well have been the report of my own Chairman of Finance, and no doubt other Councillors felt the same.

Many of us have come here for the first time, and after an arduous journey through uninteresting country for the most part—whether we came by air, rail or car it seemed to be the same—we found here a real oasis, and we were very impressed by the wide streets and the general lay-out.

Those of us who come from the ports are aware of the development taking place in Rhodesia, because we are suffering to a certain extent from the congestion caused by goods destined for Rhodesia, holding up deliveries of our local traffic. Recently we had a visit from two of your senior Railway officials to see what could be done to alleviate the position. Unfortunately, from what I can ascertain, the position has not yet changed, because I noticed in the Press there were 13 boats in the roadstead last week at Port Elizabeth. But we do not begrudge you this industrial development, notwithstanding the inconveniences that we have to suffer in the south. We wish you every success in this development and hope that in the near future you will attain the degree of development we have attained in some of our major cities, because we appreciate that the progress and prosperity of this part of Africa are to our own advantage, and that notwithstanding whatever political and other differences there may arise from time to time, our future welfares are intimately bound up together.

My wife was not fortunate enough to come up with me, but I have been kept informed by Mrs. Bradley of the entertainment and overwhelming hospitality given to our ladies, and on their behalf I want to thank the Mayor and Councillors and the citizens of Bulawayo for all they have done.

Mr. Mayor, I can assure you that we have enjoyed our stay in this city very much indeed, and that the hospitality we have received is certainly a most sincere invitation to us to come again. I would like formally to move, on behalf of the delegates and visitors, a very hearty vote of thanks to our hosts for having made this Conference such a pleasant one from a social point of view and such a successful one as a Convention. As has already been mentioned, the organisation has been remarkable, and this has been the major contributing factor to the success of this Convention.

Councillor MAJOR J. RAFTERY (Durban):

Mr. President, your Worship, Ladies and Gentlemen: My task, though a very simple one, gives me a great deal of pleasure. It is just to endorse what has been said by the previous speaker and to second the motion proposed by him. It is indeed a delight to me to be able to do so.

Mr. J. MONKS (Johannesburg):

Mr. President, Mr. Mayor, Ladies and gentlemen: On behalf of the commercial community here I have very much pleasure in thanking our hosts for the wonderful time they have given us. I used to be a

resident here, so I may be accused of partiality if I say any more, but I would like to record how very much indeed we have appreciated your hospitality.

Councillor MORTON JAFFRAY (Salisbury):

Mr. President, Mr. Mayor, Ladies and Gentlemen: As the Councillor representative of the Mother City of Southern Rhodesia, I would like to add my few words to those congratulations already given to Bulawayo on the magnificent way in which the whole proceedings of this Convention have gone through. A child is always beautiful in the mother's eye, and it is partcularly gratifying to Salisbury that Bulawayo, after the many many years of lavish care and attention showered on her by Salisbury, is at last proving her worth. To you, Mr. President, I think we are all very grateful for the marvellous amount of organisation which has gone into this Convention. It is obvious that you have secured the co-operation of all your fellow heads and in fact of everyone in Bulawayo connected in any way with the success of the Convention. It may not be known to all of the delegates present that an ample supply of water for the delegates was assured by the introduction of hosepipe restrictions a little while ago!

In one respect someone has slipped. I do not know which official was put in charge of the Weather Clerk—it may have been the Town Clerk, probably the M.O.H.—but I have no doubt whatsoever that that official will be on the carpet before very long.

In his own Department our President has taken every conceivable step to ensure that everything went smoothly. I noticed that the other night at that marvellous Gaieties performance he even took the trouble to have a few candles around. That was, I take it, just in case.

My last remark reminds me of a little story I heard recently. The Padre was visiting the condemned cells in Sing Sing Prison. Two or three of the prisoners were due to go to the electric chair that morning. He got to one chap who was terribly worried and upset about the whole idea, and he said to him, "Well, my son, I am terribly sorry you are coming to this end, but I assure you there's nothing to it." "Oh," said the lag, "I'm afraid it's going to hurt an awful lot. I'm afraid I can't face it." "No," said the Padre. "Jim, the lag next door, goes before you. In a few moments you will hear the warders come and take Jim away, you will hear the door shut, and then you will hear nothing more, so there's nothing to fear." That consoled the convict a little bit, and in a few moments he heard the warders come along, take out Jim the lag, close the door behind them, and walk away up the corridor. It was just as the Padre had said it would be. But then suddenly the most ungodly yells and screams they had ever heard in their lives, and the poor old lag said to the Padre, "There, you see. I told you I can't take it. I knew. I can't face it. I told you it would be very very painful." "Well," said the Padre, "I just can't understand it, my son. I can't understand what has gone wrong. I'll go and investigate.' So the Padre went along to the condemned cell, opened the door and walked in, and said to the Chief Warder, "What has gone wrong this morning?" "Well," said the Chief Warder, "we had a spot of load-shedding and we had to finish him off with candles."

