VERRIGTINGS van die 34ste KONVENSIE

VAN DIE

VERENIGING VAN MUNISIPALE ELEKTRISITEITS-ONDERNEMINGS VAN SUIDELIKE AFRIKA

(GESTIG 1915)

GEHOU TE

DURBAN

3 tot 6 MEI, 1960

PROCEEDINGS of the 34th CONVENTION

OF THE

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

(FOUNDED 1915)

HELD AT

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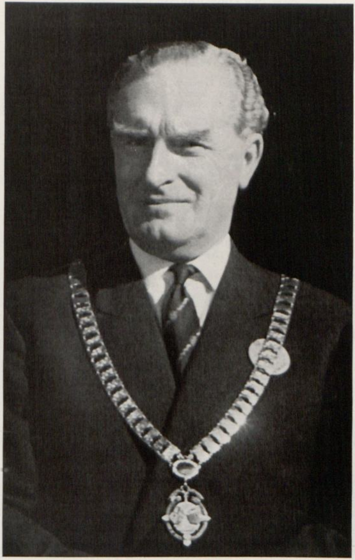
EXECUTIVE COMMITTEE 1960/61

Back Row: Cr. P. G. C. Blignaut (Pretoria), Cr. F. J. C. Castelyn (Bloemfontein), D. J. Hugo (Pretoria), G. J. Muller (Bloemfontein) F. Stevens (Ladysmith), J. C. Downey (Springs), Cr. H. J. Kruger (Springs)

Middle Row: J. L. van der Walt (Krugersdorp,) J. C. Mitchell (Salsbury), R. G. Ewing (Secretary), Cr. R. H. Main (Johannesburg), P. A. Giles (East London), J. D. Dawson (Uitenhage).

Front Row: Cr. P. S. du Bruyn (Germiston), C. Lombard (Germiston) R. M. O. Simpson (Durban) President, R. W. Kane (Johannesburg) C. G. Downie (Cape Town)

PRESIDENT, 1960—1961



Mr. R. M. O. SIMPSON, Durban

Die VERENIGING van MUNISIPALE ELEKTRISITEITSONDERNEMINGS van SUIDELIKE AFRIKA

EXECUTIVE COUNCIL/UITVOERENDE RAAD 1960/61

President:
R. M. O. Simpson (Durban)

Vice-President/Vise-President:
C. Lombard (Germiston)

Immediate Past Presidents/Voormalige Presidente:
R. W. Kane (Johannesburg)
C. G. Downie (Cape Town)

Engineer Members/Ingenieur Lede:
D. J. Hugo (Pretoria)
J. L. van der Walt (Krugersdorp)
J. E. Mitchell (Salisbury)
J. C. Downey (Springs)
G. J. Muller (Bloemfontein)
P. A. Giles (East London)

Cities or Towns Represented/Stede of Dorpe Verteenwoordig:
Johannesburg, Durban, Cape Town, Krugersdorp, Salisbury, Pretoria, Bloemfontein, East London, Springs, Germiston

Chairmen of Regional Branches/Voorsitters van Streektakke:
Natal: F. Stevens (Ladysmith) (to 31st October, 1960).
J. C. Waddy (Pietermaritzburg) (from 31st Oct., 1960).
Cape Eastern: J. D. Dawson (Uitenhage) (to 7th October, 1960).
M. P. P. Clarke (Somerset East) (from 7th Oct., 1960).

Secretaries/Sekretarisse:
Davidson & Ewing (Pty.) Ltd.
P.O. Box 7462, Johannesburg.

SUB-COMMITTEES/ONDER-KOMITEES:

Papers/Verhandelings	R. M. O. Simpson (President); C. Lombard (Vice-President); C. G. Downie, R. W. Kane (Past Presidents).
Finance/Finansiële	R. W. Kane (Convenor), J. C. Downey
Recommendations Committee for new Electrical Commodities/Aanbevelings oor Nuwe Elektriese Toerustings	J. L. van der Walt (Convenor), J. C. Downey.
Rights of Supply—Industrial Consumers/Regte van Voorsiening—Industriële Verbruikers	C. Lombard (Convenor), D. J. Hugo, J. C. Downey, P. A. Giles.
Non-European Supplies Committee/Nie-Blanke Voorsiening Komitee	R .W. Kane (with power to co-opt).

Representatives/Verteenwoordigers:

Electrical Wiremen's Registration Board/Raad vir Registrasie van Draadwerkers	R. W. Kane
Coal Allocation Committee/Komitee vir die Toekenning van Steenkool	D. J. Hugo, R. W. Kane (Alternate).
Wiring Regulations Committee/Bedrading Regulasies Komitee	J. C. Downey, J. L. van der Walt (Alternate).
S.A. Bureau of Standards/S.A. Buro van Standaarde	J. C. Downey, C. Lombard (Alternate), P. A. Giles, J. L. van der Walt.
S.A. National Committee of the International Electrotechnical Commission/S.A. Nationale Komitee van die Internasionale Elektrotegniese Kommissie	D. J. Hugo, J. Wilson (Alternate).

The Association of Municipal Electricity Undertakings of Southern Africa

34th CONVENTION HELD AT DURBAN, 3rd to 6th MAY, 1960

PAST OFFICERS AND MEMBERS OF COUNCIL:
OUD-AMPTENARE EN LEDE VAN RAAD:

	Past Presidents/Oud-Presidente:	*Secretary and Treasurer/Sekretaris en Tesourier:*
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*
1936-37	A. Rodwell, Johannesburg	L. L. Horrell, Jan., 1941*
1945-46	J. S. Clinton, Salisbury J. W. Phillips, Bulawayo	L. L. Horrell* L. L. Horrell to Nov., 1945*
1946-47	G. J. Muller, Bloemfontein	A. T. Taylor, Dec., 1945
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
1951-52	J. C. Downey, Springs	A. T. Taylor
1952-53	A. R. Sibson, Bulawayo	A. T. Taylor
1953-54	J. C. Fraser, Johannesburg	A. T. Taylor
1954-55	G. J. Muller, Bloemfontein	A. T. Taylor
1955-56	D. J. Hugo, Pretoria	A. T. Taylor to 30th June, 1955
1956-57	J. E. Mitchell, Salisbury	Arthur Tingey, Ewing & Co., 1st July, 1955. Davidson & Ewing (Pty.) Ltd., 1st July, 1956.
1957-58	J. L. van der Walt, Krugersdorp	Davidson & Ewing (Pty.) Ltd.
1958-59	C. G. Downie, Cape Town	Davidson & Ewing (Pty.) Ltd.
1959-60	R. W. Kane, Johannesburg	Davidson & Ewing (Pty.) Ltd.

*Deceased/Oorlede**

All correspondence to be addressed to:
THE SECRETARIES
DAVIDSON & EWING (Pty.) LTD.
P.O. BOX 7462, JOHANNESBURG
Telegrams and Cables: "Minute" Tel.: 835-7286

Rig alle korrespondensie aan:
DIE SEKRETARISSE
DAVIDSON & EWING (Pty.) Ltd.
POSBUS 7462, JOHANNESBURG
Telegramme: „Minute" Tel.: 835-7286

LIST OF MEMBERS/LYS VAN LEDE 30-6-60

HONORARY MEMBERS/ERE-LEDE

1957 (1944) Bradley, D. A., 9, Target Kloof Road, Port Elizabeth (Past President).
1960 Castelyn, F. J. C., 1a Arboretum Avenue, Bloemfontein.
1951 (1922) Eastman, H. A., Torwood, Parel Vallei, Somerset West, C.P.
1958 (1931) Ewer, Col. G. G., 174, Edmonds Road, Durban (Past President).
1960 Davies, L. P., 49, Union Street, Springs.
1955 (1944) Fraser, J. C., 26, Grace Road, Mountain View, Johannesburg (Past President).
1958 (1938) Foden, A., 4, Hardy Road, Selborne, East London (Past President).
1958 (1944) Hallé, C. R., P.O. Box 399, Pietermaritzburg (Past President).
1954 (1938) Kinsman, C., 7, Highgate Place, Durban North (Past President).
1956 (1939) Milton, W. H., c/o. Electricity Supply Commission, P.O. Box 1091, Johannesburg.
1956 Jaffray, A. Morton (Alderman), 8, Fairbridge Avenue, Salisbury.
1945 (1924) Rodwell, A. T., "Miranda," Oxford Road, Parktown, Johannesburg (Past President).
1956 Young, C. E. K., 6, Lexdon Circle, Pietermaritzburg.

COUNCIL MEMBERS/RAADSLEDE

1946 (1917) Aliwal North, C.P., Municipality, P.O. Box 46.
1948 (1934) Alberton, Tvl., Municipality, P.O. Box 4.
1948 Barberton, Tvl., Municipality, P.O. Box 33.
1935 (1926) Beaufort West, C.P., Municipality, P.O. Box 9.
1935 (1917) Benoni, Tvl., Municipality, P.O. Box 45.
1950 (1919) Bethal, Tvl., Municipality, P.O. Box 3.
1944 (1915) Bethlehem, O.F.S. Municipality, P.O. Box 130.
1939 (1917) Bloemfontein, O.F.S., City Council, P.O. Box 288.
1936 (1915) Boksburg, Tvl., Town Council, P.O. Box 215.
1945 (1927) Brandfort, O.F.S., Municipality, P.O. Box 13.
1938 (1927) Bulawayo, S.R., City Council, P.O. Box 591.
1947 Butterworth, Transkei, Municipality, P.O. Box 36.
1948 Brakpan, Tvl., Town Council, P.O. Box 15.
1948 Brits, Tvl., Town Council, P.O. Box 106.
1949 Bothaville, O.F.S., Municipality, P.O. Box 12.
1937 Burgersdorp, C.P., Municipality, P.O. Box 13.
1935 (1915) Cape Town, C.P., City Council, P.O. Box 298.
1935 (1916) Cradock, C.P., Municipality, P.O. Box 24.
1949 Ceres, C.P., Municipality, P.O. Box 44.
1960 Carletonville, Tvl., Municipality, P.O. Box 3.
1953 (1933) De Aar, C.P., Municipality, P.O. Box 42.
1946 Delmas, Tvl., Village Council, P.O. Box 6.
1935 (1915) Durban, Natal, City Council, P.O. Box 147.
1953 Dewetsdorp, O.F.S., Municipality, P.O. Box 13.
1935 (1919) East London, C.P., City Council, P.O. Box 134.
1936 (1916) Ermelo, Tvl., Municipality, P.O. Box 48.
1935 Eshowe, Zululand, Town Board, P.O. Box 37.
1948 Edenvale, Tvl., Town Council, P.O. Box 25.
1952 Estcourt, Natal, Borough, P.O. Box 15.
1957 Empangeni, Natal, Town Board, P.O. Box 2.
1935 (1927) Fort Beaufort, C.P., Municipality, P.O. Box 36.
1936 (1934) Gatooma, S.R., Municipality, P.O. Box 114.
1936 (1924) Grahamstown, C.P., City Council, P.O. Box 176.
1936 (1926) George, C.P., Municipality, P.O. Box 28.
1947 (1915) Greytown, Natal, Borough, P.O. Box 71.
1935 (1929) Gwelo, S.R. Municipality, P.O. Box 278.
1935 (1934) Graaff-Reinet, C.P., Municipality, P.O. Box 71.
1952 Germiston, Tvl., City Council, P.O. Box 145.

1948 (1915) Harrismith, O.F.S., Municipality, P.O. Box 43.
1949 Heidelberg, Tvl., Municipality, P.O. Box 201.
1959 Hermanus, C.P., Municipality, P.O. Box 20.

1935 (1915) Johannesburg, Tvl., City Council, P.O. Box 1049.

1952 Kempton Park, Tvl., Municipality, P.O. Box 13.
1935 (1917) Kimberley, C.P., City Council, P.O. Box 194.
1935 (1916) Klerksdorp, Tvl., Municipality, P.O. Box 160.
1935 (1934) Kokstad, E.G., Municipality, P.O. Box 8.
1951 Komgha, C.P., Municipality, P.O. Box 21.
1945 (1916) Kroonstad, O.F.S., Municipality, P.O. Box 302.
1935 (1917) Krugersdorp, Tvl., Town Council, P.O. Box 94.
1954 Kenhardt, C.P., Municipality, P.O. Box 15.

1935 (1915) Ladysmith, Natal, Borough, P.O. Box 29.
1945 Louis Trichardt, Tvl., Municipality, P.O. Box 96.
1948 Livingstone, N.R., Municipality, P.O. Box 29.
1937 (1927) Ladybrand, O.F.S., Municipality, P.O. Box 64.
1959 Lydenburg, Tvl., Municipality, P.O. Box 61.

1935 (1926) Mafeking, Bech'd., Municipality, P.O. Box 42.
1935 Matatiele, E.G., Municipality, P.O. Box 35.
1939 (1929) Middelburg, C.P., Municipality P.O. Box 55.
1935 (1926) Middelburg, Tvl., Municipality, P.O. Box 14.
1954 (1929) Mossel Bay, Municipality, P.O. Box 25.

1945 Nelspruit, Tvl., Municipality, P.O. Box 45.
1948 (1915) Newcastle, Natal, Borough, P.O. Box 21.
1944 N'Dola, N.R., Municipality, P.O. Box 197.
1936 Nigel, Tvl., Municipality, P.O. Box 23.

1948 Odendaalsrus, O.F.S., Municipality, P.O. Box 21.
1959 Orkney, Tvl., Health Committee, P.O. Box 34.
1944 (1915) Oudtshoorn, C.P., Municipality, P.O. Box 255.

1935 (1926) Paarl, C.P., Municipality, P.O. Box 12.
1935 (1920) Pietersburg, Tvl., Municipality, P.O. Box 111.
1935 (1915) Pietermaritzburg, Natal City Council, P.O. Box 321.
1936 Piet Retief, Tvl., Municipality, P.O. Box 23.
1936 (1934) Port Alfred, C.P., Municipality, P.O. Box 13.
1935 (1915) Port Elizabeth, C.P., City Council, P.O. Box 116.
1936 Port Shepstone, Natal, Borough, P.O. Box 5.
1948 (1915) Potchefstroom, Tvl., Municipality, P.O. Box 113.
1944 Potgietersrust, Tvl., Municipality, P.O. Box 34.
1935 (1915) Pretoria, Tvl., City Council, P.O. Box 440.
1951 Parys, O.F.S., Municipality, P.O. Box 39.
1953 Postmasburg, C.P., Municipality, P.O. Box 5.
1959 Peri-Urban Areas Health Board, P.O. Box 1341, Pretoria.

1935 (1915) Queenstown, C.P., Municipality, P.O. Box 113.
1948 Que Que, S.R., Municipality, P.O. Box 15.

1935 (1929) Randfontein, Tvl., Municipality, P.O. Box 139.
1935 (1929) Robertson, C.P., Municipality, P.O. Box 52.
1935 (1926) Roodepoort-Maraisburg, Tvl., Municipality, P.O. Box 217, Roodepoort.
1944 (1920) Rustenburg, Tvl., Municipality, P.O. Box 16.
1956 Riversdale, C.P., Municipality, P.O. Box 29.
1957 Rouxville, O.F.S., Municipality, P.O. Box 8.

1935 (1926) Salisbury, S.R., City Council, P.O. Box 990.
1956 Sasolburg, O.F.S., Village Board, P.O. Box 60.
1935 (1916) Somerseat East, C.P., Municipality, P.O. Box 21.
1935 (1916) Springs, Tvl., Town Council, P.O. Box 45.
1935 (1931) Springfontein, O.F.S., Municipality, P.O. Box 10.
Stanger, Natal, Borough, P.O. Box 72.
1938 (1916) Stellenbosch, C.P., Municipality, P.O. Box 17.
1948 (1927) Somerset West, C.P., Municipality, P.O. Box 19.
1935 (1915) Standerton, Tvl., Municipality, P.O. Box 66.
1959 Stilfontein, Tvl., Health Committee, P.O. Box 20.
1959 Stutterheim, C.P. Municipality, P.O. Box 2.

1959 (1927) Tarkastad, C.P., Municipality.
1949 The Strand, C.P., Municipality, P.O. Box 3.
1957 Tzaneen, Tvl., Village Board, P.O. Box 24.

1936 (1920) Uitenhage, C.P., Municipality, P.O. Box 45.
1936 (1927) Umtata, Tembuland, Municipality, P.O. Box 57.
1935 (1927) Umtali, S.R., Municipality, P.O. Box 121.

1960 Vanderbijlpark, Tvl., Municipality, P.O. Box 3.
1949 Ventersdorp, Tvl., Municipality, P.O. Box 15.
1935 Vereeniging, Tvl., Municipality, P.O. Box 35.
1955 Virginia, O.F.S., Village Board of Management, P.O. Box 156.
1947 (1929) Vrede, O.F.S., Municipality, P.O. Box 155.
1935 Vryburg, C.P., Municipality, P.O. 35.
1948 (1920) Vryheid, Natal, Borough, P.O. Box 57.

1960 White River, E. Tvl., Village Council, P.O. Box 2.

1935 (1934) Walmer, C.P., Municipality, P.O. Box 5010, Walmer.
1955 Warmbaths, Tvl., Municipality, P.O. Box 48.
1956 Wellington, C.P., Municipality, P.O. Box 12.
1953 Welkom, O.F.S., Village Board, P.O. Box 708.
1953 Westonaria, Tvl., Municipality, P.O. Box 19.
1946 Willowmore, C.P., Municipality, P.O. Box 15.
1944 (1919) Winburg, O.F.S., Municipality, P.O. Box 26.
1945 (1924) Windhoek, S.W.A., Municipality, P.O. Box 59.
1955 (1927) Witbank, Tvl., Municipality, P.O. Box 3.
1936 (1922) Worcester, C.P., Municipality, P.O. Box 37.
1960 Walvis Bay, Village Council, P.O. Box 2.

Dates in brackets initial membership as or by Engineer. Membership not necessarily continuous.

ENGINEER MEMBERS/INGENIEUR-LEDE

1949 Asselbergs, P. C., Town and Elec. Eng., P.O. Box 21, Empangeni, Natal.
1947 Aalbers, G., Municipal Electrical Engineer, P.O. Box 12, Wellington, C.P.
1939 Adams, C. H., Municipal Electrical Engineer, P.O. Box 19, Somerset West, C.P.

1960 Bozyczko, W., Municipal Electrical Engineer, P.O. Box 25, Edenvale, Tvl.
1959 Beard, G. R., City Electrical Engineer, P.O. Box 176, Grahamstown, C.P.
1948 Barratt, V. E. O., Municipal Electrical Engineer, P.O. Box 113, Queenstown, C.P.
1948 Barton, R. W., Electrical Engineer, P.O. Box 708, Welkom, O.F.S.
1957 Beesley, W., Town Electrical Engineer, P.O. Box 29, Livingstone, N.R.
1956 Benson, T., Town Electrical Engineer, P.O. Box 35, Matatiele, E.G.
1957 Booysen, L., Town and Electrical Engineer, P.O. Box 155, Vrede, O.F.S.
1956 Brown, D.C., Town Electrical Engineer, P.O. Box 21, Odendaalsrus, O.F.S.
1949 Brown, D. D., Municipal Electrical Engineer, P.O. Box 217, Roodepoort, Tvl.
1956 Bellingan, G. F., Town Electrical Engineer, P.O. Box 59, Windhoek, S.W.A.
1959 Botes, P. J., Assistant Electrical Engineer, P.O. Box 217, Roodepoort, Tvl.
1959 Billington Eales, A., Town Electrical Engineer, P.O. Box 2, Stutterheim, C.P.
1960 Boshoff, J. J., Electrical Engineer, P.O. Box 44, Ceres, C.P.

1955 Clarke, M. P. P., Municipal Electrical Engineer, P.O. Box 21, Somerset East, C.P.
1948 Cherry, J. R., Municipal Electrical Engineer, P.O. Box 139, Randfontein, Tvl.
1954 Coetzee, F. J., Electrical Engineer, P.O. Box 21, Evaton, Tvl.
1947 Cowley, B. W., Municipal Electrical Engineer, P.O. Box 33, Barberton, Tvl.
1946 Craig, J. S., Borough Electrical Engineer, P.O. Box 21, Newcastle, Natal.

1950 Dreyer, L., Municipal Electrical Engineer, P.O. Box 19, Westonaria, Tvl.
1957 Dunstan, R. S., Deputy City Electrical Engineer, P.O. Box 369, Port Elizabeth, C.P.
1956 Dawson, J. D., Municipal Electrical Engineer, P.O. Box 45, Uitenhage.
1955 De Villiers, E. E., Municipal Electrical Engineer, P.O. Box 3, Carletonville, Tvl.
1954 De Villiers, S. de V., Municipal Electrical Engineer, P.O. Box 52, Robertson, C.P.
1945 De Wet, D. P., Municipal Electrical Engineer, P.O. Box 15, Willowmore, C.P.
1944 Downey, J. C., Town Electrical Engineer, P.O. Box 45, Springs, Tvl. (Past President).
1947 Downie, C. G., City Electrical Engineer, P.O. Box 82, Cape Town, C.P. (Past President).
1957 Dreyer, H. C., Assistant Electrical Engineer, P.O. Box 94, Krugersdorp, Tvl.
1959 Durr, H. R., Electrical Engineer, Peri-Urban Areas Health Board, P.O. Box 1341, Pretoria, Tvl.

1950 Erikson, J. G. F., Borough Electrical Engineer, P.O. Box 15, Estcourt, Natal.

1944 Fisher, K. M., Municipal Electrical Engineer, P.O. Box 551, Bethlehem, O.F.S.
1952 Futcher, L., Municipal Electrical Engineer, P.O. Box 13, Kempton Park, Tvl.
1957 Fohren, H., Borough Electrical Engineer, P.O. Box 37, Eshowe, Zululand.

1945 Gericke, J. M., Municipal Electrical Engineer, P.O. Box 99, Klerksdorp.
1939 Giles, P.A., City Electrical Engineer, P.O. Box 529, East London, C.P.
1936 Grandin, P.C., Municipal Electrical Engineer, P.O. Box 114, Gatooma, S.R.
1960 Gresse, U. B., Town Electrical Engineer, P.O. Box 45, Nelspruit, Tvl.

1929 Hadfield, A. W. K., Town and Electrical Engineer, P.O. Box 278, Gwelo, S.R.
1954 Hafele, C. F., Deputy City Electrical Engineer, P.O. Box 288, Bloemfontein, O.F.S.
1953 Haig-Smith, D., Municipal Electrical Engineer, P.O. Box 55, Middelburg, C.P.
1949 Halliday, K. W. J., Municipal Electrical Engineer, P.O. Box 5, Port Shepstone, Natal.
1927 Harvey, A. Q., Town Electrical Engineer, Warmbaths, Tvl.
1949 Hattingh, J. D., Municipal Electrical Engineer, P.O. Box 8, Rouxville, O.F.S.
1953 Hatwich, A. H. J., Town and Electrical Engineer, P.O. Box 13, Dewetsdorp, O.F.S.
1953 Heunis, G. B., Town and Electrical Engineer, P.O. Box 66, Standerton, Tvl.
1956 Hobbs, I. L., Town Electrical Engineer, P.O. Box 156, Virginia, O.F.S.
1938 Hugo, D. J., City Electrical Engineer, P.O. Box 423, Pretoria, Tvl. (Past President).

1944 Inglis, J. I., Town Electrical and Water Engineer, P.O. Box 111, Pietersburg, Tvl.

1933 Jones, G. E. H., Municipal Electrical Engineer, P.O. Box 42, Mafeking, Bechuanaland.

1946 Kane, R. W., General Manager, Electricity Department, P.O. Box 699, Johannesburg (Past President).
1949 Kirberger, M. N., Town Engineer, P.O. Box 3, Bethal, Tvl.
1949 Kruger, M. J. C., Municipal Electrical Engineer, P.O. Box 13, Port Alfred, C.P.
1959 Koeslag, H. J., Electrical Engineer, P.O. Box 29, Riversdale, C.P.

1931 Lategan, J. F., Town Electrical Engineer, P.O. Box 17, Stellenbosch, C.P.
1953 Lees, D., Town Electrical Engineer, P.O. Box 45, Benoni, Tvl.
1944 Leishman, R., Deputy General Manager, Electricity Department, P.O. Box 699, Johannesburg.
1956 Lewis, L., Town Electrical Engineer, P.O. Box 25, Mossel Bay, C.P.
1947 Lombard, C., City Electrical Engineer, P.O. Box 145, Germiston, Tvl.
1944 Lotter, G. A., Town Electrical Engineer, P.O. Box 96, Louis Trichardt, Tvl.
1955 Lynch, E. C., Assistant City Electrical Engineer, P.O. Box 73, Salisbury, S.R.

1953 Macques, J. A., Municipal Electrical Engineer, P.O. Box 42, De Aar, C.P.
1948 McIntyre, H. A., Asst. Town Elec. Eng., P.O. Box 35, Vereeniging.
1948 Mathews, J. A., City Electrical Engineer, P.O. Box 194, Kimberley, C.P.
1945 Meintjies, P. A., Municipal Electrical Engineer, P.O. Box 16, Rustenburg, Tvl.
1948 Mitchell, J. E., City Electrical Engineer, P.O. Box 73, Salisbury, S.R. (Past President).
1929 Mocke, T. M., Town and Electrical Engineer, P.O. Box 23, Piet Retief, Tvl.
1934 Muller, G. J., City and Electrical Engineer, P.O. Box 288, Bloemfontein, O.F.S. (Past President).
1954 McNeil, J. L., Borough Electrical Engineer, P.O. Box 72, Stanger, Natal.
1952 Millen, T. J., Town and Electrical Engineer, P.O. Box 24, Tzaneen, Tvl.

1955 Nobbs, D. M., City Electrical Engineer, P.O. Box 369, Port Elizabeth.

1953 Odendaal, M. W., Town Electrical Engineer, P.O. Box 4, Alberton, Tvl.

1957 Paull, R. A., Municipal Electrical Engineer, P.O. Box 57, Umtata, Tembuland.
1952 Potgieter, N. A., Municipal Electrical Engineer, P.O. Box 106, Brits, Tvl.
1951 Pretorius, D. R., Town Electrical Engineer, P.O. Box 39, Parys, O.F.S.
1952 Pretorius, E. de C., Asst. Electrical Engineer, P.O. Box 113, Potchefstroom.

1957 Rautenbach, G. F., Electrical Engineer, P.O. Box 13, Burgersdorp.
1946 Redman, R. H., Deputy City Electrical Engineer, P.O. Box 1803, Bulawayo, S.R.
1927 Relihan, H. J., Municipal Electrical Engineer, P.O. Box 12, Paarl, C.P.
1948 Reyneke, G. M., Town Electrical Engineer, P.O. Box 26, Winburg, O.F.S.
1954 Ross, J. W., Municipal Electrical Engineer, P.O. Box 34, Potgietersrust, Tvl.
1934 Rossler, A., Municipal Electrical Engineer, P.O. Box 24, Cradock, C.P.
1935 Rossler, W., Town Electrical Engineer, P.O. Box 302, Kroonstad, O.F.S.
1944 Rush, W., Borough Electrical Engineer, P.O. Box 57, Vryheid, Natal.

1935 Sibson, A. R., City Electrical Engineer, P.O. Box 1803, Bulawayo, S.R. (Past President).
1954 Simpson, A. C., Municipal Electrical Engineer, P.O. Box 5010, Walmer, C.P.
1953 Simpson, R. M. O., City Electrical Engineer, P.O. Box 147, Durban, Natal (President).
1946 Sims, C. N., Municipal Electrical Engineer, P.O. Box 3, The Strand, C.P.
1937 Smith, E. L., Municipal Electrical Engineer, P.O. Box 215, Boksburg, Tvl.
1934 Stevens, F., Borough Electrical Engineer, P.O. Box 29, Ladysmith, Natal.

1956 Schaftenaar, G. A. H., Town Electrical Engineer, P.O. Box 71, Graaff-Reinet, C.P.
1956 Sulter, F. J., Assistant Electrical Engineer, P.O. Box 145, Germiston, Tvl.

1947 Thackwray, W. G., Town Electrical Engineer, P.O. Box 8, Kokstad, E.G.
1945 Theron, W. C., Municipal Electrical Engineer, P.O. Box 37, Worcester, C.P.
1946 Theron, G. C., Town Electrical Engineer, P.O. Box 3, Vanderbijlpark, Tvl.
1931 Turner, H. T., Town and Electrical Engineer, P.O. 121, Umtali, S.R.
1950 Turnbull, A. F., Town and Electrical Engineer, P.O. Box 35, Vereeniging, Tvl.

1955 Van der Merwe, F. J., Municipal Electrical Engineer, P.O. Box 20, Stilfontein, Tvl.
1959 Van Heerden, B. G., Mun. Elec. Eng., P.O. Box 48, Ermelo, Tvl.
1957 Van Heerden, W. J. B., Elect. Eng., Orkney Health Committee, P.O. Box 201, Heidelberg, Tvl.
1956 Van Meerdervoort, J. K. L., Pompe, Town Electrical Engineer, P.O. Box 43, Harrismith, O.F.S.
1949 Van der Walt, J. L., Town Electrical Engineer, P.O. Box 94, Krugersdorp, Tvl. (Past President).
1945 Vergottini, P. L., Municipal Electrical Engineer, P.O. Box 15, Brakpan, Tvl.
1951 Verschoor, D. R., Town and Electrical Engineer, P.O. Box 36, Fort Beaufort, C.P.
1955 Vorster, P. J., Municipal Electrical Engineer, P.O. Box 3, Witbank, Tvl.
1957 Von Ahlfton, J. K., Town Electrical Engineer, P.O. Box 60, Sasolburg, Tvl.

1954 Waddy, J. C., City Electrical Engineer, P.O. Box 399, Pietermaritzburg, Natal.
1952 Waldron, F. R., Municipal Electrical Engineer, P.O. Box 86, Walvis Bay.
1952 Ward, H. V., Borough Engineer, P.O. Box 71, Greytown, Natal.
1952 Williams, A. H., Assistant Electrical Engineer, P.O. Box 45, Springs, Tvl.
1938 Wilson, J., Assistant City Electrical Engineer, P.O. Box 423, Pretoria, Tvl.
1948 Woolridge, W. E. L., Town Electrical Engineer, P.O. Box 24, Harding, Natal.

1956 Yodaiken, J., Municipal Electrical Engineer, P.O. Box 115, Que Que, S.R.

1959 Zausmer, H., Municipal Electrical Engineer, P.O. Box 20, Hermanus.

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1959 Bester, J. H., Town Electrician, P.O. Box 15, Ventersdorp, Tvl.

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1959 Laas, C. P., Electrical Engineer, P.O. Box 15, Kenhardt.
1959 Lochner, J. van S., Town Electrical Engineer, P.O. Box 64, Ladybrand, O.F.S.

1956 McNamara A. B., Electrical Engineer, P.O. Box 21, Komgha.

1959 Ross, M. J., Town Electrical Engineer, P.O. Box 13, Brandfort, O.F.S.

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1946 Andrew, W. M., c/o. E.S.C., P.O. Box 667, East London, C.P.
1951 Attridge, W. H., P.O. Box 463, Tsumeb, S.W. Africa.

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1952 Bailey, R. V., P.O. Box 255, Oudtshoorn, C.P.
1956 Barnard, F. J. W., c/o. Electricity Supply Commission, P.O. Box 12, Springs.

1933 Campbell, P.O. Box 3, Impendhle, Natal.
1929 Clinton, J. S., P.O. Box 4648, Johannesburg (Past President).
1948 Conradie, D. J., R., P.O. Box 1009, Bloemfontein, O.F.S.
1959 Cowen, A. B., Southern Rhodesia, Electricity Supply Commission Corporation, P.O. Box 377, Salisbury, S.R.

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1944 Gripper, H. Jasper, c/o. Municipal Office, P.O. Box 21, Knysna, C.P.
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1949 Lutsch, W. J. F. S., c/o. Faculty of Engineering, University of Stellenbosch, C.P.

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1926 Marchand, B., P.O. Box 223, Witbank, Tvl.
1919 Mercier, G., c/o. P.O. Box 176, Mazabuka, N.R.
1946 Mole, E. W., P.O. Box 106, Saxonwold, Johannesburg.
1926 Muller, H. M. S., P.O. Box 112, Upington, C.P.

1927 Nicholas, I. J., P.O. Box 185, Dordrecht (Past President).

1959 Petersen, G. R., Federal Power Board, P.O. Box 630, Salisbury.
1934 Phillips, J. W., P.O. Box 1731, Bulawayo, S.R.

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1927 Simpson, H. G., Engineering Department, Searles Ltd., Great Brak River, C.P.

1931 Wright, G. R. E., P.O. Box 465, Benoni, Tvl.
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1957 Aberdare Cables (Africa) Ltd., P.O. Box 494, Port Elizabeth.
1957 Aberdare Construction Co. (Pty.) Ltd., P.O. Box 8514, Johannesburg.
1957 Adams, Symes & Partners, P.O. Box 1498, Johannesburg.
1957 African Cables Ltd., P.O. Box 9909, Johannesburg.
1959 African Explosives & Chemical Industries, Ltd., P.O. Box 1122, Johannesburg.
1959 Sir Alexander Gibb & Partners (Africa), P.O. Box 8180, Causeway, Salisbury, S.R.
1957 Allenwest S.A. (Pty.) Ltd., P.O. Box 6168, Johannesburg.
1957 The Aluminium Co. of S.A. (Pty.) Ltd., P.O. Box 2430, Johannesburg.
1957 Arthur Trevor Williams (Pty.) Ltd., P.O. Box 2873, Johannesburg.
1959 Asea Electric (Pty.) Ltd., P.O. Box 691, Pretoria.
1957 Aycliffe Cables Ltd., Hargreaves Works, Main Road, Eastleigh, Edenvale.
1960 African Lamps (Pty.) Ltd., P.O. Box 75, Industria.
1960 Associated Electrical Industries C.A. (Pvt.) Ltd., P.O. Box 1979, Salisbury, S.R.
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1957 Babcock & Wilcox of Africa Ltd., P.O. Box 545, Vereeniging, Tvl.
1957 Brian Colquhoun & Partners (Rhodesia), Floor Five, Century House, Baker Ave., Salisbury, S.R.
1957 British General Electric Co. of C.A. (Pvt.), Ltd., P.O. Box 845, Salisbury, S.R.
1957 British General Electric Co. Ltd., P.O. Box 2406, Johannesburg.
1959 British Insulated Callender's Cables S.A. Ltd., P.O. Box 2827, Johannesburg.
1957 Burgun (Pty.) Ltd., A. M., P.O. Box 132, Jeppestown.

1957 Caltex (Africa) Ltd., P.O. Box 714, Cape Town.
1957 Chloride Electrical Storage Co. S.A. (Pty.) Ltd., P.O. Box 7508, Johannesburg.
1957 C.M.B. Engineering Co. (Pty.) Ltd., P.O. Box 55, Denver, Johannesburg.
1959 Construction Electric Co. (Pty.) Ltd., P.O. Box 10100, Johannesburg.
1959 Contactor (Pty.) Ltd., Zuider Paarl, C.P.
1957 Crompton Parkinson S.A. (Pty.) Ltd., P.O. Box 4236, Johannesburg.

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1957 Dowson & Dobson Ltd., P.O. Box 7764, Johannesburg.
1959 Ian Drewett, P.O. Box 35, Johannesburg.

1959 Electrical Contractors' Association (South Africa), P.O. Box 11359, Johannesburg.
1957 Enfield Cables (S.A.) Ltd., P.O. Box 5289, Johannesburg.
1959 English Electric Co. (C.A.) (Pvt.) Ltd., P.O. Box 2191, Salisbury.
1957 English Electric Co. S.A. Ltd., P.O. Box 2387, Johannesburg.

1957 First Electric Corp. of S.A., P.O. Box 3961, Johannesburg.
1957 F. W. J. Electrical Industries Ltd., P.O. Box 58, Alberton, Tvl.

1958 George Kent S.A. (Pty.) Ltd., P.O. Box 7396, Johannesburg.
1957 General Motors South Africa (Pty.) Ltd., P.O. Box 1137, Port Elizabeth.
1957 W. T. Glover & Co. Ltd., c/o. W. G. Harlow, 202 Bordeaux, Sea Point, Cape Town.
1957 E. Green & Son S.A. (Pty.) Ltd., 406 Barclays Bank Buildings, Kruis Street, Johannesburg.

1959 Henley-Simplex Africa (Pty.) Ltd., P.O. Box 100, Jeppe, Johannesburg.
1957 Heinemann Electric (S.A.) Ltd., 1 Long Street, Booysens, Johannesburg.
1957 Hopkinsons S.A. (Pty.) Ltd., P.O. Box 11029, Johannesburg.
1957 James Howden & Co., Africa (Pty.) Ltd., P.O. Box 11139, Johannesburg.
1957 Hubert Davies & Co. Ltd., P.O. Box 1386, Johannesburg.
1960 Hawker Siddeley Brush (Southern Africa) Ltd., P.O. Box 75, Booysens, Tvl.

1957 International Combustion Africa Ltd., P.O. Box 5981, Johannesburg.

1957 John Thompson (S.A.) (Pty.) Ltd., P.O. Box 3570, Johannesburg.
1957 Johnson & Phillips S.A. (Pty.) Ltd., P.O. Box 552, Germiston.
1957 R. T. Jones, Esq., 43, The Avenue, Orchards, Johannesburg.

1957 G. H. Langler & Co. Ltd., P.O. Box 3762, Johannesburg.

1957 Dr. J. K. Marais, P.O. Box 8006, Johannesburg.
1957 Mr. G. H. Marais, P.O. Box 1789, Pretoria.
1957 Harold Marthinusen & Co. (Pty.) Ltd., P.O. Box 469, Johannesburg.
1957 L. H. Marthinusen Ltd., P.O. Box 64, Denver, Tvl.
1957 Merz & McLellan, P.O. Box 11578, Johannesburg.
1957 Mine Elect. (Pvt.) Ltd., P.O. Box 2356, Salisbury, S.R.
1959 Mitchell Engineering Group S.A. (Pty.) Ltd., 63 Harrison Street, Johannesburg.
1959 Morgan Crucible Company (S.A.) (Pty.) Ltd., P.O. Box 84, Jeppestown.
1959 Mouchel & Partners, L. G., P.O. Box 9732, Johannesburg.
1959 N.V. Nederlandsche Kabelfabrieken Ltd., P.O. Box 8514, Johannesburg.

1957 C. A. Parsons (Rhodesia) Ltd., P.O. Box 550, Bulawayo, S.R.
1957 C. A. Parsons & Co. (S.A.) (Pty.) Ltd., P.O. Box 3425, Johannesburg.
1959 Patrick Murray (Pty.) Ltd., P.O. Box 1541, Durban.

1957 Reunert & Lenz Ltd., P.O. Box 92, Johannesburg.
1957 A. Reyrolle & Co. Ltd., P.O. Box 9677, Johannesburg.
1960 A. Reyrolle & Co. (Rhodesia) Ltd., P.O. Box 1975, Salisbury.
1957 Rice & Diethelm Ltd., P.O. Box 930, Johannesburg.

1957 Samuel Osborn S.A. (Pty.) Ltd., P.O. Box 19, Denver.
1957 Scottish Cables (S.A.) Ltd., P.O. Box 2882, Johannesburg.
1957 Shell Co. of S.A. Ltd., P.O. Box 2231, Cape Town.
1958 Siemens Edison Swan (Pty.) Ltd., P.O. Box 7404, Johannesburg.
1957 Standard Telephones & Cables Ltd., P.O. Box 4687, Johannesburg.
1957 Stamcor (Pty.) Ltd., P.O. Box 6107, Johannesburg.
1957 Stewards & Lloyds of S.A. Ltd., P.O. Box 1195, Johannesburg.
1957 S.A. General Electric Co. Ltd., P.O. Box 1905, Johannesburg.
1957 S. A. Philips (Pty.) Ltd., P.O. Box 7703, Johannesburg.
1957 Superconcrete Pipes (Pty.) Ltd., P.O. Box 92, Roodepoort, Tvl.
1957 Switchcraft (Pty.) Ltd., P.O. Box 6444, Johannesburg.
1960 South Wales Electric (Pty.) Ltd., P.O. Box 2180, Johannesburg.
1957 Southern African Cable Makers Association, P.O. Box 2258, Johannesburg.
1960 Siemens S.A. (Pty.) Ltd., P.O. Box 4583, Johannesburg.

1957 Union Steel Corporation S.A. Ltd., P.O. Box 48, Vereeniging, Tvl.

1957 Wilson & Herd (Pty.) Ltd., P.O. Box 3093, Johannesburg.
1957 Wright Anderson (S.A.) Ltd., P.O. Box 5057, Boksburg.

1957 Yarrow Africa (Pty.) Ltd., P.O. Box 619, Johannesburg.
1959 Yorkshire Transformers (S.A.) (Pty.) Ltd., P.O. Box 44, Paarden Eiland, C.P.

1960 Zululand Electrical Utility, P.O. Box Gingindlova, Natal.

LIST OF MEMBERS, COUNCIL MEMBERS AND VISITORS ATTENDING THE 34th ANNUAL CONVENTION OF THE ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS

LYS VAN LEDE, RAADSLEDE EN BESOEKERS—34ste JAARLIKSE KONVENSIE VAN DIE VERENIGING VAN MUNISIPALE ELEKTRISITEITSONDERNEMINGS

COUNCIL AND ENGINEER MEMBERS
RAADS EN INGENIEURSLEDE

BENONI: Korsman, Cr. N. C.; Lees, D.

BETHAL: Kirberger, M. N.

BETHLEHEM: Smuts, Cr. B.; Fisher, K. M.

BLOEMFONTEIN: Castelyn, Cr. C. F.; Muller, G. J.

BOKSBURG: de Bruin, Cr. D. S.; Smith, E. L.

BRAKPAN: Oberholzer, Cr. L. R. F.; Kalk, Cr. G.; Vergottini, P. L.

BRANDFORT: Ross, M. J.

BRITS: Bodenstein, Cr. J. C.; de Wit, Cr. T.; Potgieter, N. A.

BULAWAYO: Dold, Cr. A. C.; Harris, Cr. C. M.; Sibson, A. R.

BURGERSDORP: Rautenbach, G. F.

CAPE TOWN: Downie, C. G.

CARLETONVILLE: Grolman, Cr. J.; de Villiers, E.

CRADOCK: Rossler, A.

DE AAR: Macques, J. A.

DURBAN: Nagle, Cr. W.; Simpson, R. M. O.

EAST LONDON: Giles, P. A.

EDENVALE: Archer, Cr. R. R.; Bozyczko, W.

ESHOWE: Fohren, H.

ERMELO: van Heerden, B. G.

EMPANGENI: Asselbergs, P. C.

ESTCOURT: Teale, Cr. S. C.; Erikson, J. G. F.

FORT BEAUFORT: Verschoor, D. R.

GATOOMA: Grandin, P. C.

GERMISTON: de Bruyn, Cr. P. S.; Lombard, C.

GRAAFF-REINET: van Dyk, Cr. J. A.; Schaftenaar, G. A. H.

GRAHAMSTOWN:

HEIDELBERG: Bonnett, Cr. G. P.; van Heerden, W. J.

JOHANNESBURG: Main, Cr. R. H.; Kane, R. W.

KEMPTON PARK: Jacobs, Cr. B. F. J.; Futcher, L.

KIMBERLEY: Haberfield, Cr. G. B.; Mathews, J. A.

KLERKSDORP: Gericke, J. M.

KOKSTAD: Thackwray, W. G.

KROONSTAD: Duke, Cr. E. W. C.; Rossler, W.

KRUGERSDORP: Jonker, Cr. J. P.; van der Walt, J. L.

LADYSMITH: Cochrane, Cr. D. J.; Stevens, F.

LIVINGSTONE: Brown, Cr. R.; Beesley, W.

LOUIS TRICHARDT: van den Berg, Cr. C. J.; Lotter, G. A.

MAFEKING: Jones, G. E. H.

MATATIELE: Rorke, Cr. A. H.

MIDDELBURG, C.P.: Haig-Smith, D.

MOSSEL BAY: Lewis, L.

NELSPRUIT: Gresse, U. B.

NEWCASTLE: Wilson, Cr. A. E.; Craig, J. S.

ORKNEY: Brummer, Cr. D. J.; Rattey, W. P.

PAARL: Relihan, H. J.

PIETERSBURG: Bekker, Cr. Col. A. J.; Inglis, J. I.

PIETERMARITZBURG: Pierce, Cr. R. L. G.; Waddy, J. C.

PORT ELIZABETH: Chaplin, Cr. E. L.; Murray Nobbs, D.

POTCHEFSTROOM: Theron, Cr. I. G.; de C. Pretorius, E.

POTGIETERSRUST: Ross, J. W.

PORT SHEPSTONE: K. W. J. Halliday.

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RANDFONTEIN: Jordaan, Cr. D. G.; Cherry, J. R.

RIVERSDALE: Koeslag, H. J.

ROBERTSON: Trichardt, Cr. S. P. E.; de V. de Villiers, S.

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ROUVILLE: Hattingh, J. D.

RUSTENBURG: Meintjies, P. A.

SALISBURY: Divaris, Cr. D.

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STANDERTON: Heunis, G. B.

STANGER: McNeil, J. L.

STILFONTEIN: van der Merwe, F. J.

SOMERSET WEST: Adams, C. H.

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STELLENBOSCH: Lategan, J. F.

STRAND, THE: Sims, C. N.

UITENHAGE: Calder, Cr. D. G.; Dawson, J. D.

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VANDERBIJLPARK: Thompson, Cr. G. C.; Theron, G. C.

VEREENIGING: Botha, Cr. D. H.; Turnbull, A. F.

VIRGINIA: du Plessis, Cr. L. A. T.; Hobbs, I. L.

VRYHEID: Large, Cr. R.; Rush, W.

WARMBATHS: Meininger, Cr. L. J.; Harvey, A. Q.

WELKOM: Meyer, Cr. W. F.; McLeod, Cr. A. R.; Barton, R. W.

WELLINGTON: Joubert, Cr. P. G.; Aalbers, G.

WESTONARIA: Bentel, Cr. M.

WINBURG: Reyneke, G. M.

WHITE RIVER: Greeff, J. J.

WITBANK: Vorster, P. J.

WORCESTER: Erasmus, R. H.

OTHER MEMBERS

Andrew, W. M. (Associate Member) East London.

Bailey, R. V. (Associate Member), Ndola, N.R.

Burton, C. R. (Associate Member), Kimberley.

Campbell, A. R. (Associate Member), Johannesburg.

Clinton, J. S. (Associate Member), Johannesburg.

Dawson, C. (Associate Member), Durban.

Fraser, J. C. (Honorary Member), Johannesburg.

Marchand, B. (Associate Member), Witbank.

Milton, W. H. (Honorary Member), Johannesburg.

Dalton, G. A. (Associate Member), Johannesburg.

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R. G. Ewing (Representing the Secretaries), Johannesburg.

Miss E. R. Brewin (Representing the Secretaries), Johannesburg.

Mrs. H G. Simms (Convention Proceedings Clerk), Johannesburg.

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Aluminium Company of S.A. (Pty.) Ltd., E. B. Martin, N. H. Custers, A. Kendall, Johannesburg.

Arthur Trevor Williams (Pty.) Ltd., J. T. Williams, J. A. Barnett, Johannesburg.

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Bergun (Pty.) Ltd., A. M., G. Gerber, Johannesburg.

British General Electric Co. Ltd., W. J. Hill, C. W. Tebbit, Johannesburg; H. Witherspoon, J. Brimelow, Durban.

Caltex (Africa) Ltd., N. E. Brown, Johannesburg.

Chloride Electrical Storage Co. S.A. (Pty.) Ltd., A. C. Tilley, Johannesburg.

C.M.B. Engineering Co. (Pty.) Ltd., F. W. de Zeeuw, Denver, Tvl.

Cooper & De Beer (Pty.) Ltd., C. L. de Beer, Johannesburg; C. B. Armstrong, Durban.

Crompton Parkinson S.A. (Pty.) Ltd., H. Doughty, H. M. Georgeson, Johannesburg.

Construction Electric Co. (Pty.) Ltd., R. C. Jordan, Johannesburg.

Davidson & Co. (Africa) (Pty.) Ltd., Wm. C. Massie, F. S. Haigh, Johannesburg.

Dowson & Dobson Ltd., W. D. Hutty, C. R. Dalton, Johannesburg.

Drewitt, Ian, I. H. M. Drewitt, W. C. Wallace, J. H. Golden, Johannesburg.

Electrical Contractors Association (S.A.), S. Revow, Johannesburg.

Enfield Cables S.A. (Pty.) Ltd., A. E. Torrance, L. H. Wratten, Johannesburg.

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First Electric Corp. of S.A. Ltd., L. G. Axe, F. Westall, Knights, Tvl.

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Glover & Co. Ltd., W. T., W. J. G. Emery, Salisbury; W. G. Harlow, Pretoria.

Green & Son S.A. (Pty.) Ltd., E., A. W. Bulless, Johannesburg.

Henley Simplex Africa (Pty.) Ltd., J. A. Morrison, R. W. Lord, Johannesburg.

Hopkinsons S.A. (Pty.) Ltd., E. C. Enfield, G. Richardson, W. G. van Aswegan, Johannesburg.

Howden & Safanco Ltd., James, H. K. Roseveare, E. P. Rodger, I. N. Gourley, Johannesburg.

Hubert Davies & Co. Ltd., J. T. Pyott, Durban.

Heinemann Electric (S.A.) Ltd., R. G. Middlecote, Johannesburg.

International Combustion Africa Ltd., Q. R. Nothard, G. R. C. Usher, Johannesburg.

Johnson & Phillips S.A. (Pty.) Ltd., H. L. Dawe, E. W. Dixon, D. S. Shorten, Germiston; D. R. Freeman, London.

Langler & Co. Ltd., G. H., G. H. Boyle, R. Rhodes, Johannesburg.

Lusaka Electricity Supply Corporation Ltd., W. P. Ford, Lusaka.

Marais, Mr. G. H., Pretoria.

Marthinusen & Co. (Pty.) Ltd., Harold, G. Roeske, Johannesburg.

Merz & McLellan, T. R. J. Bishop, C. E. R. Langford, Johannesburg.

Mitchell Engineering Group S.A. (Pty.) Ltd., L. O. Benckendorff, M. G. W. Seidere, Johannesburfg.

N.V. Nederlandsche Kabelfabrieken Ltd., W. I. Louw, Johannesburg; G. H. van Harten, Cape Town.

Parsons & Co. S.A. (Pty.) Ltd., H. M. Rochester, T. R. Strawson, Johannesburg.

Patrick Murray (Pty.) Ltd., M. E. Walsh, G. H. Walsh, Durban.

Reunert & Lenz Ltd., T. C. Marsh, T. K. Adams, E. J. McKechnie, Johannesburg.

Reyrolle & Co. Ltd., A., W. J. Gibbons, D. A. Anderson, Johannesburg.

Samuel Osborn S.A. (Pty.) Ltd., R. E. Harden, A. J. Simpson, Denver, Tvl.

Scottish Cables S.A. Ltd., D. G. Sutherland, Pietermaritzburg.

Shell Cables S.A. Ltd., A. C. Grant, Johannesburg; W. E. L. Tonkinson, Durban; G. Phillips, D. McGregor-Clark, Cape Town.

Siemens Edison Swan (Pty.) Ltd., J. P. Thomas, A. R. Woods, Johannesburg.

Standard Telephones & Cables Ltd., R. Oxley, Boksburg.

Stewarts & Lloyds of S.A. Ltd., R. N. Nevin, E. R. Dixon, Johannesburg.

Superconcrete Pipes S.A. Ltd., P. Stucke, A. R. Nel, Roodepoort.

S.A. Phillips (Pty.) Ltd., J. Poole, H. Raymond, P. Keen, Johannesburg.

Switchcraft (Pty.) Ltd., R. E. Wilson, H. Hellyar, Johannesburg.

Union Steel Corporation, N. G. Beveridge, T. N. D. Griffin, Vereeniging.

Wilson & Herd (Pty.) Ltd., F. H. Tyler, Durban. R. G. Edwards, Johannesburg.

Yarrow Africa (Pty.) Ltd., C. W. Suckling, Johannesburg.

Zululand Electrical Utility Co. (Pty.) Ltd., G. B. Gill, Gingindhlovu, Natal.

VISITORS

Alexander, H. P., Electricity Supply Commission, Natal Undertakings, Durban.

Anderson, J. P., South African Railways, Johannesburg.

Aspinall, H. T., Department of Education, Arts and Science, Pretoria.

Axe, L. G. S.A. Institute of Electrical Engineers, Johannesburg.

Baxter, J. D. C., Northern Cape Regional Electrification Board, Kimberley.

Beard, J. R., Merz & McLellan, Surrey, England.

Bell, T. S., Federal Ministry of Power, Salisbury.

Booth, C., Institution of Certificated Engineers, Natal Branch, Durban.

Boyce, E. R. W., South African Institute of Electrical Engineers, Natal Local Centre, Durban.

Bourguin, S., Bantu Administration, Ordinance Board, Durban.

Browne, G. F., City of Salisbury, Electricity Dept., Salisbury.

Clarke, E., Durban.

Cassidy, C. S., Public Works Department, Maseru.

Fraser, D., Fletcher, J., Electricity Department, Durban.

Fyall, D., The Northern Rhodesia African Housing Board, Lusaka.

Farquharson, J., South African Institute of Electrical Engineers, Natal Local Centre, Durban.

Gray, M., Natal Institute of Engineers, Durban.

Hill, D. R., City Electricity Department, Durban.

Jackson, A., Provincial Administration of the Cape of Good Hope, Cape Town.

Kane, R. P., Johannesburg.

Katz, L., Head of the Department of Electrical Engineering, Durban.

Kingsman, A. D., City Electricity Department, Durban.

Kinsman, C. K., Durban.

Kraft, Mrs. K., Editor, S.A. Electrical Review and Power Magazine, Johannesburg.

Lategan, Dr. P. N., Transvaal Coal Owners Association, Johannesburg.

Lineker, A. W., Rand Water Board, Johannesburg.

Low, G. A. P., S.A. Institution of Certificated Mechanical & Electrical Engineers, Johannesburg.

Malan, G. J., Chief Inspector of Factories (Eng.), Pretoria.

Malherbe, Dr. E. G., University of Natal, Durban.

Masson, G., Johannesburg Electricity Dept., Johannesburg.

Middlecote, A. A., Council for Scientific and Industrial Research and S.A. Bureau of Standards, Pretoria.

Milton, W. H., Electricity Supply Commission, Johannesburg.

Morrison, J. A., Electrical Eng. & Allied Inds. Association, Johannesburg.

Molyneux, G. C., Chief Electrical Engineer, Rhodesian Railways, Bulawayo.

Michel-Smith, J., City Electricity Department, Durban.

O'Connor, T. P., E.S.C., Natal Undertakings, Durban.

Pearce, F. O., E.S.C., Natal Undertakings, Durban.

Phillips, Prof. W. E., Professor of Electrical Engineering, University of Natal, Durban.

Prins, F. J., Council for Scientific and Industrial Research and S.A. Bureau of Standards, Pretoria.

Roberts, E. R., Department of Bantu Administration & Development, Pretoria.

Roseveare, H. K., Steel & Engineering Industries Federation of Southern Africa, Johannesburg.

Ross, J., Musgrove & Watson (Pty.) Ltd., Durban.

Tungay, R., Natal Daily News, Durban.

Van der Walt, I. D., Electricity Supply Commission, Natal Undertakings, Durban.

Van Heyningen, G. P. K., South African Institute of Electrical Engineers, Natal Local Centre, Durban.

Williams, A. R., Principal, Natal Technical College, Durban.

Winckler, W., South African Bureau of Standards, Durban.

Wood, J. T., Strand Electric & Eng. Co. Ltd., London.

LADIES

Adams, Mrs. K., Johannesburg.
Adams, Mrs. C. H., Somerset West.
Armstrong, Mrs. C. B., Durban.
Archer, Mrs. R. R., Edenvale.
Alexander, Mrs. H. P., Durban.
Anderson, Mrs. D. A., Johannesburg.
Anderson, Mrs. J. P., Johannesburg.
Aspinall, Mrs. H. T., Pretoria.
Axe, Mrs. L. G., Johannesburg.

Bailey, Mrs. R. V., Ndola.
Bailey, Miss M. S., Ndola.
Barnett, Mrs. J. A., Johannesburg.
Baxter, Mrs. J. D. C., Kimberley.
Beard, Mrs. J. R., Surrey, England.
Bekker, Mrs. A. J., Pietersburg.
Benckendorff, Mrs. L. O., Johannesburg.
Beveridge, Mrs. N. G., Vereeniging.
Bentel, Mrs. M., Westonaria.
Bishop, Mrs. T. R. J., Johannesburg.
Blignaut, Mrs. P. G. C., Pretoria.
Bonnett, Mrs. G. P., Heidelberg.
Botha, Mrs. D. H., Vereeniging.
Boyce, Mrs. E. R. W., Durban.
Boyle, Mrs. G. H., Johannesburg.
Bourguin, Mrs. S., Durban.
Brimelow, Mrs. J., Durban.
Browne, Mrs. G. F., Salisbury.
Bulless, Mrs. A. W., Johannesburg.
Burton, Mrs. C. R., Kimberley.

Castelyn, Mrs. F. J. C., Bloemfontein.
Carlin, Mrs. H. M., Vereeniging.
Campbell, Mrs. A. R., Johannesburg.
Chaplin, Mrs. E. L., Port Elizabeth.
Checketts, Mrs. V. F., Pretoria.
Cherry, Mrs. J. R., Randfontein.
Claasé, Mrs. E., Sasolburg.
Clark, Mrs. C., Durban.
Clinton, Mrs. J. S., Johannesburg.
Cochrane, Mrs. D. J., Ladysmith.
Custers, Mrs. N. H., Johannesburg.

Dawson, Mrs. C., Durban.
Dawe, Mrs. H. L., Germiston.
Davies, Mrs. L. P., Springs.

De Beer, Mrs. C. L., Johannesburg.
Deetlefs, Mrs. D. H., Pietersburg.
De Villiers, Mrs. S. de V., Robertson.
Dixon, Mrs. E. W., Germiston.
Downey, Mrs. J. C., Springs.
Drewitt, Mrs. I. H. M., Johannesburg.
Druce, Mrs. K., Johannesburg.
Duffield, Mrs. J., Johannesburg.
Durr, Mrs. H. A., Pretoria.

Edwards, Mrs. R. G., Johannesburg.
Enfield, Mrs. E. C., Johannesburg.
Erikson, Mrs. J. G. F., Estcourt.

Farquharson, Mrs. J., Durban.
Fisher, Mrs. K. M., Bethlehem.
Fletcher, Mrs. J., Durban.
Ford, Mrs. W. P., Lusaka.
Fraser, Mrs. J. C., Johannesburg.
Fraser, Mrs. D., Durban.
Futcher, Mrs. L., Kempton Park.

Gibbons, Mrs. W. J., Johannesburg.
Gild, Mrs. M., Durban.
Gill, Mrs. G. B., Gingindhlovu.
Gourley, Mrs. I. N., Johannesburg.
Gordon, Mrs. P., Mafeking.
Grant, Mrs. A. C., Johannesburg.
Grundling, Mrs. A. E., Carletonville.
Golden, Mrs. J. H., Johannesburg.

Haberfield, Mrs. G. B., Kimberley.
Haig-Smithe, Mrs. D., Middelburg, C.P.
Haigh, Mrs. F. S., Johannesburg.
Harlow, Mrs. W. G., Pretoria.
Harden, Mrs. R. E., Johannesburg.
Hill, Mrs. D. R., Durban.
Hugo, Mrs. D. J., Pretoria.
Hutty, Mrs. W. D., Johannesburg.

Inglis, Mrs. J. I., Pietersburg.

Jackson, Mrs. A., Cape Town.
Jarvis, Mrs. W. G. H., Johannesburg.
Jones, Mrs. G. E. H., Mafeking.
Jordaan, Mrs. D. G., Randfontein.

Kalk, Mrs. G., Brakpan.
Kane, Mrs. R. W., Johannesburg.
Katz, Mrs. L., Durban.
Keen, Mrs. P., Johannesburg.
Kendall, Mrs. A., Johannesburg.
Kinsman, Mrs. A. D., Durban.
Kinsman, Mrs. C. K..
Kirberger, Mrs. M. N., Bethal.
Korsman, Mrs. N. C., Benoni.
Kruger, Mrs. H. J., Springs.

Langford, Mrs. C. E. R., Johannesburg.
Langton, Mrs. L. L., Johannesburg.
Large, Mrs. R., Vryheid.
Lategan, Mrs. J. F., Stellenbosch.
Lees, Mrs. D., Benoni.
Lombard, Mrs. C., Germiston.
Lotter, Mrs. G. A., Louis Trichardt.
Lord, Mrs. R. W., Johannesburg.
Louw, Mrs. W. I., Johannesburg.

McGregor-Clark, Mrs. D., Cape Town.
McNeil, Mrs. J. L., Stanger.
Malherbe, Mrs. E. G., Durban.
Marais, Mrs. G. H., Pretoria.
Martin, Mrs. E. B., Johannesburg.
Massie, Mrs. W. C., Johannesburg.
Meintjies, Mrs. P. A., Rustenburg.
Meyer, Mrs. W. F., Welkom.
Mitchell, Mrs. J. E., Salisbury.
Middlecote, Mrs. A. A., Pretoria.
Milton, Mrs. W. H., Johannesburg.
Molyneux, Mrs. G. C., Bulawayo.
Monks, Mrs. J., Johannesburg.
Morrison, Mrs. J. A., Johannesburg.
Murray-Nobbs, Mrs. D., Port Elizabeth.
Muller, Mrs. G. J., Bloemfontein.

Nel, Mrs. A. R. Roodepoort.
Nothard, Mrs. Q. R., Johannesburg.

Oberholzer, Mrs. L. R. F., Brakpan.
O'Connor, Mrs. T. P., Durban.
Oxley, Mrs. R., Boksburg.

Pearce, Mrs. F. O., Durban.
Phillips, Mrs. G., Cape Town.
Phillips, Mrs. W. E., Durban.
Poole, Mrs. J., Johannesburg.
Potgieter, Mrs. N. A., Brits.
Pretorius, Mrs. E. de C., Potchefstroom.
Prins, Mrs. F. J., Pretoria.

Raymond, Mrs. H., Johannesburg.
Reyneke, Mrs. G. M., Winburg.
Rhodes, Mrs. R., Johannesburg.
Rochester, Mrs. H. M., Johannesburg.
Roeske, Mrs. G., Johannesburg.
Ross, Mrs. J., Durban.
Ross, Mrs. J. W., Potgietersrust.
Rossler, Mrs. A., Cradock.
Rossler, Mrs. W., Kroonstad.
Roseveare, Mrs. H. K., Johannesburg.
Richardson, Mrs. G., Johannesburg.
Rist, Mrs. C. A., Johannesburg.
Rush, Mrs. W., Vryheid.
Rorke, Mrs. A. H., Matatiele.

Schaftenaar, Mrs. G. A. H., Graaff-Reinet.
Seiderer, Mrs. M. G. W., Johannesburg.
Shorten, Mrs. D. S., Germiston.
Sibson, Mrs. A. R., Bulawayo.
Simpson, Mrs. A. J., Johannesburg.
Simpson, Miss C., Durban.
Simpson, Miss D., Durban.
Simpson, Mrs. R. M. O., Durban.
Sims, Mrs. C. N., The Strand.
Steele, Mrs. T., Durban.
Stevens, Mrs. F., Ladysmith.
Strawson, Mrs. T. R., Johannesburg.
Sutherland, Mrs. D. G., Pietermaritzburg.
Suckling, Mrs. C. W., Johannesburg.

Thackwray, Mrs. W. G., Kokstad.
Theron, Mrs. I. G., Potchefstroom.
Thomas, Mrs. J. P., Johannesburg.
Tonkinson, Mrs. W. E. L., Durban.
Torrance, Mrs. A. E., Johannesburg.
Trickardt, Mrs. S. P. E., Robertson.

Turnbull, Mrs. A. F., Vereeniging.
Tyler, Mrs. L. H., Durban.

Usher, Mrs. G. R. C., Johannesburg.

Val Davies, Mrs. H. G., Johannesburg.
Van der Merwe, Mrs. F. J., Stilfontein.
Van der Walt, Mrs. I. D., Durban.
Van Dyk, Mrs., Graaff-Reinet.
Van Heerden, Mrs. W. J., Heidelberg.
Van Heyingen, Mrs. G. P. K., Durban.
Van den Berg, Mrs. C. J., Louis Trichardt.
Van Harten, Mrs. G. H., Johannesburg.
Van Niekerk, Mrs. P. K., Standerton.
Vergottini, Mrs. P. L., Brakpan.
Verschoor, Mrs. D. R., Fort Beaufort.
Vorster, Mrs. P. J., Witbank.

Von Ahlften, Mrs. J. K., Sasolburg.

Wallace, Mrs. W. C., Johannesburg.
Walsh, Mrs. G. H., Durban.
Walsh, Mrs. M. E., Durban.
Waddy, Mrs. J. C., Pietermaritzburg.
Westall, Mrs. F., Johannesburg.
Williams, Mrs. A. R., Durban.
Williams, Mrs. J. T., Johannesburg.
Wilson, Mrs. J., Pretoria.
Winckler, Mrs. W., Durban.
Woods, Mrs. A. R., Johannesburg.
Woosley, Mrs. J. S., Vereeniging.
Wratten, Mrs. L. H., Johannesburg.
Wood, Mrs. G. B., Durban.

Yates, Mrs. G., Vereeniging.

NOTICE OF 34th ANNUAL CONVENTION

Notice is hereby given that the 34th Annual Convention of the Association will be held at the City Hall, Durban, from the 3rd May, to the 6th May, 1960, both days inclusive.

Executive Council meetings will be held at the Eden Roc Hotel.

DAVIDSON & EWING (PTY.) LTD.

per: R. G. EWING,

Secretaries.

AGENDA AND PROGRAMME

MONDAY, 2nd MAY, 1960.

9.30 a.m.—4.30 p.m.—Meeting of Executive Council — Eden Roc Hotel.

6.00 p.m.—7.30 p.m.—Civic Reception and Welcome, City Hall.

TUESDAY, 3rd MAY, 1960.

8.45 a.m.—Registration and Issue of Badges.

9.30 a.m.—Welcome and Official Opening by His Worship the Mayor of Durban, Councillor Cyril Milne.

Election of President.

Venue of next Convention.

Election of Vice-President.

10.30 a.m.—Refreshment Interval.

11.00 a.m.—Apologies and Greetings.

11.15 a.m.—Presentation (Past President's and Honorary Members' Medals and Certificates).

11.30 a.m.—Election of Executive Council.

11.45 a.m.—Presidential Address.

12.45 p.m.—Luncheon Adjournment.

2.30 p.m.—Paper: "Some economic aspects of nuclear power station operation," by W. Eric Phillips, D.Sc. Eng., LL.D. (Alberta), M.I.E.E., M.(S.A.)I.R.E., Sen. Mem. I.E.E., Professor of Electrical Engineering, University of Natal.

3.30 p.m.—Refreshments.

4.00 p.m.—Discussion on Paper.

5.00 p.m.—Adjournment.

8.00 p.m.—Cinema or Theatre Shows, or Night Flights over Durban.

WEDNESDAY, 4th MAY, 1960.

8.30 a.m.—Executive Council Meeting — Eden Roc Hotel.

9.30 a.m.—Convention Resumes.

Communications from Council.

Symposium on Supply of Electricity to Native Townships.

10.30 a.m.—Tea.

11.00 a.m.—Symposium on Supply of Electricity to Native Townships.

12.30 p.m.—Lunch.

2.30 p.m.—Paper: "A Survey of the Control of Stage Lighting," by J. T. Wood.

3.45 p.m.—Discussion on Papers.

4.30 p.m.—Adjournment.

8.15 p.m.—Members' Forum.

10.00 p.m.—Refreshments.

THURSDAY, 5th MAY, 1960.

8.30 a.m.—Meeting of Executive Council—Eden Roc Hotel.

9.30 a.m.—Convention Resumes.

Communications from Council.

Annual Report of Secretaries.

Appointment of Auditors.

Discussion on Reports of Sub-Committees and Representatives.

Discussion on Papers.

10.30 a.m.—Tea.

11.00 a.m.—Paper: "Electrical Protection of Distribution Systems," by J. Michel-Smith Electricity Department, City of Durban

12.30 p.m.—Luncheon Adjournment.

2.30 p.m.—Visits to Industries, etc., Kwa Mashu, etc.

8.30 p.m.—Convention Ball, in City Hall.

KENNISGEWING VAN DIE 34ste JAARLIKSE KONVENSIE

Hiermee word kennis gegee dat die 34ste Jaarlikse Konvensie van die Vereniging van 3 tot 6 Mei 1960 in die Stadsaal, Durban, gehou sal word.

Alle vergaderings van die Uitvoerende Raad sal in die Eden Roc Hotel gehou word.

DAVIDSON & EWING (EDMS.) BPK.
per: R. G. EWING,
Sekretarisse.

AGENDA EN PROGRAM

MAANDAG, 2 MEI, 1960.

9.30 vm.—4.30 nm—Vergadering van Uitvoerende Raad — Eden Roc Hotel.

6 nm.—7.30 nm.—Burgelike Onthaal en Verwelkoming, Stadsaal.

DINSDAG 3 MEI, 1960.

8.45 vm.—Registrasie en Uitreiking van Kentekens.

9.30 vm.—Verwelkoming en Amptelike Opening deur Sy Ed. die Burgemeester van Durban, Raadslid Cyril Milne.
Benoeming van President.
Vergadering van volgende Konvensie.
Benoeming van Vise-President.

10.30 vm.—Pouse—Verversings.

11.00 vm.—Verskonings en Goeie Wense.

11.15 vm.—Toekenning van Erepennings en Sertifikate aan Oud-President en Erelede.

11.30 vm.—Benoeming van Uitvoerende Raad.

11.45 vm.—Presidentsrede.

12.45 nm.—Middagete.

2.30 nm.—Referaat: „Sommige van die ekonomiese aspekte insake kernkragsentrale-bedryf" deur W. Eric Phillips, D.Sc. Eng., LL.D. (Alberta), M.I.E.E., M.(S.A.)I.E.E., Sen. Mem. I.R.E., Professor in Elektrotegniese Ingenieurswese, Universiteit van Natal.

3.30 nm.—Pouse—Verversings.

4.00 nm.—Bespreking van Referaat.

5.00 nm.—Verdaging.

8.00 nm.—Bioskoop of Teatergeselskap, of Nag Vlugte oor Durban.

WOENSDAG, 4 MEI, 1960.

8.30 vm.—Vergadering van Uitvoerende Raad—Eden Roc Hotel.

9.30 vm.—Hervatting van Konvensie.
Aankondigings van Uitvoerende Raad.
Simposium oor Voorsiening van Elektrisiteit aan Bantoegebiede.

10.30 vm.—Verversings.

11.00 vm.—Simposium oor Voorsiening van Elektrisiteit aan Bantoegebiede.

12.30 vm.—Middagete.

2.30 nm.—Referaat: „'n Oorsig oor die beheer van verhoog-beligting," deur J. T. Wood.

3.45 nm.—Bespreking van Referate.

4.30 nm.—Verdaging.

8.15 nm.—Ledeforum.

10.00 nm.—Verversings.

DONDERDAG, 5 MEI 1960.

8.30 vm.—Vergadering van Uitvoerende Raad—Eden Roc Hotel.

9.30 vm.—Hervatting van Konvensie.
Aankondigings van Uitvoerende Raad.
Jaar verslag van Sekretarisse.
Benoeming van Ouditeure.
Bespreking van verslae van Onderkomitees en Verteenwoordigers.
Bespreking van Referate.

10.30 vm.—Verversings.

11.00 vm.—Referaat: „Elektrisiteitsbeskerming van distribusie-stelsels," deur J. Michel-Smith, Elektrisiteitsdepartement, Durban.

12.30 nm.—Middagete.

2.30 nm.—Besoeke aan Fabrieke, ens.
Kwa Mashu, ens.

8.30 nm.—Konvensie-dansparty by Stadsaal.

Agenda and Programme – Cont.

FRIDAY, 6th MAY, 1960.

9.30 a.m.—Convention Resumes.
Communications from Council.
Discussion regarding Papers, Reports, etc.

10.30 a.m.—Tea.

11.00 a.m.—Closing Session.

12 Noon—Meeting of Executive Council—Eden Roc Hotel.
Visits and Tours can be arranged for any who would like further outings. These can be arranged either through the Electricity Department or the Official Convention Travel Agents, Messrs. Musgrove & Watson.

Agenda en Program – Verv.

VRYDAG, 6 MEI 1960.

9.30 vm.—Hervatting van Konvensie.
Aankondigings van Uitvoerende Raad.
Bespreking van Referate en verslae.

10.30 vm.—Verversings.

11.00 vm.—Afsluiting.

12.00 vm.—Vergadering van Uitvoerende Raad—Eden Roc Hotel.

nm.—Besoeke en Toere kan gereël word vir enigeen wie verdere uitstappies wil geniet. Hierdie kan gereël word deur die Elektrisiteitsdepartement of deur die offisiële Konvensie Reisagente, Mnre. Musgrove & Watson (Edms.) Bpk.

LADIES PROGRAMME

MONDAY, 2nd MAY, 1960.

6 p.m.—7.30 p.m.—Civic Reception, City Hall.

TUESDAY, 3rd MAY, 1960.

8.45 a.m.—Assemble for Registration, Issue of Badges and Official Opening.

10.30 a.m.—Tea.

11.00 a.m.—Apologies and Greetings.

11.15 a.m.—Presentation of Past President's and Honorary Members' Medals and Certificates.

11.45 a.m.—Presidential Address.
Free Afternoon.

8.00 p.m.—Cinema or Theatre Shows or Night Flights over Durban.

WEDNESDAY, 4th MAY, 1960.

a.m.—Free morning.

p.m.—Free afternoon.

8.15 p.m.—Members' Forum.

THURSDAY, 5th MAY, 1960.

a.m.—Drive and morning tea with the Mayoress.

p.m.—Visit to Industries, etc., etc.

8.30 p.m.—Convention Ball—City Hall.

FRIDAY, 6th MAY, 1960.

10.30 a.m.—Assemble for Tea and Closing Session.

p.m.—Visits and Tours can be arranged for any who would like further outings. These can be arranged either through the Electricity Department or the Official Convention Travel Agents, Messrs. Musgrove & Watson.

PROGRAM VIR DAMES

MAANDAG, 2 MEI 1960.

6 nm.—7.30 nm.—Burgelike Onthaal, Stadsaal.

DINSDAG, 3 MEI 1960.

8.45 vm.—Vergader vir Registrasie en Uitreiking van Kentekens en Amptelike Opening van Konvensie.

10.30 vm.—Verversings.

11,00 vm.—Verskonings en Goeie Wense.

11.15 vm.—Toekenning van Erepennings en Sertifikate aan Oud-President en Erelede.

11.45 vm.—Presidentsrede.
Namiddag vry.

8.00 nm.—Bioskoop of Teatergeselskap, of Nag vlugte oor Durban.

WOENSDAG, 4 MEI 1960.

vm.—Vry more.

nm.—Vry namiddag.

8.15 nm.—Ledeforum.

DONDERDAG, 5 MEI 1960.

vm.—Toertjie met verversings in geselskap van die Burgemeestersvrou.

nm.—Besoeke aan Fabrieke ens. Kwa Mashu, ens.

8.30 nm.—Konvensie-dansparty by Stadsaal.

VRYDAG, 6 MEI 1960.

10.30 vm.—Vergader vir Verversings en Afsluiting van Konvensie.

nm.—Besoeke en Toere kan gereël word vir enigeen wie verdere uitstappies wil geniet. Hierdie kan gereël word deur die Elektrisiteitsdepartement of deur die offisiële Konvensie Reisagente, Mnre. Musgrove & Watson (Edms.) Bpk.

The Thirty-Fourth Convention of the Association was opened in the City Hall, Durban, by His Worship the Mayor of Durban, Councillor Cyril Milne, at 9.30 a.m. on Tuesday, 3rd May, 1960.

Attendance at the Convention was as follows:—83 Councils represented by 50 Councillors and 81 Engineers and Associates; 2 Honorary Members (not representing Councils or Affiliates); 8 Associate Members; 115 representatives of 61 Affiliates; 48 Visitors (representing Government Departments, Public Utilities and other organisations); 194 Ladies; 3 A.M.E.U. Officials—a total of 501 persons.

FIRST DAY

THE PRESIDENT: Good morning ladies and gentlemen. I hope you all feel well after last night's party.

It is my pleasant duty this morning to introduce to you the Mayor of Durban, Councillor Cyril Milne, who will welcome you to the Convention and also open the Convention. (Applause.)

HIS WORSHIP THE MAYOR OF DURBAN Councillor Cyril Milne: Mr. President, ladies and gentlemen:

This is the second occasion upon which I am welcoming you to our city and to your Thirty-Fourth Annual Convention, but although it is the second time it gives me equal pleasure to do so officially this morning.

I was going to say to you how much I appreciate the very large gathering of delegates, but I am going to amend that by saying how very much I appreciate the large number of delegates and delegates at large! You see, Mr. President, there is a subtle difference. A delegate at large is a man who goes to conventions without his wife and I have to differentiate because I see so many wives at the back of the hall and upstairs, so therefore there must be delegates and delegates at large—and to the delegates at large, if they would perhaps like to see me after the opening ceremony, I could perhaps help them.

Now, Mr. President, I was very interested to gather a few notes on the subject of your Association, and perhaps it is as well to remind the delegates that originally your Association was called the Association of Municipal Electrical Engineers, and the first Congress was held in November, 1915. The membership at the end of the first year represented some 24 towns. Steady growth over the years to the present membership which includes 120 cities, towns, and other supply undertakings is a great tribute to the virility of your organisation and the steady progress which it has made. I think it should be stressed to your members (I am sure they already know, but perhaps it is as well to remind them) that this is not a professional body. It is an Association of Electrical Supply Undertakings, and I am sure that apart from the continuous activities through the work of your committees, your Executive Council, and the representatives on other committees and organisations, much good is done in regard to the problems which face all of us in this very large field. But I think conventions afford a unique and most important opportunity for exchange of views between the technical and councillor representatives of member undertakings, Government Departments, Electricity Supply Commissions, and other generating authorities, manufacturers and suppliers of electrical generation and distribution equipment, consulting engineers and others.

So you see Mr. President, gentlemen, you have amongst you a very large field of activity represented by your members here.

I was very pleased to see that you are devoting such a large amount of time at this Convention to the question of reticulation of electricity in to Native Townships. I have seen your Agenda, and I have very briefly read some of the papers. I want to say to you that I was amazed at the low cost structure suggested for wiring and metering of African houses.

As you know it is not possible for Municipalities to finance the electrical connection and wiring and metering from the Government Capital Fund source, and that the Government insists upon Municipalities undertaking this capital work themselves. We have found, through the university survey, that only a small proportion, possibly a third of our total Native population, is able to afford full economic rental for the four-roomed house which we have erected at Kwa Mashu and which it is proposed to be erected south of our city at the Umlazi Mission Reserve. We find that some cannot afford more than a two-roomed house, and others cannot afford more than the site and service house, so that you see, Mr. President, that your wish and desire to reticulate electricity to all Africans in Native townships is a very vast problem. Of course, I believe that if you reticulate to the permanent African house, you will have to do so also to the temporary house. We have here in Durban under construction some 2½ thousand temporary log cabin houses to meet the needs of those Africans who are unable to afford anything better. These log cabins are comfortable, they are weatherproof, but I am sure a little light on the subject—electricity, and perhaps some sort of electricity for cooking purposes—would be most welcome so long as the cost can be kept within reason.

So perhaps you could give that aspect of the matter a little consideration.

I would also like to draw your attention to the fact that in Durban we have under construction at the moment some 4,000 Indian houses, and that Indian housing in this city is a problem of the very greatest magnitude. These 4,000 houses are in what we call the Merebank-Wentworth scheme which is a dormitory to our Industrial Areas, and these houses are served by electricity—or will be. They are more than half completed at this moment. But we have a much larger scheme in an area which we know as Chatsworth which will eventually cater for 20,000 Indian houses. I am quite satisfied that to meet the economic requirements of the Indian, who is just as hard-pressed financially, and has just as great a struggle to make ends meet as the African, we will have to cut down the standard of housing, and we will, I am afraid, find it necessary to deal with a cheap standard of wooden house. There again, Mr. President, there will be a problem, as to whether or not we will feed electricity into this vast scheme. When I say "scheme" you will realise that it will house over 100,000 Indians and it will be a city in itself. The other day at your illuminations conference, I suggested that, perhaps because of the difficulty of reticulating electricity into these houses, it may be necessary to resort to some form of portable gas lighting. That wasn't met with very great favour, especially by my own electrical engineer, but I hope that it won't be necessary. I hope that you engineers, and delegates, will perhaps be able to assist this municipality in finding a way of reticulating electricity in this scheme.

Another point which I think I should mention, as a layman, or as a councillor representative here today, is the question of introducing into our undertaking a team of efficiency consultants. I want to say to you that we consider our Durban undertaking very efficient, but we have experimented in other Departments, namely our telephone department, where, of course, we have a municipal undertaking which is unique in South Africa.

That undertaking produces an enormous profit each year, and we thought that if we perhaps introduced efficiency consultants, into that department, which we considered the most efficient trading undertaking in our municipality—if that bore fruit, then it would be well worthwhile introducing them into other departments.

Now I want to say at the outset that they proved an outstanding success in the telephone department. I am happy to say that our own City Electrical Engineer, before this survey was even completed, came to see me and asked whether they could be introduced into his department. I think when we have an efficient undertaking, such as we have in Durban, there is nothing to fear from the introduction of these consultants.

One of the difficulties which confronts councillors, and I am sure heads of departments, is the question of the distribution of the Native labour force of an electricity undertaking.

We find that there is a difficulty in that for certain jobs a certain labour force is necessary, and they are probably divided into gangs. Now one has to employ the maximum number in that gang to meet the job, or the optimum job, when it comes to hand, but more often than not, one can do with many less labourers, and it is a question of moving these labourers from place to place economically, with efficient transport, so that they can be used to the maximum advantage. That is the sort of thing which we hoped that efficiency experts would be able to assist us with, quite apart from their other investigations into the department itself.

I would like to pay particular tribute to Mr. Simpson in this regard, for the way in which he has invited them into his department, saying that if there can be any improvement he would welcome it.

I don't intend to keep you Mr. President, and gentlemen, but I would like to say how very pleased I am to see you all in Durban again. Durban has very, very happy associations with you good people.

The connection of Durban with the Association goes back to the late John Roberts who was our first Borough Electrical Engineer, and was the second President of your Association, namely from 1917 to 1919 and again from 1924 to 1926. His successor, the late J. H. Giles, and Clarence Kinsman who I see amongst you this morning, were each Presidents in the years 1937/38 and 1947/48 respectively. The late Edgar Poole, Durban's first Assistant Borough Electrical Engineer, acted as Honorary Secretary-Treasurer to the Association during the various periods from 1917 to 1940.

Now I find that our present City Electrical Engineer is to be your President for the ensuing year. So you see Durban is very closely associated with your Association, and as I said last night I think it would be very fitting if perhaps you made Durban your permanent venue.

With those few words, Mr. President, I would firstly like, as I have already done, to welcome delegates and their wives to Durban, and hope that they have a most pleasant time while they are out of the conference room, and that they will have a most fruitful time while they are in the conference room.

And with those few words, Mr. President, I formally declare this Thirty-Fourth Convention of your Association formally open.

Thank you very much. (Applause.)

THE PRESIDENT: Thank you Mr. Mayor. I don't want you to get the impression that I am inclined to cross swords with you on every occasion that we meet, but I do think that in the reference to delegates at large or large delegates, to give our wives and lady friends the impression that we are keen to get away from them, is somewhat upsetting for it is not the truth at all!

Your interest, Mr. Mayor, in our Agenda is to be commended when one realises that you had a Council meeting yesterday and many other activities that kept you away from your home. You have given us some very interesting facts about your housing programmes and no doubt we will hear more

about them during the course of the Convention.

I would like to take this opportunity of referring to Mr. Gild—you mentioned this last night—but I would like to tell our members that the Executive yesterday decided, on your behalf, to send a suitable letter to Mrs. Gild in the horrible tragedy that has occurred. We all hope that a miracle will soon be manifest.

Thank you very much, sir, and I am sure we are going to have a very successful Convention.

I would like to make a few announcements. First of all, to welcome new bodies By bodies I mean local authorities, or affiliates, people like that, who are attending for the first time. Individuals representing them are not necessarily newcomers to our convention, but the bodies are.

Mr. H. J. Koeslag of Riversdale. I think it is your first attendance.

Mr. E. E. de Villiers and Clr. Grundling, Carletonville.

Mr. Greeff, White River.

Councillor Meininger and a man by the name of Harvey of Warmbaths.

From Matatiele, Clr. Rorke. I think this is your first attendance in 10 years.

Mr. Gill, an Associate Member representing the Zululand Electric Utility Company.

Messrs. Louw and Van Harten, Affiliates, I think it is the Nederlandsche Kabelfabrieken Ltd. and finally people by the name of Val Davies and Monks, representing A.E.I.

I wish you all every benefit from our deliberations. We have two very special friends. Mr. and Mrs. James Beard from Sussex, well known to many of us.

And then Mr. J. C. Wood from London, who is going to give us a Paper.

I don't know if I'm correct in this, but the paper you have seen printed is possibly going to be nothing like the one he is going to present.

Finally Mr. Marchant of Witbank—is he with us today? Mr. Marchant misbehaved himself last year in Johannesburg, and spent the rest of the week in a nursing home. We are pleased to see you back and fit and hearty.

I come to what to me is perhaps one of the most important aspects of this morning's session. I am going to hand over to your worthy vice-president, but before I do I'd like to thank all members for giving me this marvellous experience of being your President for the year. I certainly want to thank Dick Ewing on my left, who has kept me in order on many occasions. It is not exactly a benefit to have a secretary in one's home town. Finally our Executive. They have been most tolerant, and I think behaved themselves. I thank you all. I only hope I lived up to the reputation of previous Presidents.

I would now like to call on members to nominate your President for 1960/61.

Mr. C. DOWNIE (Cape Town): Mr. President, Mr. Mayor, Ladies and Gentlemen: Situated on the coast, at the southern part of Africa, are two well-known cities. They happen to be separated by a distance of 1,000 miles and are famous in the British Commonwealth—famous as sea ports, and havens for shipping. They are also equally well known and most popular throughout Southern Africa as seaside holiday resorts.

One particular reason why these two cities have become so well known arises from the hospitality and entertainment which they freely gave to troops who called there during the last war. Of special interest to us here today, however, Mr. President, is the fact that they are equally well known for something else, and that is their municipal electricity undertakings. One of them is the City of Durban. I am not going to mention the other one, Mr. President. I'll leave you to guess which one that is.

Mention of the City of Durban, calls to mind immediately, especially when one thinks of Durban's Electricity Undertakings, the engineer who built up that Undertaking, and started it on the way to what it is today. I refer to the late Mr. John Roberts.

Mr. Roberts was City Electrical Engineer of Durban for 35 years. He was the City Electrical Engineer when the Durban Undertaking was founded in 1897. Mr. Roberts was far seeing and progressive and one of the things he did was to pay special attention to developing the use of electricity for private and domestic purposes. He became, I consider, South Africa's most outstanding Municipal Electrical Engineer. His example was followed by other Municipal Electrical Engineers especially one who, during Mr. Roberts' time, became City Electrical Engineer of that other city I have just referred to. I won't mention names, but he became equally well known and there was great rivalry between him and Mr. Roberts in their day. He followed Durban's example in promoting the sales of electricity for domestic purposes and in this connection I think you are all now familiar with the famous hire purchase scheme which has been of considerable assistance in that other city for close on 30 years.

Now, Mr. Mayor, ladies and gentlemen, just before Mr. Roberts retired in 1932, a young fellow by the name of Simpson joined the undertaking as an electrical engineering apprentice.

He worked his way up from being an apprentice, and became an Assistant Engineer. He studied assiduously at the Technical College and passed his Electrical Engineering examinations. I well remember the name of Simpson, because from Cape Town I used to organise the holding of the examinations of the Institution of Electrical Engineers on behalf of The Institution of Electrical Engineers' representative for the Cape, Natal and Rhodesia. I therefore heard of Mr. Ronald Simpson quite a long time ago. As you know Mr. Simpson is a full member of that Institution. He has worked his way up the hard way. He became your Deputy City Electrical Engineer and finally City Electrical Engineer when Mr. Kinsman retired in January, 1954.

Being one of those "delegates at large" at this Convention whom you have referred to Mr. Mayor, I am interested in figures, as members of this Association will know. I studied some of Durban's annual reports, and have made a comparison between the City of Durban and that other famous city which I have referred to in the growths of the two cities as represented by their sales of electricity. Cape Town (I didn't mean to divulge the other city's name!) led the way until 1953/54. Up till then its sales of electricity every year exceeded those of Durban. I had the pleasure not so long ago therefore of writing to Mr. Simpson and congratulating him on Durban's having overtaken and passed Cape Town in the sales of electricity. Durban today, Mr. President, is virtually the second largest municipal electricity undertaking in South Africa after our own undertaking, namely Johannesburg.

I was just telling Mr. Milton who is sitting alongside me here, how I envy ESCOM in having such a "luscious" high load factor consumer as Durban.

Mr. President, I now come to the main purpose of my standing up here this morning after having told you a little bit about Mr. Ronald Simpson and his electricity undertaking. He is a most worthy successor to his predecessors who were also Presidents of this Association in their time, namely the late Mr. Roberts, and Mr. Giles, and Mr. Kinsman (whom we are so pleased to see here today). They have set very fine examples which I am quite sure Mr. Ronald Simpson will follow. He will also continue to serve Durban as well as his predecessors did, Mr. President, and by the time he retires will have had over 40 years' service with the Durban Municipality.

I have the greatest pleasure in nominating Mr. Ronald Simpson as President for the ensuing year.

THE PRESIDENT: Thank you Mr. Downie. I call on Mr. Nagle to second the proposal.

Clr. NAGLE (Durban): Mr. Mayor, Mr. President, ladies and gentlemen: It gives me great pleasure to second this nomination of Mr. Simpson as your President for the coming year.

A great deal that you said about our past engineers, John Roberts and Mr. Giles, Clarence Kinsman, and actually it has fallen to Mr. Simpson to follow in the steps of these gentlemen.

Durban has been blessed with good City Electrical Engineers, and I make bold to say that (and I am not detracting from the prestige and esteem in which these gentlemen were held) Mr. Simpson stands equally as well as those who have gone before him, and Durban is very well satisfied and the City Council is satisfied, with the conduct and the management of this great electrical undertaking.

You know, it has been mentioned here that Mr. Simpson has called in the consultants for his department. It is quite true what was said about the success in the telephone department. It so happens that the Electricity Department and the Telephone Department, Markets and Abattoirs and Transport come under the Trading Undertakings Committee.

We have to deal with the officials, and Mr. Simpson along with the other heads of the departments, has been proved most successful and satisfying to all concerned, and there has never been anything to complain about, but otherwise I can tell you this much: that I often have a fight with Mr. Simpson, and if he doesn't satisfy me about getting lights then I tear a strip off him. But he fits the bill fairly and squarely.

Now coming back to consultants. Mr. Simpson doesn't want to emulate former Durban Municipal Engineers—City Engineers, not Electrical Engineers . . .

We had a well known City Engineer (he is dead now so I can tell this story) . . . who was very impulsive, very impetuous, fiery (he was an Irishman and that speaks for itself).

However, this morning he was very concerned about how his staff were working; he wanted to get the best out of his staff and wanted to test them for malingering. So he got into his car and went out on his rounds, and he came across a gang, and the ganger was lying on an embankment with his hands behind his head, and the gang of Native boys were all sitting at the roadside. He jumped out of the car, approached the ganger and gave him a great dressing down. He said, "Get the hell out of it, go back to town and get your money—the whole lot of you." He fired the gang. When he got back to town he found that he had fired the Government Telephone Department's gang.

That is a true story so you can repeat it elsewhere. Now Mr. Simpson doesn't want to emulate this man, but Mr. Simpson is doing the right thing by calling in the consultants, and we hope that they will prove as satisfactory in his Department as they have proved in the Telephone Department.

As far as we are concerned here in Durban we feel it a great honour that you have conferred upon Mr. Simpson. When Clarence Kinsman was appointed President, we in the City Council were highly delighted, and I make bold to say that the Council of today would be as equally delighted at your nomination of Mr. Simpson being your President for the ensuing year. I can assure you that if he will give the same satisfaction to you has he gives to us, you will have no cause to regret it. And I have much pleasure in seconding the nomination.

THE PRESIDENT: Thank you Clr. Nagle. I take it ladies and gentlemen that the motion is carried. (Unanimous)

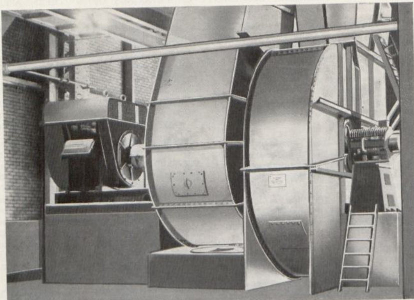
I have great pleasure in announcing Ron Simpson as your President for the year 1960/61, and will ask the Mayor if he will introduce Ron to the "Chain Gang."

The new President was installed. (Applause).

Mr. R. SIMPSON: Thank you very much indeed ladies and gentlemen. I accept this honour with very great humility. I will refer to that a little later on during my Presidential Address, so I won't delay proceedings now by making a speech.

We will now proceed with the business of the Convention, and I will call on Clr. Mr. Brown of Livingstone in connection with the venue of the next Convention.

Clr. Brown (Livingstone): Mr. President, Mr. Mayor, ladies and gentlemen: It is indeed an honour and a pleasure for me to be here today and I will take this opportunity on congratulating you, Mr. President, on your election to the most elevated office of this Association and wish you a happy and successful year.



I am fortunate in being a Council member who has had the privilege of attending a few of your Conventions. I remember the awe which I experienced last year in Johannesburg when listening to your erudite members presenting their various papers with KVA's and KW's manifesting themselves from every direction. I turned to my Electrical Engineer for some help and clarification, but he had such a serene and blissful look on his face I hesitated to approach into what was obviously a second heaven to him. I have yet to see him wear that expression in the Council chamber.

Mr. President it is my honour and privilege on behalf of the Town Council of Livingstone to invite the Association of Southern Africa to hold its next Convention in Livingstone.

Northern Rhodesia, I understand, has never had the privilege of being hosts to this Convention, and Livingstone as the gateway to this territory, as well as being the tourist capital of the Federation, has, I am confident, the facilities and amenities which you require.

We in Livingstone have one of the greatest wonders of the world, the Victoria Falls, and not quite so near, but easily accessible, one of the greatest engineering achievements of the Continent of Africa, if not the world. I refer of course to Kariba, and feel that all Electrical Engineers of South Africa should visit the source of what we in the Federation hope will become one of our biggest exports, to you in South Africa.

Thank you Mr. President.

THE PRESIDENT: Thank you Clr. Mr. Brown.

The Convention has heard this very kind invitation from Livingstone. It is your wish that we should accept? (Applause).

(Agreed).

Thank you.

Mr. Brown, will you please convey to your Mayor and Councillors our very sincere thanks for their kind offer to visit Livingstone for the next Convention, and let them know that we will be very pleased indeed to accept.

The next announcement I want to make is in connection with the Convention following —that is the 1962 Convention.

The Executive Council has discussed this on previous occasions, and we have come to the decision that it will be beneficial if we knew further in advance of the venue of each convention, so we have now decided that we will arrange two years ahead.

In that regard we have had an invitation from the City Council of East London to hold the 1962 Convention in their City. The Executive have decided, subject to ratification at the 1961 Convention at Livingstone, that they will accept this kind offer. That will allow that city, and all concerned, time to make necessary arrangements well in advance.

I will now proceed to the next item, and call for nominations for Vice-President.

Mr. J. E. MITCHELL (Salisbury): Mr. President, Mr. Mayor, delegates, ladies and gentlemen:

There are, I know, two kinds of City Electrical Engineers and Town Electrical Engineers. There are DC types and the AC types. The DC type are those that come and never go and in the capital city of Bloemfontein they have a DC type of City Electrical Engineer.

Now with Assistant City Electrical Engineers, there are also DC types and AC types. Some years ago there was an Assistant City Electrical Engineer, Bloemfontein, who decided he was going to be an AC type. Now the DC type of Assistant City Electrical Engineer are commutated which could be defined as coming very quietly—they come so quietly they are of no use to you at all, and because they are the DC type they never go when you want them to.

Now the AC types are the ones that come when you want them but go when you don't want them to go, and one of these types was Chris Lombard, who, at that time was Assistant City Electrical Engineer of Bloemfontein.

Now he decided to go to the Reef. As far as I can see he went to Germiston which is a City outside Johannesburg. Now this

Reef is a very difficult place for anybody coming from Rhodesia. You see, you set off from Salisbury, and if you go via Fort Vic you go nearly 200 miles before you come to any decent sized town; then you go another 200 miles before you come to another town, and then you go another 200 miles and you come to Pretoria, and you do another 30 odd miles and you come to Johannesburg, and there is a decent gap in between. But when you come to the Reef, and you start getting to the other side, well, you don't know where you're getting to.

They tell me there's a Main Reef Road and a Lower Main Reef Road and a road that misses the Reef altogether—I suppose that is in memoriam of some of these miners that missed it too—and this City is awfully difficult to find. Now when I begin to get near to Germiston I see a sign post which says "Germiston" so I pass it, of course. Then it says "Germiston" again and I pass that, then I come to another sign post and it also says "Germiston" but it is pointing the other way, and I haven't a clue how to get there.

Chris became the City Electrical Engineer of Germiston and that of course entitled him to become one of the members of the Reef Association of Engineers. Now the Reef Association of Engineers, are very courteous and they send each member of the A.M.E.U. Executive a copy of their Minutes, and I am going to make a suggestion to the secretary of that Association. The first page is always taken up with a list of members who have been there. I suggest that they just put down those who weren't there and it will save them a sheet of paper!

To be really serious, or semi-serious at any rate, Chris became a member of our Executive, I think in 1954. He is one of the quiet types. Some members of the Executive think aloud, and that I think fosters some debate. But Chris chews everything over in his own mind first, and when he comes out with something it is usually something to which he has given very serious thought, and contributes very considerably to the debates in the Executive.

You have heard him at many conventions over the year, and you have known that when he has either prepared something, or spoken to you on papers, or subjects or on his one aim in life, "Rights of Supply," where he is continually fighting the ESC—David and Goliath you know; he hasn't found the right stone yet, but he is still trying—Chris has been a very worthy member of the Executive for many years, and I am sure you will always agree with me that he will, in his turn, make a President worthy of this Association.

I therefore nominate Chris Lombard, City Electrical Engineer of Germiston, as our Vice-President for the year 1960/61. Thank you. (Applause).

Mr. F. J. CASTELYN (Bloemfontein): Mnr. die President, Mnr. die Burgemeester, dames en here: Dit is vir my baie aangenaam om hierdie nominasie vir Mnr. Chris Lombard te steun.

Hy is 'n persoon wat ses jaar in ons stad, Bloemfontein, werksaam was. Ons ken hom dus persoonlik—ons ken hom buite en ons ken hom binne sy werk. Die waar, hy is 'n stil teruggetrokke persoon, maar ek kan u verseker dat Mnr. Lombard een van die persone is wat weet hoe om te werk. Hy weet nie net hoe om te werk nie, maar hy weet hoe om sy doel te bereik, en ek kan u verseker hy is een van die trouste in ons land. Hy is stil—dis reg, maar in al sy optrede is hy 'n waardige mens. Ek kan u verseker dat as Vise-President, en later as President van ons Vereniging, hy sy plek sal volstaan op 'n baie waardige wyse. 'n Mens sou sê so 'n teruggetrokke persoon, kan nie altyd die nodige leiding neem nie, maar daar is 'n ander soort teruggetrokke mens, wat 'n respek afdwing, en dit is hier waar Mnr. Lombard uitblink.

Meneer, dit is vir my 'n besondere groot eer om hom voor te stel. Ons is nou nog hartseer dat hy van Bloemfontein af weg was, want Raadslede is altyd 'n bietjie skrikerig vir ingenieurs. Ek ken nie al die letters wat Mnr. Mitchell al genoem het nie, PD en ek weet nie wat al meer nie—ons het al geleer as Raadslede om nie na die letters te luister nie—ons kyk na die mens, en hierin het ek altyd, waar ek met Mnr. Lombard in aanraking gekom het, altyd 'n soort van 'n krag ontvang van die man. Hy is 'n persoon wat jou trek na hom toe, hy is 'n persoon wat jou laat voel hy het nie ander belange nie—daar is net een belang, en dit is sy werk, wat hy baie goed doen.

Sedert hy 'n lid van die uitvoerende bestuur van hierdie Vereniging van ons was, het ek opgemerk hulle span hom besonder baie in. En dit is nie omdat hy so stil is, dat hy ingespan word nie, maar omdat hy sulke deeglike werk kan lewer maar want hy doen dit so goed.

Meneer, dit is daarom dat dit vir my so 'n groot plesier is om Mnr. Chris Lombard voor te stel as Vise-President van ons Vereniging.

Dankie. (Applause.)

THE PRESIDENT: Thank you Clr. Castelyn.

Are there any further nominations? If not, I duly declare Mr. Chris Lombard of Germiston as the Vice-President for the ensuing year. (Applause).

Will Mr. Lombard come up to the main table please?

Ladies and gentlemen, before we adjourn for tea, there are several announcements that I would like to make.

(Convention Announcements Followed)

CONVENTION ADJOURNED FOR TEA

ON RESUMING:

THE PRESIDENT: The first item of business for the Convention will be apologies and greetings.

THE SECRETARY: Mr. President, ladies and gentlemen: We have a considerable numbeor of apologies this morning.

The Morgan Crucible Company.

Mr. Stoffberg of Peri-Urban Areas Health Board.

Mr. Bellingham of Windhoek.

Mr. A. B. Cowan, Escom, S. Rhodesia.

Mr. Dalton, Inspector of Machinery, South West Africa.

The Relieving System Manager, S.A.R. Durban.

The Municipality of Oudtshoorn.

Messrs. L. D. Mouchel & Partners.

The Municipality of Walmer.

Clr. Addeston of East London.

Municipality of Umtata.

Municipality of Stutterheim.

Mr. A. M. S. Muller.

Then we were very sorry to learn that Mr. Morton Jaffray would not be with us for this Convention owing to his indisposition.

Mr. C. F. Hafele of Bloemfontein.

Mr. Beard of Grahamstown, due unfortunately to illness.

Municipality of Upington.

Town Council of Piet Retief.

Town Council of Alberton.

Municipality of Aliwal North.

Chairman of the Natal Coal Owners' Society.

Chairman of the Coal Allocation Committee.

R. F. Dunstan, Port Eliabeth.

British General Electric Co. of Central Africa (Pvt.) Ltd.

Director of Local Government, Pretoria.

Chairman of the Industrial Development Corp. of South Africa.

Provincial Secretary, Natal.

Secretary for Labour, Pretoria.

Chairman of the Federal Power Board, Salisbury.

Deputy Chief Executive of the Federal Power Board.

President Tvl. and O.F.S. Chamber of Mines.

Director of Public Works, Swaziland.

Prof. Bozzoli, University of Witwatersrand.

Fuel Research Institute of Africa.

Provincial Secretary, O.F.S.

Thank you, Mr. President.

THE PRESIDENT: Thank you.

Before calling on representatives to convey their greetings in the usual manner, there are several announcements that I would like to make:—

I have been asked by the President and members of the Steel and Engineering Industries Federation of S.A. to pass on to the Convention their very best wishes for a successful Convention.

I believe Mr. Relihan, the Engineer of Paarl, who is one of our oldest members, will retire before the next Convention. If that is so, I would like to convey to him our very, very best wishes for the future. (Applause.)

Also, I am sure you'd all like to know that it is our Vice-President's lady's birthday today, so I'd like on your behalf to wish Mrs. Lombard a very happy birthday. (Applause.)

I now call on representatives to convey their greetings in the usual manner.

Mr. J. C. DOWNEY (Springs): On behalf of the S.A. National Committee on Illuminations, I bring you the greetings and wish you a very happy and successful term of office.

Mr. T. BISHOP (Johannesburg): Mr. President, could I offer apologies for absence on behalf of an honorary member, Major Redman; due to indifferent health he finds he is unable to attend this Convention. He sends you his congratulations, and to everybody here, a successful Convention.

THE PRESIDENT: Thank you Mr. Bishop, I'm sure the Convention would like you to convey to him our very best wishes.

Mr. G. C. MOLYNEAUX, Rhodesian Railways: My General Manager has asked me to convey to you, Mr. President, his greetings and best wishes for the Convention. Thank you.

Mr. W. H. MILTON, Escom: Mr. President, I have been asked to convey greetings from the Electricity Supply Commission, Union, to you and to wish you a very successful Convention.

Mr. J. R. BEARD, London: Mr. President, I have a double duty to perform in conveying to you two sets of good wishes from Great Britain. The first is from The Institution of Electrical Engineers of which I am Past President, and the present President, Sir Willis Jackson, and the Council wish you a very happy and pleasant convention.

I also, as a Past President of the British Electrical Power Convention, would like to convey to you on behalf of this year's President, Lord Chandôs and their Council their very good wishes for your Convention here. They are a sister body to you and I am particularly pleased to give you their good wishes.

Mr. H. T. ASPINALL, Department of Education, Arts and Science: I have very much pleasure, Mr. President, in conveying to you the greetings of the Department, and to wish you a very successful year of office. It may be relevant for me to mention at this stage that the Department appreciates very much the interest that this Association has shown in electrical education matters, particularly those affecting Technical Colleges.

Mr. A. W. LINEKER (Johannesburg): Mr. President, I have two apologies to offer you; first on behalf of Prof. W. Cormack, President of the South African Institute of Electrical Engineers. In the absence overseas of Prof. Bozzoli he found his present heavy duties prevented him from appearing at this Convention.

When that was found out, Mr. L. Axe was deputed to convey greetings to you, but he unfortunately was also unable to attend, so it devolves upon me to convey to you on behalf of the Presidential Council of the S.A. Institution of Electrical Engineers, greetings and best wishes for a successful year of office and a successful Convention. Also on behalf of the controlling Executive for the Associated Scientific and Technical Societies of S.A. I also convey to you the same greetings.

Mr. S. REVOW (Electrical Contractors Association of South Africa): Mr. President, on behalf of my Association, may I convey to you our best wishes for a successful Convention.

Mr. GEORGE LOUW: Mr. President, on behalf of the Institution of Certified Mechanical and Electrical Engineers, it is my pleasant duty, sir, to convey to you the best wishes of the Council.

The Council is particularly proud that it has given you one president at least in the past, and that you are to have another in the future.

THE PRESIDENT: Thank you, ladies and gentlemen. We will now proceed with the next item, the Presentation of Past Presidents' and Honorary Members' medals.

Ladies and gentlemen, it is customary at the conclusion of a successful year of office, to present the immediate Past President with a badge of office for having held office, and also a certificate, and Bobbie as you know, has fully earned this honour. He has conducted himself and the affairs of this association at the very highest level, and at every meeting, he has kept a very pleasant atmosphere running at the same time getting on with the business of the Association. It is therefore with very great pleasure that I now ask him to accept from the Association these mementoes of an outstanding year of office as your President. (Applause.)

It is also customary for the Executive during the course of the year to consider the award of Honorary Membership to certain of its members who have served the Association loyally and in an outstanding manner, and two names have been brought forward which I must put to you today to receive this honour. The first is Clr. Mr. Castelyn of Bloemfontein and the second is Clr. Mr. Davies of Springs. Both of them are very well known to you, they have both officially represented the Councils at our Conventions for many years, and I must now submit this recommendation to the Convention for your ratification of the action of the Executive in coming to this decision.

Is it your wish that these two gentlemen be so honoured? (Applause.)

Thank you, I will now call on our immediate Past President to make the presentation of the Honorary Membership certificates.

(CERTIFICATES WERE PRESENTED)

Mr. F. J. C. CASTELYN (Bloemfontein): Mr. Presient, ladies and gentlemen: I am very grateful to you for this honour—unmerited honour indeed. When it was conveyed to me it left me breathless. I didn't expect this sort of thing. Maar dit laat my dink aan die mens. As jy 'n jong man is dan wil jy graag getroud wees; as jy getroud is dan wil jy graag kinders hê; as jy kinders het wil jou graag oupa wees; dan dames en here, kom jy in die plek waar ek vandag is. Dan bly daar net een ding oor, oorlede oupa.

Ek het dit nie verdien nie, ek is partymaal 'n bietjie stroomop maar ek is baie, baie dankbaar. Ek beskou dat dit een van die grootste blyke van waardering wat ek miskien nie verdien het nie, en ek sal dit as sulks hou 'n lengte van dae.

Baie dankie, Mnr. die President. (Applause).

Clr. L. P. DAVIES (Springs): Mr. President, ladies and gentlemen: First of all I would like to thank you very sincerely for the honour you have bestowed on me today. I appreciate it as a token of appreciation of the little that I may have done to help in the running of this organisation and the problems with which you have been faced.

It was 1949 when I started my association with your organisation, and over the years I have found it most interesting; it has been educational in quite a big way. I have learned to appreciate your problems and though not being able to assist you generally, I have been able in some measure to assist.

Electricity to me is the blood stream of a country. A man's body is hopeless unless the bloodstream is running proficiently, and that applies to the running of a country, industry, commerce, domestic—where would you be without an efficient service, efficient delivery of power, known to us as electricity.

Your problems are great, but it is in your hands—the coming destiny of South Africa. I only say at this stage, Mr. President, I wish you and your colleagues the very, very best of luck in your endeavours to provide us with what we require. Thank you. (Applause).

THE PRESIDENT: Thank you Mr. Davies.

We will now proceed to the next item on the Agenda and that is to call for nominations for election to the Executive Council.

There are six vacancies on the Executive Council, the following are the names of retiring members—Mr. Van der Walt of

Krugersdorp, Mr. Hugo of Pretoria, Mr. Mitchell of Salisbury, Mr. J. C. Downey of Springs, Mr. Muller, Bloemfontein, Mr. Miles of East London, all of whom are eligible for re-election.

Those automatically appointed to the Council are—Mr. Kane and Mr. Downie of Cape Town who, by virtue of being the two immediate Past Presidents are automatically elected. Mr. Lombard being elected to Vice-President is also ex-officio a member of the Executive. These three members will therefore not be standing for election by ballot.

In your folders all those entitled to vote will find we have already issued the ballot prepared papers. Only Engineer members and one councillor member and honorary members are entitle to vote. We have endeavoured to put the ballot papers in the correct councillor's file, but in the event of my staff having made a mistake please take note that if there are two councillors from one centre, will they please decide which one is the official delegate and pass the paper to him. I would also ask our friend Walter Milton if he will be one of the scrutineers along with John Wilson of Pretoria.

In addition I must draw your attention to the fact that Mr. Dawson and Frank Stevens are already on the Executive, being Chairmen of their respective local branches of the A.M.E.U.—that is, the Cape Eastern and Natal Branches. So they will not be eligible for nomination.

I now call for nominations.

I would also remind you that each Province is entitled to one representative on the Executive, and this fact will be taken into account in the final count of votes.

All retiring members are eligible for re-election.

The following members were each duly proposed and seconded:—

Mr. Giles, East London.
Mr. Van der Walt, Krugersdorp.
Mr. Murray Nobbs, Port Elizabeth.
Mr. Mitchell, Salisbury.
Mr. Waddy, Pietermaritzburg.
Mr. Barton, Welkom.
Mr. Hugo, Pretoria.
Mr. Muller, Bloemfontein.
Mr. J. C. Downey, Springs.
Mr. Vergottini, Brakpan.
Mr. Rossler, Kroonstad.
Mr. Sibson, Bulawayo.
Mr. Beesley, Livingstone.

THE PRESIDENT: If there are no further nominations, I will read them out to you, will you please write them down.

Mr. Giles, East London.
Mr. Van der Walt, Krugersdorp.
Mr. Murray Nobbs, Port Elizabeth.
Mr. Mitchell, Salisbury.
Mr. Waddy, Pietermaritzburg.
Mr. Barton, Welkom.
Mr. Hugo, Pretoria.
Mr. Muller, Bloemfontein.
Mr. J. C. Downey, Springs.
Mr. Vergottini, Brakpan.
Mr. Rossler, Kroonstad.
Mr. Sibson, Bulawayo.
Mr. Beesley, Livingstone.

Gentlemen, will you please record your votes and I will ask the scrutineers if they will collect the ballot papers. Six only must be voted for; and please remember that each Province must have at least one representative on the Executive. For the sake of this Convention, the Federation is regarded as a Province of the Union.

Gentlemen, whilst the scrutineers are collecting and checking the papers, we will proceed with the next item on the Agenda, and I will now ask the Vice-President if he will take the Chair whilst I read my Presidential Address.

PRESIDENTIAL ADDRESS

Gentlemen, my first duty this morning is to thank you all with humble sincerity for the faith you have shown in me in electing me President of this Association. I am deeply conscious of the honour you have bestowed upon both my City and myself and of the heavy responsibilities that I must now accept: I can assure you that I will do my best to follow in the footsteps of my predecessors and maintain the high traditions of this Association.

To assist me, I am fortunate in having the advice and guidance of an experienced and well tried Executive Council, Secretaries and also past Presidents who I am sure will

always be ready to help me with a guiding hand whenever I may require it.

This morning, one of my first responsibilities is my Presidential Address. It is customary for the President of an Association such as ours to prepare an address on one or more aspects of the Supply Industry which call for a critical but constructive analysis and it is hoped that developments beneficial to the industry will arise therefrom.

As this is an Association of Municipal Electricity Undertakings, I should have no difficulty in finding material from which to prepare such an address.

All engineers and particularly those who are in charge of Undertakings such as ours must agree that one of their most important problems is the "Human One." I propose therefore to comment on the ever topical problem of Apprentice Training and the employment of Bantu Labourers.

I will also comment on certain aspects of the growth of Electricity Supply and use of fuels with particular reference to Natal's water resources.

During 1958 the South African Institution of Mechanical Engineers organised a symposium on the Training of Apprentices and I feel that it will not be amiss for me to make further reference to this all important subject in my address today. The Training of Apprentices in this country follows closely in the pattern that evolved during the Industrialization of Great Britain and which is based primarily on the personal training of a selected pupil by a Master Craftsman. Labour was cheap in those early days and opportunity a "fickle jade" and only the best were able to achieve the prize of eventually being a Master of his trade.

In those early days the Master Craftsman largely combined both what today is recognised as Professional (Engineering) responsibility and its practical application in construction.

This can be readily appreciated when we visit some of the very wonderful buildings, bridges, water supply systems, roads, etc., constructed centuries ago before research had given us our present day technical knowledge.

These wonderful edifices and works were often the efforts of "Monks" or designers who planned, supervised and executed the work from knowledge based on experience acquired by them or passed down to them by previous masters.

In those days discipline was firm, if not brutally strict and only the best survived, notwithstanding the fact that high premiums were paid for the privilege of being apprenticed and the Master Craftsman guarded this knowledge very jealously.

If we consider the practice in South Africa today, we find that it is fundamentally similar: we still look to the artisan to impart his skills to the apprentice, assisted by compulsory attendance at a technical college for part of the five-year period.

If we consider the enormous developments in the technical and industrial spheres that have taken place throughout the life of the present methods of training and compare them with the changes in the method of training I think we must agree that industrial development has outpaced any of the improvements that have been made in training methods.

Some of the major developments that have taken place during this period are as follows:

(a) The enormous growth of the world's population.

(b) The developments in transport and communications.

(c) The complexity of modern technical developments.

(d) The introduction and development of industrial legislation.

(e) The highly competitive nature of modern trading.

All these facts particularly in the light of the highly specialised and competitive nature of our present day industry, make it more and more obvious that our system of Training must undergo a complete and thorough revision.

With the stringent demands imposed by our present day economy it is becoming increasingly difficult for some of the smaller industries and businesses to carry the cost of apprentice training and there is therefore a tendency to expect a more profitable output from apprentices than is advisable with the corresponding detrimental effect on their training.

In addition, the training in these cases is tending to become too narrow, which has the effect of lowering the standard of the trained men. I am sure you will agree with me, when I say that, many artisans trained in the narrower sphere who are classified as "electricians," require a considerable period of adjustment when they are first employed in one of the Electricity Supply Undertakings.

In addition, the present system of training laid down and controlled by the Apprenticeship Act No. 37 of 1944 which insists on attendance at a technical college until the apprentice has obtained an N.T.C. II Certificate, does not appear to have been as successful as was originally expected from the point of view of technical training. This is borne out by the examination results, at the Natal Technical College which last year reflected a 32% pass list in Natal. This dropped to this figure from 40% in 1956.

This unsatisfactory condition cannot be allowed to continue and steps must be taken in an endeavour to find and correct the causes of this problem.

It must be generally agreed, that, over the past 20 years, there has been a falling off in the general standard of young men offering themselves for an apprenticeship. Why is this? It could be due to the range of opportunities open to a young man leaving school, for which there is insufficient competition due to our small white population, or it could be due to the immediate financial benefits offered by the higher salaries of commerce.

It could also be due to the psychological approach of some of our young South Africans who tend to regard manual work as being beneath their dignity.

It is possible that my views may be influenced by the fact that Durban may be more adversely effected than other centres, as we have adopted our own Conditions of Apprenticeship in the Municipality which do not allow the same remissions of time as have been granted in terms of the Apprentice Act.

Whilst this may have been a contributory factor it is not the main cause of the fall in standard. The relatively small number of suitably educated young men leaving school each year, faced with the many more remunerative posts open to them in the world of commerce due to our rapidly developing economy, is probably the most serious of the reasons.

I have made some superficial investigations in this regard in respect of Natal:—

Out of a total of approximately 1,200 to 1,300 boys leaving school each year, about 300 to 400 have obtained a Senior Certificate or Matric, the balance leave at some standard below this.

Out of this total of 1,200 to 1,300 boys leaving school, approximately 200 are apprenticed into one of the engineering trades and if the educational standard of the applicants for an apprenticeship in the Durban Municipality is any criterion, only approximately 6% will have reached a standard higher than Standard 8.

Now can we improve this state of affairs? It is obviously desirable that the standard of apprentice entering the Engineering Industry should be raised if we are to meet the challenge posed by future development and successfully face up to the very rapid rate of increase in the technological level that will take place.

Has the time arrived for a readjustment of the status of the electrician by grading the skills of the various classes of employment with the corresponding increase in remuneration level for the higher skills?

It may also be beneficial to the Industry if the training of apprentices was restricted to approved Undertakings or Industries who are in a position to establish proper training facilities.

If it is considered that the present system is entirely unsuitable, then the French system of State Training Establishments could be instituted for the full training of apprentices.

Personally from my experience, I do not favour a complete change of policy but consider that the advantages of both systems could satisfactorily be combined for the reasons which I have set out below.

The personal interest and the acceptance of responsibility for assisting in the training of apprentices by selected artisans is of benefit to both man and boy as it keeps both in touch with each other.

It also tends to develop a more responsible artisan.

The apprentice is made familiar from an early stage with actual working conditions.

If this system is to be effective, it is essential that a longer period of training at the beginning of an apprenticeship, must be carried out in a properly equipped and well disciplined school operated by the approved undertaking or industry or where this is not possible by the local technical college, where the main basic skills are taught by special instructors.

The use of approved undertakings for the training of apprentices would necessitate a levy being made on all non-training employers of engineering artisans, in order that the training firms could be reimbursed for the additional costs of training imposed on them. In this manner the costs could be fairly shared by all concerned.

To stimulate personal effort and interest, apprentices should be encouraged to establish apprentice associations in each Training Industry with a view to sponsoring lectures, entertainments and sports with the corresponding development of their characters and particularly of initiative and a sense of responsibility in these young men.

I have so far dealt only with the practical training of apprentices; it is of course essential that their practical training be coupled with a carefully selected technical course on a part time or in selected cases, sandwich basis. The course attended, to be by selection and in keeping with the capabilities of the individual apprentice concerned.

Early in the careers of these young men, selection must be made between those more suited for a practical an dthose for a more academic technical course, the more academically suited should, where possible, attend a sandwich type of course and the others a part time one with strong emphasis on a practical approach to technical learning.

It is essential, that both sections should hold each other in high regard and that the more practically minded young men must not be allowed to feel that he is in any way inferior to his more academically-minded brother.

Our present system tends to impart this feeling to those who fail in their part-time classes to the general disadvantage of the trade. It is also desirable that a high status should be given to the "master craftsman" and those who are not so academically-minded should be able to aspire to this status.

Two additional aspects must also be taken into account. The first is, that, the present system of gaining artisan status by the efflux-ion of time only should be amended, by the addition, at the end of an apprenticeship, of a comprehensive trade test, the failing of which, would make it necessary for the apprentice to undergo a further 6 months or 1 year's Improvership, or to his being classified as a 2nd class artisan, until such time as he passes this test.

It may also be desirable to raise the status of the "highly skilled artisan" by the employment of a larger number of "lesser trained men" to carry out the lesser skilled types of work. This will allow for the employment of fewer highly skilled artisans, with corresponding benefits of higher remuneration.

My thoughts move on these lines from the knowledge of the number of men who are seeking employment, who have no particular training and who, if properly handled can in a relatively short time be made capable to satisfactorily carrying out certain of the lesser skilled aspects of artisan work. Such views may be regarded as heresy by the Trade Unions, but I feel that their introduction would have the effect of raising the status of the artisan with the corresponding greater attraction to the young man looking for a particular career. Whilst I am very keen to see revisions made in the training of apprentices, I consider it to be of the greatest importance not to make the mistake of doing "too much" for these young men. It is essential that they should be encouraged to help themselves and it is for this reason that I earlier advocated the establishment of apprentice associations.

Whilst it is not my intention to get involved in details of the courses that must be carried out, I must comment on two particular aspects of their training:—

I would like some suitable authority such as the C.S.I.R. or the technical colleges to obtain various instructional films on up-to-date methods and electrical equipment for use in the various apprentice schools or in the technical colleges.

There is a dearth of suitable films for this purpose and it would be of the greatest value if films showing the various aspects of an electrician's trade, i.e. cable jointing, meter repairs, etc., could be prepared and made available to the industry as a whole.

Secondly it is vitally necessary for all technical colleges to be provided with adequately equipped laboratories.

With regard to the period of apprenticeship, whilst there is much inducement to offer remissions of time for educational qualifications, it is very difficult to satisfactorily cover a full course of training in a lesser period than 5 years.

To overcome this problem, remissions of time should be abandoned in favour of increments in wages, to act as the prize for success in passing exams, and for the recognition of pre-apprenticeship training.

Earlier in my address I stated that selected apprentices should be allowed to attend the Sandwich Courses in Electrical Engineering leading to a National Diploma in Technology. This is a most important development and I would like to see the opportunity given to the few suitably endowed students after obtaining the National Diploma in Technology to gain professional status by attending a further course of study and passing a suitable examination. These sandwich courses are of the greatest value and should be made full use of by employees.

The technical colleges of South Africa need to be complimented on their successful introduction of these courses and by what better method can industry show their appreciation than by making full use of the facilities given.

In my comments and criticisms of the standard and training of apprentices, I have made no mention of the work that could be done during a boy's school career to encourage more of them to consider an engineering future. Much could be done at this stage to encourage those who show an aptitude towards the engineering sciences either practical or academic to develop his outlook in this direction with a view to a future engineering career.

One way in which this could be achieved, would be for industry to co-operate with the schools by offering temporary employment to suitable boys during vacations in order that they could be introduced to various avenues of engineering employment, with a view to assisting them to select what they consider to be their particular calling.