Once more, Mr. President and Mr. Mayor, I would like to extend my thanks, on behalf of Salisbury, for the very magnificent show you have put up this week. Mr. Mayor, Salisbury is proud of Bulawayo at last!

Mr. W. H. ATTERIDGE (Somerset East):

Mr. President: As James Fitzpatrick said in his conclusion to his film and travel talks, "The sun will soon be setting and we shall be saying farewell", so on behalf of myself and I think of the smaller municipalities I would like to extend my thanks for the hospitality shown by Mr. Mayor and his City Councillors. Mr. President, I would like to thank you and your officials for the hard work you have put in to make this Conference a success. May the way the proceedings have carried on be your reward and last but not least, Mr. President, I cannot let this opportunity pass without thanking the "back room boys".

Mr. R. W. KANE (Johannesburg):

Mr. President, Mr. Mayor: I represent the Certificated Engineers of South Africa, and I wish to thank you most heartily for your very kind invitation to be present, and to wish you yourself a very successful

year of office. In addition, Mr. Mayor, may I thank you and your Councillors for the bery happy time Bulawayo has given us.

Councillor ROSS THOMSON (East London):

Mr. President: As the Councillor representative of that jewel of the Indian Ocean, East London, it gives me great pleasure to associate myself with the remarks and compliments passed by the previous speakers. It has been particularly interesting to me to come to Bulawayo, as I am an old Rhodesian. I had the pleasure of serving on the Gwelo Town Council some 20 years ago, so I am no stranger to Bulawayo. I am greatly impressed with the progress which I know has taken place during my 15 years' absence, and I have no doubt that a great future lies ahead for Bulawayo. The arrangements for this Convention have been of a very very high standard, and our congratulations go to everyone concerned, those whom we have met and those who are in the background; and I have a message for those in Rhodesia who cannot get their goods through quickly: "Ship them through East London and you will have no difficulty whatsoever."

Mr. J. W. SWARDT (Bureau of Standards):

Mr. President, Mr. Mayor, Ladies and Gentlemen: On behalf of the Bureau of Standards I would like to say how much we are pleased and grateful for the opportunity of attending your Convention. There is a vital link between your work and ours, and that link is growing stronger and stronger by virtue of the fact of your goodwill and collaboration. In my paper yesterday I appealed to you for your guidance and assistance. Not only did you discuss the paper by and large, but you have also given me an unequivocal resolution. For that, my special thanks.

In conclusion, I would like to say how much we enjoyed attending this Convention, and the hospitality of the city of Bulawayo, whose entertainment for sincerity, and speciality, exceeded the standards of par excellence.

Mr. G. WILLIAMS (S.A. Railways):

I would like to thank the President and the Executive of this organization for their courtesy in inviting me here. Our common problems get more numerous every day, and the co-operation between our engineers and the municipal engineers is very very necessary indeed. We have a number of common problems, and it is very pleasant to be able to get together in an effort to solve them. Mr. Mayor and citizens of Bulawayo, my very sincere thanks for the many courtesies and kindnesses received.

Mr. W. H. MILTON (E. S. C. Johannesburg):

Mr. President, Mr Mayor, Ladies and Gentlemen: As representing the Electricity Supply Commission of the Union I would like to express the Commission's very grateful thanks for the invitation it received to attend your conventions. At these conventions we get a very wide picture of the requirements of electricity undertakings; and, as you know, the Commission in the Union is concerned with the development of those undertakings having in mind its duties towards municipalities in terms of the Act. Mr. Mullins has asked me to associate the name of the Electricity Control Board with my remarks, although I feel the thanks of our visitors as well as the delegates to this Convention have been expressed by my friend Councillor Dubb with a view to avoiding too many of these speeches! Councillor Dubb did not, however, go into details, for the very simple reason that there are so many individual items for which the delegates and visitors here are deeply grateful that it would take too long to enumerate them all. One item which appealed to me very greatly, was the floral decorations we saw each day when teas were served. I understand they were provided by the organisers of the "teas". The organisation underlying the care of delegates is beyond adequate praise. The amount of time and trouble that people have gone to in looking after transport is another feature which calls for particular mention and our very grateful thanks.

His Worship THE MAYOR:

Mr. President, Councillor Dubb, and the other gentlemen who have so kindly spoken, Ladies and Gentlemen: I feel that the thanks which have been showered on the Municipality have been rather misdirected, and I would like to deflect them to their real target, and that is your President and his staff, who have been almost entirely responsible—with the occasional help of

other officials of the Municipality—for the whole of the organisation both of your Convention and of the various features which you seem so deeply to have appreciated.