It is hardly necessary for me to reiterate the importance of this, as it is obvious, that, if we are to develop our country and keep in step with future technical developments, a well trained and adequate technical staff comprising artisans, technicians and engineers is a necessity.

In making these comments on apprentices and their training, I must emphasize that I am not one of those people who think that the youth of today are not as good as they used to be. Such thoughts are far from my mind. I am confident that the young men of today are quite as good as their predecessors and I have faith in them.

The next aspect of the supply industry on which I will comment is the "labourer," the majority of whom are Bantu in Natal; in this sphere there is much that can be done to assist in the search for increased efficiency.

In considering this aspect I must take into account what appears to be the general view point of the average artisan. African labour being relatively cheap in the past, has tended to be used extensively, the duties for which he is employed being reduced to very limited functions, so that the artisan could be well served with tools and materials with the minimum of effort and delay. Being apparently cheap labour, they have been employed in relatively large numbers in some cases in preference to mechanical devices.

The time has now arrived when this aspect must receive very careful study as it is obvious that their rates of pay will increase during the next few years with the consequent effect on the cost structure of electricity supply.

It is therefore necessary for some reorientation of our present ideas with the view to employing fewer, better trained African labourers.

To achieve this, a selective employment policy must be adopted, supported by training in the class of work they are to carry out.

In addition, more incentive must be given to the labourers by offering avenues of promotion.

It can also be argued that increased mechanisation will help to increase the work output, but as mechanisation is essentially an economic problem, and at the present level of wages paid to the labourer, in many cases, African labour is cheaper than the machine.

We have recently carried out investigations into both trenching for cable laying and hole boring for pole planting by mechanised plant and it is interesting to see that at the present wage rate, the African can compete with the machine:—

Relative costs of pole planting in cost per pole (based on 2,000 poles in average firm ground):

By Normal Labour	By Machine
£3/10/0	£3/15/0

Similarly in cable trenching per yard of trench excavated (excluding laying of cable and reinstatement and transport):

By Manual Labour	By Machine
1/9 per yard	2/- per yard

As it is obvious that the wage level of the labourer will increase very considerably during the next few years, it is essential that careful investigations be made into mechanisation bearing in mind the higher wage level.

In an endeavour to obtain a comparison of the relative number of labourers to artisans employed in an undertaking of a similar class to that of Durban (i.e. a distributing authority), I have obtained comparative statistics from the London Electricity Board in the United Kingdom. Whilst these are not exactly comparable, due to more work being done by Contract in the United Kingdom, they provide an interesting comparison:—

UNITS SOLD PER ANNUM

	Total	A Per Artisan	B Per Unskilled	Total A & B
Durban	928,000,000	3,580,000	875,000	700,000
London	7,110,000,000	1,180,000	1,220,000	600,000

These facts indicate that as the wage rates of the labourer in South Africa increase so the numbers employed in each category must change until we more nearly approach the United Kingdom figures.

Due to fundamental differences in the problems existing in the United Kingdom compared with South Africa in the relation of skilled to unskilled staff, it is not possible to make a direct comparison, but we can use these comparative figures as a guide. It would appear that whilst the ratio of skilled artisan to semi and unskilled is 1:.965 in London, it would be unwise to accept this proportion as being reasonable in our country.

But it does indicate that the ratio must change very considerably from our present one which is approximately 1:4 in Durban. It would appear from these relationships that whilst the numbers of Bantu unskilled staff must be reduced with rising wages, we must expect an increase in the numbers of skilled staff employed, from previous estimates these will probably have a relationship of approximately 1:23.

Before we can effectively control the problem of working with a reduced labour

force, considerable adjustments must be made by both the labourer and the ganger or artisan.

The labourer must realise that he is an effective part of the organisation. He must be selected on the grounds of suitability and must be trained in correct methods. He must also be adequately housed.

He must be given recognition for long and efficient service, with the chance of satisfactory promotion, etc. at an effectively higher rate of pay.

I have no doubts as to the reductions in cost that can be made in this sphere but it will require a great deal of co-operation between management, artisan staff and labourer, before a satisfactory relationship can be reached. It is obvious that considerable research can be carried out into the aspect of our human problem and I hope these few comments will stimulate thoughts in this direction.

Having touched on the human aspects of the supply industry, with some trepidation I will now comment on certain aspects of fuels, with particular reference to Natal.

The consumption of electricity in South Africa increases on the average at the rate of 7% to 8% per annum. This leads to a doubling of the system load approximately every 10 years.

If we examine this aspect in relation to the whole of South Afica for all sources of generation, (municipal and Electricity Supply Commission), we find that in round figures, energy (K.W.H.) consumed per annum has increased from:
Approximately 5,600,000,000 units in 1939 to approx. 9,000,000,000 units in 1949 and to approx. 18,000,000,000 units in 1959.

If the country's economy carries on increasing as it has in the past, and there is no reason why it should not, we can expect the units consumed in 1969 to rise to approximately 36,000,000,000 K.W.H.

This will give an increment of growth during the next 10 years of approximately 18,000,000,000 units as against the 9,000,000,000 units for the previous 10 years.

36,000,000,000 units will require some 25,000,000 tons of coal for their generation, and if we compare this estimated quantity of coal with the total coal production in South Africa which for 1959 amounted to approximately 39,000,000 tons, we can appreciate the magnitude of the task that lies ahead both from the point of view of coal mining and also its transportation.

In carrying out a future survey of loading and its attendant fuel requirements, it is of interest to consider what our position is in relation to other countries, and units consumed per head of population is a satisfactory form of measurement in this regard.

From an article prepared by the Electrical Research Association, London, and published in the 1957 December edition of "Electrical Energy" which tabulates the consumption per head of population for the 24 countries using in excess of 1,000 units per head, it can be seen that South Africa is 19th on the list with a consumption of 1,290 units per head, with Norway in the lead with a consumption of 6,800 units per head.

I mention this particular fact because in South Africa there is a very large and as yet undeveloped potential consumer in the African and non-white population, who, as their standard of living rises, will become consumers of electricity of some consequence. To become consumers they will of necessity have also to become purchasers of appliances which in turn will further develop this country's manufacturing resources.

Given a modicum of courage, and faith in our ultimate destiny, this field of development cannot be and must not be underestimated, an appreciation of the possible effect of this factor, on a conservative basis, could ensure the maintenance of an annual rate of increase of electricity consumed in excess of 7% per annum for many years to come.

In making this statement, I am influenced by the fact that the African population in the Durban supply area alone has increased from approximately 160,000 to 300,000 in the last 20 years, all of whom must eventually be adequately housed.

With the growth around our cities of these satellite Bantu townships, it will be in the public's interest, to encourage the use of electrical appliances for several reasons the most important of which are:—

(a) The provision of a cheap and effective means of heat and light;

(b) The reduction of air pollution; and

(c) The stimulation of the manufacture of suitable appliances.

This latter purpose could be of great advantage to South African industry as it could give us a great advantage in the export of suitable appliances to other African areas where similar problems to ours are arising.

The magnitude of this undertaking will be clearly shown later in the business of this Convention, when a symposium will be held on Electricity Supply in Bantu Townships.

For the purposes of my address, I will refer briefly to one of our latest townships in Durban, known as kwaMashu, which is designed to accommodate approximately 100,000 people in some 11,000 houses and hostels for single men equipped with some 17,000 beds.

If an after diversity demand of .5 K.W. is taken as being a reasonable demand per consumer when they are connected to the electricity supply system, a maximum demand of 5,500 K.W. can be expected with an annual consumption in excess of 14,000,000 units (K.W.H.) (assuming a load factor of 30%).

With the rising standard of living, this figure will be appreciably increased in the future.

Earlier in my address I mentioned that South Africa was about 19th in position of various countries in respect of units consumed per head of population, using this approach: if we were to increase our consumption per head to that of say, Australia, with 1,820 units per head, our unit consumption per annum would, using the 1959 figures, increase from 18,000,000,000 units to approximately 25,000,000,000 units representing an increase of some 33%.

This increase of 7,000,000,000 units (assuming an overall load factor of 50%) would represent a demand of over 1,500 megawatts of additional generating plant, or more than double the whole of Natal's existing generating capacity.

All this is supposition, but in considering future developments, it is essential that full and careful consideration be given to all aspects of the problem and we must not be found wanting in making satisfactory provision for cheap and adequate supplies of power to turn the wheels of South Africa's future industries.

During the next 10 years it is unlikely that nuclear generations will become an economic proposition in South Africa in competition with the coal at South African prices, unless the rate of development of new types of nuclear sources of heat is more rapid than is at present expected. If, therefore, coal is to be the main fuel used in generating electricity during this next decade, then we must attempt to forecast its probable cost per ton delivered to South African power stations during this period.

Using the statistics over the last 20 years (and here I am indebted to the Electricity Supply Commission for providing this information in their Annual Reports) we find that some rather staggering price increases in the cost of coal have taken place during this period.

I have set out some of these below:

Area	1938	1948	1958	Increase in 10 Years
Durban	15/-	16/4	35/10	2.2 Times
Natal Central	10/9	11/6	29/8	2.6 Times
Witbank	2/1	4/-	10/6	2.6 Times
Cape Town	25/1	28/5	45/8	1.6 Times

These show very clearly the large increases that have taken place over this period and in particular during the last 10 years.

In endeavouring to forecast what increases are likely to take place during the next 10/20 years due allowance must be made for the fact that the economic level of the Bantu and non-whites employed in the collieries and in all other S.A. industries must be considerably increased in the future, with the corresponding effect on future coal and railage costs.

If we assume that the rate of increase in cost will be similar to that experienced during the previous 10/20 years and this, in the circumstances may be a conservative estimate, we can expect the cost of coal per ton by 1969 to be as follows:—

Durban—59/-.

Natal Central—52/-.

Witbank—24/-.

Cape Town—67/-.

Using the Durban figures it can be shown that the coal component of the cost per unit sold in 1959 amounted to approximately .21d. per unit. If we expect the cost of coal to increase during the next 10 years at about the same rate as in the past, then we must budget on paying approximately .31d. per unit for fuel cost component only.

This represents a very heavy increase in costs and it must remain one of the electrical engineer's challenges to find ways and means of reducing the impact of this increase in the cost of the unit sold to our consumers.

I may be painting a gloomy picture of future fuel costs, but I would sooner err in this direction than in the other because serious errors of judgment can be made in relation to future policy if full consideration is not given to this aspect at the present time.

In Natal this particular problem has been taken into account by the Electricity Supply Commission, in the siting of the next power station, which will be erected at Ingagane near Newcastle, in very close proximity to a coal mine. Other new and proposed Transvaal stations have been similarly sited to reduce cost of transportation.

It is at this point that I wish to make some suggestions and these must of necessity refer particularly to Natal.

This province is blessed with the best water resources of the whole of the Union. It has been stated that approximately 55% of the whole water resources of South Africa are in Natal. In an address to the 5th Annual Congress of the Umgeni Catchment Association held in Durban last year, Dr. Kokot stated that, in nine rivers between Volksrust and Mooi River, including the Umgeni and the Umkomaas Rivers, there was sufficient water to provide a daily consumption of 1,400 million gallons per day, it can be appreciated that the development potential of this province is very great and at present bears little relation to its actual industrial output which is stated as only 1/6 of the Union's total.

It is therefore in this direction that I feel that very careful and comprehensive investigations should be made during the next few years. I am certain that when the full magnitude of Natal's water resources are taken into account, in conjunction with the agricultural requirement of irrigation and industrial and domestic consumption that hydro-generation to a limited but profitable extent could be developed.

Natal's topography lends itself admirably to the siting and construction of dams, which could with great advantage to the country, assist to control the enormous amount of water which runs to waste annually during rainy season, taking with it much of the valuable top soil of our limited arable land.

I am fully cogniscent of the difficulties and peculiarities of hydro generation p.ob-lems but as our previous thoughts in this direction have been influenced by the country's past economic level, I would like to see a re-appraisal of the position on the basis of the estimated higher future level, with its corresponding higher fuel prices and in addition, taking into account the vast benefits that can accrue to the country's agriculture from water conservation.

To give some indication of the potential of some of the better known rivers in Natal:—

The Tugela River at Tugela Ferry in the Natal Midlands, based on the average annual figures compiled during the last 26 years, has an average "run-off" of 1,100,000 morgan feet, with a minimum annual "run-off" during this period of 521,000 morgan feet.

If we use the minimum annual figure of 521,000 morgan feet with a head of 200 feet approximately 20,000 K.W. can be generated continuously and using the average annual run off of 1,100,000 morgan feet some 40,000 K.W. can be generated continuously.

Further down the Tugela River at Mandeni these figures can approximately be doubled.

Even as far inland as Bergville, the generating capabilities of this river are worthy of consideration.

Considering the Umzimkulu River which rises in the Drakensburg Mountain near Underberg we find that this river also has a great potential for development, for example, at Union Bridge near Umzumkulu Village, we find that approximately 15,000 K.W. could be generated continuously throughout the year.

To give some indication of the vast quantity of water which runs to waste during the wet season in some of Natal's rivers, from information available, I have very roughly calculated that approximately 400,000,000,000 gallons of water run into the sea each year without serving any useful purpose in the following Natal rivers: Tugella, Umzimkulu, Umfalozi (Black and White), Umtamvuna, Umvoti, Umkomaas.

I can quote other rivers which can also be considered for the same purpose. I am not attempting to give you details of engineered hydro schemes for Natal, my intention is to bring to your notice an additional source of fuel for generating electricity which should be fully investigated.

I realise that in making these statements, I may be criticized on the grounds that, the seasonal variation of the monthly "run-off" of all our rivers is very great and therefore may not give stable conditions for generating throughout the year which might make such schemes uneconomic, but I must point out that practically all of Natal's major rivers traverse the province with a fall from the inland areas to the coast of some 5,000 feet thus facilitating dam sites with considerable storage capacities and with a satisfactory head.

Great advantage could also be gained for agriculture by providing the means of controlling the river flow during the wet season with the consequent benefits obtained from irrigation, which if evaluated could be used to partly offset the cost of the civil works necessary for such proposals, thus reducing the effects of these costs on both agricultural water and electricity generated.

I mentioned earlier that the coal component of the cost per unit (K.W.H.) today in Natal is approxiately .21d. per unit. If this increases during the next ten years due to increased coal mining costs, it will tend to favour the high capital cost of hydro stations.

Assuming the capital cost of a 50,000 K.W. hydro-station to be £150 per K.W. and the annual charges on this £7,500,000 outlay to be at the rate of 10% per annum operating at a 70% load factor, the cost per unit would be approxiately .6d. as against the very similar cost of a unit generating in a thermal station in Natal. This does not allow for any financial assistance that may be forthcoming from the benefits of control of river flow and irrigation.

Further, my arguments in favour of an investigation into the development of hydro-generation in Natal are based on the assumption that the economic level of the country will rise rapidly during the next ten to fifteen years due to several causes, the major being the rapid rise in the wage level of our non-white population.

The size of any of the possible schemes and their method of operation is entirely dependent on economics and could range from one of continuous generation as a base load station, to one of peak load operation. A good example of the latter type of scheme are those operated by the North of Scotland Hydro Electric Board.

I also have taken into account the fact that nuclear forms of generation may become an economic proposition during this period, particularly when you consider the overall generating costs of electricity in South Africa today, but despite any developments in the nuclear sphere of generation that may become of economic interest, I still consider it essential for a comprehensive investigation to be made during the next few years into the hydro sources of generation in this province.

I hope my comments on the various aspects of the supply industry have proved of interest to this Convention and that they may assist in highlighting the necessity of bringing about some changes in the training of apprentices and the employment of non-white unskilled workers.

My comments on the development of Natal's water resources are purely intended to bring this particular aspect of generation to the fore in the hope that its use in the sphere of generation may be fully investigated.

In conclusion I would like to thank the Department of Water Affairs for information regarding our Natal rivers and trust that their systems of recording and statistics may be further extended to assist in future investigations.

VICE-PRESIDENT: I now call on Mr. J. C. Fraser to propose the vote of thanks to our President for his Presidential Address.

Mr. J. C. FRASER (Johannesburg): Mr. President, ladies and gentlemen: At our last Convention held at Johannesburg, I had the honour of asking the Convention to accept Mr. Ronald Simpson as the incoming President. He has now been duly installed as President today, and I have again been honoured by being called upon to propose the vote of thanks to the Presidential Address.

I only wish I could fill my present duty in a more efficient manner. Enjoying the hospitality of our President, the Immediate Past President, and their good ladies, also the general holiday environment of the City of Durban, does not lend itself to digest and prepare technical matters. Nevertheless, I am grateful for the opportunity of again paying tribute to our President, and on your behalf to thank him for his most interesting and thought-provoking address.

Although the President's Address is not open for discussion, one cannot but admire the amount of work and research the author has put into his address. Most Presidents are usually satisfied to take one aspect of the electrical industry for an address, but Ronald has managed to cover four interesting aspects of municipal electrical engineering.

There is much interesting material in his address for engineers that have generating plant under their control, and those that purchase electrical supply in bulk.

We have with us today, amongst this large gathering of engineers, men who specialise in one or more of the aspects mentioned in the President's Address, and I am quite happy to leave the solution in these problems in their hands.

There is one problem that affects us all, and that is the human one.

This problem grows more difficult by the day and gives our engineers a great deal of trouble, and one cannot usually get the answers in text books or work it out on a slide rule—experience appears to be the only teacher of the human problem. Whilst the President was dealing with the training of apprentices, I could not prevent my mind going back to the days when I served my apprenticeship—the days prescribed by the President "of firm discipline," and to acknowledge the progress that industry has provided for the training of apprentices.

I do not wish to enter into a discussion on this evergreen topic, but I would like to say "Let us get back to the days when craftsmanship was acknowledged and honoured by all men," and to the youth of today I would like to say, "Stop asking industry to arrange so much for your comfort; do a little more work yourself, work harder, pay more attention to detail, and you will find that your comfort will be well assured."

Mr. President, on behalf of the Convention, we thank you for your most interesting address—an address which will be read again with greater interest when published in our Journal.

We wish you the best of health to enjoy a successful year of office, and with that I'd like to couple your good lady—we hope that she will also enjoy your year of office.

I formally move a vote of thanks, ladies and gentlemen, and ask all those present to show their appreciation in the usual way. (Applause)

THE VICE-PRESIDENT: Will Mr. Milton second the vote of thanks?

Mr. W. H. MILTON (Escom): Mr. President, ladies and gentlemen: It is my privilege to second the vote of thanks to our President for his Presidential Address which I am sure we have all found extremely interesting.

It is always difficult to give a considered statement at this stage in the proceedings because the proposer of a vote of thanks always has the advantage of speaking first and leaving his seconder in that state of uncertainty which is not resolved until he has sat down.

Our President has indicated the differences between the type produced in the days of the old master craftsman and under present-day conditions, but I think there is one factor contributing to the fall-off in present-day results which he has not voiced sufficiently strongly.

I have in mind that in those former times the master craftsman was in a position to emphasise his very high status in his own field and, with that emphasis, was able to make the younger generation, desirous of following in his footsteps, appreciate his high position.

This meant that those young people desiring to study and learn had an incentive which I feel is very much lacking today.

In these modern times I feel that we make life much too easy for those who are following in our footsteps.

Our President has referred in such strong terms to "days of firm discipline if not brutality." I would not advocate a return to those conditions but I do feel that we should more strongly emphasise the objective of the young man and, while so doing, attempt to make him realise that his efforts must be sincere and strenuous if he is to be ultimately acceptable.

One may say in agreement with our President that we do insist on compulsory attendance at a technical college for at least a part of the five-year period of apprenticeship.

This sounds very well in practice but it seems that the attendance is the aspect which is strongly emphasised and not the performance during that attendance.

Having been a lecturer in this very field, I can speak with very strong feeling on the attitude of a very large proportion of those putting in the statutory attendance. At times I felt it was the aim of that relatively large proportion to prevent the smaller number who earnestly desired to learn from acquiring that very knowledge. Possibly this was done with a view to ensuring that their fellowmen once qualified would not stand head and shoulders above them in the field of knowledge.

There is also the devastating effect of the levelling down of the product into one scale of achievement with little prospect of recognition of greater ability because any attempt to separate out the ultimate result into such grades is frowned upon by many of the controlling bodies dealing with the employment.

You may say that these are strong words but I feel with our President that it is time we overhauled our system of training and acceptable qualifications.

I agree that a readjustment of status may provide beneficial results, and that remuneration should provide additional incentive. The penalty of additional training could well be ignored—I would go further and suggest a definite weeding out of the disinterested group.

I was pleased to hear the warning regarding doing "too much" for these young men.

Coming to mechanisation, too much emphasis may be placed on comparative costs. Speed is an important factor as the reduction in capital "idle time" and earlier "revenue earning" are quite important factors, which may far out-weigh an increase in the "amount" of capital.

On the subject of the cost of coal, it is necessary to take account of factors making up that cost so that a forecast may make allowance for all the trends.

The figure quoted, if extended on a pro rata basis, assumes future development to follow past practice.

Increasing railage costs, bearing in mind past low rates which may not have met cost —and may not do so fully even now—have hastened the development of pit-head stations. All the figures used take no account of this except those for Witbank. In that case it is coincidence that produced the factor of 2.6. This price has changed from treatment of duff as a waste product at 1/6 per ton to the figure for 1958 due to expire of long term contracts and the ability to impose a price almost based on a "take it or leave it" attitude.

For stations located in the vicinity of present stations the forecast is acceptable but— and this is important—for stations located at pit-head prices will probably not even reach the 1958 figures quoted, after making allowance for the other factors influencing price increases (Witbank is again a special case).

Transmission costs are less than railage costs in these cases and price increases should not be as severe as those forecast. This aspect is indicated but only touched upon in the address.

Water resources may well be developed, but so far, the draw off for irrigation differs both in quantity and timing from that needed for generation so greatly that the two requirements cannot be considered as of mutual benefit.

A receiving dam used for irrigation canals is required below the main storage dam to act as a balancing receive before adequate provision can be made for both purposes.

These resources must be developed in time and the present day restriction must be lifted. Both needs can—and will—be met and those controls which are now obstacles will be removed. The vast fuel resources of this country can only defer the hydro development, but cannot prevent it. Let us hope we act in time to avoid condemnation by future generations.

The light this inaugural address has shed on a number of problems is very valuable and the service our President has done this Association and our country will not soon be forgotten.

I have very great pleasure in wholeheartedly seconding the vote of thanks. (Applause)

THE VICE-PRESIDENT: Ladies and gentlemen, before I ask the President to resume the Chair, I would like to ask you to express to him your appreciation in the usual way, for his valuable address. (Applause)

Mr. J. H. MCNEIL (Stanger): Mr. President, ladies and gentlemen: In a topical and very interesting address, covering a wide range of subjects, I was particularly interested in your remarks urging that investigations be carried out with a view to exploiting the potential of Natal rivers for hydro-electric generation.

No doubt many will already know, but for general information I would like to mention that some 10 years ago, the Municipality of Stanger had the foresight to embark on a hydro-electric on the Umvoti River and in March, 1952, a station of 1,000 KW capacity (which figure was governed by the average dry weather floor) was brought into commission.

Though excessive silt has been a source of irritation, this station which is one of the town's sources of supply, is an undoubted asset.

THE PRESIDENT: Thank you very much, Mr. Fraser and Mr. Milton, and and everybody. I hope it is of interest, and will prove interesting in future.

I am sorry we are a little late, and I hope it has not interfered with any of your luncheon appointments by not finishing quite on time, but there are one or two announcements I should like to make.

CONVENTION ADJOURNED FOR LUNCHEON

ON RESUMING AT 2.30 p.m.

THE PRESIDENT: Well, gentlemen, I hope you have lunched well—but not too well.

Before we get down to the main item on the Agenda, I have several announcements to make. Firstly, the election of the Executive.

The successful delegates are as follows:

J. C. Downey,
D. J. Hugo,
P. A. Giles,

Jimmy Mitchell,
D. J. Muller,
and J. L. van der Walt.

If those gentlemen will bear in mind that they have a meeting of the Executive Committee at the Eden Roc Hotel at 8.30 tomorrow morning.

The main item on the Agenda is a paper by Prof. Eric Phillips on "Some Economic Aspects of Nuclear Power Station Operation."

I shall be very pleased if Prof Phillips will come up to the main table and deliver his address. (Applause)

Prof. E. PHILLIPS (Durban): Gentlemen, when your President asked me to address you I was somewhat undecided in my mind as to what facet of that vast subject known as electrical engineering would be of interest to a body of municipal electrical engineers. A group of engineers who are primarily interested in the generation and supply of electrical energy to the consuming public.

Being an educationalist, an obvious choice of topic would be the education and training of engineers, but I feel that engineers of recent years have had a surfeit of papers and articles on training and the subject has been worn almost threadbare.

Turning to recent developments in the engineering field, I have chosen to speak to you on a more glamourised subject, namely Nuclear Power Stations, but in doing so I realise that much of what I have to say is common knowledge to most of you, but possibly a few words on the economic aspects of Nuclear Power Stations and Power Station operation will be of interest.

Living standards throughout the world are in direct proportion to the consumption of electricity per head of population whether nationally or individually; the rate of increase in electricity usage is a milieu of the rate of increase in living standards, and in all except the under-developed countries is growing at an annual rate between 6% and 16%.

Some Economic Aspects of Nuclear Power Station Operation

By ERIC PHILLIPS, D.Sc.Eng., LL.D. (Alberta), M.I.E.E., M.(S.A.)I.E.E., Sen. Mem. I.R.E., Professor of Electrical Engineering, University of Natal.

Power with which to drive machines has been the most important force in relieving man from physical drudgery and providing leisure for spiritual and mental development. Unfortunately, power expansion in many parts of the world is already being limited by the growing shortage of water resources and fossil fuels. But now there is a prospect of a nuclear power era which may have an influence just as far reaching as the Industrial Revolution.

World production of electricity at the beginning of the century amounted to about 9,000 million kWh per annum, and at present is not far short of 1,500,000 million kWh per annum. The rate of increase in electricity usage is growing at an annual rate between 6% and 16%. This rapid increase has taken place in every country. Although the rate of increase was slightly faster at the beginning of the century than in the later years, and although there are very wide disparities in per capita consumption. It is striking to note that Europe and the United States, which already have twice and six time, respectively, the world average consumption per head of population, show no signs of reaching saturation. On the contrary, the rate of increase in Europe and the United States, since the war, has averaged over 10% a year.

Figure 1 shows that the growth in electricity production follows a fairly smooth trend with a slight but steady continuous slowing down in the rate of growth. As the thermal efficiencies of steam stations get closer to the limit set by thermodynamics, it is not possible to expect in the future as big a reduction in the real price of electricity due to this factor as has occurred in the past, but it is doubtful whether that will greatly affect the demand. The estimates that have been published of the increase in electricity production expected by the United States, the Soviet Union and the United Kingdom point to a continued upsurge of demand, and it seems reasonable to forecast that this will continue on the lines suggested by Figure 1 so as to reach about nine million million kWh a year, inclusive of hydro-electricity by the end of the century. If average thermal efficiencies have reached 33% by then, this alone will be equivalent to 3,500 million tons of coal a year.

The total demand for commercial energy can be expected to increase for some time at least, at a rate that does not seem likely to be less than 2% per annum and may be more. The rate of consumption of energy is likely to be not less than 7,500 million tons of coal equivalent by the year 2,000, as compared with 2,750 million tons in 1950. Unless nuclear energy becomes more economically attractive than hydro-electricity, supplies from the latter source may amount to the equivalent of nearly a thousand million tons of coal per annum by the year 2,000 and ultimately to about 2,500 million tons of coal a year. The evidence at present available suggests that the total recoverable resources of solid and liquid fuels and natural gas are of the order of 3½ million million tons, although it must be emphasised that the recoverable reserve is a function of the demand for fuel, of extractive techniques and of the discovery of possible new sources.

If the total demand for the primary fuels continues its long term growth of 2% per annum, and if no relief were available from nuclear or other new sources of energy, the reserves of solid fuels, liquid fuels and natural gas would have been reduced by the year 2025 to about 300 years of life at the then existing rate of consumption. At a rate of growth of 3% per annum, they would have been reduced to about 120 years of life at the then current rate of use. If expansion continued at 2% per annum to the year 2050 (implying a total consumption per head of about four times that of 1950) the remaining reserves would fall to about 150 years; with a 3% rate of growth, they would be within 40 years of exhaustion. In many countries a decline in consumption would have been enforced long before then.

The need to supplement present sources of energy by a new source, however, is considerably more urgent than is implied by a calculation of possible overall demands and reserves. Experience has shown, in some countries at least, the increasing difficulties of attracting workers to coal-mining; difficulties which are likely to become greater as the standards of living rise. Of the world supplies of energy in 1950, about 25% were derived from coal. But, world output of coal has been increasing by only about 0.5% per annum, and if it is assumed that it is impossible to raise this rate of increase, then only 2,000 million tons of coal per annum would be forthcoming by the year 2000 out of a total of some 7,500 million tons of coal equivalent required on the basis of a 2% compound growth of demand.

Figure 2 shows the possible demand for the conventional sources of energy in the absence of a new source. These figures are put forward with very great diffidence. The projection of compound interest curves can lead to surprisingly absurd results in surprisingly few years, and the estimates of reserves have a substantial margin of error. But a 2% growth in total use of primary fuel has already been maintained for one hundred years and there is no immediate sign of a downward grade save in respect of the rate of population increase of a few nations. It would not be difficult to advance more sensational figures.

It should be apparent that, even if conservative estimates of economic growth and of the future demand for energy are made, the world is not far distant, measured in the units of time in which we think of the history of nations, and even of the lives of individuals, from the moment when, in the

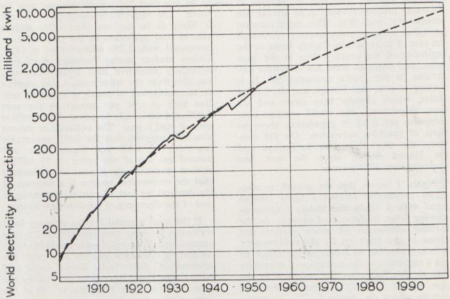


Figure 1 World production of electricity 1900-1954 with fitted trend (broken line). (Robinson & Daniel, Geneva P-757.)

	Total energy	Coal	Hydroelectricity	Oil and natural gas*
1950	2·8	1·6	0·2	1·0
2000	7·4	2·0	0·9	4·5
2025	12·1	2·3	2·2	7·6

Figure 2 Possible demand for the conventional sources of energy in the absence of a new source (10^9 tons of coal equivalent). (Robinson & Daniel, Geneva P-757.)

absence of a new source, scarcity of fuel will begin to create serious problems. The remarkable material progress of the human race during the past two centuries has largely sprung from the opportunities presented first, by coal and steam power, and more recently, by oil and hydro-electricity, to supplement human and animal muscles with other forms of energy. The wealth of the wealthier nations is due to the fact that they employ many times more energy per worker than the poorer countries. There is no task more important than to ensure that the dramatic advance of the human race over the past 200 years is not reversed over the next 200 years because of the exhaustion of fuels which made such development possible.

Atoms and Nuclear Fuels

When matter undergoes a chemical reaction, such as burning, for example, the planetary electrons of its atoms are rearranged and as a consequence energy is released. This energy appears generally as heat, as the heat of a coal fire, or light, as in a gas flame. In these reactions the nuclei of the atoms taking part are undisturbed. In some circumstances, however, it is possible to produce a reaction in which a nucleus is disturbed or even broken up, and when this is done very much more energy may be released than is possible when only the planetary electrons are involved. Unlike chemical reactions, nuclear reactions cannot generally be made to spread from one atom to the next; each nucleus has to be treated individually, but there is one exception to this rule, the reaction called nuclear fission, which is the cornerstone of nuclear power. Fission is produced when a nucleus of certain elements is struck by a neutron; the nucleus absorbs the neutron, its equilibrium is disturbed, and it is split into two more or less equal parts. In this splitting, energy is released and also more than one fresh neutron (actually about 2.5 neutrons per fission on the average); the latter are most important because they can cause further fissions in neighbouring atoms and these in their turn release more neutrons to cause yet another generation of fissions, and so on. In this way there is produced a self sustaining reaction, a nuclear fire. The fission

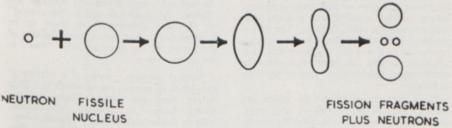


Figure 3 "Liquid Drop" model

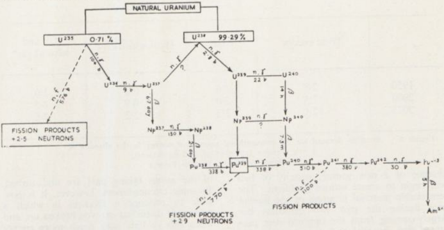


Figure 4
The irradiation of natural uranium in a flux of thermal neutrons (Blainey: J. (S. A.) I.M.M. Vol. 58.)

process may be qualitatively, and to a considerable extent quantatively, explained in terms of the "Liquid Drop" model of the atomic nucleus illustrated in Figure 3.

If the 2.5 neutrons emitted per fission each caused further fissions, there would be about six neutrons in the next generation, 15 in the next, and so on. A rapidly divergent chain reaction would follow resulting in an explosion. If, however, the volume of fissile material were small, most of the neutrons would escape from the surface instead of causing further fissions and the net re-production rate would be less than unity instead of 2.5. In this case the reaction would rapidly cease.

The fission fragments are unstable atoms whose nuclei transform by radio-active decay until they become stable. Most fission fragments undergo several transformations before reaching a stable state and the final products may be solids or gases. The fission products in irradiated fuel elements constitute an intense source of gamma and beta radiation so that the spent fuel elements require heavy shielding and remote handling techniques.

There are many fuels in which an ordinary fire can burn—coal, oil, gas, wood, even metals—but only one naturally occurring material will sustain a nuclear fire. That is the element uranium, a metal heavier than lead. Fission of the uranium nucleus by neutron bombardment was discovered by Hahn and Strassmann in 1939. By December, 1952, a controlled chain reaction in a large mass of uranium had been achieved by Fermi in Chicago, and by July, 1945, an explosive chain reaction had been achieved in Alamogordo, New Mexico.

Questions often asked at this point are: "How do you light one of these nuclear fires? Do you have to switch on your reactor?" The answer is that the uranium is throwing off neutrons continuously, even before it is put into the reactor, but that the nuclear fire begins only when there is a sufficient quantity of uranium assembled in the favourable conditions of the reactor to sustain a chain reaction. This quantity is called the critical size. When the nuclear fire "lights," the reactor is said to "go critical" or "become divergent." A point to be remembered is that only a small fraction of the atoms in the uranium will "burn" in the nuclear sense.

Natural uranium consists of a mixture of two kinds of atoms, one of which is a little lighter than the other. These different atoms, known as isotopes of uranium, behave similarly in ordinary chemical reactions, but their nuclei differ in a way that leads to different behaviour when they are split by neutrons. The lighter isotope, uranium 235, is easily split by neutrons of low energy but the heavier isotope, uranium 238, is not. Uranium 235 is, in fact, the part that burns. Uranium as it occurs in nature contains only 0.7% of uranium 235; all the rest is uranium 238. So only 0.7% of natural uranium is nuclear fuel.

Uranium 238, however, can be changed into an isotope of another element which will undergo fission and therefore "burn." Once again the ubiquitous neutron plays an essential part. When a neutron hits a uranium 238 nucleus it is absorbed; as a result, and after some internal re-arrangement accompanied by the emission of particles, the nucleus is transmuted into a nucleus of an isotope of the element plutonium, plutonium 239. The main nuclear reaction is the absorption of a neutron by the uranium 238 nucleus to form the isotope uranium 239, which is short lived with a half life of 23.5 minutes decaying into neptunium 239 with a half life of 2.3 days and plutonium 239 which is relatively stable with a half life of 24,400 years, as shown in Figure 4. As a result of other nuclear reactions which also occur, small amounts of the

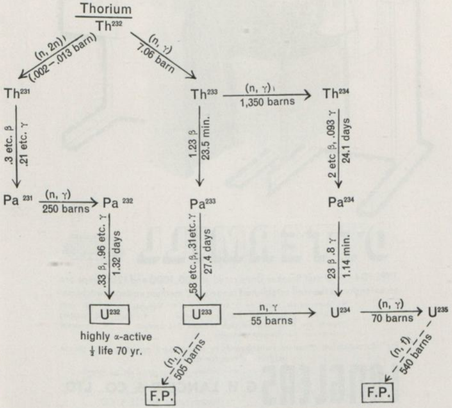


Figure 5 Neutron irradiation of thorium in a nuclear reactor. (Blainey: J. (S. A.) I.M.M. Vol. 58.)

higher plutonium isotopes and minute amounts of americium 243 are formed. This new material plutonium 239 is an even better nuclear fuel than uranium 235. In a similar manner, as shown in Figure 5, a third nuclear fuel can be made by exposing the element thorium to neutrons; the thorium isotope of mass 232 absorbs neutrons and is transmuted into uranium 233, a fissile isotope of uranium which does not exist in nature.

These three then, uranium 235, plutonium 239, and uranium 233, are the fuels of the atomic age; the essential raw materials from which they are extracted or made by nuclear transmutation, are natural uranium and thorium. For an explosive fission reaction to occur substantially pure uranium 235 is needed: for a controlled reaction to occur ordinary uranium containing the two isotopes in normal proportions may be used if steps are taken to prevent the fast neutrons released at fission from encountering uranium nuclei until their speeds have been reduced to low values. The striking thing about these nuclear fuels, compared with ordinary chemical fuels, is the enormous amount of energy that is released for each pound of fuel burnt. Thus a pound of uranium if all the atoms in it were made to undergo fission, would release as much energy as three million pounds (or 1,300 tons) of coal. Such complete utilisation of uranium has yet to be realised in practice, though the fact that non-fissile uranium 238 can be transmuted into fissile plutonium implies that it is theoreticaly possible.

The energy released in fission is imparted in the first instance to the two fragments into which the nucleus is split causing them to move apart with great speed. No way of using the energy of these fragments directly has yet been devised but the motion through the uranium heats the metal and this heat can be removed and converted into mechanical energy by a steam engine or gas turbine. In short, atomic energy can be obtained by burning an uncommon fuel in an uncommon way and then using the heat obtained in a quite ordinary manner.

Nuclear Reactors

The new fuels are burnt in new and different furnaces called nuclear reactors or atomic piles. As has been said a nuclear fire is propagated by the neutrons released in fission, about 2.5 for each uranium atom split. Some of these neutrons may be lost, for example, by being absorbed in materials other than fuel atoms or by escaping from the fuel, but provided enough of them remain to produce as many new fissions in the next generation as there were in the first, the chain reaction is maintained—the fire continues to burn at a constant rate. This state of affairs can be realised only if there is a certain minimum amount of fuel, the so called critical size. With amounts less than critical, so many neutrons escape that fewer fissions are produced in the second generation than occur in the first, and the fire dies out. In practice a reactor is designed so that it contains rather more than the critical amount of fuel. A surplus of neutrons is then available, capable of producing more fissions in the second generation than there were in the first. Left to itself the fire would then spread, but by inserting neutron absorbing material, the surplus of neutrons can be mopped up and the fire kept burning at the desired constant heat.

Neutrons released in fission are moving at high speed; they are capable of producing more fissions at this stage, but the likelihood that they will do so is fairly small and consequently a reaction can be maintained only in highly concentrated nuclear fuel. On the other hand, if the neutrons are slowed down, the likelihood that they will produce fissions is greatly increased, although, at the same time, they are also more likely to be captured without producing fission. Nevertheless, the balance is in favour of fission and a reaction can be maintained in less concentrated fuel. So there are two broad classes of reactors, fast-fission reactors in which the neutrons are used at high speed and thermal-fission reactors in which neutrons are slowed down to so-called thermal energies. This slowing down is done by allowing the neutrons to bump about among the atoms of some light material, called a moderator; a neutron bounces off the the light atoms and loses energy at each bounce, just as a snooker ball loses energy as it collides with one ball after another of the pool, until ultimately its energy is very

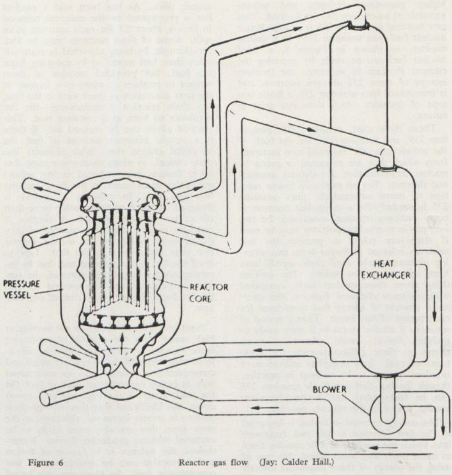


Figure 6 Reactor gas flow (Jay: Calder Hall.)

small indeed. It should be noticed that the moderating action affects only the energy of the neutrons producing fission; it does not alter either the energy produced in fission or the power level at which the reactor operates.

Fermi used carbon in the form of pure graphite as the "moderator" in the first reactor built in Chicago. It contained ten tons of uranium rods of 1 ins. diameter (some as metal, some as oxide rods) forming a lattice of 8 ins. pitch; these were inserted into a hundred tons of pure graphite, so that most of the neutrons emitted at fission were obliged to traverse at least 7 ins. of graphite, losing energy at each collision with a carbon atom; and they re-enter uranium metal at such low velocity that absorption by uranium 238 is just about equal to absorption by uranium 235, causing fission. This principal of construction is basic to all the reactors built since 1942

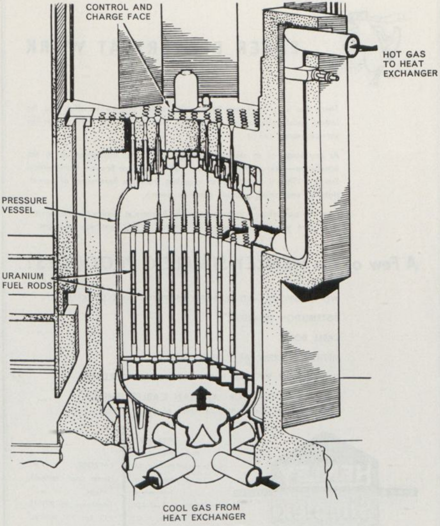


Fig. 7
Arrangement of nuclear reactor core inside pressure vessel.
(Jay: Calder Hall.)

with the exception of the so-called fast-fission reactors to be described later.

The plutonium formed after the uranium 238 nucleus has captured a neutron behaves very similarly to the uranium 235 when bombarded by neutrons, undergoing fission for all velocities. Plutonium which differs chemically from uranium can be separated by chemical processes from uranium, whereas the flssile uranium 235 may be separated from the non-fissile uranium 238 only by very expensive physical processes. Reactors may thus be built primarily to convert the plentiful uranium 238 to plutonium, with the fission energy discarded as were the three large reactors built during the war at Hanford, Washington. In these reactors the uranium rods clad in aluminium, were water-cooled and the water ran to waste. Smaller reactors built at Windscale, Cumberland, after the war, were likewise solely plutonium producers and were air-cooled, the air passing to waste. Alternatively, reactors can be built primarily to enable the energy to be used economically, or they may be dual-purpose reactors. Figures 6 and 7 show, diagrammatically, the general arrangement of graphite moderated reactors which have been installed at Calder Hall, Hunterston, Berkley and Hinkley Point.

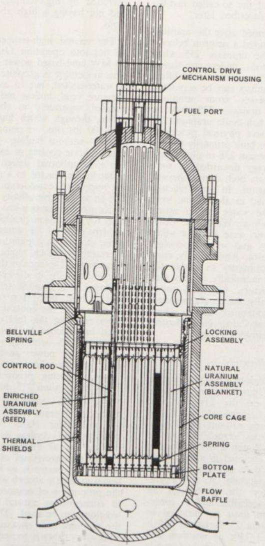
High Temperature Reactors

The first large high-temperature reactor was built for the United States submarine Nautilus launched on the 21st January, 1954: in 1957 it completed its 20,000 leagues under the sea without refuelling—ninety years after Jules Verne's imaginative story was written. Water is the moderator and coolant and is enclosed in a thick steel pressure vessel so that steam is available from it at high-temperature. As it is a relatively small reactor the probability of neutron escape is negligible and in consequence the uranium must be enriched so that the ratio uranium 235/uranium 238 is much higher than 1/140; as uranium 235 costs about $10 per gramme the fuel cost is high but the performance of the submarine probably justifies this. To prevent uranium from coming in contact with the water moderator, each piece of uranium is clad in a thin sheet of zirconium alloy, a metal not corroded by high-temperature pure water, and not having a high absorption for neutrons.

The second high-temperature reactor to be put into operation (June, 1954) was a 30 MW land-based power station in Russia. The moderator is graphite and the uranium is water-cooled, but to avoid a large high pressure vesel, hollow rods of uranium are encased separately in thin stainless steel tubing through which high pressure water at 1,500 lbs./ins.^{2} is pumped and raised to 480°F.—without boiling—by energy flssion. The separate cooling of each element makes for a complicated design but reduces the water in the reactor to a minimum. This is an important consideration because water has an appreciable affinity for neutrons, and so its use represents a loss of neutrons available for the fission process; in addition the sudden removal of water would result in a rise of neutron population, and an increase of reactivity which might be of dangerous magnitude. The core of the reactor is small, a cylinder 5 ft. in diameter and 6 ft. high enclosed in a graphite reflector; so neutron loss is high both from escape, and from absorption in the coolant and stainless-steel tubes encasing the fuel elements: the fuel must be enriched by from 0.7% to 5% of uranium 235—with two consequences, a high cost of power generation and a low yield of plutonium, only three atoms of plutonium being produced for every ten atoms of uranium 235 undergoing fission.

The third successful high-temperature reactor to operate is the dual-purpose reactor at Calder Hall. The moderator is graphite and cooling is done by carbon dioxide gas at high-pressure contained in a steel pressure-vessel of 2 ins. wall thickness. This reactor is so large and constructional materials absorb so few neutrons that the proportion of neutrons lost is very low; in consequence natural and not enriched uranium can be used. The gas flowing over the uranium rods encased in finned magnesium-alloy tubes is passed through four heat exchanges, where steam is raised and used to drive two 23 MW turbines.

In Great Britain, owing to the coal shortage and the continued rapid increase in the demand for electricity—an approximate



Longitudinal section of the 240 MW high-pressure water-cooled water-moderated reactor at Shippingport, United States.

Figure 8

doubling in each of the past four decades —the gas-cooled power reactor is being built on a large scale. More stations about the size of Calder Hall—where there are now two reactors delivering 92 MW of electricity—are being built after the pattern of the first; larger stations operating at higher pressures but of the same basic design are being built by industry and are due to produce 1,400 MW by 1961, and by 1965 a total of 6,000 MW is expected to be generated from nuclear power. This represents one third of the new electrical generating plant which will be provided in the United Kingdom by 1966, so that coal to the extent of about 15—20 million tons per annum will be saved by that date.

Other Types of Reactor

There are very many alternative forms of reactor now being developed. The largest in America is the pressurised water reactor at Shippingport, which began to operate in 1957 and is designed to produce 60 MW of electric power; it functions on the same principles as the reactor on the Nautilus and there are very many submarines and other naval vessels being constructed with reactors of this type, all of which use enriched fuel. It is shown in outline in Figure 8; it comprises a 250 ton steel vessel of internal diameter 9 ft. and of height 33 ft., having a wall thickness of 8½ ins. to withstand an operating internal pressure of 2,000 lbs./in.^{2} and made in two sections bolted together. The core is a cylinder six feet in diameter and six feet high which contains a number of sub-assemblies of highly enriched uranium 235, surrounding and being surrounded by more sub-assemblies of natural uranium in the form of oxide. Each sub-assembly of enriched uranium consists of many thin plates of uranium-zirconium alloy sandwiched between zirconium alloy plates welded to prevent contact between water and uranium. The uranium-zirconium alloy is used in preference to uranium metal since it does not undergo the dimensional changes which uranium exhibits under irradiation, and the sandwich cladding is not corroded by water at 550°F. As 60% of the power is generated in the natural uranium sub-assemblies and 40% in the enriched, there is unlike the Russian reactor, a large conversion of uranium 238 to plutonium: 8 atoms of plutonium are formed for every 10 atoms of uranium 235 disintegrating, and so the lifetime of fuel elements in the reactor is expected to be long. Water enters the vessel at the ports at the bottom, flows past the core at 20 ft. per minute, and then passes to the heat exchangers, where heat energy is given up to raise the secondry water to 500°F.

Another reactor constructed in the United States employs liquid sodium metal as coolant flowing over uranium rods encased in thin zirconium and over blocks of graphite moderator likewise encased in zirconium: a fairly expensive construction justified, possibly, by the avoidance of high pressures in the attainment of high operating temperatures, but one which also needs enriched fuel. The relative merits of these liquid or liquid metal-cooled reactors cannot be accurately judged yet and all of them need enriched uranium fuel, the cost of electricity generated from them is likely to be high until they operate at very large powers.

Economic Consideration

The projection of the world demand for power curve of Figure 1, together with the pressure on existing fuel supplies already being felt in some parts of the world, suggests that nuclear power will become essential to many countries in the next decade or two. Any reduction in electricity generating costs due to nuclear power will unfortunately not have a very great effect on the selling price of electricity to most consumers, since much of this price is composed of transmission and distribution costs.

While only operating experience can demonstrate the exact cost of electricity, the fact that, even in a geographically small country like the United Kingdom, many regions are sufficiently far from the coalfields to have electricity generation costs in modern stations about 25% higher than those of stations based on coal-fields, gives an important competitive advantage to nuclear power. As a given weight of natural uranium will produce several thousand times as much electric power as the same weight of coal, transport costs of nuclear fuel will be negligible compared with the cost of transporting coal or of transmitting electric power over long distances.

The capital costs of building nuclear power stations will, of course, vary considerably between different countries, according to local conditions. In addition, where capital is scarce, interest rates, and where applicable, profit rates, will tend to be high. In such countries, the development of nuclear power, owing to the high proportion of capital charges to total costs, is likely to be much slower than in countries where capital is plentiful. In the long run, however, the negligible transport costs of nuclear fuel should offset the scarcity of capital and enable nuclear power to be brought to the under-developed regions of the world.

Capital Costs

In order to sustain a chain reaction at full power a natural uranium graphite-moderated reactor must contain many tons of expensive fuel and many hundreds of tons of graphite moderator. In addition, it must be surrounded by a radiation shield consisting mainly of thousands of tons of concrete. If the capital cost per kilowatt is to be kept down to a reasonable level, the rate of heat output of the reactor must be high. Using gas as a coolant, this can only be achieved economically if the gas is pressurised to increase its density and so keep down the pumping power necessary to remove a given amount of heat. Thus the reactor must be placed in a large and expensive pressure vessel, making the whole assembly even more costly, and necessitating a very high heat output if it is to be economical. Nuclear power stations are therefore, at first, bound to be large running into hundreds of megawatts of electrical capacity. The initial stations will only be suitable for large integrated electricity systems, unless in a smaller system the risk of temporary loss of a considerable portion of the total capacity of the system is accepted.

In spite of all that can be done to keep down the capital cost per kilowatt, it is considerably higher than that of a coal or fuel-oil fired station, depending to a considerable extent on the nature of the site; and as a measure of conservative finance it is considered wise to depreciate the station over a shorter period than usual. Costs have in fact been based on a life of fifteen years instead of the usual twenty-five years and upwards. In addition, a natural uranium power reactor contains a stock of fuel costing, per kilowatt of electrical capacity, about half the total capital cost per kilowatt of a coal-burning station; and this incurs interest charges in addition to the fuel running cost. As a result, at equal load factors the total capital charges per kilowatt-hour would be about three times as large as that of a conventional power station. In spite of the expected low running costs of nuclear power stations, the first ones will, therefore, only be competitive if these high capital charges per kilowatt are spread over as large a number of kilowatt-hours of electricity as possible, i.e. if they are operated throughout their life at an average load of possibly 80% of capacity. At this load factor, assuming actual capital charges of 9% on capital cost and 4% interest on the fuel stock, the total capital costs per kilowatt-hour will be about 0.4 pence.

The competitiveness of later natural uranium fuelled power stations will extend to lower load factors, but as the need to build new stations to meet peak loads will not rise while there is a pool of older but not worn-out coal-burning stations, and in any case nuclear stations will be insufficient to meet base loads for many years, the chances of their being operated at low load factors are remote.

As time goes by, the proportion of total generation costs due to capital charges may be expected to fall for three reasons. First, the capital cost per kilowatt may be expected to fall in the future as experience is gained, as specialised components are developed and especially as further development enables the heat rate of the reactor to be raised. If this last factor were allowed to have its full effect in reducing capital costs, the generating capacity of the power station would become even larger. Secondly, it is hoped that the actual life of these stations will be a good deal longer than has been allowed for in the conservative accounting adopted. This alone may reduce the capital cost per kilowatt-hour by one third. Thirdly, the value of the plutonium by-product, which is dealt with more fully later, may eventually fall when supplies become plentiful. This may not, however, be for very many years.

Fuel Costs

Until there has been more operating experience, the exact level of running costs in a natural uranium power station can only be estimated, since it will largely depend on the quantity of heat that can be extracted from each ton of fuel before it must be rejected. This irradiation level depends on the nuclear characteristics of the reactor and fuel and on the metallurgical characteristics of the fuel and cans under heat and irradiation. One of the most important aspects of the nuclear characteristics of the reactor and fuel is the conversion factor, i.e. the number of atoms of fissile material created for each fissile atom consumed. The closer this factor is to unity, the more heat can be extracted from the fuel before its contribution to the reactivity of the whole reactor becomes unacceptably low, i.e. before it would be in danger of stopping the nuclear reaction in much the same way as too small a proportion of coal to ash would put out a coal fire. The conversion of fertile uranium 238 to fissile plutonium enables the plutonium remaining in the fuel after radiation to be extracted by chemical or other means and sold giving a reduction in the net running costs in the power station.

The gross cost, per kilowatt-hour, of the nuclear fuel is expected to be about 0.3 pence, at first. This should be reduced, in due course, by measures to increase the number of kilowatt-hours extracted per pounds worth of fuel, and by a reduction in fuel fabrication costs. From this gross fuel cost must be deducted the value of the plutonium extracted from the spent fuel, allowance being made for the cost of fuel processing. The exact value of plutonium as a civil fuel is not yet known, but fuel processing costs are expected to fall rapidly in the near future, and it is thought that the net credit for fuel irradiated in a natural uranium reactor will reduce its net fuel cost to not much more than 0.2 pence per kilowatt-hour.

The extraction and disposal of radioactive fission products from irradiated fuel is a nuisance in a nuclear power system, but adds very little to total electricity generation costs. In due course these fission products may become valuable by-products whose market value offsets the cost of extracting them.

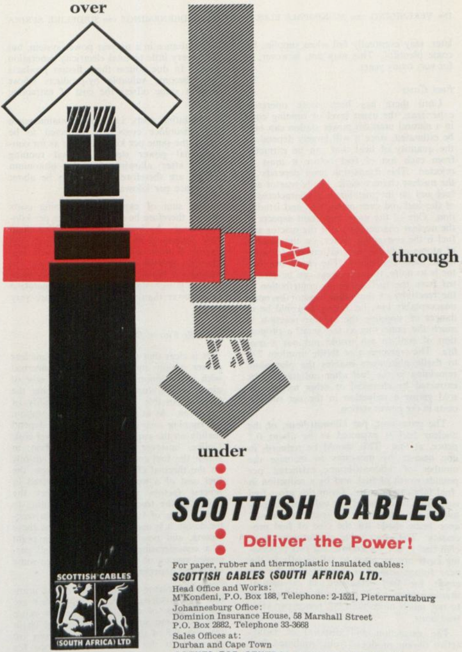
Operating costs, i.e. labour, maintenance and insurance costs, are expected to be about the same per kilowatt-hour as for conventional power stations. Total running costs, after allowing for the plutonium credit, are therefore expected to be about 0.3 pence per kilowatt-hour.

The sum of capital and running costs should therefore be about 0.7 pence per kilowatt-hour. An important point about these first stations is that their low running cost makes it most unlikely that they will ever become uneconomic to operate, since the chances of building, at any time during their life, a power station with total generation costs lower than the quoted figure are very small.

Possible Future Developments

It is clear that the development of nuclear power stations must be primarily concerned with a continuous reduction in the cost of electricity produced, while maintaining the highest possible standard of reliability of operation. As in an orthodox power station, the running costs of a nuclear station depend mainly on the capital cost and the fuel cost. Unlike, however, an orthodox station, in which the fuel cost depends almost entirely on the thermal efficiency of the station, the fuel cost of a nuclear station is related to several factors which greatly affect the design of the reactor. Before attempting to predict lines of future development in reactor design it is necessary to understand these factors, and possibly a good starting point is a consideration of the Calder Hall gas-cooled reactor of which there has been some operating experience.

In this reactor during fission of the uranium 235 nucleus, about 2.5 neutrons are emitted; one of these is required to cause another fission and thus carry on the chain reaction; 0.8 of the 1.5 surplus neutrons are absorbed in the uranium 238; hence for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every atom of uranium 235 which undergoes fission, about 0.8 atoms of plutonium are formed, and thus during the life of the fuel in the pile there is a gradual net loss of fissile material. This effect is initially marked because in some ways one atom of plutonium is equivalent to more than one atom of uranium 235, but eventually the depletion of fissile material in the fuel is such that it must be removed from the reactor and replaced by fresh fuel, or the chain reaction can no longer continue. This occurs when each tonne of fuel has produced about 2,500 megawatt-days of heat; since the complete fissioning of one kilogram of uranium produces about 1,000 megawatt-days of heat about 2½ kilograms of the uranium in every tonne of fuel has been "burnt". Only one four hundredth part of the potential energy of the uranium has therefore been used. However, the spent fuel contains some plutonium and the remainder of the uranium 235 and uranium 238 is potentially valuable. Unfortunately the cost of extracting the plutonium is so high that the value of the spent fuel is very low, in this case only about a quarter of the cost of fresh fuel.

Suppose now that the reactor had a conversion ratio of unity. Roughly speaking the quantity of fissile material would remain constant and it should be theoretically possible to burn up all of the uranium without removing it from the reactor. In fact, of course, this would not be possible, since the fuel elements would become structurally useless after only a fraction of the theoretical possible burn-up, due to irradiation damage in the fuel. However, if the material difficulties could be overcome to the extent of achieved burn-ups of, say, 10,000 megawatt-days/tonne, it is clear that the fuel cost could be roughly quartered.

If enriched fuel is required in a reactor the initial fuel cost increases disproportionately. The cost of separating uranium 235 from uranium 238 as it occurs in natural uranium is very costly, and in consequence the price of the separated uranium 235 is very high. The quoted United States price is $10 per gramme; the English price for natural uranium is £20,000 per tonne, so that if no value is given to the uranium 238, the price of the uranium 235 in the natural uranium is less than £3 per gramme. Thus for a reactor requiring enriched fuel having twice as much uranium 235 in it as natural uranium, the cost of fresh fuel would be at least £90,000 per tonne. If a burn-up of about 2,500 megawatt-days per tonne were obtained the spent fuel would still be highly enriched; however, the high cost of processing would again depress its value, and the fuel costs of such a reactor would be much higher than one using natural uranium. Only by obtaining much higher burn-ups from each charge of fuel could the costs be made comparable. There are thus three requisites for low fuel costs:—

1. The use of fuel having the lowest possible proportion of fissile to fertile material.
2. Obtaining a high conversion ratio and making the fuel very resistant to irradiation damage so that a high degree of burn-up can be obtained.
3. Reducing the cost of processing fresh fuel.

One of the most important future developments is likely to be the use of liquid fuel. This will remove the need for fabricating the fuel elements required in solid-fuelled reactors, and will considerably simplify the processing of the spent fuel. At the same time it will remove the limitations on burn-up with solid-fuel elements due to irradiation damage. Reactors using liquid fuels will in fact probably employ a system of continuous fuel processing and it should be possible to remove fission products as they are formed so that there is no loss of neutrons by absorption in them; thus the conversion ratio will be improved.

A very important factor which has not yet been mentioned is the choice of fuel cycle. At present the only fissile material available is uranium 235, and the only fertile material uranium 238. When the first natural uranium reactors have been operating for some time, however, supplies of plutonium will be available. Another very important source of fuel is the metal thorium which on neutron bombardment is transmuted into the isotope uranium 233 which is fissile. Thus there will be an eventual choice of three fissile materials and two fertile ones.

Because of the absorption of neutrons in uranium 235 without causing fission the conversion ratio of a reactor using this fuel will always be less than unity. Uranium 233, however, if used in a thermal reactor, provides about 1.3 excess neutrons so that it should be possible to obtain a conversion ratio greater than unity. Plutonium makes possible the highest conversion ratio of all, since if used in a fast reactor, i.e. a reactor without a moderator (so that all the reactions in the core occur at high neutron energies), it provides an excess of about 1.67 neutrons. Thus a fast reactor using plutonium and uranium 238 as the fertile material should be capable of producing fresh plutonium considerably faster than it burns out.

Having established the basic requirements of reactor design, consideration will now be given to a few of the possible types of reactor which may best meet these requirements. Very many different types are technically feasible, but only four will be discussed, two being of the solid-fuel type and two the liquid fuel variety.

The Gas-cooled Thermal Reactor

This is of the Calder Hall type and is necessarily of large size since to function on natural Uranium a big graphite core is necessary. The fuel rating is low and in consequence the capital cost is high, about

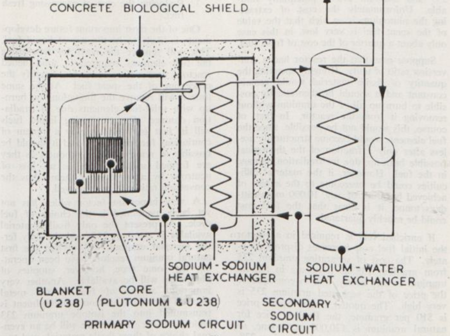


Fig. 9
Fast reactor.

twice as high as a modern coal-fire station. There is no doubt that in future designs it will be possible to increase considerably the heat output without any increase in size and without reducing the burn-up of fuel obtained. Further improvements will be possible when supplies of enriched fuel become available. It may become economic to operate the reactor on the uranium 233/thorium cycle if sufficiently high heat ratings can be obtained. Conversion ratios of about unity should be possible with the potential large increases in the burn-up which will probably be obtainable with much improved types of fuel element.