If the people of Bulawayo, the car owners, the various industries, had not rallied round us, it would have been very much more difficult and perhaps impossible to do what has been done. If we really needed any thanks we have had them right through the Convention, for people have been good enough to come up to me and to my wife and to other members of the Municipality and the staff and they have sung praises until I am quite certain that my complexion is several shades darker than it used to be—I blush.

I would just say this: that whilst I do not altogether agree with Councillor Morton Jaffray, I do not begrudge him any of the feelings of pride that are supposed to accompany maternity. We for our part offer Salisbury our filial respect.

I am glad to know that you have enjoyed yourselves, for I know these expressions were sincere. I gather that the first of your conventions was in 1915, with a break during the war, and I trust that you will all profit mightily from this 26th Convention, and be able to render enhanced services to those communities whom you serve so admirably.

PRESIDENT:

Thank you, Mr. Mayor. It may interest you to know that 198 delegates attended this Convention, and that between 70 and 80 ladies have attended.

In winding up the proceedings of this Convention I would like to express my deep thanks to Mr. Downey, the past President, and to the members of the Executive, for the great assistance they have been to me in carrying out the duties assigned to me during this week. I have never had a job like this to do before, and I was somewhat concerned as to how it would go; but I need not have been concerned, with Mr. Downey at my hand and with the assistance of the very fine body of men who represent you as your Executive Council. To them I tender my very sincere thanks for their assistance.

It is the staff of my Department who have really been responsible for all the good things to which you have referred. I myself have been unable to do anything much other than sit here and preside. The work behind the Convention, the work associated with the entertainments, has all been done by the members of my staff, and to them I tender my very sincere thanks.

I would also like to express my personal thanks to the members of the commercial community of Bulawayo for the very ready assistance they have rendered in many ways during this week. They have helped with transport, they have helped in other ways, of which you all by now will be only too well aware, and I do thank them very much indeed. I thank also the commercial community from outside of Bulawayo, who contributed so much to the entertainments and to the proceedings in their own quiet way. We are always glad to have them with us and thank them for their attendance.

I would like to refer to something of which some of you may be unaware, and that is that we have with us a very old foundation member of the Association, Mr. Bellad-Ellis. He actually attended the very first convention of the Association.

Mr. W. BELLAD-ELLIS (East London):

Mr. President, Mr. Mayor, Ladies and Gentlemen: Some men are born great; others have greatness thrust upon them. I was not aware that I should be called upon to say anything, but I must confess that I am very glad to have the opportunity just to say one or two words. It is, of course, the prerogative of the Mayor and the President to have the last word, and I hope they will, but I think it would be a nice gesture if on this occasion a letter could be sent to dear old Dr. Dobson, who inaugurated and commenced this Association in 1915 with 16 members. If we could tell him that the seed then sown has developed into such a wonderfully flowering and sturdy tree, I am sure he would appreciate that. I know it was his intention to be here today. He has not attended many of the conventions, I know, but on this occasion he did intend to come, but he is indisposed and could not get here; and I do feel, if it is not out of order, that a letter might be sent to him telling him, as I said before, that the Association has grown to huge proportions and continues to flourish.

It has been extremely interesting to me to listen to the remarks made, and I may also tell you that history repeats itself, in this respect, that in 1915 we also had to thrash out difficulties that engineers were faced with in developing new areas. At that time Johannesburg and Cape Town and Durban were going ahead with leaps and bounds, and it was a tremendous headache for engineers to know how to develop an area. They would put down a cable and in a very short time they had to put down another one. We also had the same old hardy annual of tariffs brought up by that very old stand-by and sturdy member of the Association, John Roberts, who was the inaugurator of the first cheap unit for cooking, and that sort of thing. I say again that these things are hardy annuals, still cropping up today, the same old things that occupied us in 1915.

Before I sit down, may I thank your President for his kind invitation to attend this Convention. I have known him for a great many years, and I promised him I would come, and here I am.

PRESIDENT:

I think you will all agree that we send a message to Dr. Dobson. (*Agreed.*)

It now remains for me to thank all those who have spoken so warmly of the Convention proceedings and of the entertainment during this week. I do thank you very much for the expressions of appreciation you have offered to me, and I know that you realise to whom they should really have been directed. Some of my staff are present here today, and I am glad they have had an opportunity of hearing from your own lips what you think of us in Bulawayo.

It now only remains for me to bring this 26th Convention to a close, which I hereby do.