The Fast Reactor

The fast reactor operating on the plutonium/uranium 238 cycle has the greatest potential conversion ratio of any type: thus it should be capable of producing considerably more fissile material than it consumes. Because it has no moderator, the fuel must contain a very high proportion of fissile material, at least 30—40%; the fuel is thus very expensive and, to avoid an enormous capital investment in the initial charge of fuel, a very high heat rating is necessary. This can only be achieved by the use of a liquid metal coolant, probably sodium.

This type of reactor is shown diagrammatically in Figure 9. The core, consisting of fuel elements canned in stainless steel or niobium, is surrounded by a "blanket" of uranium 238 or natural uranium. This is necessary because, due to the very small size of the core, large numbers of neutrons escape from it. These are absorbed in the blanket where plutonium is formed. Both core and blanket are cooled by liquid sodium. The sodium becomes intensely radio active and the whole of the primary coolant system has to be shielded. Sodium also reacts violently with water and to obviate the possible risk of liberating quantities of highly radio-active sodium due to a leakage in the steam generator, a secondary sodium circuit is interposed between the primary sodium and the steam circuit. This secondary sodium does not become radioactive.

In order to get the very high heat ratings required, the fuel elements must be very thin in section to avoid impossibly high temperature being produced in them; at the same time they must be mechanically stable under the conditions of intense radiation and high temperatures which obtain in the core. Since only partial burn-up of each charge of fuel will be possible, the rate of fuel turn-over will be very high, and if the costs of processing the spent fuel and blanket cannot be made sufficiently low, the fuel cost will be too high to make the reactor an economic proposition, even though a surplus of fissile material is being produced. New and much cheaper methods of processing will have to be evolved before such a system becomes a profitable undertaking. A fast reactor is now being built at Dounreay and has a core about 2 ft. in diameter by 2 ft. high producing 60 MW of heat.

The Aqueous Homogeneous Reactor

In this type of reactor, shown in Figure 10, the fuel is uranium 233 in the form of a salt in solution in heavy water; the latter acting as a moderator and chosen because of its negligbly small absorption of neutrons. As in the fast reactor, the core is surrounded by a blanket of fertile material, in this case a suspension of thoria in heavy water.

The core and blanket are separated by a spherical vessel of zirconium alloy, chosen because of its low absorptive property; the core and blanket being both contained in a spherical pressure vessel. The core solution and the blanket suspension are pumped through separate heat exchangers where dry saturated steam is produced. A conversion ratio of at least unity should be possible, so that after initially charging with fissile material, only a feed of thoria will be required. This reactor should show very low fuel costs. It requires only a very small investment of fissile material and thus the fuel rating is high and the capital cost should be low.

In order to obtain reasonable temperatures in the steam cycle, high pressures are necessary; thus to obtain dry saturated steam at 600 p.s.i.g. the core and blanket circuits must be pressurised to 2,000 p.s.i.g. Hence the thermal efficiency of the steam cycle cannot be high, not more than 25%.

The chief problems in this type of reactor are those of corrosion of the containing circuits and fuel processing. If these can be solved then in spite of low thermal efficiency the running cost should prove to be low.

The Liquid Metal Fuelled Reactor

The operation of this type of reactor, shown diagrammatically in Figure 11, is very similar to the previous type. It uses, however, the unique property of bismuth for dissolving small quantities of uranium and it is possible to dissolve enough pure uranium 233 in liquid bismuth to produce a chain reaction. The core of the reactor is a block of graphite with holes through which the uranium-bismuth is pumped, and the core is separated from the blanket which is

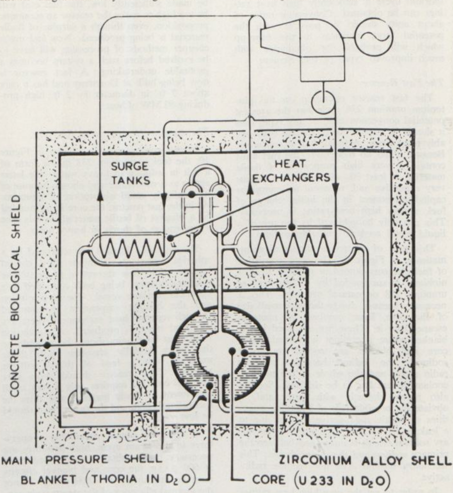


Figure 10 Aqueous Homogeneous reactor. (Blackburn: A.E.R.)

a slurry of thorium in bismuth, by a graphite vessel.

Like the Aqueous Homogeneous reactor, this reactor should be capable of a conversion ratio greater than unity. It has one considerable advantage over the Aqueous Homogeneous type, in that high temperatures can be obtained without the need of pressurising the circuit thus making high cycle efficiencies possible. For this reactor to become a practicable working proposition, much development work, chiefly on metals, will have to be done.

Nuclear Power in South Africa

In South Africa the costs of generation vary considerably depending upon the costs of fuel delivered at the power station, the total installed capacity of the station and the load factor. Figure 12 shows the comparison between the costs of operating existing South African power stations and the estimated costs of nuclear power stations. It must be emphasised, however, that the comparison shown is qualitative rather than quantitative in that a precise estimate of the cost of power genera-

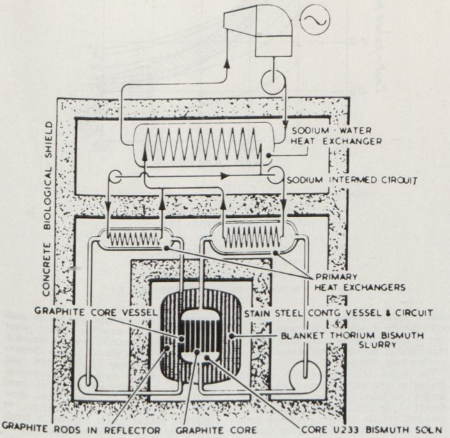


Figure 11 Liquid metal fuelled reactor. (Blackburn: A.E.R.)

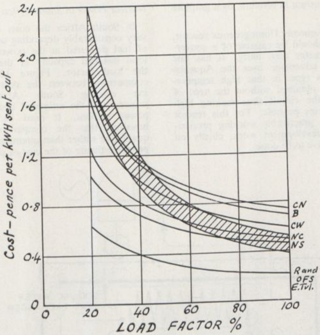


Fig. 12

Approximate nuclear power station costs lie within the shaded areas.

CW – Cape Western Undertaking E.S.C.
CN – Cape Northern Undertaking E.S.C.
B – Border Undertaking E.S.C.
NS – Natal Southern Undertaking E.S.C.
NC – Natal Central Undertaking E.S.C.
ETvl – Eastern Transvaal Undertaking E.S.C.
R&OFS – Rand and Orange Free State Undertaking E.S.C.

tion in nuclear stations can only be given when the size of station, local conditions and cost of fuel are specified, and when further experience of nuclear power station operation has been obtained.

The curves relating to South African generation costs were computed from information published in the 1958 Annual Report of the Electricity Supply Commission and are the average generating costs in the various undertakings, rather than of individual stations—in general there are two or more inter-connected stations in each undertaking. The costs for nuclear power stations were obtained from information published in the United Kingdom Government White Paper Cmd. 9389 and relate to single stations of capacities generally in excess of those of local stations. It will be noted from these curves that it would be uneconomic to establish nuclear power stations in South Africa except possibly in the Cape Western, Cape Northern and the Border regions, and even in the northern Cape it might be more economical to transit power in bulk from the Rand and O.F.S. Undertakings. The stations of the Rand and O.F.S. and the Eastern Transvaal Undertakings, which are sited close to the coal-fields, have such low operating costs that, from an economic point of view, they would be immune from competition from nuclear power stations. The stations of the Natal Undertakings appear to have operating costs comparable with those estimated for nuclear stations at the higher load factors but are more economical for lower load factors.

South Africa has ample supplies of uranium but as yet no separation plant for the production of uranium 235 has been established. The use of natural uranium as a nuclear fuel is of particular interest to this country. The South African uranium deposits are largely uraninite, which is mainly crystalline uranium oxide containing variable amounts of thorium and rare earths. For various reasons uranium and thorium used in existing reactors are required mainly in the metallic form, although the possible use of oxides, carbides and other suitable compounds is feasible. The Canadian reactor NPD now being built will use urania as fuel. It would appear that it is in the interests of this country to develop techniques which would enable her own deposits of nuclear fuels to be used with a minimum of processing thus reducing the probable costs of nuclear power station operation.

Mr. President, gentlemen, I would thank you for listening so patiently to me, and I would thank Mr. Hill so kindly for operating the projector. Thank you.

THE PRESIDENT: Thank you, Professor Phillips. We have listened with very great interest to your interesting address, we are running a little late, so we shall now adjourn for tea, discussion on the paper, and thanks to the speaker will take place immediately after we resume.

ADJOURNMENT FOR TEA

On Resuming at 4.00 p.m.

THE PRESIDENT: It gives me great pleasure to call on Mr. Chris Downie of Cape Town to propose a vote of thanks to Professor Phillips for his paper.

Mr. C. DOWNIE (Cape Town): Mr. President and gentlemen:

We have been treated this afternoon to another paper on a subject which has captured the imagination of scientists, engineers, and the public all over the world. We are very grateful to Prof. Phillips for having presented this paper to us today and especially for the trouble to which he must have gone in studying the subject and preparing the material for the paper which he has so very ably put over.

In his opening remarks, Prof. Phillips referred to the need which will arise, sooner or later, in most countries for supplementing existing fuel and other conventional sources of power.

Sooner or later the conventional fuel resources of the world will run out, a matter of 150, 200, 300 years. As far as South Africa is concerned, however, I don't think we need worry very much at this stage. I read somewhere not so long ago that, even when taking into account the increase in the demand for power that will take place, South Africa's resources of coal will last another 3,000 years.

There are not only our coal supplies, what about our rivers. You yourself, Mr. President, in your Presidential Address, have referred to the possibilities of exploiting the rivers of Natal. Those rivers are not the only ones in South Africa—there is the Orange River for instance—and I would say that before we, in this country start getting excited about nuclear power the possibilities of exploiting a river like the Orange River should be thoroughly investigated as a source of hydro-electric power. I understand that one or two preliminary investigations have been made into such a possibility.

We in South Africa, I think, are very fortunate: we are not "hard up" for fuel like they are in other countries, Great Britain for instance. We are in the fortunate position of being able to await research and developments that are taking place in the production of power from the atom.

A disturbing feature of the information contained in Professor Phillips paper, Mr.

President, is the reference which has been made to the large number of reactors and fuel cycles that are being experimented with. I understand that in the matter of reactor development alone there are over 100 different types of reactor having possibilities for producing power. These 100 reactors can be pruned down to about 30 which give some promise of having definite economic possibilities.

Now, Mr. President, when it comes to the important question, one of these days, on having to decide whether or not to invest in nuclear power, what type of reactor are we going to buy? The position at present is most uncertain, but as I say, we in South Africa, are very lucky. We have our cheap coal and I reckon that we can go on waiting for a long time continuing to use conventional sources of power and the well proved means of converting it to electricity.

A very interesting feature of Prof. Phillips' paper, of course, was his references to the economics and cost of nuclear power. The figures quoted by Prof. Phillips relate to those huge nuclear power stations that are now being built in the United Kingdom. One reads of estimates that are prepared from time to time on the cost of production of power from those nuclear stations. They are, however, mainly experimental projects. There is still a tremendous lot to be found out about them—particularly in regard to their operation, availability, life, etc. We are still quite a lot in the dark.

In addition to that, the nuclear power stations in the United Kingdom being huge ones, the estimated figures for production costs are related to very high load factors of the order of 80 or 90%, which is made possible by their being incorporated into a very large system of inter-connected power stations.

In regard to the cost of production of those nuclear power stations, I was interested to see in the most recent issue of the "Electrical Times," that in replying to a question on the running of nuclear power stations, the Minister of Fuel and Power said that in view of the 5% fall in the price of uranium last year, and the 20% decrease in the capital expense of nuclear plant installations, the Minister of Power forecasts that within 10 years the cost of nuclear power for base load generation would be equal to the cost of power from coal and oil power stations.

Now, Mr. President, the cost of coal in England is close on 80/- a ton, I mention that as an indication of how long we in South Africa—even at the Cape—can wait before we need become excited about nuclear power.

In connection with the paper that was presented to our Convention last year on the same subject, I made some estimates which indicated that until the price of coal rose above 70/- a ton at the Cape (today we are paying 47/6 a ton) there is no need for us to become concerned about nuclear power stations and that is for a nuclear station, costing as little as £120 per Kilowatt. I doubt whether, even for a load factor of 80%, the capacity of a nuclear power station for the Cape Town power supply system would be such as to come out at a cost of less than about £180 per KW.

We electrical engineers who are involved in power production, besides transmission and distribution, Mr. President, have to run our undertakings at the lowest possible cost. We are very much concerned with the cost of production of power. We are naturally very interested in nuclear power stations and reactors and all the rest of it, but we do have to bear in mind all the time what the production costs are going to be. We are not power station "empire builders."

There is of course also a lot of research being carried out into other means of producing power, that is, other than through nuclear fission. Research is being made into nuclear fusion, and these is also the possibility of producing electricity direct from the atom. For all we know, when the time comes for us to become excited about the possibilities of being able to exploit nuclear fission, there may be a "break-through" in nuclear fusion; and then we will have to make up our minds all over again whether it is going to be "fission" or "fusion", by which time the possibility of getting power direct from the atom might well have come on to the horizon. It is all rather bewildering.

One aspect of this subject that Prof. Phillips did not refer to (although he did remark at the beginning of his address about his interest in teaching!) is the urgent need for the provision of facilities in this country which will enable our science and engineering students to receive training in nucleonics and nuclear power in this country and thus save them from having to go overseas for such training.

As you know an institute is being set up in the Transvaal for teaching and research into nuclear physics and power. A considerable amount of activity is also taking place for the setting up of a similar institution in the Cape. The Stellenbosch University and Cape Town University, have got together and sooner or later we shall have in the Cape an Institute at which our local University students will be able to learn something and carry out research in the field of nuclear physics and power. I can tell you that the City Council of Cape Town, at its meeting last month, decided to contribute £30,000 towards the cost of establishing such an Institute.

Mr. President, with those few remarks, it gives me the greatest of pleasure to thank Prof. Phillips on behalf of our Association for having presented to us today a very interesting paper on such an amazing and bewildering subject. (Applause.)

THE PRESIDENT: Thank you Mr. Downie. I now call on Mr. Henry Alexander, Manager of the E.S.C. in Natal, to second the vote of thanks.

Mr. H. ALEXANDER, Escom, Natal Undertakings: Mr. President, gentlemen: The main difficulty in seconding a vote of thanks to a paper such as we have had from Prof. Phillips this afternoon, when the proposer has been so able a speaker as Mr. Downie, is that I can virtually tear up all the notes that I have prepared to second the vote of thanks. I did think that Mr. Downie might have left a few crumbs, but he seems to have left nothing, and let nothing escape his eagle eye.

It is perhaps appropriate that this paper by Prof. Phillips on Economic Aspects of Nuclear Power Station Operation should have followed your Presidential Address this morning, which laid emphasis on the necessity for a continual search on the part of all electricity supply authorities for cheaper generation.

The picture that Professor Phillips drew in his paper this afternoon, portrays, as Mr. Downie has said, an alarming number of different varieties of reactors. On comparing the different designs, it would appear that the only thing that is common to all of them is the concrete biological shield, and, as Mr. Downie has mentioned, it is difficult to know exactly what type of reactor one would be best advised to install when developments are taking place as rapidly as they are.

One is tempted to the thought that at the present time at any rate, the only thing that would prompt a supply authority to go in for a nuclear power station, would be immense courage or intense desperation. One cannot but admire the authorities in Great Britain where they have spent such enormous sums of money on the erection of power stations, which before they are completed, are obsolete.

In South Africa we have such natural resources, as the uranium salts, and again, as Mr. Downie has mentioned, it is very necessary that we do develop our own techniques and staff of scientists who will be able to develop our own natural resources and use them for our own local purposes. But is it a frightening thought that somewhere a chemist may be testing a new element, and thereby completely vitiate all attempts that have been made in the industry that has been built up for the recovery in South Africa of uranium.

The nuclear reactors that Prof. Phillips has described, do present a bewildering variety of improvements that are continually being effected, with new fission materials, new moderators, new coolants, and when one thinks how stable the conventional power station plant has been for shall we say the last 50 years, one wonders exactly whether the time has yet arrived for any country that can avoid it to climb on to the nuclear bandwagon at the moment.

From what Prof. Phillips has said, and other papers that have been published on the subject of nuclear power station operation, it is obvious that any costs that have been given relate to the costs per unit sent out of a station comprising a nuclear reactor which has taken the place of a furnace in a boiler, and conventional turbo-generator plant. As we know, from elementary thermodynamics the efficiency of a condensing turbine driving a generator is something in the order of 30 to 35% which makes one wonder whether, again, the time is ripe, or whether we haven't merely scratched the surface of the development necessary for the true development and use of nuclear fission or fusion in order to give us the source of electrical energy.

One wonders whether there is not a possibility that before the turn of the century, at the most, there will be discovered some means of creating electrical energy from some abundant and cheap material in a plant that will be so prolific in its output that the electrical energy will be able to be transmitted just as radio waves are with very low overall efficiency which will not matter, because the cost itself will be so small, and consumers will be able to obtain their electrical energy merely by tuning in just as one does with a radio to get the serial on the C programme!

One of the problems that makes us rather scared of nuclear power generation is the question of the disposal of the waste product. In South Africa we have our waste product, the ash from our boilers; sometimes in Durban we have tried to get away with blowing our ash up our chimneys, but the Civic Fathers soon put an end to that, and now we have to resort to other efforts.

In other parts of the country our ash forms rather unsightly ash dumps on the scenery, but at least these products are dormant, they are not radio-active, and there is always the problem of the disposal of the waste product that I personally feel must be satisfactorily disposed of before we can think of having any nuclear power stations in South Africa.

I understand that one method that is used is to take the waste product out to sea, but in Natal (and I presume in other parts of South Africa), those people who look after our seaside resorts and our fish might not take so kindly to that method of treatment.

We had, some 18 months ago, a lecturer in Durban who gave us a talk on somewhat similar lines to that of Prof. Phillips insofar as it described some of the more recent nuclear power stations, and one of the questions that was put to that lecturer was, "What sort of people do you use for the staffing of nuclear power stations?" "Do you use boffins and scientists and people with nothing less than a Ph.D. degree?" and the answer was that the first power station was so staffed, but it was found that the scientists, if anything did go wrong, immediately started working out exactly what had happened, and by the time he had come forward with the answer the damage was more or less irreparable, so then they used unskilled operators, with the very clear instructions that if anything went wrong "press Button B."

One of the big advantages of a succession of papers on the subject of nuclear power station operation is that it does bring the terminology, the language home to us. Where we haven't got any practical experience, we only know of these power stations from what we can read, and to some of us opportunities are given to go overseas and visit these stations and see them for ourselves, and it is a little bit confusing to go into the fine details and know exactly why you are getting heat out of a reactor, and exactly what is going on inside; but a comforting thought always comes to my mind when I reach that stage of affairs, and that is that for all the time—the many decades —that we have been generating, distributing and selling electricity, how many of us knew what electricity was?

So with this paper that we have had from Prof. Phillips this afternoon, I am very happy to associate myself with the remarks so capably made by Mr. Downie in proposing the vote of thanks, and it gives me great pleasure, Mr. President, to second the vote of thanks to Prof. Phillips for his paper. I thank you, Mr. President, for the kind invitation as a visitor to this Convention, to perform this pleasant task.

THE PRESIDENT: Thank you Mr. Alexander. As the vote of thanks has been ably proposed and seconded, will you accord Prof. Phillips the usual vote of thanks for his very interesting paper. (Applause)

Gentlemen, the paper is now open for discussion.

Mr. W. H. MILTON (Honorary Member): I am not speaking for Escom.

Mr. President, I would like to thank Prof. Phillips very much indeed for his paper and the manner in which he has dealt with his subject.

It is generally acknowledged that the nuclear stations (let's call them that), which are at present being established are recognised by the authorities establishing them as being monuments to progress. I think they fully realise that what they are doing is merely establishing the kick-off point or the foundation on which the future will build.

There has been a lot of pressure brought to bear on the basis of the honour of taking part in the erection of such monuments and that the Union should not lag behind. Personally I don't think the Union is sufficiently large, or has sufficient resources, to embark on such monuments, and in that respect I do agree with the remarks passed by Mr. Downie, that we would be well advised to await on progress before climbing on to the bandwagon so as to enjoy the efficient products which will flow from the monuments and possibly won't even be recognised as relative thereto.

The other aspect of course, which I know, is exercising scientists studying this problem, is that the present applications so far are bound up with the Carnot Cycle and its limitations as to efficiency, and I would like some comments from the author of the paper on the possibilities which are opened up to us, which may be only nebulous possibilities, of avoiding the limitations of Carnot Cycle and trying to obtain a more efficient conversion.

A point which is mentioned in the paper which interested me very much, is the allowance of 4% interest on the fuel stock. I would be very interested to know where the money is coming from at 4% for fuel stock on 15/20 year loans which will be involved in the purchase of that fuel.

The next point which I think is very important flows from the curves which have been presented. Mr. Downie did touch on the subject, but I don't think he brought the point home with sufficient emphasis.

Curves have been produced which relate principally to Escom stations, and although speaking as an honorary member, I happen to know something also about Escom stations. The curves relating to Cape Northern, for example, are related to a station of the order of 24 Megowatts maximum output capacity. Border is another relatively small station, and the only really large stations concerned are those remaining. When one looks at the Rand and O.F.S. one is considering very large magnitudes indeed, and some of these earlier figures, from which the curves must have been drawn, also incorporate some small stations which it was very expensive to operate, and which have now been virtually abandoned, with the development of the larger stations of Taaibos and Highveld.

So that when putting forward curves of that description, if you were to provide Cape Northern with a nuclear station, you would probably find that the nuclear curve of cost would not be what is given by the other, but something very much higher on the scale, in the region of 4d. and 6d. a unit.

I mention this case to show that when making a comparison it is not advisable to put down the curve of Cape Northern, in relation to the curve for a very large atomic station. They are not on the same basis. The comparison should have the same basis in order that the comparison may be realistic.

It may be that the author had in mind something more definite than I have read into his paper in putting forward the Cape Northern and I think some further remarks on that would be very much appreciated for the records.

On the subject of fuel resources, mentioned by Mr. Downie, I think we would be taking a very short-sighted policy if we look smugly at our own reserves, and say we must be thankful that we are not in the same boat as the rest of the world.

I cannot imagine that powerful groups outside the Union would allow themselves to fail—and literally fail—due to shortages of energy reserves, when there is a vast reserve in the Union. It is not unlikely, if things come to a very bad pass, the Union would be swamped out and it would find it was utilising its reserves at a rate comparable with what was happening to the rest of the world.

In other words the 300 or 3,000 years would probably dwindle to a like period to that prevailing in the rest of the world. When we reach the stage of a shortage of the natural fuels which we use at the moment—and most of our present day way of life is based on the heat content of those fuels—I think you will find that the world itself will regard fuel as an international reserve, and not something which can be owned and controlled entirely by any one nation. Perhaps Prof. Phillips has some views on that aspect.

With those remarks, Mr. President, I would very much like to congratulate Prof. Phillips again on a most interesting paper. (Applause)

THE PRESIDENT: Thank you, Mr. Milton.

Mr. A. R. SIBSON (Bulawayo): Mr. President, I would like to add my own expressions of appreciation to Prof. Phillips for the very interesting paper we have listened to, and for the very able way in which he delivered it.

I, too, have a remark to make about the curves that appear at the end of the paper with regard to the revised curves that have been placed before us for Fig. 12—I thought perhaps Prof. Phillips, and others of you might be interested to add to these, the curve of the costs of the Kariba Supply, and this, gentlemen, is not in fact the cost of Kariba supply, but the price of Kariba supply, as now declared to the receiving stations, each of which is at some considerable distance from the point of generation. The figures therefore include the cost of transmission.

If you make a mark against 100% load factor, at a figure of .29, and at about 66% load factor, .4 while at 20% about 1.06, and complete the curve, this gives you a rough picture of the cost of Kariba supply to the purchasers. The actual nett cost of supply is somewhat less than that, but you may know that the conditions imposed by the lenders of the money for the scheme required that the second portion of it should be partially financed by excesses of revenue over expenditure during the operation of the first portion of the scheme; and this pushes the prices up a little higher than they otherwise would be.

I am somewhat critical of the figures shown for the Rand and Orange Free State undertaking, and I am glad Mr. Milton got in first, because he will find it more difficult to reply!

These figures are the figures, obviously, of an existing state of affairs, and the purpose of a paper of this sort is to consider the relative economics of some future power station which is going to be built, whatever type it may be. It is therefore not of much value to examine the costs of an existing undertaking, but rather to consider costs of incremental supply.

A very quick and rough calculation tells me that even at so modest a price at £50 per KW and with an overall fuel cost of .1 of a penny per unit, and a fairly conservative figure of £1 per KW per annum for the rest of the costs of operating and maintaining a power station, the cost could not possibly be less than .85d. at the 20% load factor line, as opposed to what looks like .66d. on the present curve.

I found Fig. 13 extremely confusing. I don't understand it at all, in fact, but my confusion has been added to by, I think, some further errors in the numeration of one of the co-ordinates.

Those are my main points, but I would like also to say it is not I think an adequate argument that because nuclear power has so many variants we should therefore not employ it until the thing crystallises itself, because we are doing precisely that sort of thing by continuing to build orthodox thermal stations. We are hanging on to something which is by no means the power supply of the future, and if any new scheme can be put forward which works, and which will cost less, it should be considered on its merits. We shouldn't hang fire just because something even better may be around the corner.

Thank you, Mr. President. (Applause)

THE PRESIDENT: Thank you, Mr. Sibson.

Clr. E. L. CHAPLIN (Port Elizabeth): I am no technician, but I was wondering whether Dr. Phillips shouldn't explain Fig. 1. Fig. 1 shows the growth in electricity production, I am not a mathematician but it seems to me that the upright figures on the left of the Figure, are not in proportion. If you measure from 5 to 20 you will see that it is very nearly equal from 20 to 100; then 100 to 200 is a very small gap, and 200 to 500 is a small gap; 500 to 1,000 is a smaller gap; and I am wondering whether this graph really illustrates the actual growth in electricity production, and whether it really gives a true picture of the trend. I have drawn roughly on a piece of foolscap and my drawing gives a very different curve from the one in the Figure. Perhaps the lecturer could explain that point.

THE PRESIDENT: Professor Phillips will reply at the end of the discussion. Are there any further contributions?

Dr. ERIC PHILLIPS: Mr. President, gentlemen: I am very pleased that my paper has provoked the discussion which has come forth this afternoon. I realise that in making my comparisons in those curves the comparisons were totally unfair, but I do that with an ulterior motive—simply to provoke discussion.

We do know that if we are going to compare power stations of different types, we must of course consider similar capacities, and it was for that reason that I did produce those curves.

Furthermore, I am of the opinion, as I said earlier during my paper, that the curves which I have produced for nuclear power stations are extremely optimistic and they should be moved up the scale considerably, and I do admit that to the power station engineer and to the general practising electrical engineer, the subject of nuclear power stations is somewhat bewildering. It is bewildering even to the scientists themselves who are working on the development and design of power stations. Not one day passes but what there is some new development, and knowing what these boffins are, as soon as they get a new idea into their heads, they forget all about some of their previous ideas and work full out on that, and then realise later that possibly they have achieved something in a much more expensive way. So that there are difficulties of that sort, and one must further realise that all the stations which so far have been produced and put into action are really experimental stations, and they must be regarded as such, and I do feel that the authorities of Great Britain have been very courageous in embarking on these nuclear power stations.

With regard to a few of the points which you have mentioned this afternoon, Mr. Milton suggested that we might get away from the Kano Cycle if possible, because that reduces our efficiencies to a maximum of 33%.

Well we know that at the experimental stations in Great Britain they have been working on a piece of equipment known as ZETA where the energy transmutation was almost converted directly into electrical energy, but there they struck several snags, and although the machine seems to work quite feasibly under experimental conditions, when larger models were built the thing gave considerable trouble, and they had to more or less abandon their present design and start de novo. But it is within the bounds of possibility that within the foreseeable future it might be possible to obtain electrical energy direct without going through the heat cycle.

I was very interested to know from Mr. Sibson the cost of Kariba, and I would be more interested still if I could obtain a breakdown of those costs, into generation costs, transmission costs, and so on. The situation seems to be a very interesting one indeed.

With regard to my Fig. 1, the vertical scale is an explanation scale—otherwise the picture might present to us an untrue situation. If you are used mainly to ordinary co-ordinates, then I suggest if you re-draw the curve in that fashion, that might interpret to you better the exact situation as it has been portrayed for you by those who have taken surveys of the situation throughout the world during the past few years.

With those few remarks, Mr. Chairman, I would again thank members for a most interesting discussion. (Applause)

THE PRESIDENT: Thank you Prof. Phillips. Once again I thank you on behalf of the Association for a most interesting paper.

I would like to comment on what appears to me as being one very important aspect which arises out of Prof. Phillips' paper, that is, the training of personnel.

Mr. Downie, in his vote of thanks, stressed the importance of providing suitable training for our young engineers in the nuclear sciences and I would also like to add my comments in this regard.

Whilst South Africa is fortunate in having adequate supplies of conventional solid fuel at a reasonably low price which will probably delay the introduction of commercial generation by means of nuclear fuel for some time, we must not make the mistake of relying only on overseas for training our engineers but proceed with all haste in establishing a suitable nuclear reactor in South Africa to assist in this all important aspect.

With those few comments, Prof. Phillips, I would like to thank you again for a most interesting paper. (Applause)

Gentlemen, if you will agree I would like to move forward one particular item on the Agenda, and that is to deal with the Report from Mr. Downey in connection with the S.A. Bureau of Standards.

I ask for this alteration because I believe the representative from the Bureau, Mr. Middelcote, will have to return to Pretoria tonight and it will give him an opportunity to speak to the report. Do you agree to this alteration?

I now call on Mr. Downey to submit his report on the S.A. Bureau of Standards. It has been printed and it won't be necessary for him to read it, but he may want to make one or two comments.

Mr. J. C. DOWNEY (Springs): Mr. President, gentlemen: I have pleasure in submitting the report on the Bureau of Standards.

S.A.B.S. ACTIVITIES: REPORT OF REPRESENTATIVE

Mr. Chairman and Gentlemen,

I have pleasure in presenting the report of the activities of the S.A.B.S. during the past year:

S.A.B.S. 97—Paper Insulated Cables for General Purposes

The revision of this specification was completed and was approved by the Standards Council on 5th October, 1959. Additional requirements and tests were incorporated in the revised specification. The Specification is at present at the printers, but roneod copies are available.

S.A.B.S. 98—Paper Insulated Cables for Heavy Duty

As S.A.B.S. 98/1954 is out of print, this speciflcation was re-written in order to fall into line with S.A.B.S. 97. This document has been circulated to the members of the Cable Committee. Closing date for comment 1st February, 1960.

S.A.B.S. 150—P.V.C. Insulated Cables

In connection with the use of P.V.C. insulated cables another important and somewhat unusual aspect should be brought to the attention of all concerned. During 1959 a multi-core P.V.C. insulated, bedded, armoured and served cable laid in soil in which bad meat had been buried some years previously, was severely damaged by contact with the soil.

In this respect it should be pointed out that all commonly used plasticizers are fat-soluble and as fatty acids (stearic, Myristic, palmitic and similar long chain acids) are normally produced when meat is decomposed trouble may be expected if these acids are allowed to come into contact with plasticized P.V.C.

Aldehydes and Carbonyl-components which are produced by chemical decomposition and fats, also act as solvents of P.V.C.-materials.

In the above-mentioned case, samples of the soil were examined and found to be acid and also to contain aldehydes and carbonyl-components. It should, however, be stressed that in this case the circumstances were exceptional.

S.A.B.S. 165-1959 *Lampholders*

This specification, which covers both bayonet-cap and Edison-type screw lampholders, was approved by the Standards Council on the 8th June, 1959 and has now been published.

S.A.B.S. 166-1959 *Overhead Service Line Connector Boxes*

This specification was finalised at the 2nd meeting of the Committee on the 18th September, 1958. It was approved by the Standards Council on the 8th June, 1959, and is now available in printed form.

S.A.B.S. 184 *Electric Heating Pads and Blankets*

The specification for heating pads and blankets was finalised at a meeting held on the 17th September, 1959, and will be submitted to the Standards Council for approval on the 4th April, 1960.

S.A.B.S. 185 *Immersion Heaters for Portable Electrical Appliances*

1st Meeting—23rd June, 1959.

Sent out for comment. Return date 30th November, 1959.

2nd Meeting—18th February, 1960.

S.A.B.S. 186 *Impulsing Energy Regulators for Electric Heating Units*

After discussion of the first committee draft at a meeting held on the 22nd September, 1959, a draft for comment was issued; the return date for which is the 28th February, 1960.

*S.A.B.S. SV*122 *Safety Specification for Domestic Radio and Electronic Apparatus*

Two meetings were held in 1959; one on the 15th September and the other on the 27th October. The specification has now been issued for comment, the return date being 30th June, 1960.

Electrical Equipment Safety Specifications

The series of electrical equipment safety specifications were first published in 1950. These were subsequently amended in 1953. At that time it was decided that nine of these specifications, viz. SV 101, 102, 103, 104, 107, 109, 112, 117 and 121 be recommended for compulsory declaration. With this end in view these safety specifications were submitted to the Government legal advisers. As a result of their deliberations it was noted that:—

(a) Reference could not be made in a compulsory specification to a non-compulsory specification (in this case SV 100 and SV 119) and

(b) that only standard specifications, as opposed to safety specifications could be made compulsory.

In view of this it was decided by the Standards Council that the appropriate requirements of SV 100 be written into each of the individual specifications, that SV 119 be also declared a compulsory specification and further, that the ten specifications be renumbered and that these specifications, listed below, be declared standard specifications to which the S.A.B.S.-ellipse mark be applied:—

Old No.	*New No.*	*Title*
SV 101-1953	SV 124-1955	Manually Operated Air Break Switches.
SV 102-1953	SV 125-1955	Portable Electric Immersion Heaters.
SV 103-1953	SV 126-1955	Electric Air Heaters and Radiators.
SV 104-1953	SV 127-1955	Flexible Cords for Power and Lighting.
SV 107-1953	SV 128-1955	Portable Elec. Appliances for Heating Liquids.
SV 109-1953	SV 129-1955	Plugs and Socket-Outlets.
SV 112-1953	SV 130-1955	Electric Handlamps.
SV 117-1953	SV 131-1955	Electric Stoves and Hotplates.
SV 119-1953	SV 132-1955	Lampholders and Bayonet Lampholders Adaptors.
SV 121-1953	SV 133-1955	Apparatus Connectors.

Other changes requested by the legal advisers were also made. The Minister of Economic Affairs has now decided that the compulsory declaration of these specifications be proceeded with.

In order to clear up certain points, particularly instances in which discrepancies existed between these safety and the corresponding latest series of "quality" specifications, a committee meeting was held on the 3rd November, 1959.

The revised specifications are now being prepared for submission to the Standards Council on the 4th April, 1960, after which they will be published in the Government Gazette.

S.A.B.S. 171 *Low Voltage Lightning Arrestors*

This specification has now been submitted to the Standards Council in its final form and is expected to be published early in 1960.

S.A.B.S. 517 *Power Transformer Specification*

Committee meetings have been held to discuss the first draft. Sub-committees are now busy on certain contentious sections which will be reviewed by the main committee before the specification is submitted for general comment.

S.A.B.S. 179 *High and Low Voltage Bushings Specification*

The draft specification has been discussed by the committee and investigations by the S.A.B.S. of queries raised by the committee are now under investigation. These are expected to be clarified by mid 1960.

S.A.B.S. 178 *High Voltage Insulators*

The position is the same as in the case of the Porcelain Bushing Specification.

S.A.B.S. 516 *Motor Cycle Battery Specification*

This specification has been sent out for comment and finality of I.E.C. proposals is awaited before this specification is taken further.

In conclusion I should like to express my appreciation and thanks to all members of the staff of the Bureau of Standards for their willingness and co-operation in all matters during the year and to members of the A.M.E.U. who have so kindly and willingly given up valuable time and have rendered such good service on the various Technical Committees of the Bureau of Standards.

J. C. Downey, Representative.

There are only two points to which I would like to draw your attention: first the one that is printed under PVC insulated cables. This information is given not to frighten you, but to draw your attention to the fact that you may, at some odd chance, run into such trouble.

The other is the question of wiping metal which has been creating a lot of interest. This matter is being taken care of by the Bureau.

That is all, Mr. President.

THE PRESIDENT: Thank you. Would Mr. Middelcote like to make any comments?

Mr. A. A. MIDDELCOTE (Bureau of Standards): I should like to thank you, Mr. President, on behalf of the Director of the Bureau of Standards, for the opportunity of addressing this august gathering, and also for the help which the A.M.E.U. has given to the Bureau over the past year.

The formidable list of specifications on which A.M.E.U. members have helped have been given by the evergreen Mr. Jack Downey. However, I would like to stress further the help given by giving a refresher on what standardisation means and needs.

There are many phases to standardisation, but I think it is well worth stressing one phase.

Standardisation through the phase of simplification leads ultimately to larger production runs and therefore lower costs. It also reduces maintenance stores stock, a further saving. This requires understanding between manufacturer and consumer, can never be dictated by either, but leads to a healthy ultimate solution. It is therefore the function of the Bureau of Standards to bring about a satisfactory standard through the medium of its Technical Committees.

The major consumer opinion regarding electrical equipment is vested in the A.M.E.U. and it is for this reason that we are particularly thankful for the help given us and in return we would like to express that we exist as a body to help the A.M.E.U. and would welcome any matters of standardisation, particularly as regards simplification, which you may consider in the best interests of the community being referred to us.

Once again, Mr. President, I would like to thank you very much for the help the A.M.E.U. has given the Bureau.

THE PRESIDENT: Thank you Mr. Middelcote.

Would anyone else like to comment on the Report before its adoption?

I would like to record that whilst Mr. Middelcote has thanked the A.M.E.U. for its support, I think in turn Municipal Electrical Engineers are getting more and more appreciative of the work that the Bureau is doing, and I would like you to convey to the Director the thanks of this Association for the energy and support and the work that is going into specifications and the Codes of Practices that are being produces by the Bureau. They are of very great value.

If there are no further comments on that, we will, I presume, adopt this Report.

(Agreed).

CONVENTION ANNOUNCEMENTS FOLLOWED

CONVENTION ADJOURNED AT 5.00 p.m.

SECOND DAY

Convention Resumed at 9.30 a.m.

THE PRESIDENT: Good morning, gentlemen.

This morning we will proceed without delay with the Symposium on "The Supply of Electricity to Native Townships." I propose that the written reports that have been submited be dealt with by the authors in turn, not necessarily in the order in which they are printed, each speaking for 10 to 15 minutes in order to bring out the highlights of their contribution. Thereafter a discussion will be called for on each contribution.

The first will be Mr. Masson's report on "Electrical Work Planned or in Progress in Native Areas." I will now ask him please to come forward.

Mr. G. MASSON (Johannesburg): The schedule printed in the Agenda gives, so far as possible, details of the answers received to the questionnaire. You will appreciate that there is a lot of information one would like to have put in the schedule, but due to space, we had to leave some things out. I do hope that the abbreviations used will not be too confusing.

Report on Electrical Work Planned or in Progress in the Native Areas

By G. Masson, Johannesburg Electricity Dept.

INDEX

At the 33rd Annual Convention it was agreed that selected members be invited to submit details of the work planned or carried out in the Native townships within their areas. A questionnaire was posted to those members and the attached schedule "The use of electricity for domestic purposes by African Native Families" has been compiled from the returns received. For the convenience of members the following summary has been prepared from the schedule.

1.0 GENERAL

1.1 *Introduction*

Where the wages earned by a community are low the provision of electrical reticulation and house wiring is not an economic proposition and may be defined as a luxury.

In the course of their employment in factories, business and domestic service the non-European has learnt the advantages of electricity supply and as soon as they can afford it there will be an insistent demand for this service.

Native Administrators are pressing for electrical services which they feel are essential whether they can be regarded as payable or not. The following reasons are advanced to justify the necessity for electricity upply: —

ii (i) Street lighting is essential to prevent crime and to eliminate traffic hazards in the street.

i (ii) House lighting will improve family life.

(iii) Smog created by coal fires is becoming a serious threat to the health of the inhabitants and can be eliminated by electrical heating and cooking.

The Engineer responsible for an electrical undertaking must insure that it operates economicaly. The socialogical problems involved in a Native township may be regarded as being outside his sphere. It is, however, essential that he takes an interest in the consumer of tomorrow to ensure that the reticulation schemes now being planned and erected for street lighting are not only safe but can be readily adapted to a growing load without creating an unnecessarily high burden of capital charges.

1.2 *Financing of Electrical Schemes*

The Federation members indicate that the Local Authorities are alive to the necessity for providing electrical services.

The Union Government has laid down the policy that rudimentary street lighting is an essential service and where a Natives Services Levy is in existence, funds can be made available from this source for the bulk supply of electricity to a township and the lighting of alternate streets. Where bulk supply cables are laid underground, they should be of adequate capacity for domestic supply.

The Local Authority is expected to provide capital for the completion of street lighting financed out of the Services Levy, as well as any other services required.

2.0 TARIFFS, CONSUMPTION AND DEMAND

2.1 *General*

It is laid down by the Minister of Bantu Affairs and Development that a Local Authority may not make a profit out of services charged to the Native Revenue Account. The provision of electricity supply shall therefore be at cost but the determination of "cost" is in most cases well nigh impossible and to arrive at this figure will involve unnecessary expense.

Attention of members is drawn to the memorandum prepared at the request of the United Municipal Executive of South Africa by the Institute of Municipal Treasurers and Accountants (S.A.) Incorporated (issued in July, 1959). In this Memorandum it is stated "that where the circumstances surrounding the provision of a service to a Native area are such as to make the ascertainment of cost difficult and uncertain, the charge to the Native Revenue Account should, with the approval of the Minister, be made at a rate fixed for the purpose or at an existing tariff appropriate to the nature of the service provided that the rate of charge should not be less favourable than that made against any other consumer or user of the service under similar conditions."

2.2 *Applied Tariffs*

In the case of several large townships the Native Revenue Account is charged at the Council's standard bulk tariff rate and the income from the sale of electricity to the consumers is for the account of the Native Revenue Account.

Where supply is purchased in bulk from E.S.C.O.M. most authorities charge the E.S.C.O.M. tariff plus a surcharge to cover the cost of distribution.

Where fixed tariffs are applied, one of the following three methods is adopted for recovery of consumption.

(i) A standard charge is included in the rent.

(ii) A standard charge is applied for lighting only plus an additional charge per appliance.

(iii) The monthly charge is based on the capacity of the current limiter.

2.21 *Meters and Current Limiters*

Prepayment meters do not find any favour. The use of limiters is indicated in 30% of the returns.

Meter readings are taken monthly and accounts rendered to the consumers.

2.22 *Consumption Deposits*

The Local Government Ordinance lays down that a deposit shall be lodged to ensure payment for services. Difficulties have been experienced in one case where the Local Authority has called for a £1 deposit to cover the estimated consumption over a 2 month period. The consumers apparently find difficulty in meeting this amount or else they consider it an unreasonable sum.

To meet the requirements of the Ordinance a deposit is of course necessary and it may assist matters if the consumers can be allowed to build up the deposit by instalments.

2.3 *Consumption*

2.31 *Fixed Tariff Lighting Only*

The three returns received indicate that full use is made of the service and that illegal use of portable appliances is difficult to prevent. The average consumption for consumers of this category is of the order of 220 to 400 kWh per annum and must be rigidly controlled by current limiters to prevent excessive consumption.

2.32 *Fixed Tariff — Unrestricted Use*

Consumptions varying from 1,000 to 2,000 units per annum can be expected from this class of consumer which indicates general use of small appliances. One authority levies a monthly rate of 2s. per appliance whereas the others levy a rate dependent upon the capacity of the current limiter installed.

2.33 *Metered Tariffs—General*

Roughly 70% of the returns received indicate that supply to Native domestic consumers is metered.

2.34 *Metered Tariff — Lighting Only*

Only two returns were received under this heading viz., 130 and 360 units per consumer per annum. The higher figure appears excessive for lighting only but this is no doubt occasioned by the use of portable appliances plugged into lampholders.

2.35 *Metered Tariff—Unrestricted Use*

The returns indicate that an annual consumption varying from 220 to 3,000 units per annum can be expected. The consumption per consumer is no doubt influenced by the average earnings of the consumer, the cost of coal or other fuels used for domestic cooking and heating, and the tariff charged. A fair average consumption would be something between 600 and 1,000 units per annum unless the supply is used for cooking.

2.4 *Kilowatt Demand*

Only eleven members were able to give after diversity maximum demand figures which vary from 0.2 kW to 1 kW. Seven returns indicated an after diversity maximum demand of 0.5 kW or less, two 0.75 kW and one undertaking quoted a figure of 1.0 kW. The higher figures of 0.75 and 1.0 kW are no doubt due to the extensive use of heating and cooking appliances.

3.0 RETICULATION DESIGN

3.1 *General*

It seems that the modern trend to design townships with curved streets and irregular stand boundaries applies to all recently developed townships. Splayed street corners appear to be the rule and whilst they are no doubt essential for fast traffic they do increase the cost of overhead construction using vertical configuration of conductors.

Where streets are unmade or where kerbing is not likely to constructed for some years, poles should be planted close to the building line otherwise trouble is experienced due to vehicular damager.

3.2 *Load Centres*

3.21 *Transformer Kiosk Sites*

Since the frontage of stands in Native township is small it is essential that provision be made in the layout of the township for such transformer kiosk sites as are required to meet the future township loading. Kiosk sites should not be larger than necessary otherwise they will reduce the number of residential stands available and present the Engineer with the problem of keeping the sites free of weeds and rubbish. A site measuring 15 ft. x 12 ft. plus building line restrictions appears to be adequate for a capacity of 500 kVA.

3.22 *Load Centre Design*

The returns appear to favour the brick building no doubt due to the comparatively low cost of such structures erected by native labour. The brick building appears to be justified for important load centres, switching or linking stations.

In a number of reticulation schemes pole transformers are used although they are not as popular as would be expected. It would seem, however, that serious consideration should be given to pole transformers for use in areas where the load density is low or where the load is a developing one.

Steel kiosks are used by a number of authorities but insufficient information has been received to indicate whether they should only be used say in areas where the load density is low or whether their cost justifies the additional maintenance they require.

3.25 *Kiosk Equipment*

Slightly more than half of the undertakings use oil circuit breakers for the E.H.T. protection of the transformers and the balance use H.R.C. fuses.

L.T. protection is by H.R.C. fuses.

3.3 *H.T. and L.T. Feeders and Distributors*

3.31 *E.H.T. Feeder Cables*

Roughly 75% of the Undertakings have installed underground cables for the E.H.T. distribution within the townships. Of the remaining 25% who have adopted overhead E.H.T. mains, no indication has been given that unsatisfactory service has been given from these mains.

3.32 *L.T. Distribution*

3.321 *L.T. Distributors*

With one exception the replies to the questionnaire show that overhead mains are used exclufor L.T. distribution.

3.322 *Conductor Materials*

Approximately 66% of the Undertakings reviewed use copper conductors and the balance use aluminium.

All aluminium appears to be slightly more extensively used then steel core aluminium conductors.

Conductor Configuration

Vertical configuration is used in 70% of the reticulation schemes and the balance use horizontal configuration.

3.324 *Neutral Earthing*

Multiple earthed neutral system has been adopted by 75% of the Undertakings.

3.4 *Street Lighting*

Tungsten lighting is by far the more popular form of lighting and 85% of the undertakings use this type.

Two undertakings have used mercury and sodium fittings for main roads and access roads to the townships.

Fluorescent fittings are used by 15% of the Undertakings and they are all of the high power factor type.

Fluorescent fittings using lamp wattages of 60 and 80 watt capacity are in service whereas tungsten lamps from 75 to 200 watt capacity are in use. The most popular sizes of tungsten lamps appears to be either 150 or 200 watt.

Spacing of street lamps varies from 120 to 400 ft. Where street lighting has been financed exclusively from Natives Services Levy Funds then lighting has been provided either in every second street or else lighting at every street intersection with no lighting along the length of the blocks.

4.0 HOUSE WIRING AND SERVICE CONNECTIONS

4.1 *Wiring Methods*

One Undertaking has installed PVC sheathed wiring, one has wiring run in cleats and the remaining 85% have used the conventional conduit system.

4.2 *Standards of Wiring Work*

From the returns received it is evident that the wiring work carried out has been of a high standard. Approximately 75% of the returns indicate that lighting points are mounted in the centre of the rooms and the lighting switch is placed in the same room as the light it controls. The remainder of the replies indicate that wall bracket lights are provided with the lighting switches for the various rooms grouped at one point.

Only one Authority has provided a 30 ampere cooker control outlet.

Two Authorities have used ceiling switches with no maintenance problems, whilst two Authorities have had unsatisfactory experience. The remainder of the replies indicate that ceiling switches have not been used.

4.3 *Special Features*

One Federation member has had experience with communal kitchens for housing schemes but it appears that there is no demand for such facilities in the towns in the Union.

4.4 *Wiring Maintenance*

Roughly two thirds of the Municipalities bear the cost of the maintenance of house wiring installations and the balance expect the consumer to pay for maintenance.

4.5 *House Service Connections*

Overhead services are indicated in 66% of the replies and the balance provide underground service cables. It is interesting to note that PVC insulation is being adopted for practically all overhead and underground services.

5.0 BANTU ARTISANS AND CONTRACTORS

The returns indicate that 25% of the Municipalities employ natives to do wiring and maintenance of house installations.

Very little information has been received regarding the wages paid to electrical trainees. The Native Building Workers Act lays down minimum rates of pay for trainees and one Municipality has adopted these rates. A second Municipality is treating trainees as salaried staff at higher rates than laid down in the Act.

Native electrical contractors are operating in Pretoria and Salisbury.

6.0 UNIT COSTS

6.1 *Street Lighting Reticulation Schemes*

The cost of street lighting schemes is dependent upon such factors as size of stand, whether overhead or underground E.H.T. cables have been provided, spacing of lights, excavation and load centre costs.

The returns indicate that construction costs work out at something between £2 2s. and £12 per stand. For a lamp spacing of 240 to 300 ft. using wooden poles and aluminium overhead conductors, a unit cost of £5 per stand measuring 40 ft. x 70 ft. appears reasonable.

6.2 *Reticulation of Domestic Power and Street Lighting*

The returns indicate that the average cost per stand for township reticulation which includes E.H.T. feeder cable within the township, load centres, low voltage mains and street lighting is as set out below:—

A. *Designed for an After Diversity Maximum Demand of 1kW Per Stand*

(i) Complete underground cable system for a township with stands measuring 45 ft. x 75 ft.—approximately £45 per stand including service connections.

(ii) Complete overhead mains system for a township with 40 ft. x 80 ft.—£25 per stand excl. s/c connections.

B. *Designed for an After Diversity Maximum Demand of 0.75 kW Per Stand*

(i) Underground E.H.T. and overhead low voltage mains to supply 40 ft. x 70 ft. stands—£22 10s. per stand.

C. *Designed for an After Diversity Maximum Demand of 0.5 kW Per Stand*

(i) Underground E.H.T. and overhead low voltage mains 40 ft. x 70 ft. stands—£20 per stand.

6.3 *Street Lighting Fittings*

Street lighting fittings costing from £2 10s. to £10 for tungsten lighting are used. The average priced fitting used would appear to be of the order of £3 10s.

Fluorescent fittings cost from £5 10s. to £22 although the average price is approxi- £7 10s.

7.0 EXTENT OF WORK TO BE CARRIED OUT

There are approximately 144,000 houses built in the areas supplied by the 24 Undertakings included in this survey. Of this total 32,500 houses have been provided with electricity supply.

There are approximately 19,000 of the wired houses which have 15 ampere socket outlet whereas the remaining 13,500 permit the use of lighting only.

8.0 CONCLUSION

The decisions made today are those with which we will have to live for many years to come. Errors in planning can be costly and practically irremediable. It is therefore recommended that:—

(a) For any native township a complete scheme for street lighting and reticulation should be planned and this design should be used as a master plan.

(b) If the initial development is to be rudimentary street lighting then go ahead with such portions of the master plan that are necessary for the service required. Omit any load centres that are not required but follow the E.H.T. cable route planned to tie in with such load centres.

(c) Where the designed plan has been shaved down to the minimum requirements considered essential by the Electrical Undertaking it must be adhered to and there should be no compromise. Expedients which may result in lower initial expenditure but destroy the planning must be strongly resisted.

This report was made possible by the work of the members who completed the questionnaire and in some cases went to extra trouble to provide supplementary information. To these members a very special vote of thanks is due.

(Applause).

THE PRESIDENT: Thank you Mr. Masson.

That contribution is thrown open for discussion.

Mr. R. W. KANE (Johannesburg): Mr. President, I think Mr. Masson has some information on the connections taken by the Native house tenants, which I think will be interesting.

Mr. G. MASSON (Johannesburg): Mr. President. The replies to the questionnaire did not give any indication as to the popularity of electrical wiring installation, but in Johannesburg, towards the middle of last year, we wired approximately 1,800 houses, and the installations were handed over to the Non-European Affairs Department. It was found that initially there seemed to be some reluctance to take electricity supply.

A month after the installations had been completed and were ready for service, we had roughly about 180 consumers connected with the scheme out of a total of 1,800. For the next five months we had an increase of approximately 180 a month. It took five months to make 50% of consumers alive. The number of new connections has dwindled from month to month, and today only 70% of the total installations wired are connected up. We have had very little trouble when a consumer has once been connected. I understand, in one other Reef town, they have quite a big monthly change-over (new connections and cut offs) although the number of installations they have alive and in service remains fairly constant.

	Benoni	Boksburg	Bloem-fontein	Bulawayo	Cape Town	Durban	East London	Estcourt	Germiston	Heidelburg Transvaal	Johannes-burg
A. General											
No. of towns'ps or settled com.	3	3	1	6	2	4	3	1	3	1	20
No. of dwelling units	11,805	2,595	4,956	10,006	1,096	6,354	4,827	156	17,000	640	40,000
How many dwellings:											
Lighting only	—	—	—	756	8	—	—	106	—	—	—
Lighting and Cooking	10,724	126	300	90	484	1,500	237	—	50	640	3,100
Average family income									5% below £6		
Where no supply available..	—	£18–£20	Less than £15 p.m.	£10. 3s.	£20 p.m.	£12–£15	£12–£13	£8	5% .. £10	£9	£16
Lighting supply only	—			£8 8s.				£8	70% .. £15		
Lighting and other purposes	£16			£14 4s.				£8	20% ab £15		
Who is responsible for payment for electricity consumed	Consumer	Consumer	Consumer	Municipality & Consumer	Consumer	Consumer	Consumer	Municipality	Consumer	Consumer	Consumer
B. Town Planning Details											
Any difficulty due to Town Planner's design	No	No	Yes	No	Yes–resul. in deviat. mid-bound. const	Yes	Yes	No	Not unduly	Yes	Yes
Are street corners splayed ..	1 township	2 town's. No 1 town'p Yes	No	Existing No Future Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Do curved streets make erection of O/H mains difficult	No	—	Yes	Yes	Yes	Yes	Yes	No	Yes	—	Fair difficulty
What size sites are provided for load centres..	45' x 75' 50' x 50'	50' x 50'	40' x 30'	30' x 30'	12' x 12' 40' x 60'	10' x 15'	50' x 50'	Not provided	25' x 15' 40' x 75'	—	15' x 17' 20' x 20'
C. Financing of Schemes											
Work financed out of the Natives Services Levy	—	Bulk supply	Bulk spp. & S.L. imp. sts	—	Street lighting wir. blocks sgle & mar. quarters	Bulk supp. & rudi. S.L. completion of street lighting	Street lighting	—	Rudimentary SL	—	Bulk sup. & Rudi'tary SL Limited amount of S.L.
Work financed out of the National Housing Loans	—	Street lighting	—	—			Nil	—	—	SL & LT Reticulation	Intermed.SL.
Work financed out of the Local Authorities' own funds	External loan	LV reti-culation	Balance of work	All work	Domestic supply	Wiring	Reticulation Wiring	All work	—	—	LV Reticula. Hse. wiring
Work financed out of Other sources..	—	—	—	—	—	Sup. 3 tow's. Elec. Dept.	—	—	—	—	—
D. Design Details											
Are E.H.T. mains O/H or U/G	U/G	O/H out. township U/G Inside township	U/G	O/H	U/G	1 town. U/G. 3 town O/H.	U/G	U/G	U/G	O/H	U/G
Are L.T. mains O/H or U/G ..	2 town U/G 1 town. O/H	O/H	O/H	O/H	O/H	O/H Generally	O/H	O/H	O/H	O/H	O/H Side Roads
Where are poles planted	Near build. line	Near kerb	Near kerb	Rear boundary	Where pos. rear bound.	Near kerb	Near kerb	Near build. line	Near build. line	Near kerb	build. line Mn. rd. kerb
Do you operate with M.E.N. ..	2 town yes 1 town no	Yes	Steel pole instl.-Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Conductor configuration	2 town–Hori.	Horizontal	Old–Horizon New–Verti.	Vertical	Vertical	Horizontal	Vertical	Horizontal	Vertical	Vertical	Vertical
Conductor materials	Copper	Copper	Copper	Copper	Copper	Copper	Copper	Copper	S.C. Alum.	S.C. Alum.	All Alum.
Type of Load centre	Brick	2 Steel 3 Brick	1 Steel Bal. Brick	Pole transfr. Generally 1 steel 2 brick	Brick & O/D tran. enclo.	1 town. brick 3 pole transf.	New–steel Old–Brick	Brick	Brick	Steel	Brick Kiosks
Capacity of Load centres	300–500 K.V.A.	200–300 KVA.	500 KVA.	Pole transf. 200 KVA. Steel kiosk 300 KVA. Brick kiosk 500 KVA.	500 KVA.	Brick 300 KVA	500 KVA	75 KVA.	500 KVA.	200 KVA.	400 KVA.
E.H.T. protection of transformer	O.C.B.	O.C.B.	O.C.B.	Pole transfr. fuses Brick kiosk O.C.B.	O.C.B.	O.C.B.	O.C.B.	Fuse	O.C.B. or HRC. SwF.	O.C.B.	O.C.B.
Street lighting fittings:											
Wattage	100 w. Tung. 160w. Fluore.	100 w.	150 w.	250 w.	100 w.	75 w.	60 & 150 w.	100 w.	200 w.	150 w.	60 w.
Spacing..	Tungs. 130' Fluore. 400'	Main rd. 150' oth'r 150–300'	300'	150'–200'	200' main rd. 400' other rd.	150'	120'–150'	—	190'–800'	180'	240'
Type	Tung & Fluor	Tungsten	Tungsten	Tungsten	Tungsten	Tungsten	Tungsten	Tungsten	Tungsten	Tungsten	Fluorescent

Krugersdorp	Ladysmith	Paarl	Peri Urban Pretoria	Pietermaritzburg	Pretoria	Port Elizabeth	Roodepoort/Maraisburg	Salisbury	Sasolburg	Umtali	Uitenhage	Ventersdorp
2	1	1	1	2	3	3	1	3	3	1	1	1
3,301	970	288	2,308	—	10,000	10,025	5,000	9,740	450	2,000	3,500	—
294	—	280	Provision for 150	1,300	—	3,800	—	5,044	—	2,000	620	8
—	200	—	—	25	1,552	100	700	696	375	30	90	—
£11	£5–7 p.m.		—	—		£12		—			£11	£6 to £7
£12	£5–£7 p.m.	} £10–£15	—	£10	} £15	£12	} £20	£11.10 plus rent	} £16	} £8 plus rent	£11	£12 to £20
£13	£10		—	—		—		£25 to £30			£32	—
Consumer	Consumer or Employer	Council	Consumer	Municipality	Consumer	Consumer	Consumer	Cost of light. Includ. rent	Consumer	Employer	Consumer	Consumer
Yes	Not unduly	Yes	No	No	Yes	—	Yes	Not unduly	Yes	No	No	No
Yes	No	Yes	No	No	Yes	Yes	No	—	No	No	Yes	No
Yes	Yes	Yes	No	Yes	In some cases	—	Yes	Yes	Yes	Yes	No	No
—	—	—	—	20' x 30'	—	—	20' x 35'	20' x 20'	30' x 30'	50' x 50'	—	None
Bulk sup. & SL Maj. Rds.	—	Nil	Bulk sup. & street light.	Nil	Bulk sup. & rudi. S.L.	—	Bulk sup. & rudi. S.L.	—	—	—	Nil	—
S.L. secondary Road	Portion	Yes	—	S.L. and Wiring	Nil	—	—	—	—	—	House Wiring	—
Grade "A" SL.	Portion	—	—	Reticulation and S/C	For early schemes only	—	Balance reticulation & SL. wiring	Yes	External loans for All work	All work	Reticulation	Yes
—	—	—	—	—	2/3 kaffir beer profit for LT. reticu. SL.	—	—	—	—	—	—	—
U/G	O/H	O/H	U/G	O/H	O/H	U/G	U/G	O/H and U/G	U/G	U/G	O/H	O/H
O/H	O/H	O/H	O/H	O/H	O/H	U/G	O/H	O/H	O/H	O/H	O/H	O/H
Near kerb	Near building	Rear boundary & near kerb	Near build.	Near kerb	Near kerb	—	Near kerb	Rear boundary	Near building	Near kerb	Near building	Near building
Yes	Yes	Yes	Yes	No	Yes	—	No	Yes	Yes	Yes	No	No
Vertical All Alum.	Vertical Cop. & Alum.	Horizontal Copper	Vertical All Alum.	Vertical Aluminium	Horizontal Copper	— —	Horizontal Copper	Vertical Copper	Vertical Copper	Vertical Copper	Vertical Copper	Horizontal Copper
Steel	Pole Transf.	Brick	Brick	Pole transf. Brick kiosks	Pole Transf.	Steel and Brick	Brick kiosks	Pole Transf. Steel kiosks Brick kiosks	Brick kiosk	Brick	Pole transfr. Brick kiosks	—
300 KVA.	100 KVA.	600 KVA.	200 KVA.	Pole transf. 100 KVA. Brick 400 kva	200 KVA.	200 KVA.	300 KVA.	750 KVA.	200 KVA.	500 KVA.	150 KVA.	—
O.C.B.	HRC. fuse	Dropout fuse	O.C.B.	Switchfuse	O.C.B.	O.C.B.	O.C.B.	HRC fuses	Switch fuse	HRC fuse	Fuses	—
Fluore. 80w. Tung. 150w.	F 40 w. T 100 w.	100 w.	80 w.	150 w. and 200 w.	150 w.	200 w.	100 w.	80 w.	200 w.	200 w.	100 w.	150 w.
240'	300'	240'–300'	240'	300'	150'	200'	270'	200'	150'	300'	300'	300'
Fluor & Tung	Tungsten	Tungsten	Fluorescent	Tungsten	Tungsten	Tungsten	Tungsten	*M.rd. Merc. and Sodium S.rd. Fluor.	Acc. rd. Sod. Main rd. Mer. S. rd. Tung.	Tungsten	Tungsten	Tungsten

	Benoni	Boksburg	Bloem-fontein	Bulawayo	Cape Town	Durban	East London	Estcourt	Germiston	Heidelburg Transvaal	Johannes-burg
D. Design Details—Continued											
Flourescent street light fittings: Type of Starter	Instant	—	—	—	—	—	—	—	—	—	Hot cathode
Do multitube fittings have separate ballasts ..	Yes	—	—	—	—	—	—	—	—	—	Yes
Are they high p.f. type ..	Yes	—	—	—	—	—	—	—	—	—	Yes
No. of tubes per fitting ..	2	—	—	—	—	—	—	—	—	—	2
Length of tube	5 ft	—	—	—	—	—	—	—	—	—	3 ft.
Are street lights provided in every street	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Old town Yes New town No
Approx. cost of street lighting fittings	T £1 7s. 6d. F £22 8s. 0d.	£2 7s. 6d.	£3 0s. 0d.	£2 10s. 0d.	£6 0s. 0d.	£3 0s. 0d.	£2. 10s. 0d.	£3 0s. 0d.	£3 7s. 6d.	£3 7s. 6d.	£5 10s. 0d.
Approx. cost of street lighting wire guards	—	10/-	—	£1 1s. 6d.	6/-	—	£2 0s. 0d.	—	—	—	—
House S/C Type of insulation O/H services	A.M.E. P.V.C.	P.V.C.	P.V.C.	P.V.C.	P.V.C.	P.V.C.	A.M.E.	P.V.C.	—	P.V.C.	—
House S/C Type of insulation U/G services	P.V.C.	P.V.C.	P.I.L.C.A. P.V.C.	—	—	P.I.L.C.A.	P.V.C.	—	P.V.C.	—	P.V.C.
House S/C Size of conductor ..	O/H.0085'sq. U/G.0225'sq.	O/H 2— No. 10 SWG. U/G .007 x 2	O/H No. 6 SWG.	0.0225 sq. in.	7/.044	0.0225	.0145 sq. in.	10 S.W.G.	From .007 sq. in.	10 S.W.G.	.0225 sq. in.
House S/C Size of meter/amperes	20 & 40	10	40	40 amp.	As required	10	5 to 25 amp.	—	from 10 amp.	5 amp.	10 & 20 amp.
E. Tariff.											
For Bulk supply to townships ..	Escom + 5%	1d. per unit	Not metered	Standard	Accord. with I.M.T.A. Memoran.	Standard	Cost	Escom	Escom	—	Standard
For consumers	20kwh. @ 3d. Bal at 1d.	Standard	Standard	3d. per unit min 8/- p.m.	Standard	Standard	Standard	—	Standard	1/3d. per la. mcb. 1d. kwh.	Standard
Is sup. available 24 hours per day	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	—	Yes
Are current limiters used ..	No	No	No	Yes	No	No	No	No	No	Tariff accor. to mcb cap.	No
Do yoy levy a fixed charge:											
Lighting only	No	—	No	2½a. 12/6pm. 5 ,, ,, 22/6 ,, 7½ ,, ,, 32/6 ,, 15 ,, ,, 45/- ,, 22½ ,, ,, 60/- ,, 30 ,, ,, 75/- ,,	No	—	—	2/6d. p. mon.	—	—	No
Unrestricted use..	No	—	No		No	—	—	—	—	—	No
Have you a special tariff for African township	Domestic tarff is a special one	—	Under considera.	No	Min. room ch not app. to Nat. consu.	No	—	—	Yes	No	No
F. Metering											
Do you meter individual consu.	Yes	Yes	Yes	Spec. cases	Yes	Yes	Yes	No	Yes	Yes	Yes
Are prepayment meters used ..	No	No	No	No	No	No	No	No	No	No	No
Any problems with prepayment meters	—	—	—	—	—	—	—	—	—	—	—
G. Consumption and Demand											
Annual consumption. Fixed tariff — Lighting only	—	—	—	260 kwh. to 767 kwh.	—	—	—	530 kwh.	—	—	—
Annual consumption. Fixed tariff — Unrestricted..	—	—	—	—	—	—	—	—	—	—	—
Annual consumption. Metered—Lighting only	—	—	—	—	130 kwh.	—	—	—	—	—	—
Annual consumption. Metered—Unrestricted use..	320 to 460 kwh.	600 kwh.	2400 kwh.	2,508 kwh.	1200 kwh.	3000 kwh. Lamontville 840 kwh. Chesterville	1564 kwh.	—	960 to 1,200 kwh.	420 w.	637 kwh.
After diversity demand — Fixed tariff Lighting	—	—	—	—	—	—	—	—	—	—	—
After diversity demand — Fixed tariff unrestricted	—	—	—	—	—	—	—	—	—	—	—
After diversity demand—Metered lighting..	—	—	—	—	130 w.	—	—	—	—	—	—
After diversity demand—Metered unrestricted..	220 to 400 w.	—	500 w.	—	740 w.	500w. Lamon. 270w. Chest.	750 w.	—	—	276 w.	400 w. Nat. met. rea.
How are accounts collected — payable at	Township Office	Town Hall	Treasury	Payable at office	Township Office	Township Office	Township Office	—	Payable at Office	Mun. offices	Pay. at office

Krugersdorp	Ladysmith	Paarl	Peri Urban Pretoria	Pietermaritzburg	Pretoria	Port Elizabeth	Roodepoort/Maraisburg	Salisbury	Sasolburg	Umtali	Uitenhage	Ventersdorp
Yes	—	—	Instant	—	—	—	—	Instant	—	—	—	—
Yes	—	—	No	—	—	—	—	No	—	—	—	—
—	Yes	—	Yes	—	—	—	—	Yes	—	—	—	—
2	1	—	2	—	—	—	—	2	—	—	—	—
4 ft.	3 ft.	—	2′	—	—	—	—	—	—	—	—	—
Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
£16.10s. M.R £2 secondy.	£5	£4. 10s. 0d.	£8 12s. 6d.	£3 10s. 0d.	£1 10s. 0d.	£10	£3 0s. 0d.	£6 15s. 0d.	£18 Mercury £13 Sodium £3 Tungsten	£5	£2 10s. 0d.	£5 10s. 0d.
—	—	—	—	—	—	£1	10s.	—	—	—	£1	—
Old V.R.I.	P.V.C.	A.M.E.	—	A.M.E.	P.V.C.	P.V.C.	P.V.C.	P.V.C.	—	P.V.C.	P.V.C.	—
New P.I.L.C.	—	—	P.V.C.	—	—	P.I.L.C.	—	—	P.I.L.C. P.V.C.	—	—	—
7/.036 and .0225 10 amp.	7/.044 20 amp.	10 S.W.G. —	0.01 sq. in. 20 amp.	0.0225 sq. in. 10 amp.	0.0225 sq. in. Not used	0.0225 sq. in. —	7/.044 20 amp.	— —	0.0225 sq. in. 40 amp.	No. 8 S.W.G. Not used	7/.036 in. No	0.01 sq. in. 10 amp.
Escom	—	Escom	J.C.C. Bulk	—	Standard 3/6d. p.m. p. 1 amp. mcb. 1.10s. p.m. p. 15 amp mcb.	1d. per unit	Escom	—	Assesed Cost	1.75d. per unit 1 amp. limiter free 5 amp. lim. 15/- p.m.	1½d. per unit	Cost
Standard Yes	Standard Yes	7/6d. v.m. 0.95 kwh. Yes	Standard No	Standard Yes	Yes	Standard Yes	Standard Yes	Standard Yes	Standard Yes	No	Standard No	3d. per KWH. Yes
No	No	No	No	Yes	Yes	Yes	10 amp. mcb	Yes 1 & 5 amp.	No	Yes	Yes	No
—	—	—	No	No charge	—	6/- p.m. per 1/2 amp mcb	—	Included in rent	—	—	1 amp. lim. 2/- per m.	—
—	—	—	No	2/- per appliance	Yes	—	—	10/- 5 amp. limiter	—	—	No	—
No	No	No	No	No	—	No	7/6d. covers wiring and connection	No	—	No	No	No
Yes	Yes	No	Yes	Economic houses only	only if dem. ex. 15 amp.	Yes	Yes	74 houses	Yes	No	Spec. cases	Yes
—	No	No	No	No	No	Yes	No	No	No	—	No	No
—	—	—	—	—	—	No experien.	—	No	—	—	—	—
—	—	—	—	—	—	350 kwh.	—	1 amp limiter 400 kwh.	—	—	220 kwh.	—
—	21	—	—	930 kwh.	1,000 kwh.	—	—	5 amp limiter 2,000 kwh.	—	—	—	—
—	—	—	—	—	—	—	—	1,000 kwh.	360 kwh.	—	—	240 kwh.
—	—	—	—	480 kwh.	—	2,500 kwh.	500 to 1,500 kwh.	3,000 kwh.	500 kwh.	—	—	240 kwh.
—	—	—	—	105 w.	—	Nil	—	1 amp limiter 250 w.	—	—	50 w.	—
—	—	—	—	160 w.	410 w.	—	—	5 amp limiter 600 w.	—	—	—	—
—	—	—	—	—	—	—	150 w.	300 w.	—	—	—	180 kwh.
—	208 w.	—	—	350 w.	—	—	—	1.0 kw.	750 w.	—	—	—
Native meter reader	Payable at office	—	—	Payable at office	Payable at office	Payable at office	Payable NEAD	Payable at office	Payable at office	—	Payable at office	Payable at office

	Benoni	Boksburg	Bloem-fontein	Bulawayo	Cape Town	Durban	East London	Estcourt	Germiston	Heidelburg Transvaal	Johannes-burg
H. Reticulation costs											
(a) **Street lighting reticulation scheme.**											
No. of stands in town'p con.	—	—	1,593	2,800	1,651	11,500	995	—	10,000	—	3,238
Size of stand	—	—	50' x 100'	30' x 100' 40' x 80'	40' x 65'	40' x 70'	40' x 80'	—	40' x 75'	—	40' x 70'
Cost per stand, street lighting	—	—	£8 4s. 9d.	£13	£4	£10	£18 0s. 0d.	—	£10	—	£4 5s. 0d.
Cost per street lamp erected	—	—	£80	£40	£38	Est. £56	£122. 8s. 0d.	—	£200	—	£42 4s. 0d.
(b) **Street lighting and domes. power**											
No. of stands in township ..	8,751	Stirton 1,180 Galeview 416	4,956	350	1,651	—	85	156	4,000	640	3,100
Size of stands..	45' x 75'	St. 50'x50' Gale 75'x75'	50' x 100'	40', 50', 25' x 80'	40' x 65'	—	40 x 80	50' x 100' 40' x 70'	45' x 75'	40' x 70'	40' x 70'
A.d.m.d. catered for	1 KVA.	0.5 KVA.	—	1.0 KVA.	0.5 KVA.	—	Bus. only	100 w.	0.5 KVA.	0.3 KVA.	0.5 KVA.
Average cost per stand including street lighting..	U/G reti. £45 incl. S/C ca.	Stirt. £12/10 Gale. £19/5	£40	£29	Est. £27	—	£32 6s. 6d.	—	£13 10s. 0d.	LT mains SL £6 5s. 0d.	£19 15s. 0d.
I. Wiring.											
No. of houses wired	8,184	125	250 Domes. 50 Business	11	492	1,500	346	106	50	—	3,100
Size of service cable	0.0225 sq. in.	.007 or 10 swg	O/H 7/.052 in.	O/H .0225 sq. in.	7/.044 sq. in.	0.0225 sq. in.	0.0225 sq. in.	10 SWG.	—	7/.036 3/.036	.0225 sq. in.
Cost of service cable	Incl. in Cost of reticula.	O/H ± £15 U/G ± £25	£8-10 1 ph. £16-10 3 ph.	£10	O/H £3-0-0	O/H £8 est.	O/H £14	O/H	U/G	£7 10s. incl. meter	£11 15s. 0d.
Cost of meter	£3 13s. 4d.	No charge	Incl. s/c cst.	£4 approx.	10/-	£3 13s. 0d.	incl. s/c cst.	—	—	—	£3 13s. 4d.
Cost of limiter, fuses or m.c.b...	—	mcb fuse £1	—	mcb 12/6 ea.	12/6d.	mcb. —	—	—	16/3	16/-	12/6
Cost of house wiring (L = light S = socket)..	(3L 1S) £11 10s 0d.	—	—	5L 2S £24 8s 2d.	2 L £9	4L 2S £30	—	—	—	2L 1S £5	2L 1S £3-10s
Cost of house wiring	£8 11s. 0d.	—	—	5 L 2 S £20.4	4L 1S £14-10	6L 2S £40	—	—	—	4 L 1 S £6-10	3L 2S £5 13s.
Cost of house wiring	£10 10s. 0d.	—	—	—	5L 1S £16	—	—	—	—	—	3L 1S £4 15s.
Cost of house wiring	£12 19s. 0d. £16 10s. 0d.	—	—	—	—	—	—	—	—	—	3L 1S £5 10s.
No. of sockets per house	1	—	—	2	1	2	Consumer provides wiring.	—	Houses wired by Consumer	2	1
Type and rating of socket outlets	15 amp. 3 pin	—	—	—	15 amp.	15 amp. 3 pin		—		15 amp. 3 pin	15 amp. 3 pin
Are cooker control units provided	No			—	No	No		—		No	No
Wiring system used	Conduit	Cleated	Cleat-ceil. Con. no ceil.	Cleat & Conduit	Conduit	Conduit	To be done by private contractor	Conduit		Conduit	Conduit
Are lights mounted in centre of rooms	Yes	Yes	Yes	Yes	Yes	Not necessarily		Yes		Wall bracket	Wall bracket
Are lighting switches grouped in one position	3 Grouped 2 individual	No	optional	Both group. and individ.	No	No		No		Yes	Yes
Are ceiling switches used	—	—	—	Yes	No	No		No		No	No
J. Special Features											
Have communal kitch. been used	No	No	No	No	No	No	No	No	No	No	No
Any special service layouts ..	No	No	No	—	No	No	No	No	No	—	No
Any special design features ..	No	No	No	—	No	No	No	No	No	—	No
K. Maintenance											
Who is resp. for wiring mainten.	Municipality	Consumer	Consumer	236 Municip. 600 Employ.	Municipality	Municipality	Consumer	Municipality	Consumer	Consumer	Municipality
L. Bantu artisans and contrac.											
Do native wiremen carry out installation work	Yes	will be perm. New town.	No	No	No	No	No	No	No	No	No
Do native wiremen carry out maintenance work	Yes	will be perm. New town.	No	No	No	No	No	No	No	No	No
Are native contractors permitted	Yes	Not at pres't	No	As soon as available	No	Yes	No	No	Yes	No	Yes
How many nat. cont. in your area	None	—	—	None	None	None	None	None	None	—	None
Are connection fees charged for individual dwellings..	Private hous time & mat.	Yes time & mat.	—	Home owner. £14.14s.hse.	No	£4 £6 for U/G con.	—	—	Yes	—	—
Other connection fees..	—	—	—	—	—			—	—	—	—
Wages paid to electrical trainees											
1st Year..	£15 10s p.m. C £7 19 3d.	—	—	—	—	—	—	—	—	—	—
2nd Year	£16 5s p.m. C £7.19.3d.	—	—	—	—	—	—	—	—	—	—
3rd Year..	£17 0s. p.m. C £8.13.4d.	—	—	—	—	—	—	—	—	—	—
4th Year..	£17 15s. p.m. C £9.10.8d.	—	—	—	—	—	—	—	—	—	—
5th Year..	£18 5s. p.m. C £9.10.8d.	—	—	—	—	—	—	—	—	—	—
C = C.O.L.A.											
Wages paid to qual. nat. artisans	—	—	—	—	—	—	—	—	—	—	—

Krugersdorp	Ladysmith	Paarl	Peri Urban Pretoria	Pietermaritzburg	Pretoria	Port Elizabeth	Roodepoort/Maraisburg	Salisbury	Sasolburg	Umtali	Uitenhage	Ventersdorp
1,300	969	280	2,308	806	—	15,000	5,000	—	—	—	—	—
40' x 70'	45' x 75'	60' x 80'	50' x 100'	25' x 55'	—	50' x 60'	40' x 75'	—	—	—	—	—
£5 1. 0d.	—	£5 3s. 3d.	£9 12s. 0d.	£2 2s. 0d.	—	—	—	£12 all roads £5 side rds.	—	—	—	—
£39 0s. 0d.	£2	—	£49 0s. 0d.	£14. 15s. 0d.	—	—	—	£64 main rd. £31 side rd.	—	—	—	—
—	980	280	Not yet available	1,325 40' x 50'	10,000	—	5,000	—	450	—	620	—
—	45' x 75'	60' x 80'		60' x 100'	40' x 80'	—	40' x 75'	—	45' x 80'	—	40' x 70'	—
—	1.0 KVA.	10 KVA.		0.225 KVA.	1.0 KVA.	—	0.3 KVA.	—	1.5 KVA.	0.3 KVA.	0.25 KVA.	—
—	£3 8s. 8d.	LT. & SL. £5 3s. 3d.		Approx. £5	£25 to £27	—	—	—	£22 10s. 0d.	—	—	—
294	200	280 10 swg.	Not	1,325	1,552	3,900	700 O/H	5,740	375 .022 and	3,200	620 O/H	8
7/.036 7/.044	7/.036	7/.036	yet	0.0225 sq. in.	0.0225 sq. in.	0.0225 sq. in.	7/.044	—	0.0145	7/.036 in.	7/.036	O/H
Cost plus 10%	O/H £1 15s. 0d.	—	available	£10 0s. 0d.	O/H £15	U/G £20	£2 10s. 0d.	O/H 1 ph. £8	£7	O/H	£4	—
no charge	£3 5s. 0d.	—		£3 5s. 0d.	—	—	£3 11s. 6d.	—	£3 3s 4d.	—	—	—
—	—	—		10/- to 15/-	16/-	15/-	—	16/9	14/6	15/-	£1	—
—	4L 1S £16	—		5 L 1 S £11	4 L 1 S —	1 L £5	4 L 1 S £12	4 L £18	5 L 1 S £10	—	2 L £6	—
—	—	—		—	—	3 L 1 S £14		4 L 1 S £21 6 L 2 S £45	5 L £7 10s.	—	—	—
—	—	—	—	—	—	—	—	Incl. cooker	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	2	—	—	1	1	—	1	1 & 2	1	—	—	—
—	15 amp. 3 pin	—	—	15 amp. 3 pin	15 amp. 3 pin	15 amp.	15 amp.	5 & 15 amp.	15 amp. 3 pin	13 amp.	—	—
—	—	—	—	No	No	Nil	No	30 amp.	No	—	No	No
Conduit	Conduit	Conduit	—	Conduit	Conduit	Conduit	Conduit	Conduit	Conduit	Conduit	Sheathed	Cleated
—	Yes	Yes	—	Both wall br. & cen. mount.	Yes	Yes	Yes	Yes	Yes	Wall brack.	Yes	Yes
Yes	No	No	—	Yes	No	No	Yes	No	No	Yes	No	No
No	No	—	—	No	No	No	Yes	Yes no prob.	Yes no prob.	Unsatisfac.	No	No
—	No	No	No	No	No	No	No	Yes	No	No—being Considered	No	No
—	—	No	No	No	No	No	—	No	No	No	No	No
—	No	No	No	No	No	No	—	No	No	No	—	—
Municipality	Consumer	Priv. cont.	Consumer	Municipality	Municipality	Municipality	Municipality	Municipality	Municipality	Municipality	Restd. sup. Municipality Meter. Cons.	—
No	No	No	No	No	Yes	No	Yes	No	Yes	Yes	Yes	No
No	No	No	No	No	Proposed	Yes	Yes	No	Yes	Yes	Yes	No
No	None avail.	No	Yes	No	Yes	Yes	Yes	Yes	No	No	None available	None available
None	None	—	None	None	2	None	None	4	None	—	None	None
Yes	£5 per hse.	—	Time and Material	Yes	Time and Material	Yes	—	£1 per dwelling	—	—	£15	£5
—	—	—	—	—	—	—	—	—	—	—	At cost	At cost
—	—	—	—	—	Rates-Build. Workers Act	—	£1-17-6 p.w. 18/3 cola.	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	£7 per week incl. c.o.l.a.	£5 p.w. incl. COLA.	—	—	£2 16/- p.w.	—	—

In Johannesburg the main reason for the slowness in taking to the use of electricity supply is the fact that they have to provide a deposit equal to two months' consumption. This point gives a lot of difficulty. I think the tenants object to paying a pound and not getting something in return. In the case of the other Municipality I referred to it seems the deposit is used as a savings bank. When funds get low they have their electricity cut off and they get their deposit back.

We have suggested, to officials of both our Treasury and Non-European Affairs Departments, that they should investigate some scheme where the Native could build up a deposit, but there does seem to be some problem with the Local Government Ordinance.

It is unfortunate that the Government insists on the wiring installations being treated on an economic basis. This has either meant an increase in the rents or alternatively a monthly surcharge from 2/- to 2/6d. to cover the cost of the installations.

This may have something to do with the slowness of the tenants to make use of electricity supply. The township that we have wired is the Orlando East sub-economic housing scheme. We would like to hear if anybody else has had similar difficulties in making the use of electricity popular, or encouraging people to become consumers when houses are once wired.

THE PRESIDENT: Thank you Mr. Masson. Durban did experience similar difficulties. We found that in a sub-economic scheme in which all 1,200 houses were connected, that the deposit required by the treasurer was one of the greatest objections we had to overcome. The Native just could not see why he had to pay for two months accounts when he hadn't used the current. It took quite a lot of argument before they would agree to pay; in fact it was only due to the fact that we persuaded the City Treasurer to reduce the amount of the deposit that we satisfied them.

Before we have any further discussion, I would like to compliment Mr. Masson for the very useful tabulated information which he has compiled and which is of very great value.

Mr. G. B. HABERFELD (Kimberley): I would like to ask Mr. Masson what his experience has been, or what he has been able to ascertain from any replies to the questionaires on the following problems.

What steps are taken to recover outstanding accounts? If the supply is cut off, is a re-connection fee charged? Do the bad debts reach very high proportions? Do the meter readers make out the accounts themselves or are they rendered by the Bantu Affairs Department or by the Treasury? Is the cost of the meter readers a debit against the Bantu Revenue Account, or is it a charge against the Electricity Account? Any additional expense in the way of collection fees or disconnection fees—are they high for the amount of services rendered?

Mr. G. MASSON (Johannesburg): Mr. President, unfortunately there was so much that one would have liked to have included in the 8-page questionnaire. The information is therefore not altogether as complete as it could be. In Johannesburg we have an old-established township where the Natives have had supply for about 10 years, and in that housing scheme electricity supply is very popular. I have been told by the superintendent in charge of the township that if Natives don't pay their rents, he cuts off electricity supply, and they pay their rent. There are bad debts but the proportion is very low.

If the supply has to be cut off for arrears, we charge 10/- for re-connection.

The majority of replies to the questionnaire indicate that the Treasury Department is responsible for rendering accounts and the account is paid at the township office.

In Johannesburg the Non-European Affairs Dept. gets supply in bulk, and pay the bulk tariff, and they re-sell at the Councils' standard domestic tariff (the same as applied to European consumers). The cost of meter readers is charged to the Native Revenue account. Any profit or loss from the sale of electricity is to the account of the Revenue Account.

There does not appear to be a high account for the collection of accounts. In Johannesburg all domestic consumers are charged 2/- per month to cover the cost of meter reading, etc. I am fairly confident most supply authorities charge all expenses in the native areas to the Native Revenue Account. Alternatively they charge the consumers direct, and they recover all costs. There is no indication that the Native areas are subsidised by any electrical authorities.

THE PRESIDENT: Thank you Mr. Masson.

We must proceed quickly with this symposium. I don't want to leave anything out, but we are restricted to the morning sessions. As all these contributions are very closely related, the questions arising will in many cases be similar, so I will now call on the next person to give his ten minute contribution. I must ask the Contributors please not to read through their full contributions, because there isn't time, but talk for ten minutes on any of the particular points that you wish to bring to the fore, after that we will adjourn for tea and on re-assembling have a quarter of an hour question time.

The next contribution will be "Reticulation in Non-European Towships" submitted by the City of Bloemfontein.

Mr. G. J. MULLER (Bloemfontein): Mr. President, gentlemen: I will briefly and shortly read through this short contribution and show some colour slides to illustrate the paper.

Reticulation in Non-European Townships

Submitted by Electricity Department
City of Bloemfontein

The purpose of this paper not to indicate how reticulation of Non-European Townships should be, but rather to air some views on the subject, in the hope that more information on the technical and economical aspects of the problem will become available from discussion.

In Bloemfontein the general reticulation of these Townships has not yet been tackled, although the matter has been under consideration departmentally for some time. We have in fact not satisfied ourselves that it can be done on an economic basis, so far we have only provided a certain amount of street lighting, generally in every alternate street and too widely spaced to be really considered as an attempt at illumination of the road surface, the main object being to provide lights for pedestrians and naturally also for supervision of the area by night. Government and Municipal buildings, Churches, schools and a certain number of private houses belonging to the more well to do residents have however been connected and consumption charged for under the normal applicable tariffs.

In the latter part of the previous sentence lies, I think, the main difference of our Non-European areas from most of these areas elsewhere. By far the bulk of Non-European housing in our areas is privately owned by Non-Europeans. We think that we can claim to be the originators of the present site and service schemes, as Bloemfontein for many years has made ground available to its Non-European inhabitants on the basis of a monthly rental (stand rent) and bought materials in bulk to be made available at cost to the inhabitants to build their own houses to suit their taste and pocket under the paternal surveillance of the City Non-European Affairs Department.

Speaking strictly legally, the builder of such a house acquires only the right of occupation, as the ground remains the property of the Council, in practice however, over many years such properties have been sold, let, bequeathed and generally dealt with as private property.

This arrangement suited the inhabitants very well as can be judged from the fact that of over 5,000 houses in Batho and Bochabela villages only 500 are Council owned while in Heatherdale the village for Coloured people there is a bare dozen out of 400. This very large percentage of private ownership has however made the planned standard installations by the local authority impossible, while hire purchase schemes for installations could also not be considered, especially as the facility was not available to the European areas.

Conditions are however changing and of late, as referred to earlier, not only public buildings, but a fair sprinkle of private dwellings have been connected up under exactly the same conditions as in the European areas of the City, a fair crosscut of the type of present consumer is indicated by slides which will be shown.

Having regard to the present wage levels which are expected to rise quite steeply in the not too distant future, and the cost of coal, wood, paraffin, candles etc., it would appear that if capital can be kept very low, a case could be made out for the economic supply of these areas, which should considerably improve living conditions for these people, and perhaps almost as important, make the general use of radio in Non-European houses possible. It seems a pity that in the latest extensions to the native townships, namely the Government controlled site and service scheme, electricity in the homes should have been considered a luxury as funds from the Service Levy fund are made available for street-lighting only. This complicates matters somewhat as the street lighting is usually almost on integral part of the reticulation, and as the capital of the levy fund was extracted from European employers for better native housing, the use of such funds might have materially reduced loan charges thus making it possible to bring the modern amenity of electric power within the reach of a far greater number of inhabitants, capital being today one of the major items in electricity costs.

The problem is thus to make electricity available to the lowest income groups of the population on an economic basis without any form of subsidy. To make this possible it is necessary in the first place to design a reticulation system which brings capital cost to irreducible minimum, keeps the maintenance cost low and does not sacrifice safety for cost.

Secondly the absolute minimum in cash payments must be expected from prospective consumers. This entails including the connection to the premises and the wiring installation in the design and cost of the reticulation system.

Thirdly, for social and economic reasons the scheme must be erected and maintained by Non-European staff stationed in the areas.

Finally, tariffs must be divorced from those generally applicable in the European areas, in order to derive the benefit of special low cost design, and the cater for the generally low income level, but bearing in mind that very well to do consumers will also have to be catered for.

Design

To design a scheme involving minimum capital outlay right into the consumers premises, I think that current practice will have to be entirely disregarded. The market will have to be studied for materials likely to promote the objective, and careful use made of materials considered suitable. Basically an overhead system is cheaper in first cost than an underground one, but maintenance is generally higher, particularly with open conductors in native areas where throwing of wires over the conductors seems to be a pet diversion of the youth of the village! An underground system offers greater stability, but can be very expensive, particularly where hard digging is encountered, and if cost is saved on the depth of excavation, damage to cables may result which take time to locate and are fairly costly to repair.

A lightweight aerial cable would therefore seem to be indicated for HT or LT mains, using as supports, the streetlight standards. Aluminium cored cables with plastic insulation and sheath and built-in steel or steel cored suspension wire provide these physical qualities and are available on the market, although not tried yet as far as I know in this country. The 11KV cable has three cores with a steel suspension wire moulded into the P.V.C. sheath which thus takes on a figure of eight shape in section. The low voltage cable has three or more separate insulated cores and one steel cored bare core to act as support and neutral laid up together with rather a long lay, such however that the cores remain together when suspended. To reduce weight and possibly cost of overhead joints where these may be necessary a technique using a suitable apoxy resin could no doubt be evolved. To maintain flexibility in operation while at the same time avoiding the danger of exposed H.V. bushings becoming a target for stone and wire throwers, a small metal kiosk at ground level would be necessary. The transformer may be of the American rural type with built in H.V. and L.V. overload protection and lighting arrestors. In this case the only further equipment in the kiosk would be splitter fuses or isolators for fault location up or down the line from the step down point.

Having provided insulated cables for the mains it would be natural to retain the inherent advantages of cable for the services to the consumers as well. With great variety in size shape and quality of the roof as can be judged from the slides taken in the native villages, aerial cable for this purpose seems excluded. For the services to premises P.V.C. insulated aluminium cored, wire armoured and P.V.C. sheathed cable is thus proposed. This type of cable would have the advantage of simpler make off. No particular make off beyond tidying up with plastic tape, is in fact required. The cable could for reasons of cost not be buried more than 15 to 18 inches underground, but with the wire armour earthed, reasonable protection would be afforded to persons in the event of mechanical damage to the cables, while the P.V.C. insulation should limit extensive damage to the cable as a result of moisture. To limit the cost of cable, we visualise feeding three consumers from one take-off from the mains, making use of a small overground splitter-box on the building line, to facilitate locating faulty sections.

As far as the installations are concerned it is not intended to limit supply in any way and normal single phase metering is therefore proposed with a miniature circuit breaker as service protection and possibly to determine demand charge. Three consumers circuits controlled by a splitter switch would complete the distribution board.

The type of wiring to be used is still undecided both on account of the nature of some of the buildings and the cost factor which must be kept to a minimum. Of the three circuits, one would be an optional stove circuit, in twin 7/20 s.w.g. one in twin 7/22 s.w.g. would supply two 3 pin 15A safety plugs, and the third, in twin 3/22 s.w.g. would supply lighting up to six points.

The material which appears to suit the circumstances seems to be two core wire braided cable, which could be stapled to convenient woodwork, the braiding being bonded through and serving as earth conductor. For lighting points batten holders with E.I. shade and an adjacent ceiling switch on a common block would suffice.

Costs

It has unfortunately not been able to get costs on some of the cables considered for the purpose, but bearing in mind existing fixed and variable costs and the fact that the average charge to consumers should not exceed the average amount now spent by them on coal, wood, paraffin and candles, the average charge in our case should not exceed 30/- which for us would limit the capital spent in the area per consumer to £50. This is possibly a stiff target considering that it covers H.T. and L.T. mains, services and house installations in the area concerned, but it should not be beyond the design ingenuity of manufacturers and supply engineers.

Staff

Without wishing to get embroiled in politics it is necessary to say that if the native is expected to take care of himself in his own area, the time has come to see that nothing is done in native areas by Europeans which could possibly be done by the Non-Europeans themselves. It would in any case avoid risks that European staff might be exposed to.

For the present the availability of skilled Non-European workers is low but for the installation of a scheme such as envisaged, it would be desirable to recruit a small number of Non-European artisans, while every Electricity Department must have a number of old hands among its Non-European employees, who with a short training course could be let loose on construction work which will not involve coming near live equipment. This would result in a considerable saving on labour which would be reflected back to the benefit of the Non-European residents in reduced construction capital. Supervision at engineering level would, for the present at least, until Non-European engineers become available, have to be undertaken by the Department's engineering staff, while planning would in any case be a function of the Department's Distribution Engineer and his planning assistants. This I think would be in accordance with the Government policy of separate development with full co-operation.

Metering

In conclusion I would like to say a few words on metering of such supplies. The very limited capital available creates the temptation to control the supply by means of a limiter and to raise a fixed charge, which to be economic must be equivalent to the average cost per consumer. But the very fact that there is no individual responsibility makes for waste in the use of power, which in turn increases the average cost and may finally make the service unacceptable to the consumers.

To work down the minimum cost there must be individual responsibility by metering and to bring supply within the reach of all, the determination of the fixed charge should be on a basis complying as closely as possible with consumer requirements.

Demand meters have been used by certain undertakings, but for the present purpose I favour the use of miniature circuit breakers, which I suggested to the convention some years ago for the double purpose of protecting the installation and fixing the standing charge. The ideal breaker would be one with a magnetic trip for fault protection and a thermic trip reliably adjustable from 1 amp to 5 amps.

The cost of a single phase meter, would for such installation be a serious item of cost, and world markets may have to be scoured to see if this item cannot be reduced.

THE PRESIDENT: Thank you Mr. Muller. Discussion will take place after tea.

TEA ADJOURNMENT.

On Resuming:

Contribution from Mr. A. R. SIBSON, Bulawayo.

Mr. President, pursuing the question of economic supplies to African Townships, the last paragraph headed "Metering" in the contribution from Bloemfontein, urges the case for Kilowatt-hour metering. I wish to urge the case for maximum demand control.

We have a long established custom of measuring the service to domestic consumers in terms of Kilowatt hours, but there is today little justification for this custom. Even with power generated by conventional thermal Power Stations approximately 80% of these costs are in the category of fixed charges. I estimate that, in the Federation, when the bulk of supplies emanate from Hydro-Electric sources, over 90% of the total costs of supply will be of the nature of fixed charges.

Under both these conditions it is clear that it is no more illogical—in fact it is less illogical—to charge the consumer solely in terms of maximum demand than it is to measure it solely in terms of Killowatt hours.

The application of the maximum demand principle can be done in either of two ways. The demand can be measured in the case of unrestricted supply, the consumers being debited with the monetary equivalent of the demand registered. This carries with it the dangerous implication that the demand indicator has to be reset at each meter reading, all evidence other than the figure written down in the meter book by the reader being destroyed. This would open up possibilities of an interesting nature, particularly in large African Townships.

The alternative is to employ current limiters which restrict the supply to predetermined demands for which appropriate monthly charges are raised. In Bulawayo, the cost of meter reading and accounting amounts to approximately 4/- per consumer, per month and the value of eliminating this cost in the case of consumers in African Townships will be appreciated.

The Bloemfontein notes complain that the fixed charge must be equivalent to the average cost per consumer. By having a series of limiters available, of differing sizes, this can become less serious. In any case, are the wastages in Kilowatt Hours that might take place as a result of the use of current limiters as serious as the wastage in Kilowatts that now take place all over the country when only KWH are measured? Bloemfontein appears to be concerned with the moral effect of permitting a consumer to waste electricity at the expense of the community. Provided the overall costs to consumers are no greater, I suggest that it is not the function of a supply authority to concern itself with the morals of its consumers.

However, I am sure it would not take long for African consumer to discover that unnecessary use of lamps and appliances would shorten their lives at consequent cost to himself. I think that experience has proved that this incentive is an adequate controlling factor.

Mr. G. YATES (Vereeniging): Mr. Muller requested members of the cable industry to comment on his proposals for insulated cables, for high voltage and low tension distribution.

I think he was particularly concerned with the mode of the new type of 11 KV and low voltage aerial cables, which he was considering for use in non-European townships in order to reduce costs of reticulation.

I would say from the outset that as far as I am aware the types of cables which he is considering are not at present manufactured in Southern Africa, but there is no doubt that with the technical resources available to the cable industry in this country a suitable type of cable can and will be designed and manufactured to meet this particular need.

Since the matter was raised, I have had a few thoughts on the subject, and I would like to make some preliminary comments on the constructions mentioned in Mr. Muller's contribution.

Firstly, in regard to the use of aluminium conductors. To achieve the same electrical characteristics of current carrying capacity and voltage drop it is of course necessary to use a larger conductor than would be the case if copper conductors were used, and this must inevitably result in a larger cable. The wind loading on the cable, particularly in the figure eight type of construction, is increased with consequent troubles which this brings.

We have all seen the skipping rope effect which is associated with the old type of twin dumbell section of overhead service wires, and although some alleviation from the trouble is gained by imparting a twist to the cable during installation, there is nevertheless still a hazard involved.

Now we come to the insulation of the conductors. For the 11 KV cables, two

main factors have to be considered. If the cable is to be used in relatively long runs the insulation must be such that no excessive dielectric losses are involved, the cable will be subject to direct solar radiation, and the heat resisting properties of the insulant will have to be good, so that the current carrying properties of the cable are not impaired.

A number of insulating materials are of course available to us, PVC we know best, but it is doubtful whether this is the ideal material for use in long runs of 11 KV cable on account of its relatively high power factor which consequently increase dielectic loss. Polythene is a better insulant from this point of view, but its behaviour under short circuit conditions is suspect on account of its relatively low melting point.

It is, however, used in the production of cables similar to those envisaged by Mr. Muller. I would refer to the polythene insulated and PVC sheath types of telephone tables, incorporating a steel catenery wire which are at present being manufactured and used extensively in this country. These cables are, of course, relatively small.

New thermoplastic materials, such as high density polythene and polypropolyne are now becoming available, and these hold considerable promise so far as the manufacture of 11 KV aerial power cables are concerned.

Finally, we must not forget the synthetic rubbers which are now on the market, and it could well be that a butyl rubber insulant is the best answer to the problem. It will withstand continuously, temperatures of 80 to 85 degrees centigrade, and is extremely chemically stable and inert.

So far as the insulant of low tension aerial cables is concerned, PVC is probably as good as any, and as long as the colour is black it can be used perfectly satisfactorily for outdoor exposure without further protection.

I hope that the preliminary comments will be of assistance to this Association, and you may rest assured that the cable industry in this country will co-operate to the utmost in assisting to provide suitable cables which will help towards reducing costs of Native township reticulation. (Applause).

Thank you Mr. President.

Mr. C. DOWNIE (Cape Town): Mr. President, I have come to this Convention quite unprepared to say anything in connection with our contribution to this symposium. I didn't know this was going to happen. I imagined these contributions would be published, as they have been, that they would be thoroughly read by the members, and then put over for discussion and questions. Even on the matter of questions, Mr. President, I am not so well prepared. If I had known there was going to be something like this I would have brought "my Mr. Masson", but I had better say something I suppose!

Cape Town's contribution describes what we have done for our Langa Native Township. This township comprises two sections, one in which there are married Natives and another section where the bachelors live.

Originally housing units for married Natives were unwired. They were built with no wiring whatever, and were subsequently wired, and we have described in here what we did for the wiring of these married quarters. We have given you some indication of the costs of wiring these married quarters, and incidentally, at the bottom of page 37 of the Agenda proceedings, something rather important has been left out.

We described here how we did the wiring, the staff involved in doing the job, and say: ". . . the average cost per point, including service mains connections, worked." It should say ". . . worked out at approximately £3."

We have also described how we wired our bachelor units, and there are pictures here showing the metering equipment, photographs of the bachelor township and of the reticulation. We also have a bit to say about the maintenance troubles we have had, and one of the things we found necessary was to replace ordinary lamps by means of ES lamps, to save theft of lamps.

House Wiring, Earthing and Service Connections at Langa Native Township, Cape Town

Submitted by Electricity Department
City of Cape Town

General

The Native Township at Langa is situated about 8 miles due east of Cape Town and is about 813 acres in area.

It consists of both Married Quarters and Single Quarters, and houses a total population of about 25,000 people of whom about 18,000 live in the Single Quarters. When the scheme was started in 1927, the accommodation was designed for 5,000 people, so that today the population is 5 times as great as the original scheme.

Married Quarters

All Married Quarters are single storey buildings arranged on a simple 2- or 4-room layout. (See diagram S.F.3251). All have asbestos roofs and cavity brick walls. Each dwelling consists of 4 rooms and a toilet, and has 5 lighting points. There are generally 4 such dwelling to a block. (See photograph No. 1). Those built initially had no electrical installations, except a few which were provided by the tenants themselves under the Council's Assisted Wiring Scheme.

In 1940, a total of 204 of these dwelling blocks were built (see photograph No. 2), and wired for lights and one power plug. A 3-phase, 4-wire supply was given to a central point (see photograph No. 3), the single phase meters being mounted in a common meter box (see photograph No. 4), and the tariff being the ordinary Council Domestic Rate for Lighting and Power. The installations were carried out by the Council's Electricity Department, all lights having their own switch drops.

In 1956, 148 blocks (which were built in 1953) were similarly wired, the plug being next to the meter board in the kitchen. (See photograph No. 5.) These units were all given single phase connections (see photograph No. 6) and separately metered, the tariff being as above.

As these houses were all occupied, the installation of lighting and power could not be carried out in the most economical manner, and in fact the work presented several problems peculiar to a Native Location, such as varying conditions of cleanliness and order, and a pungent interior aroma.

The combined main switch and distribution board in the kitchen measures 16" x 9" x 2" deep, and is held on by a ⅜" dia. "U" shaped bolt cast in the wall. At the top is mounted a 5-way neutral earthing bar in a metal case, and to this are connected the mains neutral, the connections to the spike and water pipe and the neutrals of the 2 lighting circuits.

The live main goes through the splitter switch and via the 2 splitter fuses to the lighting circuits. (See diagram S.F.3252).

Batten type lampholders with a wide base are used, screwed directly on to a surface type conduit box. At first, brass B.C. holders were used, but so many were damaged or stolen that a change to bakelite E.S. holders was made, and all later buildings are so equipped. The use of E.S. holders also discourages the theft of lamps. The lampholders, unfortunately, are the weakest part of the whole installation, being subject to severe twisting strains, and the insulation is the weakest part of the lampholder.

Installation Work

The order of work in all buildings is as follows:—

(1) The conduit runs marked on the drawings are measured up, and the

No. 1. Early examples of Married Quarters.

No. 2. Later type of Married Quarters with 3-phase supply to blocks and common metering point.

No. 3. Married Quarters showing 3-phase supply to blocks.

measurements checked from the buildings.

(2) All conduit is cut, screwed and bundled up ready for each unit.

(3) The conduit is erected in the units, the runs following the beams, walls being avoided wherever possible.

(4) The units are then wired and fittings erected.

(5) Mains connection and earthing are completed as soon as the wooden pole and the earthing spike are in position outside the kitchen door. The spikes are put down by the building unit, using water pressure to "jumper" them into the sand, which is done rapidly. (See photograph No. 6.)

The pole is 16 ft. long and is about 4 ft. in the ground.

The full staff consisted of nine men, four electricians and five labourers, the work being subdivided as under:—

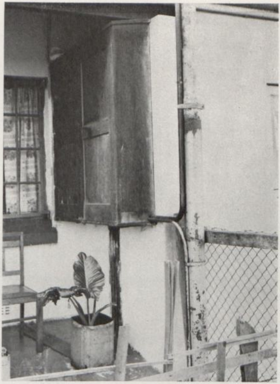
Erecting Conduit—2 electricians and 2 labourers.

Wiring and Fittings—1 electrician and 1 labourer.

Mains and Earthing—1 electrician and 1 labourer.

Plus one labourer for cutting and screwing conduit.

This staff set-up was found to work satisfactorily, and the average cost per point, including service mains connections, worked out at approximately £3.



No. 4. Married Quarters showing common metering point, 3-phase supply and conduits to other houses in block.

The installations are all of the surface type, run on the beams and walls. The walls are not plastered, but are bagged and then whitewashed. Where conduits are run on the ceilings, the line of the beam is followed.

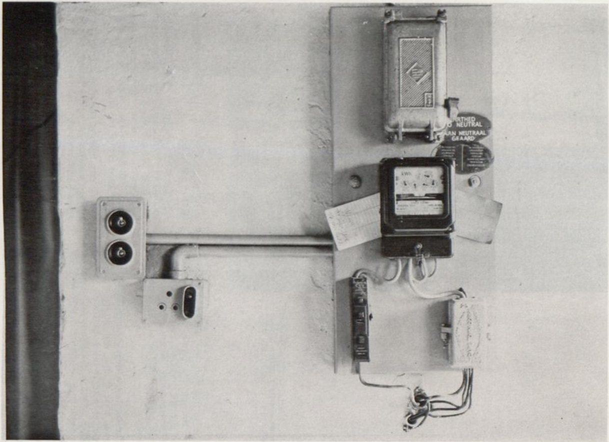
The conduit is heavy gauge, butt-welded, screwed type, $\frac{3}{4}''$ dia., with fittings to match. Particular care is taken to ensure that the conduit system is electrically and mechanically continuous to ensure a safe and durable installation. All the runs are as simple and direct as possible, to save time and labour.

In the earlier installations, 3″ round wood blocks and brass batten-holders were used at lighting points with vulcanised rubber insulated conductors.

In the later installations, P.V.C. insulated conductors were used throughout, with wide-base batten-holders mounted on surface type conduit boxes. Switches are single gang industrial type, and power plugs where used are of the same type.

Only one lighting circuit is required, the average number of points being 5. A 15 ampere splitter switch is mounted on the top of the meter board, with one circuit for lights and the other for the power plug. (See photograph No. 5.)

When the houses are let, 60 watt clear lamps are put in, but no shades are fitted.



No. 5. Latest Married Quarters (1956) showing industrial type socket outlet and separate metering.

The earthing is by means of a spike, connection to the water pipe and bonding to the system neutral at the meter board.

A frequent trouble met with, which is difficult to control, is that tenants buy electrical fittings and mount and connect these up themselves in ways which are unsatisfactory and even dangerous. Another danger is the persistent use of bell wire for "extensions" from lampholders. Plug-in type electric stoves are popular and many are in use, together with kettles and irons, but very few hotplates or radiators.

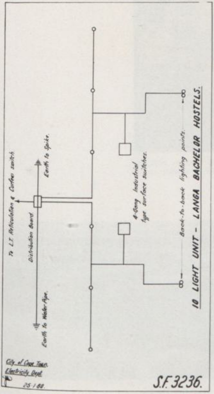
Bachelor Hostels (Single Storey Blocks)

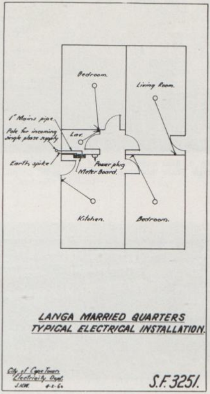
(Photographs Nos. 7 & 8.)

The electrical work on these began in 1954. The main blocks, 104 ft. long, are divided into two sections with a dividing wall. Each section consists of two 5-roomed hostels with 3 bedrooms, toilet and a common kitchen, across which a dividing wall can be built, if required, later. These are referred to as 10-light "units."

Each room has one lighting point, with a common switch point in the passage. As in the Married Quarters, all work is surface in screwed conduit. There are no power plugs provided. The installations were designed with great care, the main points being good quality materials and multiple earthing for safety, with easy erection and low overall cost.

With this in view, switch-drops in the rooms were omitted, a 4-gang 5 amp. industrial type switch being used. (See sketch





No. 6. Rear view of Married Quarters (1956) showing wooden pole and single phase incoming supply also earth to spike. This is similar to the Bachelor Quarters.

No. 7. General view of Bachelor Hostels.

No. S.F. 3236 and photograph No. 9.) The kitchen light has a single-way ironclad switch on the distribution board. (See photograph No. 10.)

Maintenance troubles are chiefly cracked and broken lampholders, especially the long shrouded type required in the toilets and showers. Switch troubles are avoided by the use of the industrial type as these, properly fixed, are practically indestructible.

The trouble encountered in the Married Quarters of tenants putting up lighting fittings of their own does not occur in the Bachelor Hostels. The Hostel tenants, however, have a bad habit of using an old lampholder as an adapter, with flex roughly twisted on, which is a highly dangerous arrangement.

All the Bachelor Hostels and the eight 4-storey blocks of Men's Quarters are supplied from a separate overhead network controlled by a main switch (called a "curfew" switch) operated by a watchman. The switching times are as under:

	On	Off
Summer	8.00 p.m.	6.00 p.m.
Winter	6.00 p.m.	8.00 a.m.

This is necessary as it has been found that the natives leave the switches in their rooms "on" all day, leading to great wastage of current and burning out of lamps.

The metering equipment (main kWH meter and 3 check meters) is located in the same brick cubicle as the curfew switch, as this forms a convenient point for bulk metering.

The rent for all the Bachelor Hostels is £1 per man per month, including water and electricity.

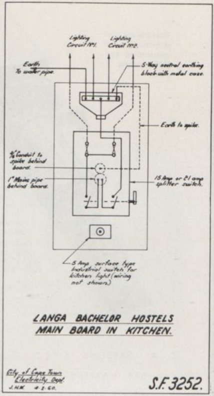
Shops

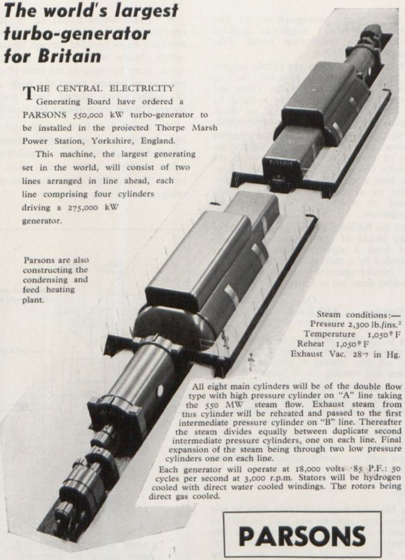
A block of shops and trade stalls in two back-to-back sections was built in 1958 to replace twelve earlier shops which were only galvanised iron shacks. Each section consists of 5 shops and 10 trade stalls. (See photograph No. 11.)

A common meter room is used, one for each section, and single phase energy is charged for under Rates 1 and 6. (Lighting & Power.)

A 3-phase 4-wire 0.0225 sq. in. plastic armoured cable is run from a special set of overhead mains (not fed through the curfew switch already referred to) to each meter room. Four bus-bars, in the form of cable, are run on battens round the walls about 18 inches above ground level, and the meters (30 per meter room) fed from these.

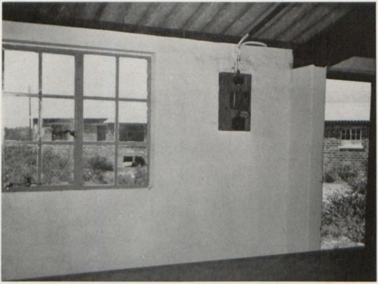
The installations in the shops and stalls are similar to those already described, except that each shop has a 10 gallon water heater supplying either a sink or a hand basin. The butcher's shops also have special refrigeration in their cool rooms.





No. 8. Bachelor Hostels showing the "diamond" formation of blocks. Kew Town Housing Scheme in distance.

No. 9. Bachelor Hostels. View in kitchen showing position of distribution board and 4-gang switch in passage.



No. 10. Bachelor Hostels. Kitchen, showing position of light switch and earth conduit to water pipe.

No. 11. New shops, 1958, showing centre block.

Notes on the High and Low Voltage Reticulation and Street Lighting Langa Native Township, Cape Town

Submitted by Electricity Department,
City of Cape Town.

The township of Langa was established about 1927, the development of somewhat more than half the total taking place in the first few years. Some 25 years later bachelor quarters were erected in the remainder of the township to complete the development of the area.

The electricity supply was originally taken by means of an 11kV overhead line to a single sub-station, but when the final expansion took place the overhead line was replaced by an underground cable spur from the nearest sub-station. In addition a second sub-station, Washington Street, was established to cater for the load in the bachelor quarters.

The feeder replacing the overhead line consists of approximately 600 yards 0.06 sq. in. 3-core 11kV. cable from Grenville Avenue Substation to Langa Substation. The feeder from the latter to Washington Street Substation is approximately 1,000 yards of 0.0225 sq. in. 3-core 11kV. cable.

The spur feeder from the ring main is protected at Grenville Avenue Substation by overload and earth fault inverse time delay relays, and the transformer at Washington Street Substation is protected on the 11kV. side by means of overload trip coils and an earth fault relay at Langa Substation.

The low tension feeders at both substations are protected by AC trip coils in the oil circuit breakers. The transformers at Langa Substation are protected by overload trip coils with time lag fuses and an earth fault relay.

The transformer capacity in the township is 1350 kVA, made up of two 300 kVA units at Langa Substation and one 750 kVA unit at Washington Street Substation. At Langa Substation the peak load is about 375 kVA while at Washington Street the peak reaches 600 kVA.

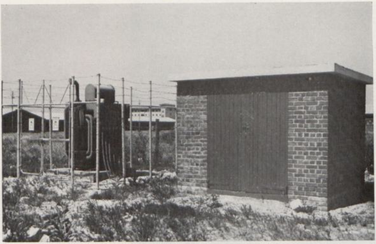
Consumers in the older section of the township fed from Langa Substation are individually metered, while the consumption in the bachelor quarters is metered in bulk. Consequently the substation at Washington Street consists of a transformer on a slab, and a brick kiosk to house the two low tension oil circuit breakers and the metering equipment. The high and low tension oil circuit breakers at Langa Substation are housed in a brick building of typical design, with the transformers on slabs outside the building.

The estimated cost of providing the above installations today is as follows: —

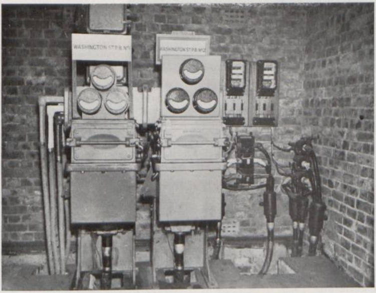
Langa Substation	
0.06 sq. in. 11kV feeder from Grenville Avenue Substation	£1,400
Substation Building	£1,800
Switchgear	£4,000
Transformers	£1,600
Washington Street Substation	
0.0225 sq. in. 11kV. feeder from Langa Substation	£2,000
Brick kiosk and wire enclosure	£500
Switchgear, metering equipment	£600
Transformer	£1,500
	£13,400

The low voltage reticulation consists of a 380 volt three-phase four-wire system using copper conductors with a cross-sectional area of 0.1 sq. in. for the main distribution and 0.05 and 0.025 sq. in. for branch lines. Three low voltage feeders emanate from Langa Substation and two from Washington Street Substation, and in addition there is a street lighting supply at each centre.

In the older portion of Langa Township the standard method of construction with 30



General view of Washington Street Substation, Langa Township.



Interior view of brick kiosk at Washington Street Substation showing L.T. switchgear with the bulk metering equipment on the right.

Typical construction used for overhead mains in older section of Langa Township.

foot steel poles and cross-arms was employed for the low tension mains, the pole spacing being approximately 35 yards. However, for the sake of economy in the area where the new bachelor quarters are situated, wooden poles have been used extensively, with the conductors mounted vertically on the poles instead of horizontally on cross-arms.

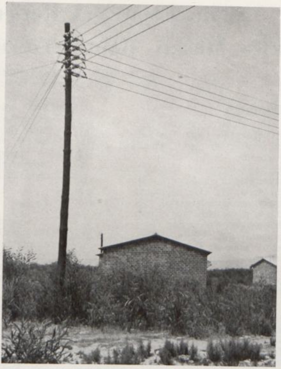
At present-day prices the average cost of erecting low voltage mains using wooden poles with copper conductors mounted on the poles shows a saving of 30-35% over the conventional method using steel poles and cross-arms. Of course, the main saving is in the price of the poles.

In main streets the spacing of street lights is approximately 60-70 yards, but elsewhere the distance between lamps is increased to approximately 100 yards. There are altogether 300 street lights in the township, all of them being 100 watt incandescent lamps.

It is estimated that the cost of providing the low voltage reticulation and street lighting in Langa Township at today's prices would be approximately £22,000 for the older part and £13,000 for the newer section. Of this amount about £3,000 would be spent in providing street lighting conductors and fittings.

THE PRESIDENT: Thank you Mr. Downie. Arising from the Cape Town contribution are there any further comments to make?

Clr. J. A. VAN WYK (Graaff-Reinet): Ons het volgens die referate wat hier gelewer is gesien dat daar verskillende skemas vir die meting van elektriesekrag wat voorsien is aan die Bantoedorpsgebiede. Aangesien al hierdie referate terug verwys na groot stede toe sal ek net graag wil weet of die persone wat hierdie referate gelewer het, ons kan



Typical construction used for overhead mains in newer section of Langa Township.

inligting gee in verband met kleinerdorpe wat ook wil ingaan vir elektrieseverspreiding skemas. Wat sal die beste wees, om byvoorbeeld in grootmaat te verkoop aan die Naturelle Departement en dat daardie departement die bedrae invorder, of dit sal die koste regverdig om b.v. meters in huise te sit sodat die Elektrisiteits Afdeling direk met die verbruikers kan handel.

THE PRESIDENT: Thank you.

Are there any further comenmts?

Gentlemen, we will proceed to the next, if there are no further comments on the Cape Town contribution.

If there are any comments that our Cable Making Affiliates would like to make in connection with the Bloemfontein contributions, I shall be pleased to have them now or they could be sent in writing and added to the final proceedings.

I shall now call on Mr. Hill from Durban to present this Contribution on the "Electric Reticulation of Kwa Mashu Township"; here again I must ask him to be as brief as possible with his introductory notes, so that there will be time for discussion.

Mr. D. R. HILL (Durban): Mr. President, gentlemen: First of all I would like to mention that the description which I am about to give on the electrical reticulation of Kwa Mashu is an abridged version of that contained in a booklet giving notice of this convention.

In this version I have attempted to exclude the technical aspects in favour of financial considerations which are at present, and for that matter, probably always will be, our greatest concern as far as Bantu townships are concerned.

The Electrical Reticulation of kwa Mashu Bantu Township, Durban

By D. R. Hill, B.Sc.(Eng.), A.M.I.E.E.
City of Durban, Electricity Department.

Introduction

The problem of devising an economic reticulation for Bantu Townships is one that is confronting most Municipal Supply Authorities in the country today. It is generally recognised that electricity in the home plays a considerable part in improving the social life of a community, and from experience already gained, it is evident that this is particularly true in respect of Bantu Townships. This aspect, however, is not primarily the concern of the engineer but at the same time, co-operation between all persons involved in directing activities relating to native communities is essential in order that the best results can be obtained from all available resources.

Several papers have now been written on the subject of reticulating Bantu Townships and these together with subsequent discussions appear to have covered the subject fairly thoroughly. I feel that these papers have all made a valuable contribution to the sources of information now available for the guidance of both present and future engineers engaged in this particular type of work and, although this paper probably contains little that is not already familiar to most of us, I hope that it will serve the purpose of again focussing attention on the problems involved and at the same time make available to those interested, the methods employed and experiences gained at kwaMashu.

At this stage, I would like to give a few statistical details in order to present a general picture of kwaMashu Bantu Township and the electrical work involved in reticulating the Township.

The Township which is situated 8 miles north of the centre of Durban, covers an area of 3,000 acres and will be divided into 10 neighbourhood units. Of these 10 neighbourhood units, 9 will be in the form of Bantu village units, for family housing and will contain approximately 11,000 dwellings whilst the remaining area will be developed on the cottage hostel system and provide for approximately 17,000 beds. The total ultimate population of the Township is estimated at approximately 100,000 persons.

Finance

In common with other similar schemes, the capital cost of the electrical reticulation at kwaMashu is being financed from Native Services Levy and Government Housing Funds subject to the approval of the Minister for Bantu Administration and Development.

The financial arrangements are as follows:—

1. Cost of access from existing City Mains to the Scheme to be financed as a grant from Native Services Levy Funds.
2. Cost of major distribution system to provide for eventual full reticulation of the scheme including domestic supplies, to be financed as a grant from Native Services Levy Funds.
3. Cost of street lighting in village units. A rudimentary form of street lighting with lights spaced 300 ft. apart in every second road to be financed as a grant from Native Services Levy Funds and the additional cost of supplementing the street lighting system to provide lights 150 ft. apart in all roads, to be financed from Government Housing Funds.
4. Cost of reticulation in Hostel Area. The low tension reticulation including street lighting and the internal wiring of the hostel buildings to be financed from Government Housing Funds.