Convention closed at 12.05 *p.m.*

SOCIAL EVENTS

Bulawayo, lacking the many natural attractions of the Cape and other large Union centres, put itself out especially to entertain delegates, visitors, and their wives during the Convention period.

Trains brought visitors to Rhodesia a full day before official business commenced and on Sunday, 4th May, arrangements were made—as a result of the kind invitation of the Rhodesia Natural Resources Society—to visit the farm of Col. G. Barry to witness examples of soil reclamation work for which Southern Rhodesia is becoming justly renowned. About 28 spent the day in this way, enjoying an al fresco lunch provided by Col. Barry.

On Monday evening a Mayoral Sundowner Party in the City Hall attracted, in all, about 400 visitors including many from the host City. Most of the visitors proceeded afterwards to the Guild Hall where a Supper Dance, organised by Sir George Usher, provided a welcome and interesting finish to the first day's proceedings.

On Tuesday morning, the ladies were taken by buses to visit the Khami ruins. Though not as pretentious these ruins are, in their way, as interesting as the famous Zimbabwe with which they are culturally linked. The party was shewn the various points of interest by Mr. Cran Cooke, who has interested himself in the archaeology of Khami for some time.

In the afternoon all visitors and their wives made the pilgrimage to Rhodes' grave in the Matopo hills and were duly impressed by the grandeur of the World's View. Tea was taken on the way back at the Matopos Dam Hotel and the visitors then prepared themselves for the highlight of the social events.

Dressed in the style of the "Gay Nineties" with side-whiskers complete, guests enjoyed an hilarious evening at the "Gaieties", presented by the Bulawayo Theatre Club. Memories of the Music Halls of the last century were revived as the audience cheered the herione and hissed the villain, the while individual members took snuff and passed the time of the day with the Chairman, Dr. Mark Webster.

In the meantime, the more serious-minded of the visitors were taken to the Steelworks to watch a pour of steel from the 1,600 kVA electric arc furnace, by the kind invitation of the Rhodesian Iron & Steel Commission.

On Wednesday morning the ladies were entertained to tea by the Mayoress at Bulawayo's famous swimming bath. By this time the weather which had been

exceptionally warm for the time of the year, became cold and windy, and the Wednesday engagements, being outdoor, were to some extent marred by this circumstance. In the afternoon a bus ride round the city, visiting among other places the Pise-de-Terre housing estates of the National Housing Board and the Mzilikazi location, and finishing up for afternoon tea at Lakeside, kept the ladies occupied.

On Wednesday evening all visitors and their wives attended a special Concert in their honour given by the Bulawayo Municipal Orchestra. Unrehearsed wind effects from a ventilator in the roof of the City Hall added interesting if not mellifluous harmony. The President appeared in an unexpected guise, conducting the orchestra in one of his own compositions, a work for piano and orchestra in which David Lourie played the solo part.

The concert was intended, it is hoped with some success, to calm the nerves and reduce the blood-pressure of the visitors before bidding them good-bye at the closing session before lunch on Thursday. The thanks of the Association are due to the Mayor and Council of Bulawayo for providing so lavish a programme of entertainments and to the staff of the Bulawayo Electricity Department, who worked tirelessly in carrying out the programme smoothly and without a hitch. The special provision of baby-sitters, in particular, was much appreciated by those with children who were thereby enabled to take more advantage of the entertainment provided than would otherwise have been possible. The provision of transport from hotels to the various functions and to the sessions of the Convention itself was also greatly welcomed by those who had no other transport available. The social entertainments generally were voted among the best that members had experienced at previous conventions.

VISIT TO LIVINGSTONE

A record of the Convention would not be complete did it not include some reference to the hospitality extended to certain fortunate delegates by the Municipality of Livingstone.

Those delegates who were at Victoria Falls on the 10th May, were taken on a visit to the Hydro-Electric Station at the junction of Third and Fourth Gorges during the morning. In the afternoon they travelled by Municipal Bus to Livingstone's magnificent airport and there entertained to afternoon tea: unfortunately it was not possible to arrange for the Comet aircraft to put down during the time the delegates were there! The party then spent a very enjoyable half-hour at the Rhodes-Livingstone Museum and all wished that the time available could have been longer, but they were due at the Boat Club on the Zambesi for a Cocktail Party.

Those who were fortunate in being of the party will long remember the cordial hospitality, the congenial surroundings and the beauty of the sight as the sun went down over the Zambesi.

The thanks of all concerned are due to His Worship the Mayor and Councillors of Livingstone, the genial Town Clerk and the very energetic Assistant Electrical Engineer, Mr. Watkins.

Printed by
L. S. GRAY & CO. (PTY.) LTD.
8 GLENLUCE ROAD, GLENESK,
JOHANNESBURG