Financial Implications of a Low Voltage Reticulation Throughout the Township

It will be noted that provision has not been made for financing the low voltage reticulation required for domestic supplies and possibly the internal wiring of the 11,000 houses in the Township.

The source from which the necessary capital can be made available and the determination of an economic tariff are two items presenting difficulties, and at the present time, these matters are still under consideration.

Under the existing policy of the Government, the Local Authority is expected to provide the additional capital required to reticulate the Township in order to make domestic supplies available in addition to the street lighting already being provided. The additional capital required for this work including the internal wiring of all houses, is estimated at approximately £600,000 to be spent over several years, and it is hoped that it will be possible to obtain some form of Government assitance in this respect and thereby ease the burden on the City's ratepayers.

It is felt that although there will be a large number of potential consumers in the Township, it is probable that for the first few years, a comparatively small number will be able to afford electricity. In view of this, it will be realised that to provide electricity to a relatively small number of consumers in an area as large as kwaMashu, a considerable amount of initial capital expenditure will be involved. Suggestions to reduce the initial high capital expenditure by establishing certain areas or zones in which domestic supplies would be made available have not met with favour for various reasons, from the Local Bantu Administration Department, and furthermore, the arrangement may possibly conflict with the terms of the Electricity Act.

The second problem, which is the determination of an economic tariff, also presents certain difficulties, as the tariff applied must be sufficiently attractive to encourage people to wire their homes and make use of electricity. From investigations already carried out, it appears that the anticipated revenue at kwaMashu, based on the Electricity Department's existing tariffs, will not be sufficient to cover generation and distribution costs. This problem has not yet been resolved and is the cause of considerable concern at the moment.

In order to indicate the revenue that can be expected from Bantu townships I have taken the liberty of analysing and presenting details of the average consumption of 1,200 consumers at Chesterville Bantu Township, Durban, in a manner similar to that presented in respect of Eastern Bantu Township, Johannesburg, in a paper read by Mr. Masson at last year's convention, as I feel that these statistics give a clear picture of the position.

The April, 1959 unit consumption figures have been taken and are analysed as follows:—

(a) 2% used between 5 and 10 units p.m.
(b) 15% „ „ 11 „ 20 „ „
(c) 17% „ „ 21 „ 30 „ „
(d) 14% „ „ 31 „ 40 „ „
(e) 12% „ „ 41 „ 50 „ „
(f) 8% „ „ 51 „ 60 „ „
(g) 18% „ „ 61 „ 100 „ „
(h) 9% „ „ 101 „ 200 „ „
(i) 5% used more than 200 units per month

For consumers classified above, the corresponding average revenue based on the Electricity Department's Tariff for private residences is as follows:—

	1955/1956 Tariff	1959/1960 Tariff
(a)	From 2/6 minimum	2/6 minimum
(b)	„ 2/7 to 5/-	2/7 to 5/-
(c)	„ 5/1 to 6/9	5/1 to 7/-
(d)	„ 6/10 to 7/4	7/1 to 7/8
(e)	„ 7/5 to 7/11	7/9 to 8/4
(f)	„ 8/- to 8/6	8/5 to 9/-
(g)	„ 8/7 to 10/10	9/1 to 11/8
(h)	„ 10/11 to 16/8	11/9 to 18/4
(i)	„ 16/9 & higher	18/5 & higher

An indication of the load growth in Chesterville, is given by the graph (Fig. 1) showing the average consumption per consumer over the 12 month period from August to July for the years 1955/1956 and 1958/59.

It would appear, therefore, that for a number of years some form of subsidy will be necessary to make up the deficit between revenue and expenditure if existing tariffs

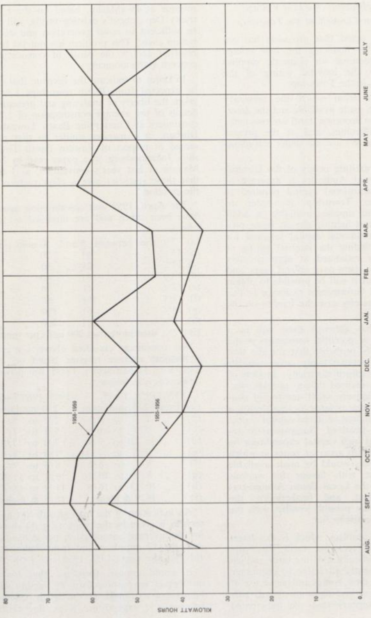


FIG. 1. AVERAGE MONTHLY CONSUMPTION PER CONSUMER
CHESTERVILLE. DURBAN.

Fig. 1.

are to be applied to the Township. This subsidy would presumably be provided by the Bantu Administration Department, on a basis to be mutually agreed upon with the Electricity Department. A possible arrangement would be the segregation of operating and maintenance costs for the Township Reticulation from the rest of the Area of Supply, in order to arrive at the annual amount required in the form of a subsidy. It is considered that all work in connection with the supply of electricity in the Township should be carried out by the Electricity Department and not become an additional function of the Bantu Administration Department.

Future Load Growth

In 1959, the after diversity consumer demands in Chesterville and Lamontville Bantu Townships, Durban, were 270 and 500 watts respectively and it appears resonable to plan an initial system on an after diversity demand of .5 K.W. per consumer. At kwaMashu, this would give a maximum demand of 3.3 K.W. per acre. This demand is due mainly to a lighting load and it is felt that it could be increased considerably if we adopt an active policy of educating these people in the uses and advantages of electricity. In this respect, a small utility electric stove selling at about £4 has already been designed and manufactured in this country and it is felt that eventually, as wages increase and living standards improve, further appliances such as small refrigerator units, etc., will also become popular.

Reticulation Design

The following general principles were adopted when the initial plans for the reticulation were prepared.

1. The high voltage reticulation to be an underground system.
2. Transformer kiosks to consist of brick buildings to be erected by Bantu labour.
3. All street lighting mains to be overhead.
4. Low voltage reticulation to be overhead in the family housing areas.
5. In the Hostel Area, all hostel buildings to be supplied by means of an underground low voltage reticulation.
6. House services to be underground if economically justifiable.

A development programme over a period of 6½ years was drawn up initially for the construction of the Township and it is anticipated that this will be completed at the end of 1963 or early in 1964. For convenience, Unit Areas are being developed successively and at present roughly four Unit Areas have been completed.

The electrical reticulation is being carried out in step with the building programme, and in this respect, it has been found convenient to wait for final completion of roads before attempting to plant poles or lay underground cables. At present, as already mentioned, the electrification is being restricted to full electrification of the hostel area and street lighting only throughout the family housing areas. The work of reticulating the whole of kwaMashu as at present planned will entail the construction of a 33/6.6 K.V. stepdown substation, the laying of 15 miles of 11,000 volt 3 core .1 sq. in. cable, 20 miles of low voltage cable, building and equipping of 30 transformer/switching substations, planting 3,000 poles, erecting 80 miles of overhead street light mains and connecting 2,800 street light fittings, all at a total estimated cost of £260,000.

In designing the reticulation, the underlying principle of keeping costs to a minimum was borne in mind and this aspect is receiving continuous attention resulting in modifications to existing practices from time to time. This consideration has influenced the choice of conductor sizes for underground cables and overhead mains and the type of transformer buildings etc. It was considered essential to install an adequate basic 6,600 volt reticulation which could be extended at a later date, and so enable further transformer substations to be connected into the system as and when required. A master plan of the 6,600 volt system layout to suit the physical layout of the Township, was prepared and the schematic layout of this plan for various stages of development are shown in Fig. 2.

From this drawing, it will be noted that it was necessary to resort in one instance to a temporary 6,600 volt overhead main to

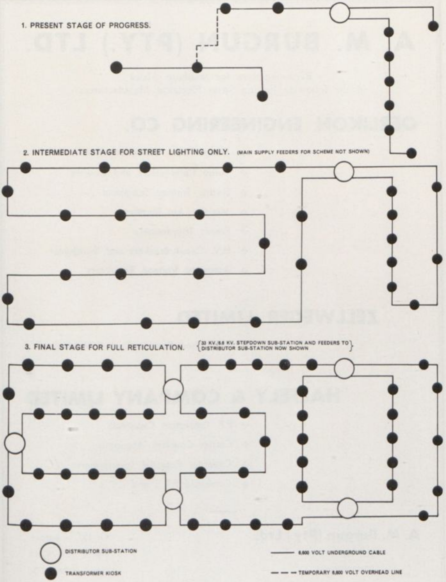


FIG. 2. SCHEMATIC LAYOUTS OF 6600 VOLT SYSTEM.

provide certain kiosks with a supply. This was necessary as the high voltage cable could not be laid along the planned route in an area which was still undeveloped.

Generally, conventional methods of electrical reticulation have been employed, but at the same time various ideas and arrangements have been introduced mainly with the idea of attempting to reduce costs. In this respect the following points may be of interest.

(a) *Underground Cables*

The high voltage reticulation will be at 6,600 volts but 11,000 volt cable is being installed in anticipation of a changeover to this voltage at a future date. Generally speaking the soil in the Township contains a high percentage of clay and a considerable amount of shale is also encountered. In an attempt to reduce the cost of trench digging, two mechanical trenching machines were tried out. The smaller of these two machines was capable of digging a trench 3 ft. deep by 12 inches wide in average soil at the rate of 40 ft. an hour at a cost of just over 6d. per ft. The larger machine was able to excavate a similar trench at the rate of 250 ft. an hour at approximately the same cost. This cost, however, was in excess of the cost of excavating with Bantu labour which was again resorted to. It is felt however, that should wages increase substantially, mechanical trenching will become economic and have to be reconsidered. It may be of interest to mention that the average cost of excavating, laying cable and back-filling the trench in the Township is 3/- a foot. This figure, of course, does not include cable costs.

(b) *Transformer Kiosks*

The transformer kiosks are utility brick buildings with corrugated asbestos roofs, the external dimensions of the kiosks being 14 ft. 6 ins. by 9 ft. 6 ins. and 10 ft. high (Fig.

Fig. 3.

3 Transformer Kiosk). The buildings are being constructed with Bantu labour under European supervision at a cost of £200 each. They provide adequate accommodation for a 300 K.V.A. transformer, a 3 way ring main panel and low voltage distribution boards for L.V. and street lighting supplies, the ring main panels being manufactured in the Department's workshops. The panels are fitted with three airbreak switches and the overall cost is considerably less than that of the more usual type of panel fitted with oil immersed links.

(c) *Low Voltage Reticulation*
Overhead Mains:

As already mentioned, street lighting throughout the Township is being supplied from single phase overhead mains. Up to the present, supplies of electricity have only been given to public and administrative buildings but as the intention is ultimately to reticulate the Township with a three phase, four wire overhead mains system, the layout of the street light mains has been planned with this object in view.

The usual difficulties experienced in laying out the overhead mains are familiar to all engaged in this type of work. The tendency to design townships with curved streets, splayed corners and irregular stand boundaries prevails with the usual resultant difficulties.

In the interests of economy, connection between two lines crossing at road intersections with splayed corners is being made by vertical mid-span jumpers and in isolated cases where this is not possible, an underground loop cable is used to connect the two lines together.

Creosoted wood poles with copper conductors are being used throughout. 30 ft. poles are generally used but where ground has been filled for road construction it has been necessary in certain cases, to plant poles at the foot of the bank and in order to maintain adequate ground clearance, 35 ft. poles have been employed.

(Fig. 4 is a photograph of a typical road in kwaMashu showing the type of overhead mains construction.

Service Connections

Domestic suplies of electricity have not yet been provided in the family housing areas. The type of service connection to be used is still under consideration although underground cable services are generally favoured, and are at present being provided to shops and various other public buildings.

In the Hostel Area, all hostel buildings are being supplied by a completely underground low voltage reticulation system. In desgning this reticulation, it was necessary to make certain assumptions regarding electrical load and diversity. The Hostel Area consists of 32 and 16 bed bungalow type buildings. 300 K.V.A. transformers in brick kiosks have been strategically placed, each to supply buildings containing approximately 3,000 beds. Five main .1 sq. in. L.V. feeder cables radiate from each kiosk. The feeders are graded, depending upon voltage conditions, along their length down to .06 sq. in., .04 sq. in. and .0225 sq. in. with single phase .0225 sq. in. service cable T-offs to the individual buildings. A system of

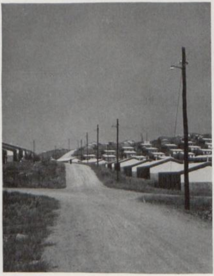


Fig. 4.

looping from one building to the next is being adopted where this will mean a saving in both labour and cable.

In order to facilitate looping, a special type cast iron distribution box has been designed (Fig. 5). The box, which is mounted outside the building, has two compartments. The upper compartment contains the normal distribution board for the building and is fitted with miniature circuit breakers. The lower compartment can be fitted with one or two cable entry glands as required, and the loop cable joint is made in this compartment. The box is completely weatherproof, being fitted with a sliding door which cannot be inadvertently left in the open position. Other adventages of the box are its rugged construction and non-rusting properties. The cable connections to the box shown in Fig. 5 had not been made at the time of taking the photograph.

Up to the present, paper insulated lead covered armoured cables have been used

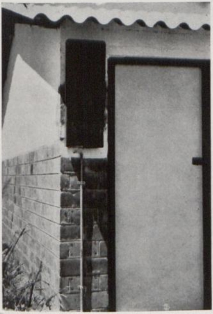


Fig. 5.

for the L.V. reticulation in the hostel area, but it is the intention to make use of plastic insulated cables to a greater or lesser extent depending on the economic aspect of their use. The new continuous current rating of plastic insulated cables has eliminated one disadvantage over the paper insulated cables. It is doubtful however, whether the use of plastic insulated cables in this particular type of reticulation will effect much in the way of a saving owing to the high cost of the gland fittings. This matter is being investigated and in any event, the saving in actual labour with plastic cables may be a deciding factor in their favour.

A further saving in cable costs could possibly be effected by adopting a multiple earthing system using the outer sheath and armouring as the fourth core in a concentric cable.

(d) *Street Lighting*

A simple type of cast iron street light bracket fitted with a plastic or fibre glass reflector and complete with all other fittings at a total cost of £2 5s. each is being installed throughout the Township (Fig. 6). The brackets are fitted with a 75 watt incandescent lamp and mounted at a height of 20 ft. above road level. It has not been found necessary to provide wire guards over lamps to protect them from stone throwing and from experience it has been found that this type of damage only occurs in non-built up areas.

Other types of street lighting such as fluorescent, sodium or mercury vapour are not considered suitable, mainly from a cost point of view but it is possible that one of these more effective types of lighting will be employed in the main roads at a later date.

Street lighting in the Township is controlled by Solar Dial type electric spring-operated time switches installed in the main substations. A contactor is energised by the time switch which in turn energises the street light circuits. Several circuits, each protected with a miniature circuit breaker, radiate out from each supply point. A cascade system is used to energise the contactors at each transformer kiosk, all control equipment being installed in the substations or kiosks.

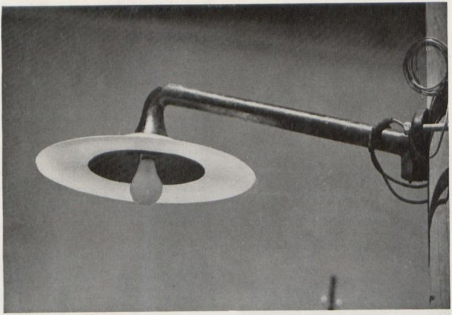


Fig. 6.

(e) *Internal Wiring of Residential Building*

The type of wiring suitable for residences in Bantu Townships is generally dictated by the conditions encountered and the necessity to keep costs as low as possible. For example, with open ceilings, cleat wiring is not considered advisable owing to possible interference by the occupants. Black conduit is also considered to be unsuitable due to corrosion caused by limewashed walls. Pre-fabricated wiring harnesses have been tried out but subsequent maintenance difficulties have tended to preclude the use of this method. As a result of past experience, therefore, the policy of wiring in galvanised conduit has been adopted. It is also felt that wood mounting blocks should not be used as these are likely to harbour vermin, and deteriorate rapidly with rough treatment.

The layout of the wiring installation and the number of points provided, will of course, affect the cost. In this respect, it is considered essential to provide suitable socket outlets, otherwise the use of multiway adaptors and makeshift connections to lampholders increases subsequent maintenance costs, and in any event, if the Bantu is to be encouraged to use electrical appliances, the proper facilities must be provided. The practice of fitting miniature circuit breakers on distribution boards has been generally adopted as these have the advantage of limiting circuit loading and preventing the insertion of fencing wire and hairpins as "fuses."

At Chesterville in 1955, 1,265 houses were wired using galvanised screwed conduit at a cost of £23 per house, this being a contract price. Each house consisted of 2 bedrooms, a kitchen and diningroom with one light per room and two socket outlets. At kwaMashu, a bungalow type hostel building with 16 living rooms providing accommodation for 32 single persons and complete with ablution and laundry facilities, is at present being wired under contract at an average cost of £110 per building. The wiring is being carried out in galvanised screwed conduit and 21 lighting points and 8 socket outlets are being provided per building.

Conclusion

The problems, both financial and technical, that are being encountered in providing electricity supplies at kwaMashu are common to all Electricity Supply Authorities and although there are several approaches to these matters, it is hoped that this paper will serve a useful purpose in making available a general picture of the position at kwaMashu.

The actual methods of reticulation are generally speaking, conventional, but again it is hoped that the descriptions of this aspect of the electrification have proved of interest to those persons connected with this type of work.

In conclusion I would like to express my thanks to the City Electrical Engineer, Durban, for having been given the opportunity of presenting this paper to the Association, and also my thanks to my colleagues in the Durban Electricity Department for their assistance in its preparation.

THE PRESIDENT: Are there any questions arising?

Mr. F. STEVENS (Ladysmith): Mr. President, just one little point: I note they have put corrugated asbestos roofs on the substations. I was wondering whether that is wise in locations where, should there be any sabotage, these would be so easily damaged by throwing rocks on the roof.

THE PRESIDENT: Any further questions?

Mr. F. O. PIERCE, ESCOM (Durban): Mr. President, I should like to ask Mr. Hill two questions in connection with the estimates for cable laying. Do the estimates provide for the laying of slabs above the cables and if so what type of slabs?

Secondly, is the estimate of 3/- a foot for the trench 3ft deep — is that the normal depth of laying of low voltage cables in the township?

Mr. W. H. MILTON, ESCOM (Johannesburg): Mr. President, I would like the author to expound on the very general statement that "from figures given it would appear therefore that for a number of years some form of subsidy will be necessary." There is no indication as to why the loss would be incurred. If the costs per dwelling supplied are comparable with those costs within the Durban area for European occupation, one would assume that the tariff supplies would also meet cost.

THE PRESIDENT: Than you Mr. Milton. Any further comments?

Mr. N. R. PRICE (Johannesburg): Mr. President, with regard to Mr. Pierce's enquiry re the cost of the excavating of the trench. Is the figure of 3/- a foot just cost or does it include also supervision and transport, and does he provide any bedding for the cables viz. sifted soil or sand or other means?

THE PRESIDENT: Any further contribution?

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, I don't know whether you will rule me out of order, but there was a question asked under the previous discussion, which was not replied to. May I reply on behalf of Mr. Downie?

Mnr. die President, die Verteenwoordiger van Graaff-Reinet het gevra waar daar op grootmaat aan die Naturellegebiede voorsien word of dit dan betaalbaar is, om 'n meter te installeer. Mnr. Downie antwoord dat in Kaapstad is dit die beleid om aan die Naturelle afdeling te voorsien teen 1d. per eenheid. Daar word blykbaar nie handelgedryf met elektrisiteit in die Naturellegebiede in Kaapstad nie, maar in hulle getroude kwartiere, is daar wel meters in die afsonderlike huise geïnstalleer wat 'n hele paar huise van daardie punt af meter. Mag ek net my eie stuiwertjie in die beurs gooi, deur te sê: ek dink my kollega Mnr. Downie is foutief deurdat hulle handel nie volgens die Wet op Naturellegebiede van 1945 nie waar die Elektrisiteitsondernemings van Plaaslike Besture verbied word om handel in Naturellegebiede te dryf. Volgens dié Wet moet Elektrisiteitsondernemings van Plaaslike

Besture elektrisiteit teen koste aan die Naturelle Administrasie voorsien. Nou wil ek vra dat daar vertoë gerig moet word aan die Uniale Naturelle Administrasie dat hierdie kwessie van koste beter gedeffineer en beter vasgepen moet word. Op Krugersdorp handel ons so; ons beskou koste wat dit ons per eenheid kos om daar te lewer. In ander woorde, dit sluit al ons koste in, dit sluit ons *meter koste* in; op die huidige oomblik is dit 'n rapsie oor .8d. per eenheid en daarom verkoop ons aan die Naturelle Departement van die Munisipaliteit teen omtrent .8d. per eenheid. Hulle verkoop dit teen ons gewone tariewe en hulle maak 'n profyt daaruit wat dan in die Naturelle Rekening gestort word. Maar ons is nog nie seker of ons interpretasie van koste korrek is nie. Ander moontlike koste is wat ons aan E.V.K. daarvoor betaal, wat heelwat goedkoper is. Ek dink die Naturelle Administrasie van die Unie moet beter verduidelik wat hulle verwag. As daardie wetgewing stiptelik uitgevoer moet word sal die koste van lewering van elektrisiteit beter gedeffineer moet word.

Dan wil ek ook graag aan mnr. Masson van Johannesburg vra wat was die ondervinding in verband met straatligte, word daar baie skade aan straatligte gerig — meer so as in blankegebiede? Ek dink ons is almal 'n bietjie skrikkerig om duur en goeie lig armature in lokasies te gebruik weens die moontlikheid van skade.

Dankie Mnr. die President.

THE PRESIDENT: Thank you Mr. van der Walt.

Mr. G. MASSON (Johannesburg): Mag ek dankie sê aan Mnr. van der Walt vir sy antwoord op Mnr. van Dyk se vraag oor tariewe. Ek wil graag byvoeg dat waar daar net 'n paar verbruikers in 'n Bantoedorp is, sal die Uniale Naturelle Administrasie waarskynlik geen beswaar maak teen die verkoop van elektrisiteit aan sulke verbruikers teen standaard tarief nie. Die owerhede wil sorg dat die Plaaslike bestuur nie 'n onredelike profyt uit die voorsiening van essensiële dienste aan naturelle maak nie. In gevalle waar 'n elektrisiteitsonderneming 'n aansienlike hoeveelheid krag direk aan Bantoeverbruikers verskaf teen standaard tarief, sal dit seker aanneemlik wees as 'n pro-rata deel van die onderneming se profyt in die Naturelle-Rekening gestort word.

In verband met skade aan straatverligting, ons ondervinding in Johannesburg is dat ons streke in die blankegebiede het net sowel as in die Naturellegebiede waar ons baie skade aan ons lampe ly.

Ek dink die antwoord is, om in daardie gebiede 'n skerm te gebruik om daardie skade te vermy. Ons het 'n skerm getoets vir fluoreerbuislampe, wat heeltemal goeie diens gegee het, en ons is van plan om hierdie skerms te gebruik in die gebiede waar baie skade gely word. Ons ly baie skade aan gloeilampe en fluoreerbuise maar die skade aan toebehore is gering.

Mr. D. G. SUTHERLAND (Scottish Cables Ltd., Pietermaritzburg): Mr. President I have no comments to make particularly on the last paper, but in view of your earlier request for a contribution from a representative of one of the cable manufacturers, I feel it would be discourteous if I did not say something before this discussion concludes.

I must apologise for my late response, but you caught me and no doubt my colleagues in the industry, rather on the wrong foot.

The problem is obviously to provide a supply to the various houses as cheaply as possible. This can be done either by uninsulated overhead supply, by insulated overhead supply, or by insulated underground supply.

Regarding an insulated overhead supply, the service from the low tension main into the house presents no difficulty. Already multi-core, two- three- four-core cables are bread and butter lines.

With regard to the low tension distribution mains, interest seems to lie in the direction of a multi-core thermoplastic insulated cable with some built-in suspender and support. There is no great technical problem involved, although it is not a particularly nice type of cable to make, but I would just like to throw out what seems to me a possible warning to engineers considering this type of cable. In this country with very high temperatures, particularly in the summer, I personally would be rather suspicious and rather afraid that there might be some softening of the compound and the possibility of the displacement of the supporting wire.

In one of the papers, Mr. President, reference was made to the possibility of aluminium conductors for such a cable. Now I appreciate that there is no space problem involved in an overhead cable of this type, but again I would like to remind engineers that the larger the conductor the greater the amount of thermoplastic compound that would be required, and in view of the relatively high proportion of the cost of the insulant, in a cable of this type, I very much question whether an aluminium conductor is really justified in preference to copper.

Coming to the question of insulated underground cables, there seems to be a prevailing idea that thermo-plastic insulated cables are going to be considerably cheaper than the traditional type of paper insulated lead covered and armoured cables.

Our opinion is that that is not so. While in the case of the smaller conductors, such as 0.04 and 0.06 there is a slight saving to be shown; when you get up to the larger conductors, particularly into the 37 strand conductors, it is quite the reverse, and a standard type of thermoplastic insulated armoured cable is likely to be anything up to 20% more than the corresponding paper insulated type.

As Mr. Emery said earlier in this discussion, it is quite possible that a solution may be found in the concentric neutral cable, but in this country at any rate, very little has been done to develop that type of cable, and I would not like to say any more on that subject at present.

Mr. President, might I suggest that since this is likely to be a matter of considerable interest to all the members of your Association, this is a subject which might very well be discussed by representatives of your Association with the Technical Sub-Committee of the Joint Consultative Commitee of the Electric Cable Makers of South Africa.

I would like to put that thought to you, as one thing that will not reduce the cost, is for each engineer, each undertaking to develop his own particular brand of special cable for this purpose, and to create a large number of unnecessary varieties.

THE PRESIDENT: Thank you Mr. Sutherland.

Gentlemen, I think we will move on to the next contribution, and Delegates can refer back at any time to any of the previous contributions, but first I must ask Mr. Hill to reply to the points raised by the previous speakers. We must then pass on to the next contribution.

Mr. D. HILL (Durban): Mr. President, gentlemen: The point raised by Mr. Stevens in connection with corrugated asbestos roofs, I agree entirely with Mr. Stevens, but as I tried to bring out from the paper, we have tried to do everything at the absolute minimum of cost. In Kwa Mashu all the roofs of all the family houses are asbestos, and we hope that the Natives there will stop throwing stones on our particular kiosk roofs.

Reply to Mr. Pierce — Durban.

The question in connection with cable laying: three feet is the minimum depth at which we lay cable and we do not normally lay concrete slabs over all cables.

Reply to Mr. Milton — Johannesburg.

I think that the low revenue that we can expect from Native consumers (in certain cases this is no more than 2/6 a month), will tend to make this reticulation scheme unpayable. I think someone earlier mentioned that meter reading could cost something up to 4/- per consumer.

Reply to Mr. Price — Johannensburg.

The cost of cable laying, 3/- per foot, is an overall cost and includes the cost of excavating the trench, laying one or more cables in the trench and back filling, with all transport and supervision included That is a figure that we have found from our experiences at Kwa Mashu, having recorded cable laying as a separate cost.

THE PRESIDENT: I will now call on Mr. Brown, Salisbury; will he please make his contribution as brief as possible to give more time for discussion. The remarks are

on Electrical Appliances for Communual Applications.

Mr. G. F. BROWNE (Salisbury): Mr. President, gentlemen: At the outset I would like to say how deeply I appreciate the privilege of being allowed to prepare a paper for publication in your Proceedings, and of being here today to attempt to answer any questions which may arise from it.

I will make no attempt to read this paper, but possibly just make a few remarks in further amplification and rounding off of the paper.

The main theme of the paper is that, so far as Salisbury is concerned at least, the African population at the present time cannot afford to use electricity in their homes on any great scale whatsoever. In my opinion, the proper procedure for the next few years is to encourage the use of electricity on a communal scale. We have gone quite a long way along this road in Salisbury already, although we admit that we are still learning, and we have a long way to go.

With regard to boiling tables I think it is not necessary to say very much at all. All of those members of this Association who came to Salisbury four years ago had action at our braaivleis and I am sure they can testify to the excellence of the hamburger steaks which we produced. It may be of interest to our hosts to know that the great majority of the boiling tables which we have in Salisbury were actually manufactured by a well-known Durban firm, and it will of course be of general interest to know that the heating elements were made by a firm in the Cape Province.

I would like to explain that in our kitchens for communal feeding the tables have no heat control switches and no local switches at all for use by the Africans who are cooking their food. We provide a small brick switchroom adjacent to the kitchen in which there is one switch fuse for each table. The Native administrators require to have a police boy in the building all the time and one of his duties is to select the number of tables which are required for use in accordance with the number of Africans who require to cook their food. We have found that the whole system works very economically. We don't have tables burning away all day without anybody using them. One point of interest may be that already in Salisbury we have 200 of these cooking tables each rated at 12 KW and I think you will agree that 2,400 KW of hotplates is quite a sizeable contribution to our load.

With regard to water heating, I am not going to wade through these different types of water heaters because essentially there is nothing novel about them whatsoever. To my mind the novelty is that it should have become necessary to provide hot water for Africans. Also in Salisbury we think that this type of load is going to be developed very considerably in the future.

You may have noticed in perusing the paper that, where we have used electrode water heaters controlled by thermostats and contactors, the safety thermostat or low water cutout which is provided is always used to trip a circuit breaker and not the contactor.

We have already justified this, because numbers of the contactors provided for us by manufacturers were not quite 100% and we did find that they had a tendency to stick-in. Consequently when the thermostat commanded them to open they stuck-in, the water started boiling, and the equipment was tripped by the safety thermostat operating on the circuit breaker.

The steam raising equipment we are installing has very few novel features; it is the standard type of equipment manufactured in the United Kingdom.

One thing which I think you should bear in mind, if you are going to install steam raising equipment, is that the losses on a steam boiler are constant regardless of the load. In other words, if you have a steam boiler which is 95% efficient, then that 5% of full load loss occurs whether the boiler is on full load or whether it is on low load. If you are going to put in a boiler which has to be steaming pretty well 24 hours a day, but not necessarily at anything like its full capacity, it will frequently pay you to sub-divide it and put in a number of small boilers instead of the one big boiler.

In that case you will make quite considerable savings in the losses which occur.

Regarding miscellaneous applications; there is nothing very new there. In Rhodesia we provide European beer and light wines for the Natives. Owing to advertising by the beer companies, the Natives have decided that they must have cold beer. They like their beer the same way as you and I like it, and we have had to put in refrigeration equipment in all the beer gardens.

One of the typical equipments that we are working on now is for a cold room which can store 40,000 bottles of beer. This is only one of a number cold rooms mind you. The condensing equipment has a heat transfer of 80,000 B.Th.U. per hour. In this particular building we did consider whether we should try and combine this refrigeration equipment with requirements for water heating in a heat pump application. We thought it would be quite feasible but it was very difficult to interest local suppliers of refrigeration equipment in it and also, as the building was going up pretty quickly, we decided that this time we would give it a miss. We hope in the future on some refrigeration equipment to get in a heat pump application.

In these beer gardens it has now become the practice to provide dance floors, which are very popular with the Natives. They consist of circular concrete slabs about 40 feet in diameter. We put six poles around them and festoon coloured lights from pole to pole, and cross them from one corner to the other. The poles are painted in various bright colours. When I saw the first one turned on, I thought the effect was truly remarkable, because within a few moments of the lights going on and the music starting, 20 or 30 Africans were jiving away on this platform and hundreds of them congregated around. They really love it.

For public address systems in Native townships, so far we have used expontential horn loudspeakers. In a new township now under construction we are considering whether we can use column type speakers which give an infinitely better reproduction. The horn type is quite all right for speech but it is very poor for music and we are experimenting to see if we can, at the same cost, do a job with column type speakers which will really have a high quality reproduction.

We are also considering whether it would be preferable to put in a radio rediffusion system instead, with a loudspeaker inside each house which of course would be under the control of the occupiers.

I would like to refer you just briefly to the last two paragraphs of my paper in which I have recommended that in future we should look towards providing communal kitchens for Africans who live in houses with their families, as distinct from those who live in hostels; and also that we should consider providing establishments where Africans can obtain hot baths.

I don't want to give you the wrong impression. This isn't something we are going to do tomorrow or even next year in Salisbury. These ideas have been put forward and I may say that our own Native administrators have come down quite strongly against them. They have brought out some very good reasons why they won't work. One thing they have said about communal kitchens is that you will find that Africans will be introducing poison into each other's meals and that they will be putting spells on each other with witchcraft. Also it has been said that no African will ever pay to have a bath.

I don't quite agree with those objections and I feel that the answer to this question will only be arrived at by an experiment being made. I hope that in due time the City Council in Salisbury will provide the money for an experiment so that we can find out what the answers to these problems are.

I would particularly point out to you of course that there are very sizeable batches of load which can be attracted if you go in for large-scale water heating.

Thank you Mr. President. (Applause).

Electrical Appliances for Communal Applications

By G. F. Browne, C.G.I.A., A.M.I.E.E.,
M.(S.A.)I.E.E., City of Salisbury,
Electricity Department.

1. INTRODUCTION

At the present stage in development of native communities, economic factors largely prevent the extensive use of electricity by individual families. In order to bring improvements in living standards associated with a full use of electricity to any substantial proportion of the native population it is essential that the concept of communal use of facilities should be accepted.

Some progress has been made towards providing suitable electrical appliances for communal needs although so far these have been applied only for use by unmarried native males housed in hostels.

The magnitude of the achievement to date may be gauged from the fact that 35,000 natives housed in 50 hostels and other communal buildings consume about 8 million kilowatt hours per annum. Possibilities for further load development in existing hostels alone amount to not less than another 20 million units per annum.

2. BOILING TABLES

Traditionally the staple diet of the native is mealie porridge varied with occasional meat and vegetable stews. The food is cooked over an open fire in a pot or saucepan. Roasting or baking in ovens is unknown.

This type of cooking can be provided for excellently by means of electric boiling tables. A boiling table consists of a sturdy structural steel framework supporting heavy cast-iron hotplates. The iron plates are heated by means of tubular, metal-clad, mineral insulated, air heating elements clamped underneath. No heat control switches are provided and the tables are switched on and off from a central point inaccessible to the users.

It is essential to provide hot water for starting porridge and for subsequent washing of utensils. The former reduces cooking time and increases hourly throughput, resulting in savings in capital cost of buildings and equipment and in running costs. The latter is desirable for hygienic reasons.

Operating results have been good, some tables having been in use for 6 years or more with negligible expenditure on maintenance. Cracking of hotplates is liable to occur due to repeated heat cycling but, owing to sturdy construction and the type of elements used, this has had no markedly detrimental effect. Cracked hotplates continue to give good service even after several years.

Experience in Salisbury indicates that approximately 10 square inches of hotplate surface area should be allowed for each native and that the hotplates should be rated at about 1.1/3 kW per square foot. Water heating equipment capable of supplying about 1⅓ pints of hot water per hour per native and rated at 0.05 kW per native is adequate. Energy requirements amount to approximately 0.73 kW hours per native per day, including that used for water heating, at a cost in Salisbury of 0.48 pence.

Up to the present time two hundred 12 kW cooking tables have been installed by the Salisbury Municipality.

3. WATER HEATING

3.1 *General*

Domestic thermal storage type water-heaters are unsuitable for large scale communal applications owing to low heat recovery rate and the large number of appliances required.

Centrally placed water-heaters with hot water pumped to all points of utilisation through a piping ring main have proved satisfactory.

Usually a water-heating system inherently has some storage capacity and this may be useful for dealing with peak requirements. Having regard to expected peak demand for hot water, and to the electricity tariff applicable, a balance must be achieved between kW rating and heat storage capacity. In line with Salisbury electricity tariffs, systems installed have small heat storage capacities and are capable of producing hot water at approximately the same rate as it is used. Capital costs are thereby kept to a minimum without any increase in running costs.

3.2 *Resistance element water-heaters*

Where soft water is available water-heaters employing resistance immersion elements can be used successfully and have least capital cost.

A typical example now being installed by the City of Salisbury is rated at 300 kW. It comprises a 600 gallon storage vessel from which hot water is pumped through a piping ring main covering four floors in two buildings. The system is designed for a continuous draw-off of 1,400 gallons of 130°F. water per hour for ablutions and laundry purposes. The water-heater is controlled by a thermostat and a single contractor. Safety features include an excess temperature thermostat and a low water level cut-out both arranged to trip a main circuit-breaker. Hot water will be supplied for 4 hours daily except at week-ends when it will be available for 12 hour periods. On this basis energy consumption is expected to be 1.7 kW hours per native per day at a cost of 1.1 pence.

3.3 *Electrode water-heaters*

Electrode water-heating systems are similar to the resistance element type except that heat is generated directly by passing current through water by means of immersed electrodes.

Generally the resistance of City water is too high to be used effectively without chemical dosing. Dosing consists of adding a small amount of washing soda or common salt, in Salisbury about 4½ ounces per 100 gallons is sufficient. Tannin may be added as a corrosion inhibitor.

Because of chemical dosing it is necessary to isolate the electrode water-heater from the building pipework.

A typical system consists of a hot water storage vessel connected to closed circuit piping traversing the building and feeding all the points at which hot water is utilised. The water in the vessel and piping is kept in constant circulation by means of a motor driven pump. Heat is generated in the electrode water-heater and is transferred to the water in the storage vessel by means of a heat exchanger through which hot water is circulated continuously. The heat exchanger may consist of a nest of copper pipes inside the storage vessel.

Three 110 kW electrode water-heaters and one rated at 65 kW have been installed by Salisbury Municipality.

4. STEAM RAISING

Where cooked food is supplied to large numbers of natives it can be cooked most conveniently in large steam heated pans. The advantages of steam raising by electricity for this purpose are as follows:—

(a) Rapid response of boilers to fluctuating steam demand.

(b) No boilerhouse is required. The boilers may be placed in the kitchen at considerable saving in building costs. Cost of steam piping and heat losses is kept to a minimum.

(c) Cleanliness in operation and no waste for disposal.

(d) Boilers are almost fully automatic and require a minimum of attendance and maintenance.

(e) Electrode steam boilers are inherently safe against damage due to low water level.

A steam generating system now under construction for the City of Salisbury comprises two identical electrode type steam boilers each rated at 380 volts, 600 kW with a combined output of 4,000 pounds of steam per hour. The boilers work into the same steam range and they can be used separately or together. Normal working gauge pressure is 30 lbs./sq. in., and all condensate is returned to the hotwell.

The boilers are fitted with automatic load controllers to ensure that steam production is adjusted continuously in accordance with varying requirements. Each controller consists of a pressure sensitive device which exercises control by starting and stopping boiler feed pump and also by operating a feed water bye-pass valve. The controllers work in conjunction so that one boiler only accepts load when steam requirements do not exeed its capacity. To satisfy large steam demands the boilers share the load. The boilers alternate automatically in the leading and trailing roles every 24 hours and they are subject to remote supervisory control for load shedding.

The kitchen in which this equipment is to be used will supply cooked meals to 4,000 natives and the installed capacity of steam raising equipment is 0.3 kW per native. Electricity consumption for steam raising is expected to be about 1.35 kW hours per native per day at a cost of 0.88 pence.

5. MISCELLANEOUS ELECTRICAL APPLIANCES AND APPLICATIONS

In Salisbury, as elsewhere, new uses for electricity in native areas arise almost daily.

An important innovation is the provision of hot water for ablutions and laundry purposes throughout a large hostel accommodating 1,000 natives. This is new today but it is foreseen that in the not too distant future this amenity will have to be provided in all hostels.

Manufacture of native beer utilises mixers, conveyors, centrifuges, pumps and refrigeration equipment, to all of which electricity is vital. Distribution of the product is facilitated by the use of compressors, pumps, agitators, and electronic beer dispensers. Now that light wines and European style beer are available to natives, no beer kiosk is complete without cold storage equipment.

Newest recreational amenities are outdoor dance floors each with a permanent installation of 500 coloured lamps, tape or record player, amplifier and loudspeakers.

Plenty of floodlighting is required at all social centres. Applications include novel floodlighting equipment for a portable boxing arena, and a naval searchlight mounted on a 40 foot high lattice tower is used for crowd control at a native sports stadium. As a matter of interest the searchlight was installed previously at the Kariba Dam.

A full scheme has been prepared for floodlighting a football pitch to English Football Association standards and this will be a first class amenity when it becomes reality.

All Municipal townships and hostels are covered by broadcasting networks. Outdoor exponential horn loudspeakers and 500 watt amplifiers are used in townships and three hostel complexes are served by 250 watt amplifiers. Hostel amplifiers can be used independently or in conjunction with township equipment. In emergency, overriding control permits all equipment to be operated, or put out of action, by remote control.

Administration and security requirements make it essential to provide a VHF radio communication system for the Native Administration in the near future.

6. CONCLUSION

So far the main large scale application of electricity in native areas has been for cooking and development has taken the easier path by providing facilities only for natives housed in hostels.

Experience gained to date must be considered as a preparation for the real task ahead, that of making the benefits conferred by a full use of electiricity available to all in native townships, particularly to families. The only approach which has any hope of economic success in the foreseeable future is to develop communal facilities to the greatest extent.

For example it is suggested that in new townships communal kitchens should be provided for neighbourhood groups of say 50 families. Townships could be laid out so that kitchens are reasonably convenient to all houses and, in fact, the kitchens should be made the focal point of the area. It should be surrounded by a fenced off open space containing shade trees, benches for the mothers and playground equipment for the children. It would provide a pleasant place for the women of the neighbourhood to meet, perhaps rivalling the attractions of the local beer garden and certainly having more beneficial results. Initially these kitchens could be equippel with boiling tables but development of suitable electric ovens is desirable.

One development which will have very far reaching social consequences is the establishment of communal bath houses in native townships, similar to those which have existed for many years in the cities of Europe. Here natives will be able to obtain hot baths with soap and towels, at moderate charges. This may be considered by some as far fetched and fanciful but I prefer to believe that it is inevitable progress.

Opportunities for influencing the pattern of development of native people for good exist in this work and it is perhaps particularly gratifying to those concerned with electricity supply that the possibility of very considerable load building is also present.

THE PRESIDENT: Thank you Mr. Browne.

Any matters arising out of that?

Mr. J. McNEIL (Stanger): Mr. President, this may not be the appropriate occasion to raise this particular matter. If so, then I ask the indulgence of the members.

I would like to know the feelings of the members regarding the implications contained in Clause 50 of the Electricity Act, wich reads as follows:

> "In any proceedings against an Undertaking arising out of damage or injury caused by an induction or electrolisis or otherwise by means of electricity generated or transmitted, by or escaping from the plant or the machinery of any Undertaker, it shall not be necessary for the Plaintiff to prove that damage or injury was caused by the negligence of the defendant, and damages may be recovered notwithstanding the absence of such proof."

In Stanger we have the usual public liability insurance cover, but I would like to know whether we have made adequate provision to meet all eventualities implicit in the concluding phrase of paragraph 1.

I am sorry to learn that our Honorary Legal Adviser is not here, otherwise he would have given us the benefit of his knowledge.

Mnr. H. A. DURR (Gesondheidsraad vir Buite-Stedelikegebiede): Mnr. van der Walt het gepraat oor die beskerming van straatligte. Ons het 'n baie berugte naturelle dorp naby Johannesburg, Alexandra Naturelledorp. Hy was berug maar hy is nou bietjie skoon gemaak. Ons het straatligte daar ingesit en baie van die straatligte met skerms en al is alreeds gebreek deur klipgooiery.

Dan wil ek graag die kabelvervaardigers vra of daar nie 'n goedkoop manier is om geleiers te insuleer nie. Ons het die moeilikheid van draad-gooiery. Elke aand is twee of drie strate se ligte uit orde weens hierdie soort vandalisme.

Met verwysing na Mnr. Browne se referaat oor opwasgeriewe in Salisbury. Ons Bantoe Administrasie is van plan om volgende jaar water te voorsien. Dit sal alles gratis verskaf vry opwas bakke en ook baddens met warm word aan die naturelle.

THE PRESIDENT: Thank you.

Mr. J. R. MITCHELL (Salisbury): It had not been my intention Mr. President to speak on this symposium, but I think it would be possibly discourteous of me if I did not rise to my feet to thank all the various contributors to this symposium as I happen to be the proposer of the original suggestion that such a symposium should be given.

What worries me about it is; where do we go from here?

It seems to me that we have now collected a good deal of information; we shall all get down to it and see what other people are doing, possibly write to them to see what results they are having, but I am going to suggest that either a committee or subcommittee, be set up to continue this information from Convention to Convention.

As I said at the last Convention this is going to be one of our biggest problems. I think it is going to come quicker in both our countries, than we expected even last year. The problems of supplying electricity to these Native urban areas cheaply (and obviously it must be cheap otherwise the subsidy is going to be high, because as far as the Federation is concerned, certainly the

Native wages are such that there must be a subsidy even if it is a gradually reducing subsidy) must be continually studied. So any idea that anybody has in any town or city in our two countries which can decrease the cost and increase the efficiency of giving electricity supply to Native urban areas should be made known to everybody.

There is one difficulty in the whole of this subject of Native urban area supply to the electrical engineer; I have said at many Conventions that the electrical engineer is a salesman. His job is to sell electricity; the more electricity he can sell, the higher the standard of living — the higher the standard of living, the greater the economy of the country. The higher the standard of living you can give to the African, the higher the economy of the country; and the more electricity you can put behind the elbow of the African the greater his production power; the greater his spending power . . . the more electricity he can use, and you come back to your own job of selling the greatest amount of electricity.

You are of course, as a municipal official, in that one great difficulty of trying to strike a judicious balance between selling more and more electricity to the African, if the Native Revenue Account on the other side has to pay for it, so consequently you must work one with the other. But I do feel that it is almost a vocation with us, that we must press on with electricity for the African — not only domestic electricity, not only in the nature of the apparatus, as Mr. Browne has so ably put forward to you, but also in the factory. We must press on and really go out into the field, and sell electricity to the industrialist—get staff, or go yourself into the various factories and say: now this can be mechanised; this can be done by electricity if you did this that and the other. Work out the cost for him. Show him that he could possibly have less African labour but a better paid African labour, and you'll increase the sales and accordingly increase the standard of living.

Therefore, Mr. President I would like to suggest that this subject be carried forward from year to year, and I ask the Executive to consider what form that could take.

Again, I would like to thank all the contributors to this subject and hope they will continue the good work in the future.

Thank you Mr. President.

Mr. A. R. SIBSON (Bulawayo): Mr. President, I would like to make a plea to our manufacturing community to bring back on to the market some useful types of thermal storage cooker.

Some years ago these types of cookers were produced and used overseas. Recently they have become of less interest to the ordinary consumr, but I suggest the use of thermal storage cookers will make a very big difference to the African use of electricity in the home.

I don't entirely agree with Mr. Browne's suggestion that all cooking should be concentrated in communal centres. I think that we shouldn't overlook the possibility of cooking in the home. At the present time, most African houses are provided with some form of cooking device, costing a certain sum of money. If we could have a reasonably cheap, low wattage, thermal storage cooker it would enable electricity to be used without adding materially to the cost of the house.

Mr. W. H. MILTON, ESCOM (Johannesburg): I have had experience of the particular section of the Act referred to by Mr. McNeil. Mr. McNeil did not read the second section, which states that in any such proceedings it shall be an offence if the damage or injury was due to the wilful act or the negligence of the person injured, *or of some person not in the employ of the defendant*, or of some person operating the plant or machinery of the defendant without his consent.

The point is simply this: normal accidents that you may encounter in these Native township reticulations will be due to negligence on the part of the injured. If you have complied with the standard regulations when dealing with your work you need have no fear of being held responsible for accident or injury.

The larger supply authorities are usually willing to "self-insure" themselves rather than place the insurance with an outside party, because claims seldom amount to what you would have to pay in premiums to an insurance company which has little experience of the possible magnitude of such claims over a long period of time.

The only outside insurance one need consider is that required during the actual construction of the work, and a number of authorities do take out separate insurance policies, so that, although the Electricity Act alters the usual procedure of the law, that is, to assume that the person is innocent until proved guilty, one need have no particular fear in the Union of the harshness of that procedure.

As an example, if because of a defect in your own system you cause the destruction of consumers' appliances, without having first warned him of the possibility, and that he is required to protect himself against such a liability, the supply authority is immediately liable. But in all normal circumstances of accident, you need have no fear — provided you have followed the law's requirements in relation to installation work.

Mr. J. L. McNEIL (Stanger): I did, indeed, read paragraph 2 of that regulation, but I was definitely more concerned with regard to the implication regarding injury. Damage to equipment cannot be very extensive, but it was more in the nature of injury to people who would not come under paragraph 2. In other words in the case of a pure accident. I feel that we have nothing quite in the nature of third party insurance to provide for this, because I feel that public liability will not cover that. I certainly welcome the assurances given by Mr. Milton.

THE PRESIDENT: Gentlemen, I would have liked to ask Mr. Masson to comment further on his paper, but as there seems to be very little time, I hope he will do that in writing, so that it can be included in the proceedings.

I would like to thank Mr. Mitchell for suggesting the continuing of this symposium and we most certaily will pass that on to the Executive for further discussions with the view to keeping this alive not necessarily in the form of symposiums, but we could keep the information already collected up to date for information of members of the A.M.E.U.

There will be an opportunity this afternoon, during question time, for any other members who wish to contribute to the discussions. Mr. Masson will have that opportunity as well.

I would like to thank the contributors very much for the efforts to which they have gone. I am sorry that in some cases we have had to cut down the time that has been available to them, but otherwise we could not possibly have got through, and there is still quite a lot of further information that could be produced by further discussion. In the event of making up some time this afternoon the opportunity for further discussion will be given.

(CONVENTION ANNOUNCEMENTS FOLLOWED)

THE PRESIDENT: We regret to announce that Mr. Burgers, our legal adviser, has had to resign due to pressure of work. This is most unfortunate but we have had no alternative but to accept. I would like this Convention to record a very sincere vote of thanks to him for the very able way he has carried on this honorary duty in the past, and we hope that the pressure of work will ease up in due course, and that he may be able to take up the position in the future. Will the Convention support that recommendation? (Applause).

In connection with the committees and sub-committees — last year's committees were re-elected without change in view of there being no changes on the council.

CONVENTION ADJOURNED FOR TEA.

On Resuming at 2.30 *p.m.*

THE PRESIDENT: Will you please be seated, gentlemen?

I am sure you will all be sorry to hear that Mr. Vergottini of Brakpan was taken to hospital this morning. He has had a coronary attack but I believe he is comfortable. He is in a sanatorium and if I get any more news this afternoon I'll let you know how he is getting on. Apparently he has not been feeling too well for the last few days.

Mr. Aspinall has brought with about 100 copies of a proposed scheme of technical training in mechanical and electrical engineering that has been produced by the Department of Arts and Sciences. It is set out in some detail and copies have been left at the Enquiry Counter. Will those members who are interested please take one.

Arising out of the Executive Meeting, your attention is drawn to the fact that a letter has been received from the Postmaster General drawing the attention of all municipal electricity authorities to the erection of electrical power lines and supply of electricity to respective consumers and in relation to the provisions of Section 88(1) of the Post Office Act which refers to the responsibility of obtaining permission from and notifying the Post Office of extensions and he has asked if this association will cooperate in drawing the attention of its members to the necessity of complying with the provisions of this Act.

We propose to issue a bulletin after the ending of this Convention.

It now gives me great pleasure to introduce to you Mr. J. T. Wood who has come from London to read us a paper on "Stage Lighting."

There are 60 slides which may be of interest on this subject and it is hoped that all delegates will be able to see them as it is not possible to darken this hall. (Applause).

Mr. J. T. WOOD (London): Mr. President and gentlemen:

Since arriving in Durban I have been asked by a great many people to deal specifically with certain departments of stage lighting which are especially applicable to the needs of this country, and in consequence I have made alterations to suit this position, and I propose to give you a survey, first of all, of the equipment which has been available in the post war years, and then after that is over, to deal specifically with the equipment which is suitable for small halls at a moderate price.

A Survey of the Control of Stage Lighting

By J. T. WOOD

Progress prior to 1939

As we know, theatrical performances have existed for many centuries, and in all countries commenced in the open air, relying on daylight to enable the audiences to see the actors. No doubt with the decrease in time available for leisure and also in certain countries due to the vagaries of the weather, the performances had to take place at night and indoors so it became necessary to use artificial light to replace daylight and in the early times the use of this light was merely functional in that it was used to provide light on the acting area.

At first also little scenery was employed, the actual atmosphere being indicated by the text and costume. Later when scenery as we know it today was added, this was painted in very great detail to give the effect required and the great spectacles which filled the theatres tended to be mechanical. Several examples still exist of this machinery, of which the Royal Theatre in Drottningholm, Sweden, has an outstanding equipment which enabled the scenery to be changed in view of the audience by means of an elaborate system of ropes, levers and pulleys. The actual scenery still exists and the clouds, waves, etc., were beautifully painted in perspective and, although the movement imparted to them was rather stilted, the marvels of the mechanical systems must have been as much heralded as the modern systems of projection etc. are today and the system of floating clouds and rolling waves as important a feature of the old theatres as are the electrical effects and flying machines for the Rhinemaidens in the modern Opera Houses. Equally the thunder machines, a sort of wooden skittle alley, down which cannon balls were rolled, to fall finally with a resounding crash into a reinforced receptacle, have long since given way to the tape recorder and loudspeaker.

Although the Drottningholm Theatre used oil for its lighting, it is interesting to note that thought had been given to the conrol of lighting and arrangements provided to swing the wing lighting off stage, thus providing a dimming effect when required.

The oil lighting in due course gave way to gas and although we find apologies for smell and heat in some of the early playbills of the Opera House, Covent Garden, this new illuminant allowed much more dramatic use to be made of light and complete central control was obtained of the lighting. Equally arrangements were provided for "plugging in" side floods in much the same way as we would plug in a flood today. It is also interesting to note that the firm of Clémançon in Paris, who are responsible for installations in L'Opéra, the Comédie Française and most French theatres, had started in business making Gas boards and that the French word for switchboard, "jeu d'orgue," derives from the organ-like construction of these gas controls.

The first fully electric installation recorded in England was made by Mr. Siemens, who was then in England, in the Savoy Theatre in 1881 for Richard D'Oyley Carte. This was replaced in the 20's by a more modern installation which is at the moment being renewed. We have no record of the details of this installation, but we know that the early installations consisted of footlights and battens and the high-lighting was obtained by arc lights replacing the old lime lights, Sir Herbert Tree's production of *Drake* using forty of these.

The first dimmer was, of course, the liquid dimmer and although the last complete installation of liquid dimmer pots was removed in London last year, there are still many examples to be found in operation in Italy and elsewhere. One of the first important installations of this type in London was that at the London Coliseum which was installed in 1904, but Siemens had constructed a multicontact resistance dimmer with a fairly good load ratio, which was installed in the London Opera House (later known as the Stoll Theatre in Kingsway) and many continental theatres. These wire dimmers, of course, did not give such good load variation as the pot dimmer, which by judicious adjustment of the quantity of salt could be made to handle almost any required load and can be best compared with the variac of today. Both the liquid and Siemens resistance were drawn from a central control by means of tracker wire suitably counterweighted and this method is still employed in its many variations to this day.

In England and America after the 1914/18 war the liquid dimmer with its tracker wire control was replaced by the dead front panel control using multicontact resistance dimmers and combining all switching and fusing in one unit. This naturally led to rather large controls and the pure mechanics of moving a quantity of these resistances by hand limited the number as also did the space available on stage. These limitations did not apply to such an extent on the continent as the mechanical inertia of the system was overcome by the counterweight and so very compact control boards could be constructed. In England development was rather obstructed by the retention of D.C. in many theatres and although between the wars A.C. was available, in the larger cities, especially those with tramways, there was a reluctance on the part of the supply companies to shed the D.C. load of the theatres, particularly in view of the amount of money they would have to pay out for replacement of specialised equipment.

On the continent, however, the Bordoni transformer made its appearance in 1929 and was adopted by Siemens, whilst a rival patented by Ing. Salerni of the Rome Opera was eagerly adopted by A.E.G.. Both types enabled one or more brushes to be moved along the winding of a transformer and the form of construction enabled a direct replacement to be provided for the older type resistance units.

In consequence the mechanical side of these controls was developed to a high degree of perfection and the later models had in effect a full scene preset. Each control lever possessed a three-position locking knob which either freed the lever from the master shaft or caused the lever to move downwards by means of a clockwise or upwards by anticlockwise turn. Each lever was provided with adjustable trips for each direction and by setting these limits and the knobs as required, one operation of the shafts all the levers moved to the desired position. The size of these controls was also reasonable as the levers could be accommodated at 1¾" spacings with 14" between the rows.

Parallel with these developments considerable progress was made in the production of tungsten projector lamps and, whereas in the days of Tree forty or fifty circuits might well have covered the control of the footlights, battens and floodlighting equipment, the forty arc lamps were being replaced by tungsten lamps all requiring dimmers. In consequence the need for more and more control circuits became apparent.

In England and America theatres rarely belong to those who present the plays and so the tendency in these countries was for the control equipment to be of a portable nature, but in the continental theatres the size of the controls increased, one hundred or more circuits being commonplace, whereas in America and England the number of theatres so equiped could be counted on the fingers of one hand.

The equipment manufacturers, however, were aware of the needs and two methods of approach were used to enable this object to be achieved by the provision of controls for over one hundred circuits which could be operated by one man. In 1934 the specification for the Royal Opera House, Covent Garden, called for one hundred and thirty-four circuits and apart from the consideration of space, the size of the existing manual controls made their use impracticable. The existing multicontact dimmers were unsuitable for tracker wire operation and this form of control had always been unpopular due to maintenance troubles if the cable run was at all complicated, and in this case an existing building did not help. The invention by Mansell of the electro-magnetic clutch provided the solution and the dimmer bank was placed in a remote position, but the shafts were driven by hand by means of a fast and slow capstan wheel mounted on the perch platform.

The coupling and uncoupling of the individual dimmers by means of the clutches was accomplished by means of a two-way and off switch, above which was mounted a voltmeter giving a reading showing the position of the dimmer. This installation is still in full working order, and, although due for replacement, is in use nightly.

From this the Light Console (Bentham 1935) was a logical conclusion and this design which harnessed the electric organ console to the control of lighting was a unique step forward in the search for a means of controlling large numbers of circuits from a small console. The hand driven shafts of the Covent Garden system were easily replaced by motor driven shafts and the coupling of each circuit to the action was effected by the "stopkeys," which possessed the advantage of group control from the normal keyboard preset piston, permitting prearranged groups to be brought into operation at will.

The keyboard or "notes" became the operational centre of the control and by pressing the appropriate key the groups of dimmers could be raised, lowered, turned on or blacked out with ease. Moreover, the duplication of many of the general controls for foot operation freed the hands for setting up future arrangements. The drawback to the system was the fact that it was designed for direct operation by a lighting specialist and did not cater for the repetition of exact dimmer settings, as required today. For music hall, ice show, revue and large spectacles, however, it is still without rival and many large installations, such as Drury Lane with two hundred and sixteen circuits, bear witness to its efficiency.

Whilst this progress was made in England, the Americans were pursuing another line of thought with the introduction of the all-electric remote controlled dimmer system at the Radio City Music Hall in 1933. The use of a saturable reactor for control current had been well established, but the heavy saturating current required had prohibited its use for stage purposes although a simple reactor system had been installed in the Metropolitan Opera House, New York. The advent of the thyraton provided the means of controlling the saturating current from small potentiometers and led to the design of a control board by the General Electric Co. of America in conjunction with Kliegl Bros. which was installed at the Radio City Music Hall. Similar installations were supplied to the City Center and through the B.T.H. Company to the Odeon, formerly the Alhambra in London. These installations are of great importance as they provide the first examples of the all-electric multi-preset board. That at Radio City has five full presets enabling five cues to be preset and the lighting to be changed from one preset to another at any desired speed. These five presets are in addition to a master or rehearsal board which enables the lighting to be set up in the usual manner. This installation, which was for three hundred and fourteen circuits consisted of a large reactor room in which the dimmers were housed together with the fuses and main switches, and a control desk situated behind the conductor in the auditorium. The operator faced the stage and the five preset panels were at his back. As many know, the Music Hall is open for some fifteen hours a day, giving five performances on the stage lasting approximately one hour each. A new show is presented monthly and has to be rehearsed and lit during the night. In consequence it is quite usual to find that these monthly shows are planned to use six major lighting changes to suit the limitations of the board. The installation suffers from the main defects of the saturable reactor in that a considerable time lag occurs between the action taken at the control desk and the resulting operation of the lighting.

From the foregoing, it is clear that by 1939 there was already a definite trend in the development of preset and remote control of stage lighting, dividing into two clear-cut paths the all-electric system of America and the electro-mechanical system, either by clutch or tracker wire, of Europe.

Post War Development

At this point we must again consider the lighting technique which was changing rapidly and which was to have a marked effect on the future. In Germany, where the large theatre, fully mechanised, was the order of the day, running expense has never been a problem and in consequence, although many lighting units were designed for cyclorama effects, the spotlighting had remained under the control of individual operators from bridges, galleries or front of house positions, which resulted in the need for fewer sources of light. In England and America, where wages were either too low to attract suitable labour or too high to be economical, the trend was towards the use of a large number of spots controlled from the board. The necessity for touring also helped this trend in that the lighting could be positioned on arrival and large numbers of technical personnel would not be necessary during the performance. In consequence, at the end of the war the demand was definitely existing for control boards with a larger number of circuits than ever before and the space required became another problem.

As always during wartime, many developments were hastened by the unlimited money available for research and so at the end there were many new tools available for the theatre.

The first change of importance came from Sweden, where the simple reactor was investigated and due to the availability of high quality steels an efficient magnetic amplifier was produced, which consisted of two stages with feedback and required only small currents for its control. Moreover a load variation of 30 to 1 was obtained and with more recent models 50 to 1 or more. The first installation of some thirty circuits was installed at the studio theatre in Malmo and in 1950 the National Theatre in Oslo was completed with over one hundred circuits, followed by the Folkteatret in the same city with one hundred and eighty circuits.

At the same time George Izenour at Yale University and the author in England were working on the idea of dropping the reactor used in the Radio City installation and operating the lighting directly by means of thyratons. The Izenour method used two tubes back to back, producing single phase A.C. and the first installation was at Yale University where he was working, and consisted of forty-four circuits with ten full presets. The author's system used a simple three phase rectifier system producing D.C. which had the advantage of spreading the load evenly over the phases at all times and was provided as standard with one scene preset. The first fully operational installation was at Reykjavik in early 1950, followed closely by those at the Old Vic, Stratford-upon-Avon and many others.

As these two systems are examples of important principles in the construction of remote controls, it is worth emphasizing the essential differences in layout, as this affects the whole consideration of the subject.

The Izenour system consists of two essential components, a rehearsal desk, which is in effect a normal stage board in miniature, and a preset panel containing ten small levers for each circuit on the rehearsal panel, four hundred and forty for a forty-four circuit board etc. The rehearsal desk has a master crossover fader with switching facilities to permit any one preset to be faded to any other. It should be noted that the term "fade" is used here as in sound technique and denotes the blending of one setting into another and not the passing through a blackout position.

The method of operation is to find the necessary light settings on the rehearsal board and then transfer these to one of the presets. Thus for each cue one preset is required and it is assumed that by providing ten it would be possible to reset if necessary in order to maintain continuity.

The author regarded the problem in another way. From observation of the operation of large manual boards it became clear that at times the facilities were not sufficient and so the object of the design was twofold, first to reduce the size of the desk so that one person could reach the number of dimmer levers with ease, and secondly to add to the facilities already existing by providing a second fully operational panel with a cross fader: thus the simpler cues could be carried out normally and, when necessary, the other panel be brought into use, as opposed to the preset to preset arrangement of Izenour.

Both systems have the inherent disadvantage that when cross-fading from one preset to another all those circuits which are to remain in the same position have to be set to the same position on every preset. Parallel with these developments, Mr. Bentham, who had in his light console retained the important feature of the old mechanical boards which enabled dimmers to be unlocked while retaining their status quo, introduced full dimmer presetting to the mechanical system. An extremely sensitive polarised relay enabled the clutches to be de-energised when the dimmer reached the position preset on the desk, so that full dimmer presetting was now possible using the well-tried resistance or transformer dimmer (1955).

Up till this period the German theatres had been re-equipped with the prewar systems already described, but the two large manufacturers were not idle and, as was to be expected, one (A.E.G.) produced a two tube Thyratron control and the other a magnetic amplifier, both with very interesting developments at the desk. It must be clear to all that, providing the design is adequate, there is no operational difference between the magnetic amplifier and the thyratron dimmer. In both of these solutions multi-presets were added. The former system provided two desks as in the author's design, but in addition each dimmer unit, which was removable; contained a neat arrangement of six mechanical presets operated by cams. Two of these were arranged to give full-up and zero, the remainer being available for presetting to any desired positions. In order to record the settings found at rehearsal it was only necessary to turn all the levers back to zero by means of a master wheel. The cam, however, only moved as far as the lever, so that on reversing the process the lever was returned to its original position. In operation, cue 1 was operated on the left-hand board and this was faded into cue 2 on the right. The blackout preset control then brought all levers on panel 1 to zero and preset 1 brought them back to the settings recorded. This board gave the same possibilities as the Izenour system from two sets of levers (two hundred in the case of a one hundred way control, instead of one thousand with the Izenour system).

The other system was developed as an exact replica of the original Bordoni type control, but with a miniature control desk having four or more motor-driven shafts, the adjustable limits and all the facilities of the old type. Instead, however, of the reversing gear used on the large system, use was made of magnetic clutches to attach the individual dimmers to the shaft. Under pressure of the competition of the eight preset system, an additional preset panel was introduced, incorporating the appropriate number of channels, each of which had a cleverly designed potentiometer unit with four concentric levers: these could be preset one at a time to the desired positions. In operation any preset could be coupled via polarised relays to the main panel, when the operational levers could be driven to their new positions by means of the motorized shafts. The system was operationally similar to the Bentham polarized relay system, except that there was no form of memory for the channel selection and therefore the locking and unlocking of groups of dimmers at random from two hundred to three hundred was not so easily accomplished and, as the clutches etc., were situated at the desk, this became larger.

Summary of equipment available today

At the beginning of 1959 there were available three main types of dimmers and two main types of control desks and we should now summarise the position.

Dimmers (1) Resistance and/or Transformers

These can be called old and trusted friends. The resistance is often much maligned as wasteful, but the following points should always be considered:—

(a) At the full-on and at the full-off positions the standing losses are nil.

(b) At the worst position the watts dissipated in the dimmers only amount to 37%.

(c) By using special winding techniques dimmers may be wound to cater for loads varying by plus or minus one-third, and thus are satisfactory for the majority of theatre uses.

Auto transformers are well known and, although there is always a small loss, are extremely efficient. The price, however, is high compared with the resistance.

(2) Direct Thyratron Dimmers

These are load independent and in either version have given good service. They lend themselves well to remote control circuitry but have given rise to difficulties due to ventilation problems, as the mercury thyratrons did not operate at the temperatures quoted by the makers: these have now been improved and can be called satisfactory provided adequate measures are taken to ensure even operational temperature.

The three tube version gives more kilowatts for a given tube size and a better phase balance, but has the drawback that the output is direct current. The two tube version gives sinusoidal output, but has a more complicated control system: both systems are prone to interfere with audio and video circuits in the building.

(3) Saturable Reactors and Magnetic Amplifiers

(a) The simple saturable reactor can best be compared with the resistance, as in the simple form it is not independent of the load. It does, however, permit small control desks to be constructed, but there is a drop of between 10 and 15 volts across the reactor in the full-on position, which may require compensation.

(b) The magnetic amplifier or transductor is load independent over a wide range, requires a small operating current and thus lends itself to preset control. It is, however, expensive and has a volt drop of between 30 and 50 volts, according to type, which necessitates compensation. Both these volt drops are those applying to the 220/250v range.

The magnetic amplifier had the advantage over the thyratron in that it was not subject to the same troubles due to ventilation, although some ventilation was necessary, but the prime cost was very high, due to the special grain orientated steels required to keep the size and weight to reasonable limits.

Types of Control Desk

These can be divided into two very distinct groups, the all-electric and the electro-mechanical.

1. The all-electric desk is distinguished by the fact that one desk is always completely occupied in maintaining the lighting in its present position. In consequence, in order to perform ten cues it is necessary to have ten presets: this, in turn, demands either a large amount of room or small components, which are difficult to adjust accurately.
2. The electro-mechanical desks are those which cause the dimmer to move when required, but the desk supply can then be interrupted and the desk rearranged without upsetting the existing lighting. It should be noted that of the two German systems, the A.E.G. falls into the first category and the Siemens into the second, as, although the dimmer is all-electric, there is an electro-mechanical link between the preset panels and the main or rehearsal desk.

The advantage of the electro-mechanical system is that when it is combined with group selection, as in the Bentham system, it is possible to work several cues without invoking a full change to another preset. As no dimmers move, unless they are coupled, if the change is small but awkward it is easily preset as only a few dimmers have to be changed. These can be altered on the same panel and will move when the coupler keys are operated. Hand control would probably be impossible due to the wide spacing of the levers concerned.

Future Progress

During 1959, however, two major develments have occurred which may well cause a revolution in future design. In America the S.C.R. dimmer has been introduced with success. The Silicon Controlled Rectifier is, in simple language, a solid state thyratron or large capacity transistor, and basically the dimmer can best be described as similar to the two tube thyratron dimmer. It has, however, very great advantages in that the weight is negligible compared with others, the voltage drop is of the order of 2, and the rectifier itself is so small that it has been described as "a cadmium plated bolt head." Unfortunately, at the moment the inverse voltage rating is the main difficulty and although rectifiers are available now in the 120v working range at a reasonable price, the 230v working types are difficult to obtain and costly. The American units available at the moment are constructed as a sealed plug-in unit and can be obtained in two sizes to control loads from 6 watts up to 4kw and 10kw respectively. From the point of view of the theatre, they can be considered as an all-electric dimmer replacing the thyratron or the magnetic amplifier. Prototypes of the 230v version have been constructed both in England and Germany, but, until the rectifiers are available at a competitive price, development is at a standstill.

The second development was the production in England by Leggett of a fully automatic system to be used in conjunction with the standard electro-mechanical transformer dimmer bank. Due to the large number of circuits being installed in single installations and also to difficulties occurring in the Television studios, where time for recording lighting plots is at a premium, a requirement had arisen for a means of automatic recording and reproducing of lighting plots.

A demonstration was given to television lighting engineers of such a board in March, 1959, the system working with standard Hollerith punching and reading machines. The system was always under the control of the operator, but when once a scene was set, the cue number, dimmer settings, switch positions and motor speeds could be recorded on the card.

When the card was placed in the reading machine, the settings were restored to the control desk, at the touch of a button, but, of course, the lighting did not change until the move was started by the operator. This meant that, if necessary, last minute changes could be made to the settings if the unexpected happened on the stage.

This automatic recording of plots did not evoke the enthusiasm expected, chiefly due to the drawback of the system, which did not permit the producer to stop and go back frequently, as is so often required at rehearsals. Great interest has, however, been shown in the large Opera Houses, where the repertory system requires a recording device.

There was an interesting by-product of this experiment, which may well be considered in the future. The designer, considering the possibility of two hundred to three hundred circuits, was of the opinion that the desk would be too large for easy operation. Moreover, in order to fit in with the punch system, the standard lever was replaced by a series of internally illuminated push buttons, like an adding machine. He argued that, instead of the operator turning to reach the two hundred levers, it would be better if the levers turned to suit the operator. Accordingly the desk was constructed with ten sets of pushes, representing ten levers, and extra pushes engraved 1-10, 11-20, etc. The difference in size between a desk for one hundred and a desk for two hundred circuits would then be only the space necessary for ten pushes.

This novel idea may still prove to be the interesting result of this experiment and provide the solution to the space problem in large installations, which is already becoming difficult.

Finally, the experience gained in working with the S.C.R. and Punch card system, has resulted in the development of a transistorised preamplifier for the simple reactor incorporating a certain amount of feedback. This permits preset operation whilst providing a load ratio of at least 4 to 1. Moreover, as one amplifier can operate two reactors in parallel, it is possible to improve this by using a 500 watt reactor in parallel, thus giving a range of nearly 20 to 1, which is more than adequate for theatrical purposes.

In conclusion, the author would like to thank the Joint Managing Directors of The Strand Electric and Engineering Co. Ltd., for affording the opportunity for the reading of this paper. In addition, he would like to thank those Theatre Managements and Engineers who have given him the opportunity of examining and operating the majority of the systems described.

THE PRESIDENT: Thank you very much, Mr. Wood.

We have had the pleasure of listening to a very interesting paper and I am sure there are a number of delegates who would like to ask some questions.

I shall start off with one or two; I notice that in all the slides you have shown us, the use of footlights appears to have been abandoned. I would like to hear your remarks on this aspect. And also your reference to battens, in that they seem to be used specifically for lighting backdrops.

Have these two particular items of lighting on stage been completely replaced by the small spotlights?

Mr. J. T. WOOD (London): Mr. President, the question of footlights is a very thorny one which comes up on every occasion. The answer is that in most theatres (with the exception of perhaps the opera houses) they are not using them. Whether or not they are provided is rather a question of finance, and another thing to be borne in mind is that if you have a footlight you have three circuits, three dimmers, which can very often ill be spared.

I feel that they need not be provided any more, and if they are provided they should at least be made portable so that they could also be used as backlighting, alternatively with the front position. The reason also against their use is that they can provide very awkward shadows, all of which means that you have to increase the top lighting in order to remove the shadows from the footnights, and the problem then becomes complicated in that the power demand goes up.

Any theatre or large hall which is expecting to receive ballet companies, in particular, should be provided with a full set of battens, because they have to use very often classical scenery of borders and wings, and of course every time you have a border and a wing you have to have a batten behind it. You can see by looking at this stage here that you have a large number of curtains going backwards, and behind each curtain you must have a batten because of the shadows thrown by the borders.

Now it is very much open to criticism as to whether, if those two black borders have been omitted, that is to say the second and the third, and their associated battens, whether any effect would have been lost. The argument is, "Well of course, the people in the front row will then see the ceiling," but does that really matter when you consider the cost of providing the borders and the battens in order that they shan't see the ceiling. And that is why, in the smaller halls, fewer and fewer people are installing them.

The reason that you have four battens here is because of the stage layout demanding those drapes.

THE PRESIDENT: Thank you Mr. Wood. Any further questions?

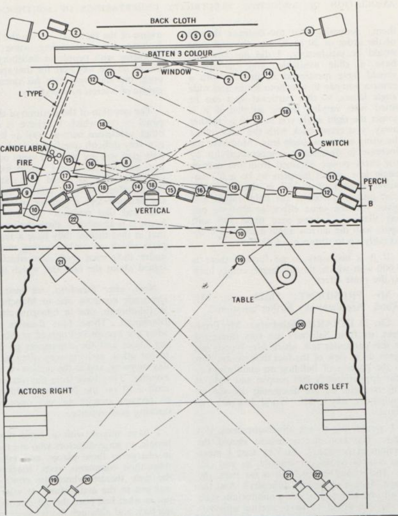
Mr. VAN DER WALT (Krugersdorp): Mr. President, to Mr. Wood, through you: I think most of us are confronted with the problem of having an old stage which must meet with modern requirements, and one big problem is the front of house spots.

You have given an idea, and shown the type of spot that can be mounted on a bracket on the side of the wall: could you indicate to us the maximum distance that you could put those spots from your stage?

Mr. WOOD: The first question which must come here is not that of maximum distance, but an angle to the stage, because taking this hall as an example, if you were to put your front of house spots either immediately under the first balcony or the second balcony (which would be a place for concealment), the angle would be such that they would be unusable because of the shadows that you would get.

You can see, sitting here as you are, that you are looking straight at the first circle, and so light coming from there will throw a large shadow on the back of the stage, and the angling of these spot lights is the first consideration, and the rough and ready guide is that the spot should form an angle of 300 with the stage; that is the angle between the horizontal and the stage should be thirty degrees.

Having ascertained that you'll find that you're very limited as to where you can put



Ref.	POSITION	PATTERN	COLOUR	Ref.	POSITION	PATTERN	COLOUR
1	Up Stage Right Sun Act 2	143	Double 52	11	Down Stage Left Perch Top	45	52 & 31
2	„ „ Right Sunset	123	35	12	„ „ „ „ Bottom	„	40 & 31
3	„ „ Left Sun Act 1	143	53	13	No. 1 Bar Spot	45	52 & 31
3	„ „ „ Moon Act 2 Sc. 1	143	40	14	„ „ „	„	52 & 31
4	„ „ Batten	"S" Type	17	15	„ „ „	„	52 & 31
5	„ „ „	„	18	16	„ „ „	„	52 & 31
6	„ „ „	„	32	17	„ „ „	„	52 & 31
7	Centre Right Archway Act 1	"L" Type	17 & 31	18	„ „ Floods	237	17 & 31
7	„ „ „ Act 2	„	52 & 31	19	F.O.H. Spots	23	52 Diff. Glass
8	Fire Flood	237	34 & 31	20	„ „	„	52 Diff. Glass
9	Down Stage Right Perch Top	45	52 & 31	21	„ „	„	52 Diff. Glass
10	„ „ Bottom (not used)	„	52 & 31	22	„ „	„	52 Diff. Glass

them. Assuming that the distance then is of the order of 20 or 30 feet, the unit zone would be satisfactory. I did not however, have a slide available, and perhaps I should have mentioned it, that as with a camera you can fit telephoto lenses and wide angle lenses, so that particuar spot can be fitted with varying lenses, so that if it is to get the right angle you have to go further away, you come back with the same effect by using a narrow angle lens. Moreover the increase in distance is compensated for by the extra power obtained from the narrow angle lens, which happens to be a 6" diameter instead of a 3½" in this particular case and so increases the light output and gives you the same effect, so that we can say that . . . I have seen these 500 watt spots with the narrow angle used quite comfortably up to distances of 45 feet.

If it is necessary to go further, there is 1,000 watt which, though larger, comes back to the same effect.

Mr. PRESIDENT: Thank you, Mr. Wood. Are there any further questions?

Clr. D. DIVARIS (Salisbury): Mr. President, we from Salisbury are very interested in this particular talk which Mr. Woods has given us in view of the fact that we are now in the process of building an auditorium to seat approximately 800 people, and right at this moment we are discussing the sort of equipment which Mr. Wood has told us about.

I would like to ask three questions, if I may. The first one is: where should the equipment be sited? And by that I mean the control panels, or console, as you call it. The second one is, if it is far from the stage, does it cause any difficulty? And the third one is if you have an auditorium such as we are going to have, seating approximately 800, it would appear that we would have to get quite an elaborate type of console, and if we got this particular type of console, would we have to employ a skilled operator? Could he be trained, and would he of necessity be a full-time person, or could we just train our Mr. Mitchell here to do the job after hours? (Laughter).

MR. J. T. WOOD (London): In the first place I am afraid that Clr. Divaris is not aware of the fact that, during the last week, I have been discussing some of these problems with people in Salisbury which I visited on the way here for that specific purpose, but the answer to his question is of course of interest to everybody.

The question of the position of the control panel is one which I believe is exercising other gentlemen here as well as himself. It is a very difficult question indeed, and I can only give you my personal views on the subject, and in this case I would like you to remember that, as I told you, showing you the Stratford-on-Avon control desk, I was the designer and originator of that control desk and that position. In that particular house it is absolutely ideal, the reason being that in that theatre they have a repertory of plays which we could say they manufacture under their own roof, and which are designed about the facilities which they have.

Now, after Stratford, we installed four electronic controls, one in Manchester, one in Edinburgh, one in Glasgow and one in Blackpool. Those four theatres comprise what are known in England as No. 1 Touring Dates and the companies go from one to the other, arriving very often on a Monday morning, and at the earliest on a Sunday evening. They have from the time of arrival until 7.30 on the Monday night in which to prepare everything and open with the opening performance.

I have talked with a large number of people, to stage directors who are the people in charge in these places, and asked them what their comments were. Blackpool was the only theatre where the control board was put in the auditorium. It was actually put in what had been the old cinema operating box, and although the engineer in Blackpool had demanded this position because he wished his electrician to be unmolested and clear of the stage, the users of the equipment, in the form of a travelling company, said in every case where I made enquiries that they did not like this system, because when they arrived at the theatre with 12 hours to put on a performance, they like the electrician to be in contact, actual contact with the stage director.

We know full well that talk back facilities can be easily provided but they are not very satisfactory in moments of stress, particularly where the stage is concerned, where a loud speaking telephone cannot be tolerated, from the noise angle, and there is no doubt that the stage management like to be able to talk to the operator and say, "In a few moments we're going to do this, or this will be the next cue," and get a personal contact.

On the other hand, as in the case of Stratford and the Old Vic, and as you saw, in Mannheim Theatre, Germany, the front of house position has been chosen and is working extremely satisfactorily.

I think, therefore, that you must discuss with the proposed users of your hall and get a certain concensus of opinion, but if it is to be travelling companies coming in at the last moment, my advice would be not to site the apparatus remote from the stage.

There are other devices. If the questioner would visit the Reps Theatre in Salisbury, they have put the control desk there on the stage. They have a little side room off tho stage from which there is a door into the front of the stage, which could have been admirably used for the purpose and which would give the operator a better view than he would possess on the stage, but would allow that amount of contact. As I understand the use of your hall is for a multipurpose, the front of house position, I feel is perhaps not altogether wise.

As far as the distance is concerned, the amount of distance which can be tolerated nowadays is really unimportant. I have myself seen controls used 8 or 900 yards away from the lighting, so that that should present no problem whatever. The cables involved are not expensive, and that should not cause any embarrassment.

The third question, regarding the type of labour required, I think that any manufacturer of equipment would be unwilling to supply apparatus which was unsuitable for the location. My own employers would not consider supplying an apparatus which they did not think could be maintained and operated by the personnel on site.

The operation of I think 90 circuits, can be quite simply accomplished and I don't think you need have any fears about that.

THE PRESIDENT: Thank you Mr. Wood. Are there any other contributors?

Mr. J. W. KANE (Johannesburg): Mr. Wood, I am rather disappointed that you were not a little bit more forthright, and said that Jimmy Mitchell could never be taught to operate anything of this nature!

Mr. Wood, one rather peculiar question I think, I believe it is the common practice on the Continent, where you have multiplicity of circuits, as I should imagine you have, on these control panels, to use the frame as a neutral. It is I think common practice in America. Can you tell me whether that is the trend in Britain nowadays?

Mr. J. T. WOOD (London): I'm afraid we are not allowed to use the frame as neutral. In fact we ourselves always provide an insulated neutral. In some countries, I think it's Finland, we have to provide facilities for earthing the neutral at the frame, but I didn't know that it was permitted anywhere else. I'm rather surprised to hear you say that it is.

Mr. R. W. KANE (Johannesburg): I am only assuming it is rather common on the Continent. Our Planetarium in Johannesburg has arrived in South Africa without any neutrals at all except the frame.

Mr. J. T. WOOD (London): I have never heard of that. I know the Germans have just constructed a big control for Cologne and there we had to keep them isolated. I believe that something funny goes on in Sweden. I'm not too certain about Sweden.

Switzerland is definitely very, very fussy and in fact we got into trouble there the other day because we supplied a board which had yellow wire in it and one of these internal connections, and they made us paint it green because they said it wasn't neutral. But in most countries, we did an installation in Poland, and there very definitely they were isolated, and that is all I can tell you about it.

Mr. R. W. KANE (Johannesburg): Thank you. It rather looks as if what is good enough in a country is totally different from what it sells to anybody else!

THE PRESIDENT: Gentlemen, we had better curtail the general discussion as time is getting on; I would now like to call on Mr. J. C. Downey to propose a vote of thanks to Mr. Wood for his paper.

Mr. J. C. DOWNEY (Springs): Mr. President, Mr. Wood, gentlemen: I should like to thank Mr. Wood for his interesting paper on the control of stage lighting. Good stage lighting planning is a job for a specialist, and it is indeed a rare occasion to have a specialist such as Mr. Wood presenting a paper to the A.M.E.U. on stage lighting, but the paper as published is a little disappointing, and does not answer the general problems with which the average municipal electrical engineer is faced in South Africa, and for this I would like to level a little criticism at at persons responsible for advising the author on the details of his subject matter. Much valuable and useful information that could have been included in his presentation has therefore been omitted, which would have been most valuable to all of us.

It is a pity I did not meet Mr. Wood at the last C.I.E. Convention in Brussels, as I would have surely placed these points before him.

The author has made a passing remark on the use of gas for stage lighting, and some information from one which actually worked at the Drury Lane Theatre, when gas was the only means of providing the lighting of the stage. I was informed that the heat caused by the multitude of gas jets was teriffic, especially up in the flies; and apart from the fire hazard, the incidents behind the stage were many. In one case an apparent explosion by a faulty gas line caused the persons working in the flies to vacate the theatre at the double, but on reaching the street they found that nobody had followed, then they returned to find that the act was proceeding quite normally.

Many amusing and embarrassing situations do arise backstage in amateur theatre, and the one operating the lighting effects is called upon to do all sorts of jobs as well. In dealing with a bomb scene, a blank cartridge from a gun was fired into an empty barrel to give the effects of a muffled explosion. The barrel provided by the local merchants was originally one which had contained oxide of lead. The operator emerged from the sound effects looking like a Red Indian as he was covered in red oxide.

In a town hall built a few years ago the control board was placed in such a position that it required three persons to operate the lighting, one which took the actors' cues, another to transfer the cues, and another for operating the board. No blackout switch had been provided, and when this was required the over enthusiasm of the operator pushed the levers over at such a rate that arms jumped the stops and caused a flashover, tripping the main circuit breaker supplying the town hall. Fortunately a flash of lightning outside from the storm at the time gave the audience the impression that the lightning had caused a blackout and had delayed the proceedings.

You will be interested to know that two of the operators are two of the municipal electrical engineers in this hall at the present moment, and should therefore be regarded as dangerous operators!

This shows what happens when the basic design and planning are not carried out by persons with the required experience in stage lighting. The bulkiness of control equipment has been a real problem in the past, and has always presented the problem in selecting the correct position so that the operator can see what is happening on the stage.

The new control methods described by the author are not only interesting, but fascinating, as the bulk of the control box is not only reduced but can be operated simply by one person.

In the new Civic Theatre recently completed in Springs the control box which is no larger than a small accordion is placed in the projection room, which enables the operator to have a full view of the stage, and in addition he is in full knowledge of what is happening from the stage by means of a small loudspeaker.

I understand that a new idea is to place the lighting effects operator in front of the stage, with a remote control box in the position where the conductor of the orchestra stands. This, I understand, would enable him to watch and see the full effects of his work, and to hear at the same time.

The author's views on this would be most welcome.

Theatre lighting is receiving more attention everyday, now that Civic Theatres are being erected in many centres. The smaller towns, must of necessity, use their town halls, not only for public functions such as bazaars, dances, bioscope shows, but also for school concerts and theatrical shows as well. It is the lighting of these stages that present a real problem to the local engineers, as money is usually extremely limited. It would, I am sure, be a great assistance if the author could explain the basic principles of stage lighting in a written reply.

We are indebted to the author for his enlightenment on the developments of stage lighting control equipment, which is obviously a job for a specialist in large theatres.

Mr. President and gentlemen, I have much pleasure in proposing a hearty vote of thanks to the author for his most interesting and informative paper. (Applause)

THE PRESIDENT: Thank you Mr. Downey.

I now ask Councillor Main of Johannesburg to second the vote of thanks.

Clr. R. H. MAIN (Johannesburg): Mr. President, gentlemen: I too would like to add a word of congratulation to Mr. Wood for the extremely interesting paper that he has presented here this afternoon; I think it was extremely well illustrated, and it certainly contains a tremendous amount of information on the question of how to handle and control the "lumin" required on a proscenium in modern days.

I have only one grouse at the type of questions being asked. We are all inclined to think of our little tupenny-hapenny stages that are being erected all over the Union of South Africa, and I think it is right and appropriate to acknowledge the fact here in our country of South Africa at this stage, that I think Mr. Wood's paper has been very timeous indeed.

I may be a little prejudiced in this matter, but right now Johannesburg is concerning itself, I may say, not at the request of the public, but in fact following on the demand of the public, particularly theatrical societies, who, in fact, have almost given an ultimatum to the City Council of Johannesburg, to provide them with an adequate theatre.

Mr. Wood, I can assure you that this presented us with very many problems, and I am sure that our technical staff too, were very pleased to know that the City Council of Johannesburg went to the trouble of in fact sending our consulting architect overseas to study these things, the design of prosendiums, the design of cycloramas, the study of illumination—although of course, I have my doubts as an engineer about the efficiency of an architect when it comes to matters of illumination. But that is by the way, Mr. President!

I think that this afternoon we have been treated to a very fine paper indeed, on the very many things that deserve the attention of design engineers when it comes to stage illumination, and I can assure you that in the Union of South Africa there is a definite upward trend in the demand for theatres, not only for opera, but the ordinary live theatre. We saw a performance last night, Mr. President. I had nothing to complain about the illumination—I thought it was very well done! But one has to bear in mind that, when you are dealing with human beings, whether in live theatre or anywhere else, you have the people who forget when they have really had their time, and in fact live in the theatrical world on borrowed time.

I mention this because one often has the occasion where you have the grand old lady with her knobbly knees, who still insists on appearing on the stage, and still thinks that she is the great lady of the day, and if anybody happens to comment about those knobbly knees she immediately turns round and blames the illumination engineer for having focussed attention on them!

Now that is just a little example of the tremendous importance that can in fact be attached to this question of illumination.

As an engineer, too, I was particularly interested in this silicone control rectifier, and the dimming arrangement, particularly as I think, in due course (I think Mr. Wood indicated it would be 1962), we would have a price. I do think that it will enable very many of the smaller local authorities, particularly in this country, to in fact invest in not only decently designed prosceniums but also adequate and proper illumination.

Mr. President, I do not wish to protract the seconding of my vote of thanks. I am sure that many others would still like to put a few questions to Mr. Wood, and it indeed gives me very much pleasure in seconding the vote of thanks to Mr. Wood for the very excellent paper he has delivered here this afternoon.

THE PRESIDENT: Thank you Clr. Main, for your very interesting and pleasant seconding of the vote of thanks.

I will ask Mr. Wood if there are any particular comments he would like to make in reply before we thank him formally.

Mr. J. T. WOOD (London): I must thank you very much for having allowed me this opportunity to appear today. I will try and deal with the proposer's request for some information on the general use of stage lighting. As far as the silicone control rectifier is concerned, I said we would get a price in 1962, but I'm afraid I musn't give Johannesburg too much encouragement in that respect. We shall just have to wait and see. Thank you very much.

THE PRESIDENT: Thank you, Mr. Wood, before asking the Convention to accord you the usual vote of thanks, I must endeavour to press you to change the form of your written paper to us today, in order to bring it more in line with what you have told us about. The paper that you actually gave us followed by the discussion which has taken place, should prove to be a very valuable paper, and of great assistance to many engineers in South Africa.

With those few words, I will thank you once again for a very interesting paper, and also thank you very much indeed for travelling such a long distance to read it to us.

Will you please accord Mr. Wood a vote of thanks in the usual manner. (Applause).

CONVENTION ADJOURNED AT 4.30 p.m.

ON RESUMING AT 8.15 p.m.

MEMBER'S FORUM

THE PRESIDENT: Good evening, ladies and gentlemen. Thank you very much for turning out this evening to this Forum. I'm sure you won't regret it. If Jimmy Mitchell is up to his usual form, I'm sure he'll keep this session running very nicely with little difficulty, and I don't think anybody will go to sleep either!

I think we will proceed with the Engineer's Forum. We have a very heavy programme to get through. I don't know how far we will take it tonight, but I'm sure he will do his best to get it through, and I'm not going to waste any time by talking, but will hand you over to our Quizmaster, Jimmy Mitchell, and wish you the best of luck. (Applause).

Mr. J. MITCHELL (Salisbury): Mr. President, ladies and gentlemen: Good evening, I hope you will forgive the opulence, but my friend Alec bought me this cigar just to give tone to the proceedings!

We have a big programme tonight, and you must not expect too much. If I may I'll sit down for this.

As I say you musn't expect too much because, like the story I heard about the Yorkshireman. Like all politicians, he promised them the earth, then off he went to Westminster and they didn't see him for about 18 months. Anyhow, he decided to come back and talk to them and tell them all what had happened, and then he said "Any questions?" and one Yorkshire farmer got up and said, "Ay! When we put 'ee in for Member of Parliament, tha told tha's goin' to do all sorts of things for us and nowt's happened yet." So the member thought he'd keep to agricultural language and he said, "Well, you farmers know you can't have things quickly. For instance, you buy a new bull and put it in with the cows, you don't expect to see

it full of calves the next morning." "Nay," said the farmer, "but we expect to see a few contented faces!" (Laughter).

Quizmaster: Mr. J. E. Mitchell (Salisbury)

Questions 4, 5 and 7 taken together:

QUESTION 4:

Why is a standard of delivered voltage to consumers laid down by the Electricity Control Board and no attempt made to enforce it? Is not there a need, as in assizing weights for a grocer or butcher, to see that suppliers of electricity deliver "full weight" electricity?

Should the undertaking be called upon to maintain a comprehensive set of voltage records?

QUESTION 5:

Does not the lack of any form of control of performance of distribution systems lead to a general lowering of standards?

QUESTION 7:

Will television require a higher standard of performance of the average distribution system in South Africa than exists?

Mr. W. H. MILTON (Johannesburg): Pointed out that the variations in voltage which are permitted in terms of the law applicable in the Union of South Africa are closely regulated, and a consumer could instigate proceedings against a supply authority in the event of voltage differing by more than that prescribed. However, it was possible to agree to lower standards with with a particular consumer.

As regards assizing, Mr. Milton felt that the costs of any system to achieve this would far outweigh its advantages to the consumer.

Generally, he held that complaints of bad voltage regulation were usually satisfactorily settled. But this might not be true in some of the smaller Municipalities where the costs of networks had been stepped down to make undertakings pay while tariffs were still reasonable. In such cases voltages were sometimes very bad. Mr. Milton emphasised that these supply authorities were subject to severe penalties as laid down by the Electricity Act.

Mr. Milton said he thought that control of performance of distribution systems would not affect standards. The problem was one for engineers and councils, and with a reasonable approach there should be no lowering of standards.

Mr. R. M. O. SIMPSON (Durban): Mentioned the relationships between Escom and Durban, but questioned whether voltage standards (plus or minus 5%) were as hard and fast as Mr. Milton suggested. He inferred that the regulations could not be enforced.

Mr. R. W. KANE (Johannesburg): Thought that voltage standards applied only to licensees or possibly, permit holders. He felt that regular voltage tests were rather unnecessary, but that periodic load tests would serve to indicate what was happening on a system.

Mr. Kane pointed out (regarding question No. 5) that control existed in the engineers and others. He suggested that the questioner was really looking for somebody to guide him in his problems, and standardise all installations regardless of costs and conditions.

Mr. W. H. MILTON, Escom (Johannesburg): Stressed that although many Municipal authorities were under the impression they were exempt from the provisions of the Electricity Act, this was not correct. Municipal authorities were regarded, in terms of the Act, as undertakers, and the regulations dealing with voltage and frequency therefore applied to them.

THE QUIZMASTER: Referred to the difficulties introduced by finance, and doubted whether an Electricity Control Board could enforce the Act or regulations when another Act precluded the provision of the funds necessary to improve the reticulation. If finance were available, an authority might have to choose between furnishing a statutory supply to one consumer, as against using the finance to connect new consumers.

As regards question No. 7, the Quizmaster said that investigations had established that most modern television sets incorporate voltage control, and would tolerate a voltage variation of plus or minus 10% without loss of picture standards. In older sets tolerable variation was about 6%. However, where consumers had apparatus such as water pumps with pressure operated 2 and 3 h.p. motors, considerable distortion could result if the voltage fluctuation exceeded the tolerances.

QUESTION 11:

Normally street lighting is installed by a Municipal authority to provide a measure of illumination which assists in ensuring the safety and protection of citizens who use the streets and sidewalks at night time.

From time to time requests are received to shade the street lamp fittings because the rays of light from the lamps interfere with the sleeping arrangements of the occupants of bedrooms, of houses, flats and hotels bordering the roadway.

Taking into account the function of street lighting, should a Municipality be compelled to shade street lamps at the request of a consumer?

Mr. R. M. O. SIMPSON (Durban): Stated that he felt street lighting should be shaded only when this could be done without loss of light to the road surface to the disadvantage of any other user.

He quoted a case where, following pressure, a very bright street light was shaded by a sheet of metal some three feet square. Every week about three inches was cut from the shade, until it had been removed altogether. Nobody groused!

Mr. W. H. MILTON, Escom (Johannesburg): Said that in his experience the majority of complaints were that street lights were out, and that the complainants objected to using their own lighting by which to retire to bed. He did agree that he also knew of complaints where street lights occasioned inconvenience, and he felt that some form of shielding of light from windows of adjacent property was justified in some circumstances. He said such shielding was not expensive, and could be achieved with little trouble to the supply authority.

Mr. R. W. KANE (Johannesburg): Agreed that normally it was not difficult to shade street lights. He inferred that should street lights be so arranged as to not illuminate a complainant's property, there would still be difficulties.

THE QUIZMASTER: Summed up by saying that the inconveniences caused by street lighting must sometimes be considered secondary to the main purpose of such lighting, and that the prerogative of shading must be left with the authority concerned.

QUESTION No. 6:

Is local authority ownership of an electricity undertaking a good thing for the country?

Mr. J. L. VAN DER WALT (Krugersdorp): Sketched the history of Municipal trading in South Africa, and emphasised that the trading services rendered by local authorities were generally monopolistic, characterised by distribution systems which it would be uneconomical to duplicate. To avoid exploitation of the public by private individuals, it was essential such services should be publicly owned. Furthermore, high investment and the lack of profit would restrict the services offered by a private undertaking.

Objections to Municipal enterprise were: inefficiency; bureaucracy; no risks, with the facility of losses being made up from the rate fund; and unfair competition, in that Municipal monopolies deprive individual private enterprise.

Arguments in favour of Municipal trading were: economies of scale and inter-relation of Municipal activities reduced costs; soundness of credit, and methods of financing of local authorities promoted the financing of schemes more cheaply. Subsidisation was possible from general rate funds to make services available to poorer sections of the community.

Therefore it would appear that Municipal trading due to its monopolistic character did not permit competition, gave no guarantee against rising prices or against inferior service.

But comparing a Municipal monopoly with a private monopoly, the Municipal monopoly had the following advantages. There was no profit incentive, and thus costs were reduced. And experience indicated prices did not rise arbituarily, and excellent service was rendered. Should profits result either the ratepayer benefits, or production methods are improved, and all benefit.

Mr. Van der Walt summarised, making it clear local authority ownership of an electricity undertaking was a good thing for the country provided: authorities were not tempted to raise charges merely to balance the budget; the undertaking was run on business lines; profits were a fair return to ratepayers on money invested; charges were competitive; and the monopolistic character was not abused.

THE QUIZMASTER: Invited discussion on the other aspect of the question as to whether it was a good thing to have a local authority or a national authority.

Mr. G. J. MULLER (Bloemfontein): Opined that the questioner had not considered how much less he would have in the affairs of the undertaking if the owner did not hunt for his vote.

Mr. W. H. MILTON, Escom (Johannesburg): Felt that the question as asked dealt with national interest and not individual interest, and he pointed out that considerable analysis would be necessary before constructive comment could be offered on the ownership by a specific local authority and its effect on the national economy. Thus, if a local authority increased cost to the community it represented, the damage (if any) was suffered solely by that community, and the nation as a whole was unaffected.

Mr. Milton thought that the criterion to be used as a basis of analysis was posed by the statement that it was in the national interest that electricity be made nationally available at a price as low as possible in the area of utilisation, with due regard to satisfactory service.

Under the Electricity Act, 1958, the Administrator of a province could call upon Escom to advise as to the best course for a local authority to pursue. The Administrator was not compelled to accept such advice. It was therefore possible for a local authority with the approval of the Administrator, to ignore the best interests of the ratepayers and consumers of that authority. But Mr. Milton thought that this position arose only because the Government felt it was in the national interest for Municipalities to have a free hand to deal with their own communities, subject to possible guidance from the Administrator concerned.

Mr. G. KALK (Brakpan): Questioned whether, in the case of a conurbation such as that of the Reef, in the interests of economy an electricity undertaking should not be constituted by representation from the adjacent towns.

THE QUIZMASTER: Mentioned that in the United Kingdom, in the interests of efficiency, joint electricity authorities had been formed. Possibly, however, ratepayers of one area might parochially prefer their individual undertaking.

Mr. W. H. MILTON, Escom (Johannesburg): Said that the South African Electricity Act did not provide for combination as had been suggested. However, it was possible under the Act for towns which individually could not comply with the legal requirements (particularly in regard to qualified staff and finance) to cede their rights to Escom, which, in approved cases, would undertage the reticulation of these areas. Escom was able to do so because of the economies of scale, so for instance, instead of each town requiring relatively highly-paid certificated personnel, Escom had the advantage of manning an inter-connected system.

Mr. A. R. SIBSON (Bulawayo): Pointed out that the arguments advanced for the elimination of local authority ownership of electricity could also be applied to the elimination of ownership of other services. He therefore examined the question from the aspect of whether local authority ownership was a good thing generally for a country.

Mr. Sibson mentioned the risks of concentrating the major resources in the hands of the central authority, and said that the larger undertaking the greater the danger of bureaucratic troubles. Certain services, such as railways, were best managed by the central authority. But services such as electricity, which were monopolistic only in relation to given areas, were best managed by more than one authority, so that there was healthy competition between areas.

Central authority management usually led to levelling out of prices. While there was probably no objection to this in the case of an institution such as the post office, where the cost of the service to a business was not significant, the effects on the country's economy of level prices for resources such as electricity could be serious.

Only if it were possible to level out economic factors such as climate and general productivity of the soil would it be possible to justify the levelling out of electricity prices. In the best interests of the country, full advantage should be taken of every geographical area's resources. This principle applied equally to electricity.

Clr. R. H. MAIN (Johannesburg): Believed generally that it was in the interests of a local community to control and own the electricity undertaking serving that community. Indeed, in matters such as town planning, it was in the interests of a better communal service to extend the idea of local authority control further than was now recognised.

But Mr. Main did appreciate that in certain matters broader aspects had to be considered. Thus the water conservation scheme in the Reef complex was far more than a local authority matter, and, similarly, it would be senseless and pointless to establish separate generating stations to serve individual needs. The community idea in such cases must stretch beyond local authority boundaries.

QUESTION No. 14:

Has any member experienced somewhat excessive vertical conduit runs and been concerned with the necessity for supporting the wiring therein? Are there any views on the maximum spacing of supports?

Mr. E. R. W. BOYCE (Durban): Pointed out that in cases of large buildings of over ten floors, unless some support was given to conductors, these conductors were in effect held by the grub screws in the distribution board on the final level, a most unsatisfactory arrangement.

One method of support was, at every fourth floor, or at every 40 feet, to bring the conduit into a metal housing, and to provide some form of non-deteriorating capping to secure the main.

A more modern method of wiring large buildings was to use a rising grade of mains. Metal housed busbar trunking was provided, with copper bars graded down as the higher levels were attained. The busbar to the trunking should be adequately supported on insulators, which should be accessible from floor to ceiling level for the entire run. Usually one distribution board position was used for every two floors, and the wiring was brought back to both floor levels, from the top floor down to the bottom floor up to this position. Isolation could also be provided at these positions.

Mr. Boyce thought the cost of the modern method was about the same as the older.

Questions Nos. 15 and 16 taken together.

QUESTION No. 15:

When three balanced circuits are fed, one from each phase of a three phase supply, what are members' views on a looped neutral being used? Are there any opinions on the type of precaution necessary to prevent breaking the neutral at a looping connection?

QUESTION No. 16:

The South African Wiring Regulations state that socket outlets shall be wired on subcircuits separate from subcircuits to fixed lighting points. The regulations of other countries are not so definite although one or two suggest separate socket outlet circuits to kitchens, laundries, etc. Are there any objections to permitting lighting, fixed heating and socket outlets on one circuit with a limiting protection for the circuit?

THE QUIZMASTER: Said, in regard to question No. 15, that when three balanced circuits were used at a particular point on an installation, no objections should be made to looping the neutral conductors. But if the loads on each phase were separate, looped conductors should not be used. Individual neutrals should be installed back to the distribution board.

In regard to question No. 16, the Quizmaster said that normally fuse ratings for lighting circuits should be unsuitable for circuit outlets other than five amp. type, which were to be used for lighting only. If 50 amp. outlets were used, additional fuses would be required, and this in fact would be a separate circuit.

Questions Nos. 21 to 27 inclusive, taken together:

QUESTION No. 21:

Trading undertakings owned by local authorities and so-called public utilities do not, in South Africa or Rhodesia, pay local or state taxation:

(a) What are the advantages or disadvantages to the economy; and

(b) Why do other countries levy taxation on public utilities or other publicly owned activities?

QUESTION No. 22:

Is the practice of repaying all loans on any annuity basis to the lender (say a building society) sounder than diversifying the economy by each local authority creating and administering its own sinking funds for the redemption of loans?

QUESTION No. 23:

What are the reasons for ensuring that electricity undertakings be publicly owned and secondly, that they enjoy cheap money?

QUESTION No. 24:

What is the basis for the cliche that electricity should be cheap when the average capital expenditure is £14 to earn £1 per annum gross income?

QUESTION No. 25:

Should public utilities make a greater contribution to the reservoir of capital in South Africa by being compelled to create reserve funds and to maintain contributions to them annually?

QUESTION No. 26:

What reward should the Municipality enjoy and receive from the trading undertaking for benefits received such as:

(a) Free working capital

(b) Free administration

(c) Cheap money

(d) Monopoly rights

(e) Collateral of the town.

QUESTION No. 27:

Should depreciation of plant and equipment be calculated upon the historical cost of the assets or their replaceable values?

Mr. A. R. SIBSON (Bulawayo): Question No. 21: Mr. Sibson felt that the question was incorrect: most trading authorities did pay local taxation, and particularly rates. As regards ordinary tax, in the case of his own undertaking, taking one year with another no profit would be made, and consequently no tax would be paid.

Question No. 22: Mr. Sibson said that both methods were sound and were used. Sinking funds were used for the purpose of financing other schemes.

Question No. 25: Mr. Sibson said that each undertaking had to make its own decisions as to the method of handling its affairs.

Question No. 26: As regards (a) and (b), Mr. Sibson doubted if free working capital and administration existed. (c) If cheap money was made available, there was probably justification for making a small charge for the facility. (d) It was not the trading undertaking, but the Municipality that held any monopoly rights. (e) The town's collateral was synonymous with "cheap money."

Question No. 27: Replacement value was the better basis for depreciation, but was difficult to forecast.

Mr. J. L. VAN DER WALT (Krugersdorp): Question No. 21: Inasmuchas local authorities did not pay taxes on their trading undertakings to the central government, the central government did not pay rates and taxes to the local authorities. He suggested that there was perhaps a case for the central government paying rates in respect of properties used for more than just local services, but, generally, it was best to let sleeping dogs lie.

Under the South Africa Act of 1909, local authorities were deemed to be part of the government, and it was unethical for one to levy taxes on the other. Therefore, local authorities should not in fact pay import duties.

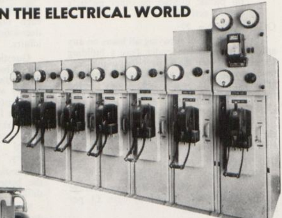
Question No. 23: Electricity undertakings were natural monopolies, and capital investment was large compared with returns. Protection of public interest was possible, and inter-relation of Municipal services and accounts made economies possible.

Electricity undertakings enjoyed cheap money because of the security of local authorities. Loans were repaid after a

JOHNSON AND PHILLIPS

MANUFACTURERS OF SWITCHGEAR AND TRANSFORMERS IN SOUTH AFRICA

A POWER IN THE ELECTRICAL WORLD



A typical 11 kV 150 M.V.A. Switchboard for Municipal duty, manufactured by Johnson and Phillips South Africa (Pty.), Ltd., at their Driehoek Works, Germiston.

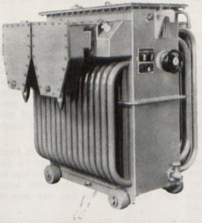


Illustration of a 200 kVA 6600/525 Volt 3 Phase Mining Type Transformer. Manufactured by Johnson & Phillips Transformers (Pty.), Ltd.

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P.O. Box 552 GERMISTON TELEPHONE 51-8651 TELEGRAMS: "SAJUNO" GERMISTON definite period, and the rate of interest was fixed.

Question No. 24: Electricity should be cheap, although investment was high, because of the absence of profit motive. Capital was available at low interest, and economies of scale reduced costs.

Question No. 25: Reserve funds were used by central and provincial governments to counteract recessions by instigating large schemes. Expansion of electricity undertakings was required during boom periods, and it was not always possible to defer expenditure to recessional periods.

Question No. 26: The reward a local authority should receive from the trading undertaking in respect of the factors specified was a fair return on the capital invested by the ratepayer, who created these factors. It was not correct to speak of a reward for monopoly rights, since a local authority traded under a monopoly to protect the interests of the community, and not to make a profit. The Municipality could not be rewarded for safe guarding its own interest.

TEA INTERVAL

Mr. J. BERRY (Affiliate, Vereeniging): Question No. 21: Mr. Berry pointed out that public utilities could be provided by "private" companies. However, on the assumption that in the context of the question government or statutory bodies were meant, he held that such authorities should pay all taxes, with the possible exception of income tax. With this exception, taxes generally were levied for services provided, and unless every form of economic activity paid for the services it received, confusion would result. Income tax was excluded by Mr. Berry as the interest on loans to public authorities were subject to such tax in the hands of the recipient.

Question No. 23: Mr. Berry said that certain activities for technical reasons were monopolies. Monopolies should not be in the hands of private companies, but should be operated by the state or statutory authorities.

A monopoly by its very nature could arrange its income to cover costs. Thus, when borrowing money, it could secure a lower rate than the ordinary risk capital of private enterprise. Mr. Berry emphasised that cheap money was enjoyed by Municipalities because they were monopolies, not because they were Municipalities.

Question No. 24: Mr. Berry suggested that, having regard to interest payments and depreciation of assets, if an investment of £14 was earning only £1 gross income, there was a shocking misuse of capital.

Question No. 25: Mr. Van der Walt had referred to "this age of managed money." Mr. Berry felt that managed money was of no use to mankind: it did not help those people who believed in freedom; it could only assist the drift into totalitarianism.

Question No. 26: Mr. Berry suggested that free working capital and free administration could not exist. Cheap money was available to a monopoly, because a monopoly had no difficulty in adjusting price to pay loan interest: the return was in fact guaranteed. Similarly, the collateral of a town in fact consisted of the town's monopoly rights.

Question No. 27: Mr. Berry said that depreciation should be considered in relation to all factors concerned, not just historical cost. In the case of a private company depreciation on either historic cost or replacement value was of little avail when a change of technique rendered the manufacturing plant useless.

Mr. Berry pressed for a convention devoted solely to economic matters because of the confusion of thought that existed on such matters. He gave as an example the use of the word "profit", and pointed out that in a capitalistic economy profits were the sole measures of efficiency.

FORUM ADJOURNED AT 10.45 p.m.

In order to minimize the cost of printing of the record of Members' Forum in the Proceedings the Executive Council resolved that it be précised. Duplicate copies of the full contributions to the Forum submitted by Messrs. J. L. van der Walt, W. F. Milton and J. R. Berry will be made available to Members of the Association on application to the Secretaries.

THIRD DAY

On resuming at 9.30 *a.m.*

THE PRESIDENT: Good morning, gentlemen. We will now proceed with the business of the Convention.

I have not yet had a report about Mr. Vergottini. But apparently, he is not quite as bad as expected. They did think when they took him away that he was suffering from a coronary but apparently it turned out to be bronchial trouble that affected him in a similar manner, so he will be able to return home on Saturday.

The first item on the Agenda this morning is the Annual Report of the Secretaries. These reports have been printed in the Agenda, you have all had the opportunity of reading them, and we do not propose to read through them at length. The Secretary is here, and is available for any questions arising. The Report is now open for discussion.

As there are no comments, I will call on Mr. Chris Downie of Cape Town to propose a vote of thanks.

Mr. C. DOWNIE (Cape Town): Mr. President, gentlemen:

I feel somewhat like a shareholder or a director of one of these big commercial enterprises, or industrial enterprises—not a monopoly—who is called upon to move the adoption of the Statement of Accounts and the Balance Sheet. The only thing—or the great difference of course, is that fact that the commercial or industrial enterprises I have referred to—their balance sheets run into many millions of pounds.

Our Balance Sheet and Statement of Accounts is just a matter of £5,731 and our working expenses £3,444. Extremely small figures, Mr. President, but when one considers what organisations we represent, I reckon that all of us, taken together, must represent one of the biggest enterprises in South Africa. Our total capital investment, I guess to be something like 150 million pounds. Our turnover I would say is something like 30 million pounds per annum, and although the statement of accounts here show that as far as the organisation of the A.M.E.U. are concerned, we are just very small fry. Actually we are a huge concern. There is nothing much in the Balance Sheet that calls for comment. The great thing is that we are able to make a profit, even though it is a small profit, and I would say that the position was very healthy as far as the A.M.E.U. is concerned.

The proposal of a vote of thanks for the Annual Report, Mr. President, gives one the opportunity to pay tribute to our secretaries, Davidson & Ewing (Pty.) Ltd., but especially to Mr. Dick Ewing, who so conscientiously and fervently carries out his duties on behalf of his firm.

I happen to know what Mr. Dick Ewing does, how extremely well he carries out his duties in his office on our behalf in Johannesburg, and I can say that we are extremely lucky in having a firm like Davidson & Ewing and particularly Mr. Ewing in performing this function on behalf of our Association.

I would like to mention also the name of one of his right-hand men, in his business, Miss Brewin. I happen to know what she does, too. On your behalf, Mr. President and gentlemen, I move the adoption of the Report and Accounts, and at the same time express our appreciation for the manner in which our Secretaries carry out the work for us. (Applause)

THE PRESIDENT: Thank you Mr. Downie. I now call on Mr. Blignaut to second the motion.

Mnr. P. G. C. BLIGNAUT (Pretoria): Mnr. die President, dit is vir my 'n plesier om hierdie aan te sluit by Mnr. Downie se voorstel. Ons het hier voor ons die Jaar verslag deur die Sekretarisse. Ek dink ons kan ook Mnr. Ewing en sy maatskappy baie hartlik bedank vir die manier waarop hulle het vir ons voorgedra het. As raadslede is ons gewoon daaraan om baiemaal baie lywige dokumente te moet deurworstel om 'n paar feite in die hande te kry. Hier het 'n mens met 'n oog opslag het jy alles wat jy nodig het om te sien wat die verigtinge was gedeurende die jaar, en ek dink lank-laas het ek gesien dat so baie in so min woorde gesê is.

Nogmaals wil ek my dan aansluit, en hierdie voorstel van Mnr Downie gesekondeer. Dankie.

THE PRESIDENT: I can fully support those sentiments. (Applause).

The Secretary's Report has been proposed and seconded. It is moved that it be adopted. Is that the wish of the meeting?

(Agreed)

Annual Report of the Secretaries

To the President and Members of the Association.

Mr. President, Gentlemen,

It gives me great pleasure to submit to to you the Annual Report of your Association together with the Revenue and Expenditure Account and Balance Sheet for the financial year ended 29th February, 1960.

Obituary:

I deeply regret having to formally record the passing of the following Members not previously mentioned in the Annual Report. They were referred to by the President at the 33rd Convention:

Mr. E. Poole originally of Durban was a foundation member of the Association and first acted as Secretary Treasurer in 1917. His association with the A.M.E.U. lasted for 15 years.

Mr. Coulthard, a former Member of the Association, also passed away prior to the 33rd Convention.

Thirty-third Convention:

The 33rd Convention of the Association was held in Johannesburg from Tuesday, 12th May, to Friday, 15th May, 1959. Delegates were welcomed to the Convention by His Worship the Acting Mayor of Johannesburg, Councillor A. Gorshel.

The Convention was formally opened by Mr. R. Gettliffe, President of the South African Institute of Electrical Engineers, and a record total of 570 members, delegates, representatives, officials, visitors and ladies attended.

On behalf of the President, Members of the Association and all others who attended the 33rd Convention held at the Cranbrooke Hotel, Johannesburg, it is my pleasure to place on record appreciation to His Worship the Mayor and City Councillors of Johannesburg for the hospitality extended to those attending the Convention as well as for the assistance rendered in connection therewith.

It is indeed a pleasure to have the opportunity of recording appreciation for the work of the President. In recording the proposal of Mr. Kane as President, Councillor Ross-Spencer referred to his outstanding ability to keep calm and unruffled irrespective of problems and irritations. It is this quality coupled with an inimitable sense of humour and an ever willingness to do a job of work that contributed so largely to the success of the Johannesburg Convention in 1959. To Mr. and Mrs. Kane I extend the sincere thanks of all.

The first paper presented at the Convention was "Nuclear Power" by Mr. A. E. Powell. This paper introducing as it did for the first time discussion at a Convention on a subject which will in the more or less distant future be one for ever increasing consideration and study by those responsible for the provision of electricity supplies was unanimously accepted as an outstanding

contribution to the Proceedings of the Association. The remaining papers were "The Supply of Electricity to Native Townships" by Mr. G. Masson and "The Development of a Method of Reticulation for the Johannesburg Township of Montgomery Park" by Mr. W. Barnard, B.Sc.(Eng.), A.M.I.E.E., A.M.(S.A.)I.E.E. Mr. Masson's paper, dealing as it did with an aspect of the development of Undertakings which is receiving particular attention at the present time, aroused a great deal of interest and as a result it was decided that the programme of the 34th Convention should include a symposium devoted to the further discussion of various aspects of Electricity Supply to Native Townships. Mr. Barnard's paper evoked much informative discussion on reticulation problems.

Members' Forum maintained its usual high standard and provided many members with an opportunity for discussion on a wide variety of problems.

The Convention unanimously accepted the invitation to hold the 34th Convention in Durban.

Membership:

The following new members were elected during the year ended 29th February, 1960:
Councillor Members:

Peri-Urban Areas Health Board.
Lydenburg Municipality.
Stilfontein Health Committee.
Orkney Health Committee.
Tarkastad Municipality.
Hermanus Municipality.
Stutterheim Municipality.
Kenhardt Municipality.

Engineer Members:

A Billington Eales (Stutterheim).
H. A. Durr (Peri-Urban Areas Health Board).
H. A. McIntyre (Assistant Electrical Engineer, Vereeniging).
R. K. Jooste (Oudtshoorn).
B. G. van Heerden (Heidelberg).
P. J. Botes (Assistant Electrical Engineer, Roodepoort).
G. R. Beard (Grahamstown).
E. de C. Pretorius (Assistant Electrical Engineer, Klerksdorp).
H. J. Koeslag (Riversdale).
H. Zausmer (Hermanus).

Associates:

M. J. Ross (Brandfort).
B. F. Carpenter (Middelburg, Tvl.).
J. H. Bester (Ventersdorp).
J. H. Jordaan (Vryburg).
G. T. van Wyk Schoombee (Lydenburg).
J. S. Lochner (Ladybrand).
C. P. Laas (Kenhardt).

Associate Members:

A. B. Cowen, Chairman and Chief Engineer, Southern Rhodesia Electricity Commission.
G. R. Peterson, Deputy Chief Executive, Federal Power Board of Rhodesia and Nyasaland.

Affiliate Members:

The Morgen Crucible Co. (S.A.) (Pty.) Ltd.
The English Electric Co. (C.A.) (Pvt.) Ltd.
N.V. Nederlandsche Kabelfabrieken, Ltd.
African Lamps (Pty.) Ltd.

	1958/59	1959/60
Councillor Members	112	120
Engineer Members	109	119
Honorary Members	13	12
Associate Members	31	30
Associates	1	9
Technical Associates	1	–
Affliates	87	90

Finance:

The Income and Expenditure Account for the year under review and the Balance Sheet as at the 29th February, 1960, which are submitted to you herewith do not, I feel, call for any particular comment. The excess of Income over Expenditure of £152 19s. 1d. is not unsatisfactory when it is considered that the Presidential chain has been written off, heavier than normal printing and stationery charges were incurred due in part to the printing of the Constitution, and a reduced profit was made on the Proceedings due principally to a reduction in advertising, resultant upon various amalgamations. It will be noted that the accumulated funds of the Association now total £4,744 17s. 2d.

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

BALANCE SHEET — 29th FEBRUARY, 1960

1959				1959		
4,592	ACCUMULATED FUNDS		4,744 17 2	1	PRESIDENTIAL BADGE Nominal Value	1 0 0
4,114	Balance at 28th February, 1959	4,591 18 1		46	FURNITURE AND FITTINGS—at cost less depreciation	55 0 0
478	*Add*: Excess of Income over Expenditure for the year ended 29th February, 1960	152 19 1		3,773	INVESTMENTS—Fixed Deposits at, and Savings Account with, Building Society including interest accrued	3,964 9 10
123	PROVISION FOR AGENTS' COMMISSION		88 10 6	448	DEBTORS	938 9 0
—	CREDITORS		898 9 0	20	PAYMENTS IN ADVANCE	20 0 0
				10	DEPOSIT—Davidson & Ewing (Proprietary) Limited	10 0 0
				417	CASH AT BANK	742 17 10
£4,715			£5,731 16 8	£4,715		£5,731 16 8

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

R. W. KANE,
President.

Report of the Auditors to the Members of the Association of Municipal Electricity Undertakings of Southern Africa.

We report that we have examined the Books, Accounts and Vouchers of the Association for the year ended 29th February, 1960; we have satisfied ourselves of the existence of the securities and have received all the information and explanations we have required. In our opinion the above Balance Sheet is properly drawn up so as to exhibit a true and fair view of the state of the affairs of the Association as at 29th February, 1960, according to the best of our information and explanations given to us and as shown by the books of the Association.

SAVORY & BRINK,
Chartered Accountants (S.A.)
Auditors.

Johannesburg, 8th March, 1960.

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 29th FEBRUARY, 1960

1959			
19	Audit Fee, 1959		18 18 0
—	Bad Debts—Sale of Proceedings		1 0 0
12	Bank Charges		11 14 6
1,413	Convention Expenses		1,446 4 1
5	Depreciation — Furniture and Fittings		6 5 6
324	Executive Council Expenses		295 13 7
191	Attendance at Half-yearly meetings	295 13 7	
133	Attendance at other meetings	—	
8	Insurance		17 8 9
43	Postages and Telegrams (general)		87 9 3
—	Presidential Chain written off		60 0 0
176	Printing and Stationery (general)		338 12 10
900	Secretarial Fees		900 0 0
15	Subscriptions Paid		15 0 0
3	Sundry Expenses		57 18 6
23	Telephone		34 18 6
478	Excess of Income over Expenditure Transferred to Accumulated Funds		152 19 1
£3,419			£3,444 2 7

1959		
168	Interest on Fixed Deposits and Savings Account	191 15 1
242	Proceedings—Schedule 1	102 17 6
1,290	Subscriptions—Affiliates	1,395 0 0
1,715	Subscriptions — Council and Other	1,753 15 0
4	Sundry Revenue	15 0
£3,419		£3,444 2 7

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

Schedule I

PROCEEDINGS:		
Advertising—Gross		958 10 0
Less: Provision for Agents Commission 1960	88 10 6	
Add: Underprovision for Agents Commission 1959	2 6 0	90 16 6
		867 13 6
Add: Sales		226 0 0
		1,093 13 6
Less: Cost of printing	894 19 0	
Sales Commissions	95 17 0	990 16 0
		£102 17 6

Messrs. Kane and Downey continued to be members of the Finance Committee during the year under review and I again thank them sincerely for their assistance to the Association in this capacity. The continued support of the advertisers in the Proceedings is acknowledged with appreciation.

General:

The Regional Branches of the Association in the Eastern Cape and Natal are developing and will clearly play an increasingly important part in the work of the Association.

Johannesburg acted this year as host for the Mid-year Executive Meeting and on behalf of all we convey thanks for the hospitality extended on the occasion of the meeting.

The essential work of the various Sub-Committees of the Association as well as its representatives on other Technical Committees and Organisations has continued during the year under review. To the various individuals concerned we convey the appreciation of the Association for their most valuable work on behalf of all Member Undertakings.

To you, Mr. President as well as all other Members of the Executive Council I express sincere thanks for the continued assistance and courtesy which you have extended to us over the past year.

To the Association and all its Members we extend best wishes for 1960/61.

R. G. EWING,

for DAVIDSON & EWING (PTY.) LTD.

Secretaries.

5th March, 1960.

The next item is the appointment of auditors. The Association's auditors are Messrs. Savory & Brink, who have carried out the duty well. I would like to move, from the chair, that their services be continued for the next twelve months. Is that agreed?

(Agreed)

The next item, the Discussion on Reports of Sub-Committees and Representatives.

Here again we will follow the same procedure as we did with the Report of the Secretaries. The Reports have been printed in the Agenda and have been available to everybody, so it will not therefore be necessary to read them.

(1) **Recommendation Committee for New Electrical Commodities.** Are there any points to be raised by the Convention. Mr. Van der Walt is there anything you wish to wish to add to it?

Then are you satisfied to adopt the report?

(Agreed)

REPORT OF THE RECOMMENDATIONS COMMITTEE FOR NEW ELECTRICAL COMMODITIES

The Committee's composition was slightly altered through the old Safety Precautions Committee falling away and being replaced by the new Wiring Regulations Committee of the South African Institute of Electrical Engineers. The composition is therefore as follows: —

A.M.E.U.: Bureau of Standards, S.A.I.E.E. (Wiring Regulation Committee): Electricity Supply Commission; Electrical Engineering and Allied Industries Association; Electrical Contractors Association of South Africa; Johannesburg City Council.

Three meetings were held during the year and members were kept informed of the findings through the usual news bulletins.

A noticeable trend is the appearance on the market of special wiring commodities such as special skirting and floor joists to take the place of tubing.

The re-appearance of quick heating water heaters is also noticeable, but the Committee still has these under consideration.

P.V.C. tubing to replace the conventional conduit has also come to the fore.

J. L. van der Walt, Representative.

VERSLAG VAN DIE AANBEVELINGSKOMITEE VIR ELEKTRIESE WARE

Die samestelling van die komitee het ietwat verander deurdat die ou Veiligheidsvoorsorg-komitee deur die nuwe Bedradingsregulasies-komitee van die Suid-Afrikaanse Instituut van Elektrotegniese Ingenieurs vervang is. Die samestelling is dus soos volg:

V.M.E.O.: Buro vir Standaarde; S.A.I.E.E. (Bedradingsregulasie-komitee); Elektrisiteitsvoorsieningskommissie; Electrical Engineering and Allied Industries Association; Elektriese Kontrakteursvereniging van Suid-Afrika en Stadsraad van Johannesburg.

Daar was drie vergaderings gedurende die jaar gehou en lede is van die bevindings deur die gewone nuusbriewe verwittig.

'n Opmerkbare neiging is die voorkoms van besondere bedradingsmateriaal in die vorm van vloerlyste en vloerbalke, albei van staal, wat ook geskik is om die plek van die gewone staalbuise te neem.

Die herverskyning van vinnige waterverwarmers is ook opmerkbaar.

P.V.C. geleierbuise tree nou ook na vore om die gewone staal geleierbuise te vervang.

J. L. van der Walt, Verteenwoordiger.

(2) **Rights of Supply Sub-Committee,** convened by Mr. Lombard. There is a short report available. Are there any comments?

May we then adopt this report?

(Adopted)

RIGHTS OF SUPPLY SUB-COMMITTEE

The Association's Hon. Legal Adviser has prepared a Memorandum on the South African urban local authority's right to supply electricity within its area of jurisdiction and this has been circularised to all members of the Association.

The Committee met once during the past year.

C. Lombard, Convenor.

ONDERKOMITEE REG VAN VOORSIENING

Die Vereniging se Ere-regsadviseur het 'n Memorandum voorberei oor die Suid-Afrikaanse Stedelike Plaaslike Bestuur se reg om elektrisiteit binne sy regsgebied te voorsien en dit is aan alle lede van die Vereniging omgestuur.

Die Komitee het eenkeer in die loop van die jaar vergader.

C. Lombard, Saamroeper.

(3) **Import Duty on Overhead Line Hardware.** That was a special report submitted by Mr. Lombard. You will see what came out of the deliberations and efforts in that regard. Are there any comments from the floor? Mr. Lombard, is there anything you wish to say? (No). May we then adopt this report?

(Adopted)

We must thank Mr. Lombard for getting something moving in this regard.

IMPORT DUTY—OVERHEAD LINE HARDWARE

It will be recalled that it was reported at the last Convention that application had been made to the Board of Trade and Industries for an increase in import duty on overhead line hardware. The Convention then resolved that representations be made to the Board to oppose any such increase.

On receipt of these represntations, the Board requested the Association to furnish it with certain information which was not at all readily available. A meeting with certain local manufacturers of overhead line hardware was held and it was established that the present range of overhead line hardware manufactured in the Union was very limited and mainly confined to certain items which were foundry products. This information was conveyed to the Board with the

INVOERREGTE: YSTERWARE VIR BOGRONDSE GELEIDINGS

Onthou sal word dat daar tydens die laaste Konvensie gerapporteer is dat by die Raad van Handel en Nywerheid aansoek gedoen is om verhoging van die invoerregte op ysterware vir bogrondse geleidings. Die Konvensie het toe besluit dat vertoë tot die Raad gerig word om sodanige verhoging te opponeer.

Die Raad het die Vereniging by ontvangs van sodanige vertoë om sekere inligting gevra wat gladnie juis maklik bekombaar was nie. 'n Vergadering is met sekere plaaslike fabrikante van ysterware vir bogrondse geleidings belê en daartydens is dit bevestig dat die huidige reeks ysterware wat in die Unie vervaardig word, uiters skraal is en hoofsaaklik tot sekere items beperk wat gieteryprodukte is. Dié inligting is aan die submission that if additional protection should be found necessary, this should be limited to certain cast items which were within this range of economic local manufacture.

It was further suggested that a Technical Advisory Committee should be formed in order to investigate matters of this nature and advise the Board and that the A.M.E.U., Escom, Assocom, and the S.A. Federated Chamber of Industries should be represented on this Committee.

The Board's final decision in regard to this matter is not yet known.

C. Lombard.

Raad oorgedra met die standpunt dat beskerming net tot sekere gegote ware beperk moet word binne die reeks plaaslike ekonomiese vervaardiging as bykomende beskerming dan noodsaaklik gevind sou word.

Voorts is aan die hand gedoen dat 'n Tegniese Advieskomitee in die lewe geroep word om sake van so 'n aard te ondersoek en om die Raad te adviseer, en dat die VMEO, Eskom, die Handelskamers en die S.A. Gefedereerde Kamer van Nywerhede in die komitee verteenwoordig word.

Die Raad se finale besluit in verband met hierdie saak is nog nie bekend nie.

C. Lombard.

(4) We now come to the **Wiring Regulations Committee.** The Report has been tabled. Are there any comments? Would Mr. J. C. Downey like to make any further comment. (No).

WIRING REGULATIONS COMMITTEE

As reported by Mr. Fraser at the 33rd Convention of the A.M.E.U. last year the Safety Precautions Committee held its last meeting on the 22nd June, 1959, and the first meeting of the newly formed Wiring Regulations Committee was held on the 21st July, 1959, and since that date there have been four further meetings.

The Railways are not represented on this Committee and in addition there are Advisory Committees in the Cape and Natal which are serving a very useful purpose.

The Committee dealt with a number of queries from supply authorities and others on the regulations, but has been mainly concerned with a revision of earlier amendments and consideration of further proposals prior to the essential reprint of the Regulations, the Afrikaans version being out of print.

The January, 1960 amended version of the Second Edition of the Wiring Regulations was released by the printers recently at a cost of 7s. 6d. per copy.

In general the amendments to the Regulations consist of minor alterations to the section covering definitions of terms and to Regulations 222, 304, 309, 310, 322, 401(H), 502(J), 504(A), 401(O), 504(E), 606(E), 606(J), 606(K) (1955 Edition), 901(C), 903, 116(B), 1116(C), 1201, 1202, 1203, 1302(E) (Afrikaans version only), all the Tables and the respective indexes.

Regulation 305, 402(L), 405(L), 606(J) (1955 Edition), 606(I), 901(D) (1955 Edition), 1222(E) and 1222(F) have been deleted with the adjustment to existing and remaining designations where necessary. A new Regulation 411 has been introduced.

The major alterations of interest concern the location of the main switch and fuses, the minimum rating of conductors for various circuits, the use of shaver socket outlets in bathrooms, earthed concentric wiring, the quantity of socket outlets on a circuit and the permissible current rating of conductors.

J. C. Downey, Representative.

Mr. J. W. KANE (Johannesburg): We sent round a letter that we had received from the Wiring Regulations Committee in connection with Regulation 204. I think everybody has had a copy. I would like to know if any member is prepared to pass any comments on it. The real problem is that that regulation, which gives you some form of guide, regarding diversity factors is mainly, we think, applicable to domestic installations.

When you strike the large buildings, blocks of flats, mixed flats and businesses and so on, every one and, shall I say, many consulting engineers, have different view-points as far as diversity factors are concerned.

We don't know whether to alter the regulation, even to the extent of merely saying it is for domestic installations only, or whether to produce a table somewhat similar to the overseas institution regulations which gives a variety of diversity factors for different installations. But, if anything, we think the overseas diversity factors are more conservative than even our own out here.

Some members may be able to help us.

THE PRESIDENT: Thank you Mr. Kane. Would anybody like to speak to that?

Mr. E. R. W. BOYCE (Durban): Mr. President, there is a tendency these days to provide regulations and over-regulate for the various functions which industry has to perform.

The present diversity factors, which are headed under Regulation 204, are very satisfactory and very workable. It is my opinion that these should not be altered, but the regulations do permit an engineer to take into consideration all the facts of the load that he is going to handle; and if you leave the regulations as they are the engineer can make his own decision as to what diversity factor should be applied to the type of load which he is going to handle.

THE PRESIDENT: Thank you Mr. Boyce. Are there any additional comments that may help Mr. Kane?

Mr. G. J. MULLER (Bloemfontein): Mr. President, I don't think Mr. Kane needs much help. I'd like to make an enquiry about a comment I made to the Association in the course of the year.

We noticed a rather serious discrepancy between the English and Afrikaans versions in connection with the earth continuity resistance of installations. I presume that the English version is the authorised version? Perhaps it might be worthwhile here to draw attention to this discrepancy so that people who are using the Afrikaans version would be warned of this discrepancy. I don't think it has been corrected yet, Mr. President.

Mr. J. W. KANE (Johannesburg): Really, your representative should answer this question not me!

It was drawn to the attention of the Association some years ago, I think about 1955 or 1956, that this mistake existed in the Afrikaans version. Unfortunately the gremlins, or carelessness, something like that, the new 1960 edition of the Afrikaans version contains the same mistakes—plus a few more! We are arranging to produce an errata slip that will be sent to anybody who would like it, by the Institute and of the 2 or 3,000 copies that still exist to be sold it will be inserted as it is sold.

But the main fault still is that the Afrikaans version refers to 1 ohm while the correct version is .2 of an ohm, and I think it is in regulation 1202 that there refers to socket outlets, they have cheerfully printed the new regulation, and slung in for good measure, a portion of the old regulation. In addition, the number of tables that have been altered, for argument's sake, Table 14, the reference in the book to Table 14, should read say, Table 10, and there are one or two minor mistakes of that nature but they have all been corrected in this errata slip.

THE PRESIDENT: Thank you Mr. Kane. For the sake of members, when will that errata slip be available?

Mr. R. W. KANE (Johannesburg): Any moment—in fact, I should imagine they would be ready now.

THE PRESIDENT: Thank you. Any further comments?

That completes discussion on the Wiring Regulations Committee. I presume that is also adopted by the meeting?

(Adopted)

We will now refer to the first Report which was held over: The Electrical Wiremen's Registration Board.

This, like the others, has been laid on the table; there is no need to read it. Would Mr. Kane like to make any further comments before it is thrown open for discussion?

ELECTRICAL WIREMEN'S REGISTRATION BOARD

Mr. President, Ladies and Gentlemen,

I am indebted to the Wiremen's Board for permission to produce the statistics and information quoted in this report.

I note that it is some time since our members have had details of the composition of the Board and consequently I am repeating their names.

The Chairman is Mr. G. J. Malan, Chief Inspector of Machinery (Factories) and the members are Messrs. T. D. Bowness, A. Elisio, J. M. Fraser, B. G. Lindeque and R. W. Kane.

There have been 10 meetings of the Board during 1959 and in all 481 applications for registration have been considered. 669 Candidates took the examination for Section A with 21.1% passes, whilst for Section B, 455 sat with 70.5% passes. There were 11 practical examinations (Section B) and 4 written examinations (Section A).

During the year under review 8 applicants were exempted from examinations and 339 were registered after passing the prescribed examinations or a total of 347 applicants were registred during 1959. This brings the total registrations from 1940 to 7,554.

The Chairman, in addressing Convention during 1959 reported that 41 areas had been determined during May, 1959. For record purposes there are:—

The Municipal areas of:—

Beaufort West, Bethal, Bethlehem, Brits, Burgersdorp, Caledon, Carolina, Ceres, Christiana, De Aar, Ermelo, Estcourt, Ficksburg, Graaff Reinet, Harrismith, Hennenman, Kuruman, Ladybrand, Ladysmith, Louis Trichardt, Middelburg (Transvaal), Moorreesburg, Mossel Bay, Odendaalsrus, Parys, Riversdale, Senekal, Somerset East, Swellendam, Umtata, Upington, Ventersburg, Vryburg, Vryheid, Warmbad, Wolmaransstad and Wolseley.

The Village Management Boards of Sasolburg, Virginia and Welkom.

The Magisterial district of Lower Tugela.

The total number of determined areas to the end of 1959 is 114.

In addition the Board during the latter portion of 1959 has recommended to the Minister that the Magisterial district of Umzinto which includes Scottburgh and Umkomaas of the Natal South Coast should be determined and the customary 12 months' notice has been given. The necessary notice to determine the municipal areas of Bothaville and Winburg was enforced during 1959 and final determination was published early in 1960.

During the year under review the Witwatersrand Technical College informed the Department of Labour that they would no longer be able to conduct the practical examination (Section B) and arrangements have been made for this examination to be conducted at the Olifantsfontein Trade Testing Organisation under the Department of Education, Arts and Science. This affects the Witwatersrand area only.

Following a query from a number of centres it was obvious that the thorny question of continuous supervision was causing some concern and at the September meeting of the Board it was agreed to recommend that Section 20 of the Act be amended so as to permit members of the restricted classes referred to therein to work under constant personal supervision, except in the ultimate year of apprenticeship or training when such supervision need not be personal. Members will recollect that this was discussed, together with other proposed amendments as far back as 1953 and finally reported in some detail in the 1957 proceedings, reflecting the decision of the Board taken during 1956. Since 1956 a few amendments have been adopted and the Board has again asked the Department of Labour to proceed with the outstanding amendments.

The Board has been informed that consideration will be given to the proposed amendments during the 1961 session.

R. W. Kane, Representative.

Mr. G. J. MALAN (Department of Labour): Mr. President, Mr. Kane has so fully covered the field that there is very little for me to say, but I should like to make a few comments on trade tests.

A scheme whereby apprentices are trade tested in their fourth year of apprenticeship was introduced with the object of affording the above-average apprentice an opportunity of qualifying before the normal expiry date of his contract, and of meeting the growing demand for artisans in industry. Apprentices in the various trades are required to undergo the test in the penultimate year of their apprenticeship, and an appreciable number of apprentices succeed annually in qualifying early, resulting in benefits, not only to themselves, but to the country as a whole.

Insofar as apprentice electrical wiremen are concerned, forty candidates entered for the practical test during 1959. Of this number 31 or 77.5% passed, and 9 or 22½% failed. Of this 31 who passed, 22 or 71% were in their fourth or fifth years of apprenticeship, and reduced their contract period by one year or less. The remaining 9 or 29% who received no remission for passing the test have failed in the initial test, but they became eligible for registration immediately upon completion of their contracts.

From the above figures it is clear that the scheme has proved to be a success and provided all employers take a fatherly interest in their apprentices, and encourage them to take advantage of the opportunity offered, even greater success should be possible.

THE PRESIDENT: Thank you Mr. Malan. Are there any further comments?

Mr. W. H. MILTON, Escom (Johannesburg): Mr. President, there is one point in connection with the determination of areas which has caused Escom very considerable concern over a long period of time. It is a point which we have drawn attention to, but for some reason the point is ignored.

In the report, to quote particular examples at the present time, we find that the areas determined include, the Municipal areas of Bethal, Bethelehem, Carolina, Ermelo, Escourt, Ficksburg, Harrismith, Middelburg, Tvl. (I don't think I need read any more). But you will observe that they are the Municipal areas. Now both the municipalities themselves and Escom are supplying consumers outside those municipal boundaries, and it seems rather farcical that the supply authority is called upon to ensure that wiring work is done by registered wiremen, within the municipal boundary, but connected to that same system, and right next door to it, anyone can do the wiring work.

Municipalities may not have had the same difficulties that Escom has faced in this connection, but in our own particular case, we have met complaints (I put it as mildly as that) from contractors doing wiring work that we have no right to insist upon a registered wireman doing wiring work just outside the municipal boundary; in fact, our requirements in that connection are challenged, and, quite rightly, we would have no legal standing whatever in refusing to accept wiring work carried out by non-registered wiremen.

I don't see why, in determining these areas, they cannot use the standard phrase of the "magisterial area." The only one referred to here is the "magisterial district of the Lower Tugela." In particular, as far as we are concerned, we have not the same right to refuse work done outside the municipal areas as a municipal authority. When we are reticulating in an area, and I named a number of these which are actually mentioned in this report; as being developed by Escom on behalf of the municipalities for the meantime, we must, of necessity, supply the rural areas round about if the farmers in those areas can afford to meet our terms of supply, and, as I say, it is absolutely farcical that in a municipal area we can insist on the wiring work being done by registered wiremen, but right next door we are powerless.

We do attempt to enforce the provisions on the basis that the more people who are employed as registered wiremen, and out of necessity, required to do the wiring work, the more substantial will be the effect of that legislation.

Many years ago at one of these conventions I raised that very point, but the argument which in those days was used against the determination was usually "Oh, there are not sufficient registered wiremen in the area to justify the determination," and my retort was always that, as long as you maintain the position that you will not determine an area until you have sufficient registered wiremen, there is no incentive to register. So I would like some explanation as to why it is dealt with as "municipal areas" and not "magisterial districts."

Mr. R. W. KANE (Johannesburg): Mr. President you will appreciate I hate crossing swords with Mr. Milton of Escom, Headquarters!

I just want to draw his attention to "the magisterial district of Umzinto which includes Scottburgh and Umkomaas." Escom asked for the determination of "Umzinto" and the board decided that—we had never heard of Umzinto, but we had heard of Scottburgh and Umkomaas, and they were all in the magisterial area, and that was one occasion that we, on our own, recommended to the Minister that the magisterial area should be determined.

I think the answer is to a certain extent in Escom's own hands, in a strict inspection of any type of installation, whether it is done by a licensed wireman or not. The type of installation must strictly conform with the regulations.

When an approach comes to the board for determination, the town itself is approached. There they are asked how many contractors there are, how many wiremen, how many are licensed, what their area supply is, the nature of their organization—and as many factors as possible are sought from the town itself.

You have a case—when you refer to magisterial areas—of Heidelberg incorporating a place, Balfour. There was no desire to determine Balfour at this stage, and unfortunately the board is controlled by a Minister who seems to think that, despite the safety requirements of the Act, we have got to be a little bit careful in not creating any hardships; and it is of recent years that this recent thing has crept in—municipal area for magisterial area—because sometimes the magisterial area just means nothing.

THE PRESIDENT: Thank you, Mr. Kane.

Mr. W. H. MILTON, Escom (Johannesburg): Mr. President I was shocked at the remark passed by Mr. Kane regarding the remedy lying in our own hands. If we had felt that, and felt it for the reason put forward by Mr. Kane, I would suggest that this Association should have done its utmost to prevent the promulgation of the Act itself.

If it is sufficient for us to carry out an effective inspection, then it is surely on the ground put forward by Mr. Kane, quite useless to employ registered wiremen. There must have been some purpose behind the Act, and it is a matter which was fought very strongly over a very long period of time by one of the leading members of this Association. I refer to the late George Swingler. His complaint always was that we were up against the carpet-bagger, to use his own term, and that such wiring work, as is in sight, and can be effectively inspected, could be done in such a manner that it would be acceptable to anyone. What he was worried about, always, was the work which was buried out of sight, and which, for example, could only be inspected by a complete withdrawal of the wiring work from conduit.

He instanced, and you'll find it in your records, cases of the V.I.R. work—most of the work being done was V.I.R. in those days—where he had found short lengths of V.I.R. leading into switch points, plug points, and the lamp holder battens, whereas in the conduits themselves he had actually come across cases where bell wire was being used. And it was for that reason that he pushed so hard for the promulgation of this Act, which would give very satisfactory redress on the part of the supply authority that on finding that work had not been carried out as it should be carried out, that person could be struck off the rolls and prevented from doing further work.

As far as we are concerned, the point which I made—and it is a real one—is that people who are unable to obtain registration because of their lack of knowledge, and their inability to do a good job, insist on the right to do wiring work just outside a municipal area, and there is no legal redress against it. Our inspectors can certainly turn the work down, right, left and centre, but this Association does look after the interests of the poor devil who is having the work done, and it is only after the work is done that you find it is defective and it has to be done again that the trouble arises.

So I am very surprised that Mr. Kane should suggest that it is our inspection which gives sufficient protection. It protects us, but it doesn't protect the user.

THE PRESIDENT: Thank you Mr. Milton.

I presume that before determining areas in the future that Escom will be given the opportunity of having their say, to try and protect themselves against those troubles. Anyway, that is in the hands of higher authority.

Mr. G. B. HEUNIS (Standerton): Mr. President, there are a couple of points I would like to discuss under the Electrical Wiremen's Registration Act of 1939, and the object in doing so is to ascertain whether the experience we have had in Standerton is also applicable to other centres.

We had a case in the beginning of this year against a man who extended his electrical wiring to the back yard. In doing so he energised the fence between him and his neighbour, and also a number of water taps in the yard of a neighbour.

The wife of the neighbour, I believe, got a few shocks due to this. The man was summoned and he was fined 10/- for this contravention.

In 1958 there was a case against a farmer in the same district for neglecting to inoculate his animals against anthrax and he was fined £25 and I was wondering whether the value of an animal is really 12½ times that of the neighbour's wife.

(LAUGHTER)

If that is so, Mr. President, I wouldn't have anything more to do with my neighbour's wife!

Mnr. die President, daar was ook verlede jaar 'n uitstaande hofsaak teen 'n ongekwaliseerde naturel wat huisbedrading gedoen het. Toe die magistraat uitspraak gee in die saak, toe het hy gesê daar was nie veel skade gedoen nie—hy het die jong £2 beboet.

Wat daardie magistraat nie besef hierdie dinge gaan nie skade wat gedoen is nie, maar oor lewens wat op die spel is.

In 'n ander saak, Mnr die President, was 'n verklaring gedoen deur die Polisie—teen 'n sekere man; daar was twee klagtes. En ten opsigte van elke een van daardie klagtes het ek aan die polisie die naame gegee van twee getuies. Na twee maande het ek ondersoek ingestel en gesien dat daar nie veel in my sake gedoen is nie. Ek het aan die Prokureur-Generaal van die Transvaal geskrywe in verband met die aangeleentheid, en versoek dat hy my inlig waarom die saak nie verder opgevolg was nie.

Hy het my geantwoord en gesê dat hy doen navrae. Ek het vier maande gewag en weer die selfde brief aan dieselfde persoon geskryf, en ek het dieselfde antwoord gekry.

In Maart maand van jaar—dit is tien maande nadat die aanklag oorspronklik aangemeld is—is die saak verhoor en die saak is verhoor ten opsigte van die een aanklag met die hulp van die twee getuies ten opsigte van die ander aanklag, en die saak is teruggeroep.

Daar het niks verder gebeur nie.

Mr. President, I am of the opinion that neither the Police, nor the usual Public-Prosecutor, nor the magistrates are competent to hear cases, investigate, and judge in cases of this nature. I say I am of the opinion. I don't say they are not competent —I am just of the opinion.

I believe on the Witwatersrand there is a special industrial court which decides on cases like this. Now the object of bringing this to your notice, Mr. President, is just to ascertain whether my experience is consistent with that of other centres, and it would be very helpful to know what the position is there.

I do not feel inclined, as a municipal official to take up, and to assist whoever is to be assisted in cases like these, if I have no definite responsibility under the Act to do so. If the experience in other places is similar to mine, I would be very pleased to hear what the delegates who have had that experience have to say.

THE PRESIDENT: Thank you very much.

Mr. E. R. W. BOYCE (Durban): Mr. President, since the introduction of the Act in the Durban area, the various prosecutions which are undertaken under the Act, in the first cases that we took a hand in, a lot of people that we prosecuted got away with a caution and discharge.

It has been our policy when making or building up a case to obtain the fullest details, and make it absolutely foolproof and waterproof. The fines then went up to approximately £5.

Representations were then made through the police in view of the nature of these offences, and in prosecutions over the last two or three years, they have been as high as £80 or 120 days' hard labour; £20 on each count, or 40 days' hard labour on each count. And in the majority of cases recently, £25 or 60 days I think it was. Two others quite recently—£20 on each count, or 40 days, and in a recent case, after the magistrate had sentenced the two accused, he made a court order for the entire wire installation of this residence to be removed and stripped under police supervision.

I think it is only a question of the municipalities concerned making direct representation to the Commissioner of Police in their areas for the penalties to be stepped up a bit.

THE PRESIDENT: Yes, that is the position. I think Mr. Boyce is quite right there; we have had some severe fines imposed on people who have infringed this particular Act, and it probably will be dependent on the Engineer approaching the magistrate of the area, and the Chief of Police for that matter, and putting him into the picture, because a lot of them do not appreciate the full problems arising from such contraventions.

Mr. R. W. KANE (Johannesburg): Mr. President I am interested in hearing what happens in Durban, but I think I am right in saying that the majority of us have experienced the same sort of troubles as the representative of Standerton. You do a lot of work in preparing all the facts, then you hand it over to the legal people, and it is amazing how they are inclined to treat these things as a bit of a nuisance sometimes; that is the impression I have got.

Nevertheless, whether it is a small fine or a big fine, I think where you get the odd man who is causing a lot of trouble, build up a case against him and then report him to the Board, and let the Board take action against his licence.

THE PRESIDENT: Thank you, Mr. Kane.

Of course I think one of the biggest deterrents is, if you can enforce a complete stripping of the wiring. That affects the contractor, and the contractor alone.

Any further comments?

Mr. G. B. HEUNIS (Standerton): Mr. Kane says that the Board will take action against the man who has a licence, but he hasn't got a licence, that is the point!

Mr. E. L. SMITH (Boksburg): Mr. President, we have found in Boksburg that the best way of dealing with this matter is not to present a case to the legal advisers, or the Council's legal advisers, but immediately hand the matter over to the police, and we have done that during the past two years, and have had wonderful results. We have had about 12 or so prosecutions, and in each case the public prosecutor has taken a personal interest in the matter, and has fined the chap from £10 to £20 or more, or one or two months' imprisonment. We find it very effective, and people are getting very careful in regard to wiring work.

A recent one was a fellow in renewing a roof cut away the overhead services while still alive and left them lying in the street alive, and, as you know, if there was an electrocution the Electrical Engineer would be in a very precarious position, and the public prosecutor took a very serious view of that and he got £20.

I think therefore that the best way to do it is to hand it over to the police immediately, and not bring in the Council's legal advisers—because then it is really a long process indeed. We get good results by handing it over originally to the police.

THE PRESIDENT: It possibly may be an advantage to refer this matter to the sub-committee or committee concerned with Electrical Wiremen's Registration with a view to passing on to those concerned the importance of supporting the Engineer in the execution of his duty. That might be one help, but one can also help oneself to some extent by one's own by-laws. If the Council passes its by-laws covering a general point, even if you are not protected by the Act, in an area that is undeclared, you could still enforce the stripping of wiring if it did not come up to the standard that you wanted it to.

Time is getting on now. I would like to finalise this particular matter. Would it be the wish of the meeting that Mr. Kane take this matter up on your behalf to the Wiremen's Registration Board?

(Agreed)

There is one more comment. Mr. Kinsman.

Mr. C. K. KINSMAN (Durban): Mr. President, one is concerned when one learns of the disparity in the treatment of offenders by magistrates in different parts of the country. One sympathises with a magistrate, probably not being aware of the consequences of breaches of the Act, and I would add to your suggestion, sir that the Electrical Wiremen's Board approach the Secretary of Justice drawing attention to these very wide disparities, and try and assure through the prosecutors, pressing for more severe penalties and more uniform penalties throughout the Union.

THE PRESIDENT: Thank you Mr. Kinsman. I might say it is very pleasant to hear your voice again at a convention.

We must pass on to the next item. It is just about time for the tea adjournment. We have gone through all the committees, but there was one for which we did not receive a report; and that is from Mr. Hugo on the S.A. National Committee of the International Electro-Technical Commissions. I presume this was not possible.

Mr. D. J. HUGO (Pretoria): It is not possible to report, Mr. President.

THE PRESIDENT: Thank you. Just before we close, it might be of advantage if Mr. Kane were to clearly define the relationship of the New Commodities Committee and the Wiring Regulations Committee to everybody. Would that be of advantage to the convention?

Mr. R. W. KANE (Johannesburg): Mr. President, as you know I met the local branch of the Wiring Regulations Committee last week. One of the real purposes of meeting these good people was to explain to them that the Wiring Regulations Committee is concerned mainly with regulations, and any new product that is acceptable to the country, which in turn would require an amendment to the regulations. But the recommendations committee of this Association fills a different function altogether.

There are many things coming into the country that are either sent around from agent to agent with the desire to sell them in the country—electrical products. Or there may be other things such as ducting, and various items of that nature, that are not covered by standard specifications. Where in the past, we all, from time to time have inspected these things and said whether they are or are not good enough for use in our area, I want to remind members of our own committee.

When people come to you to say they are using this thing in Johannesburg or Cape Town or Durban—unless they can produce proof of it, I would say to them, "You are not the testing authority. Send them off to Standards Bureau, en route to Recommendations Committee." I am saying this because one or two people are inclined to send things to the Wiring Regulations Committee that really should go to our own Recommendations Committee of this Association. We in turn (I am now referring to the Recommendations Committee—I seem to be answering for many representatives here today) will tell you whether we think a thing is suitable for use. It is up to you to decide whether you are going to adopt it.

We have learned, though we were very cautious about it some years ago—we have also learned that we will now tell you when an article has been before the Committee and not considered suitable for use in its present form.

THE PRESIDENT: Thank you Mr. Kane. That concludes the Reports of Committees, and I would like you to record your vote of thanks to the convenors of those committees for the work they have done during the course of the year.

(Applause)

CONVENTION ADJOURNED

On Resuming at 11.00 *a.m.*

THE PRESIDENT: Gentlemen, we will now proceed with the business of the Convention, but before commencing with the main item on the agenda, there are several announcements to make:

(Convention Announcements Followed)

The main item on the Agenda for this session is a paper entitled "Electrical Protection of Distribution Systems" by J. Michel-Smith formerly of the Electricity Department, Durban. Since writing this paper, Mr. Michel-Smith has joined the staff of Natal University, but he is giving the paper in the name of Durban Municipality.

Mr. J. MICHEL-SMITH (Natal University): Mr. President, gentlemen: The title of this paper is "Electrical Protection of Distribution Systems, with special reference to the Durban Corporation system."

I should like to take this opportunity of thanking the City Electrical Engineer of Durban and members of the City Council of Durban for doing me the honour of allowing me to present this paper.

(Applause).

Electrical Protection of Distribution Systems

With Special Reference to the Durban Corporation Electrical System

By J. E. P. MICHEL-SMITH, B.Sc.(Eng.)

Introduction:

Protection of electrical apparatus is largely a matter of economics, the more complex and costly forms being used to protect feeders and apparatus handling large blocks of power. However, generally, the more complex a protection scheme is, the less reliable it is over a period of time and in order to justify its installation, regular maintenance and testing must be carried out.

Generally, protection has two main objects; one is to protect current carrying conductors of feeders and apparatus against thermal damage resulting from overcurrent conditions and the other is to protect insulation against rupture or puncture by overvoltage.

There are two principal causes of overcurrent. They are overload (load impedance too low) and short circuit. Short circuits may occur either to earth (in the case of systems having an earthed neutral or star point) or to an adjacent current carrying conductor.

On the Durban Corporation System, all overcurrent protection of the H.T. and L.T. systems is used with the express object of avoiding thermal damage due to short circuits as previously defined and not overload. The most reliable means of preventing overload is to obtain current readings throughout the system at least once annually, preferably at time of peak load on all H.T. and L.T. feeders and transformers. Maximum reading ammeters are not as yet used to any extent by the Durban Corporation.

Overvoltage protection on the Durban Corporation System is effected by the usual means, i.e. lightning arrestors or more correctly surge diverters and/or spark gaps situated at appropriate points on the system.

The main items of electrical plant on a distribution system requiring protection are overhead lines, underground cables, transformers and substation busbars.

The four main types of protection at present used by the Durban Corporation comprise overcurrent, earth leakage current, current balance and Buchholz and winding temperature protection for transformers.

Other forms of extra high voltage feeder protection (not at present used by the Durban Corporation) are distance protection with impedance and mho relays (with or without carrier relaying between feeder ends), directional earth leakage and phase comparison protection combined with negative phase sequence detection, both forms being combined with feeder end to end relaying by means of H.F. carrier.

Computation of fault currents on the Durban Corporation System:

In computing the short circuit currents for faults at any point on the System, only two types of fault are considered. These are balanced three phase faults for overcurrent protection and single phase to earth faults for earth leakage protection. Faults of the latter type result in maximum earth currents and consequently maximum currents in C.T. secondary residual circuits. These fault currents are also easier to calculate by means of symmetrical component analysis than those resulting from double phase to ground faults. Average earth resistivities are also assumed.

Figure 1 is a sketch showing only the interconnected portions of the Electricity Supply Commission and the Durban Corporation systems which would affect the fault levels at the three major points of supply to the Durban Corporation, i.e. Congella Power Station, Umgeni Power

Station and Springfield substation. All other portions of the Durban Corporation network are radial or dead end feeders radiating from all three of these major points of supply.

Recently, however, since the commissioning of 132 K.V. at Coedmore by Escom, the Durban Corporation interconnectors via Berea Park and Alice Street substations have been opened at the points shown in Figure 1 with a corresponding reduction in fault level at the points of supply to the Durban Corporation.

There are only two earthing points or sources of earth or zero sequence currents on the System. The first consists of a solidly earthed neutral of the 33/6.6 K.V. coupling transformer at Congella Power Station (referring to Figure 1). The second consists of a neutral of one of the 33 K.V. earthing compensators at Springfield substation, earthed via a 12 ohm. liquid resistor. This gives a substantial reduction in earth fault current, resulting in better co-ordination of the earth leakage protection

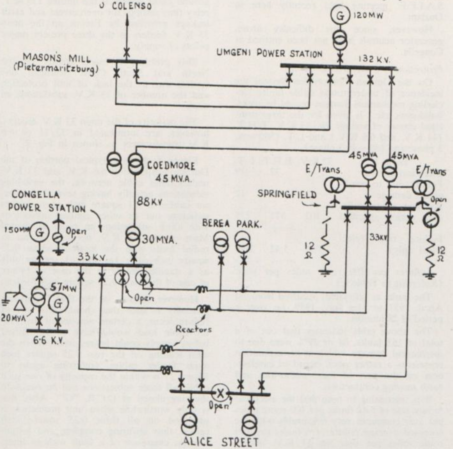


Fig. 1. Interconnected portion of the Escom and Durban Corporation Systems.

on feeders radiating from this substation, and less disturbance on the system.

At Congella Power Station, on occasions in the past, 33 K.V. generator earthed neutrals have been used but have recently resulted in third harmonics resonating with certain critical values of cable star capacitance and inductance, causing maloperation of earth leakage protection on the Durban Corporation feeders from this power station. This difficulty was the cause of an investigation, the findings of which formed the basis of a short paper presented at an S.A.I.E.E. meeting held recently here in Durban.

However, since this difficulty arose, generator neutrals have not been earthed at Congella.

Protection of Underground Cables:

On the Durban Corporation System the incidence of underground cable faults (including mechanical damage caused by picks, bulldozers, etc.) is given for the three principal classes of voltage viz. 33 K.V., E.H.T. (11 K.V. and 6.6 K.V.) and L.T. (500 volt, 3 phase and 380 volt, 3 phase).

Table 1	33 K.V.	E.H.T.	L.T.
Electrical failure	8	72	19
Failure due to mechanical damage	2	50	12
Average route miles over period specified	102	571	275
Failure rate (electrical only)	3.36	5.42	2.97

Failures per 100 route miles per year. (Referring to Table 1.)

The faults as tabulated, occurred from 1st April, 1957 to 31st July, 1959, i.e. over a period of 28 months.

The above table indicates that out of a total of 163 faults, 64 or 39% were due to mechanical damage, which in my estimation represents a rather poor record of carelessness on the part of local authorities and earth moving contractors.

It is interesting to note that the electrical failure rate of 5.42 faults per 100 route miles per year compares very favourably with the accepted average failure of 6 faults per 100 route miles per year for 11 K.V. underground cables in Great Britain.

These electrical failures on the Durban Corporation System include a small percentage due to earth movement and subsidence and include failure in the cable run, at joints and failures of terminal boxes.

The protection of underground cables is in actual fact the protection of a network, the component parts of which will be dealt with in logical order starting from the source.

One of the problems confronting the protection of the 33 K.V. and E.H.T. underground cable system is the limited I.D.M.T. relay time settings for overcurrent and earth leakage provided by Escom on the main 33 K.V. feeders at the three present major points of supply.

This problem is much greater on the North and South Coast overhead line feeders due to the lack of unit protection and the number of 33 K.V. substations en route.

The majority of the main 33 K.V. feeders, however, are terminated in 33/11 or 6.6 K.V. transformers as shown in Fig. 2.

Figure 2 shows a typical portion of the Durban Corporation 6.6 K.V. and 33 K.V. underground cable network, the switching substations actually having several distributor cables of 0.1 square inch cross section radiating out to other similar substations with kiosk substations en route as shown. Most of the 6.6 K.V. network is run as radial feeds with the interconnecting 0.25 square inch cable (as shown) serving only as a standby feeder in the case of failure of one of the main 0.25 square inch feeders.

However, loading on the E.H.T. network generally is such that should this sort of failure occur, a certain amount of distributor cable load would have to be shifted before supply could be restored. When the total loading on the two 0.25 square inch main feeder cables (referring again to Figure 2) is within the capacity of one such cable, all three substations can be run with the ring closed at O.C.B. "G". Also, this is only worthwhile when unit protection is provided on all three 0.25 square inch cables, thus ensuring complete and instantaneous clearance of a fault without interruption of supply.

The starting points for protection co-ordination, of course, are the overcurrent settings of the I.D.M.T. relay on O.C.B. "A" in Fig. 2 which, to quote a typical case are 100% current plug and 0.4 time multiplier for a C.T. ratio of 300/5 for each.

As far as earth leakage protection is concerned, the current and time settings at O.C.B.'s "A" are set by Escom but in fact can be as light as possible since these are not affected by earth faults beyond the 15 M.V.A. transformers.

Unit protection is also installed in some cases to protect the 33 K.V. cable and transformer jointly. This consist of Overall Translay in the case of the older 33/6.6 K.V. substations.

O.C.B. "B" in Fig. 2 is fitted with reverse power protection only, about which more will be said later.

In all cases on the Durban Corporation system, the overcurrent relay current plug settings are such as to start relay operation on a primary current some 30% above the

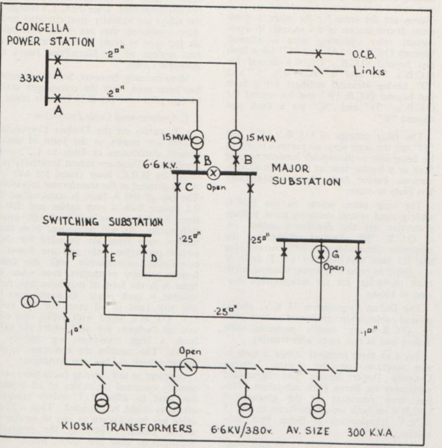


Fig. 2.

cable rating, thus providing protection against short circuits only, as mentioned previously. The appropriate tripping times are then obtained by adjustment of the time multiplier.

Fault currents are calculated for the worst conditions for co-ordination i.e. three phase faults assumed and maximum generator subtransient reactances under maximum plant conditions being used.

Considering the case of 6.6 K.V. radial feeding and again referring to Fig. 2, taking one radial feeder into account only as conditions are the same for the other, a minimum discrimination of 0.4 seconds in overcurrent relay operating time is allowed between O.C.B.'s . "A" and "C" for a fault just beyond O.C.B. "C", 0.4 second for O.C.B.'s. "D" and "F" (O.C.B.'s. "C" and "D" having identical settings) for a fault just beyond O.C.B. "F" and 0.4 second for O.C.B.'s. "D" and "E" for a fault just beyond "E".

The relay settings of O.C.B.'s "C" and "D" are the same since no purpose is served by being able to distinguish between a cable fault or a busbar fault at the switching substations, busbar faults being considerably less likely to occur.

The only other points on the E.H.T. underground system requiring earth leakage protection are the distributor cables, i.e. at O.C.B. "F". Typical settings are the minimum obtainable, i.e. 20% current plug and 0.1 time multiplier for a C.T. ratio of say 200/5 in order to provide sensitive earth fault protection for the transformers situated in kiosks.

The Duban Corporation 33 K.V. underground cables when terminated at both ends on O.C.B.'s are usually protected with Solkor and in two cases with translay.

Tee'd or three terminal Solkor is used in two locations on the system, between Congella Power Station and Springfield substation via Berea Park substation. This has been necessary in the absence of O.C.B.'s on both tee-off positions to the 15 M.V.A. transformers at Berea Park substation.

The speed of Solkor operation was recently demonstrated when a 33 K.V. cable between Alice Street and Springfield substations was bulldozed, the cable being cleared so rapidly that practically no sign of burning was visible at the site of fault in spite of a fault level in excess of 500 M.V.A.

As far as the E.H.T. underground cable system is concerned, only the 0.25 sq. in. main feeder and interconnector cables have unit protection.

Merz-Price protection has been used for many years for these cables and is made up of a current balance circuit using 3 pilot cores where no current circulates under normal conditions. Since the C.T.'s energising the relays are virtually open circuited under these conditions, they are of the distributed air gap type to avoid core saturation. Current settings of the Merz-Price relays are usually 0.1 amp.

More recently, however, Solkor protection has been used, with the consequent saving of one pilot core per E.H.T. cable route.

L.T. Underground Cable Protection:

L.T. cables on the Durban Corporation System are mostly in the form of underground distributors or feeds to L.T. overhead lines. These are almost invariably protected by H.R.C. fuses (rated for 440 volt A.C.) situated at the transformer substation. The use of 400 A fuses is standardised for 0.2 square inch 4 core cables and 200 A fuses for 0.1 square inch and 0.06 square inch cables. As will be noticed from these ratings, such fuses are intended for short circuit protection only and are found to co-ordinate satisfactorily with the transformer primary protection, even when the latter is in the form of expulsion type fuses situated in each phase. In some cases for 380 volt (and in all cases for 500 volt), L.T. O.C.B.'s, fitted with series trip coils and oil dashpots are used where the cable feeds a large consumer, e.g. factory or works. This enables the consumer to distribute power via his own switchgear.

Incipient or self clearing faults have occasionally occurred on cables of all voltages but tend to affect L.T. cables relatively often, as might be expected. Thus a faulty cable has been known to stay in service for several months, operating the protection occasionally until the cores finally burn through completely.

Consumer services where tapped off the underground distributor are fused with 60 A or 100 A fuses at the consumer's meter position.

Protection of Transformers:

In dealing with this subject, the smaller transformers will be dealt with first. Generally, on the Durban Corporation System, the two main causes of transformer failure are breakdown between turns on the H.V. coil and overload. Core hot spots have, however, accounted for some failures.

The smallest transformers on this system are in the main of the pole mounted type, single phase and three phase, varying from about 10 K.V.A. to 50 K.V.A. and operate off E.H.T. (either 6.6 K.V. or in certain areas, 11 K.V.).

Protection on the H.V. side invariably consists of expulsion type fuses situated in each phase and of such rating as to safely carry a certain amount of transformer overload as well as co-ordinate with the L.V. protection for faults occuring on the L.V. side.

The L.V. protection consists usually of H.R.C. fuses, the fault clearing time of which is so short that co-ordination with the H.V. is assured. However, many of the older pole transformers are fitted with rewirable type L.T. fuses which have a far longer melting time than H.R.C. fuses, for the same ratio of fault current to fuse rating. This unfortunately results in many H.V. fuses being blown for L.T. faults. This position is slowly being rectified with replacement of all rewirable fuses by the H.R.C. type.

The worst conditions for co-ordination between H.V. and L.V. fuses occur for maximum expected fault currents, with a balanced three phase fault on the L.V. side of the transformer. Fuse co-ordination is satisfactory when the fault clearing time of the L.V. fuse is about ½ of the H.V. fuse pre-arcing time for the primary and secondary fault currents calculated assuming zero supply impedance and about 5% impedance for the transformer. This consideration usually dictates the rating of the H.V. fuses, the L.V. fuse rating being fixed by the L.T. distributor size.

The standard sizes of L.T. H.R.C. fuses as adopted by the Durban Corporation for pole type transformers are 60 A, 100 A and 150 A, the 60 A size only being used in the case of one or two consumers being supplied from the one transformer.

Also, the standard sizes of expulsion type H.T. fuses adopted for pole transformers are 5 A, 8 A, 10 A and 15 A, the first three sizes being fast burning and the 15 A, a slow burning type.

Transformers situated in substations and kiosks ranging in size from 50 K.V.A. to about 500 K.V.A., 11 K.V. or 6.6 K.V./380 volt are usually supplied through unfused links on a ring-main-panel as depicted in Figure 2. In some cases, the ring-main-panel is fitted with fused links to supply the transformer.

The L.T. protection of substation transformers has already been dealt with in the section of this paper dealing with the protection of underground cables.

To protect transformers from about 500 K.V.A. to 1,000 K.V.A. in size situated in kiosks, an O.C.B. in a ring-main-unit is used. This O.C.B. is fitted either with an I.D.M.T. relay for overcurrent and earth leakage or time lag fuses, also wired for overcurrent and earth leakage as described earlier. In the case of the relay, the settings would be the minimum allowing for a slight margin of transformer overload and the distributor cable relav at the substation would have its settings increased to allow about 0.4 second difference in operation for a three-phase or earth fault at the kioks transformer.

The major substations in most cases on the Durban Corporation System consist of two identical 33 K.V. cable/transformer feeders, each feeding separate sets of E.H.T. busbars at the substation, one side of which is shown in Figure 3(a), (b) and (c). The transformers are either 5, 7.5, 10 or 15 M.V.A. each, 33/6.6 K.V. ratio (in one case 33/11 K.V.), and are in the case of the 7.5, 10 and 15 M.V.A. ratings, run as dead end feeders with the 6.6 K.V. busbar coupler open in order to limit the 6.6 K.V. fault level in the vicinity to 150 M.V.A. However, it is sometimes advantageous to run with the transformers in parallel when their ratings do not exceed 5 M.V.A. each.

Major Substation Protection 33-6.6Kv. as used by the Durban Corporation.

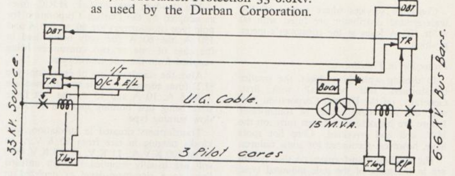


Fig. 3(a).

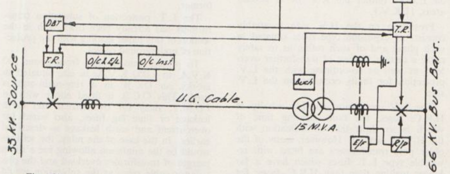


Fig. 3(b).

Figs. 3(a) and 3(b). Used with Long Cable - Transformer Feeders.

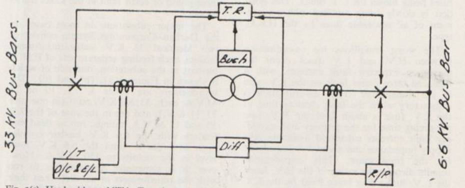


Fig. 3(c). Used with 15 MWA. Transformer at Substation with 33Kv.OCB's.

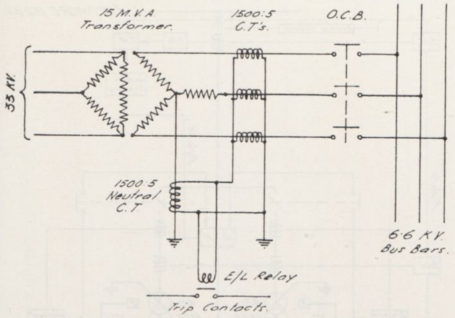


Fig. 4.

If a transformer or cable fault should occur and the transformers are not running in parallel (referring to Fig. 3(a)), the Translay relay at the source end of the feeder would operate only causing the tripping relay (T.R. in Fig. 3 (a)), at the 33K.V. end of the feeder to operate, which it turn would operate the 6.6 K.V. O.C.B. at the substation end, via a surge proof type D.B.T. intertripping relay. This inter-tripping feature is installed to avoid the possibility of energising the 33 K.V. side of the transformer and the cable from the 6.6 K.V. busbars without an earthed neutral point.

Directional overcurrent or so-called "reverse power" protection is installed at the 6.6 K.V. end (referring again to Fig. 3(a)), as a back up to the Translay to avoid the possibility of feeding back into a fault on the 33 K.V. side from the 6.6 K.V. busbars in the event of the two transformers being run in parallel. Polarising of this directional relay is effected by means of potential transformers installed on each power transformer.

Bucholz protection is always installed on the large transformers under discussion, tripping the 6.6 K.V. O.C.B. directly and the source end 33 K.V. O.C.B. also, by means of a second intertripping circuit as shown in Figure 3(a).

The only other protection necessary is the I.D.M.T. overcurrent and earth leakage installed at the source end as back-up.

However, there are two cases on the Durban Corporation of 15 M.V.A. transformers without unit protection. Very light I.D.M.T. earth leakage settings are used at the source end to protect the entire 33 K.V. winding in the transformer, in addition to high-set instantaneous overcurrent protection, set to operate for cable faults only.

The 6.6 K.V. winding of this transformer is covered by restricted earth fault protection, the basic circuit of which is given in Figure 4.

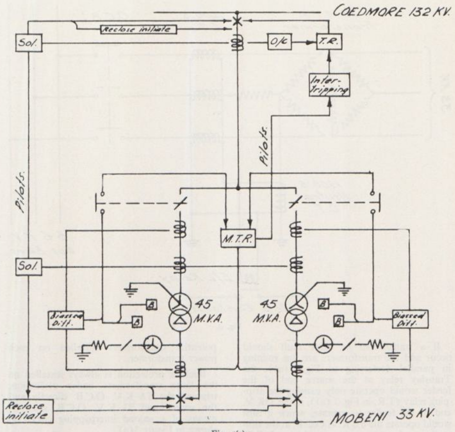


Fig. 5(a).

Restricted Earth Fault Protection:

The restricted earth fault relay is of the instantaneous type set to cover about 90% of the 6.6 K.V. windings. It is difficult by this method and any other known economic method to protect satisfactorily the remaining 10% of the winding adjacent to the neutral point.

Otherwise the rest of the protection of these transformers is the same as that shown in Fig. 3(a).

One of the most popular forms of protection for large transformers belonging to the delta-star or star delta groups is the "biassed differential" type, or to be more explicit, is a current balance system consisting of a relay operated by the unbalance between transformer primary and secondary currents and restrained by "through" current. It is also sufficiently flexible to remain stable when using on-load tap-change gear, but can be set so lightly that tripping may be caused by the comparatively long transients which occur when energising large transformers. To offset this effect, the relay element itself is of the induction disc type with an adjustable inverse time characteristic.

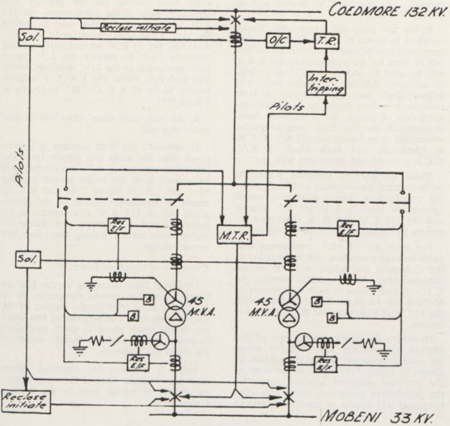


Fig. 5(b).

This protection is used by the Durban Corporation at Alice Street substation and is shown in Fig. 3(c) where there are 33 K.V. O.C.B.'s controlling the 15 M.V.A. transformers.

A brief description will now be given of two alternative forms of protection proposed for the new 90 M.V.A. Durban Corporation substation at Mobeni. This new substation will consist of two 132 K.V. overhead line feeders, each terminating on two 45 M.V.A. 132/33 K.V. transformers.

In both proposed schemes each transformer will be supplied, from a set of 132 K.V. disconnects and will feed the 33 K.V. busbars through an O.C.B. The transformers will be star/delta with the 132 K.V. neutrals earthed, to enable graded H.V. insulation to be used, and a 33 K.V. earth will be obtained by means of an earthing compensator connected directly to the L.V. terminals of each transformer. The neutrals of these will then be earthed via a link and liquid resistor. Since the two transformers on any one feeder will be run in parallel, only one 33 K.V. neutral will be earthed at a time.

In the first proposed scheme, one feeder of which is shown in Figure 5(a), it is contemplated that biassed differential protection will be used for the transformers and Solkor will be used to protect the 132 K.V. line. In addition, this line protection only, will initiate single shot auto-reclosing at both ends so that there would be no lengthy interruption of supply for a transient fault. However, if the line fault were to persist subsequent to reclosing, the 132 K.V. O.C.B. at Coedmore and both local 33 K.V. O.C.B.'s would trip again and lock out.

There will also be Buchholz protection on both main transformers and both earthing transformers, which protection would operate the local 33 K.V. O.C.B.'s directly and the 132 K.V. O.C.B. at Coedmore remotely by means of intertripping via pilots.

For back up, I.D.M.T. overcurrent and earth leakage protection will be installed at the Coedmore end which will not initiate auto-reclosing. As a matter of interest, the C.T.'s of each phase in each transformer at Mobeni will be parallelled to balance with the C.T.'s at Coedmore for the Solkor protection.

However, on expert advice, we of the Durban Corporation will probably adopt the second proposed protection scheme as shown in Figure 5(b). This is the same as the previous proposed scheme except for the transformer protection which it is contemplated will consist of sensitive restricted earth fault current on the primary and secondary sides of the transformers, the 132 K.V. neutral current being used to restrict the H.V. earth fault protection to the H.V. windings, the 33 K.V. neutral current being similarly used to restrict the L.V. earth fault protection to the L.V. windings, bushings and L.V. cable, the L.V. C.T.'s being located in the 33 K.V. O.C.B.'s as shown in Figure 5(b).

In this way, each transformer will be protected as a unit.

In addition, for both schemes it is proposed that the main trip circuit from the protection circuits of each transformer will be isolated from the feeder master tripping relay (M.T.R. in Figure 5 (a and b)), by means of auxiliary contacts in the appropriate set of 132 K.V. disconnects in the event of that transformer unit being removed from service leaving the other still in commission.

Protection of Overhead Lines:

Overhead lines belonging to the Durban Corporation have proved themselves to be by far the most troublesome portion of the electrical system. The majority of line faults are of the single phase to earth type since flashover and breakdown usually occurs at the site of the insulators.

Table 2 indicates the electrical failure rates for overhead lines of the three principal classes of voltage used by the Durban Corporation.

Table 2

	33 K.V.	E.H.T. 6.6 K.V. & 11 K.V.	L.T. 500 v. & 380 v.
Average route miles over specified period	33.5	225	753
Persistent Faults:			
Caused by storm	32	67	23
Miscellaneous causes	20	435	152
Total faults per 100 route miles per year	34.4	112	11.7

This analysis was made over the period August, 1957 to July, 1959, i.e. 24 months. Unfortunately, the statistics for transient line faults over this period are unreliable due to the operations of numerous pole mounted auto-reclosers, both automatically resetting and weight operated types. The logging of readings over this long period is also not sufficiently accurate since counter readings include occasional manual operations of auto-reclosers for line maintenance.

As can be seen from Table 2, the fault record for E.H.T. overhead lines on the Durban Corporation system is poor by comparison with that of certain other similar systems and is mainly attributable to the fast growing vegetation in the Durban area.

At times, with our shortage of staff, we have found it difficult to attain the requisite degree of maintenance under these conditions.

The simplest form of protection for E.H.T. overhead lines is the expulsion fuse which is widely used by the Durban Corporation. The recently adopted standard sizes of expulsion fuses are 5, 8, 10, 15, 25, 40, 65 and 100 amp. conforming with the preferred standard ratings as laid down by N.E.M.A. of the U.S.A. (except for the 5 and 8 amp sizes), 15 amp through to 100 amp sizes are of the slow burning type, which are usable with the new auto-reclosers, about which more will be said presently, and yet which will still afford satisfactory protection for transformers of such size as to require fuses of these high ratings. This eliminates carrying stocks of fast and slow burning fuses of the same ratings and the consequent confusion of faults staff and linesmen, etc., when replacing.

These fuses have to conform to a specification drawn up by the Durban Corporation regarding the current/pre-arcing time characteristics.

This specification, having sufficiently generous limits to allow most fuse manufacturers to tender, lays down that fast blowing fuses (5, 8 and 10 amp.), must melt in 0.1 sec. at a current lying between the limits of 10 and 15 times the fuse rating and that slow blowing fuses (15 and 100 amps.) must melt in 0.1 sec. at a current lying between the limits of 20 and 30 times the fuse rating. This specification is necessary in view of the great diversity of makes of fuses of this type on the market and the rather critical requirements of the auto-reclosers.

For many years, three phase pole mounted 11 K.V. auto-reclosers of about 75 M.V.A. breaking capacity have been used by the Durban Corporation. These have a small time delay and can in addition to the normal series trip coils in each phase, be fitted with a shunt trip coil operated from residually connected C.T.'s for each fault protection. However, this latter feature is not used by the Durban Corporation to my knowledge.

These auto-reclosers have given good service but suffer the disadvantage of having to be rewound by a linesman after a certain number of reclosing operations, which is accomplished by raising a weight on a chain.

Recently, however, the Durban Corporation has taken advantage of a new type of pole mounted auto-recloser manufactured in Britain for use on E.H.T. up to 11 K.V. This is a multi-shot auto-recloser specifically designed for one or two quick trips to clear transient faults followed by one or two (as desired) time delay trips of sufficient duration to blow the slow burning fuses used to sectionalise the line and thus isolate the portion affected by a persistent fault. The quick trips are not of sufficient duration to blow fuses, if ratings of the latter are chosen correctly.

Much literature appears to have been disseminated on this subject and it appears that the mode of operation of all makes of this type of recloser is much the same with a choice offered of tripping times and sequences, number of reclosures up to lock-out and current rating. The auto-reclosers purchased by the Durban Corporation are made as single phase units but can be ganged up together to form a three phase set with independent operation on each phase except at lock-out of one unit. when all will lock-out and so prevent single phasing of three phase loads. The tripping current is twice the rated current. Dead time

between successive reclosures is about one second to allow for de-ionization of the air at the site of flashover, burning away of bark or twigs etc., from the line before re-energising.

These auto-reclosers also have the advantage of automatically resetting for a full cycle of operations provided lock-out does not occur the actual reclosing energy being obtained from the large current solenoids in each phase. In the smaller current ratings, the thermal limitations of this solenoid dictates the maximum short circuit current that can be handled and does, in many cases, preclude the use of an auto-recloser of a particular rating in situations where the fault current is high.

The Durban Corporation have noticed quite a decrease in outages apparently mainly due to the rapid clearing of transient faults before insulation becomes thermally damaged or conductors parted.

In Britain, the tests of these same auto-reclosers at 11 K.V. by the B.E.A. over a long period under all the conditions met with in that country and using carbon tetra chloride filled fuses for sectionalising, apparently gave very gratifying results.

Results of these tests appeared in an extract from the Electrical Review of 28th September, 1956, by R. Mallett and N. C. Heathcock, and would indicate that about 80% of all the 11 K.V. overhead line faults experienced were of a transient nature and were cleared successfully by the auto-reclosers.

The tests also showed that the greatest single cause of 11 K.V. transient and persistent faults on overhead lines was lightning, which is surprising considering the lower isokeraunic level in Britain compared with that in Durban and districts. Locally, the most troublesome factor affecting E.H.T. overhead lines is bark, branches and trees being blown onto the line by wind, which is very prevalent here.

Lightning is known to account for a small percentage of the failures on the Durban Corporation system although it is often difficult to ascertain during a storm whether lightning surges or vegetation being blown onto the line actually cause the transient faults.

In order to install an auto-recloser of the type already described, the first step is to ascertain the maximum line load and the

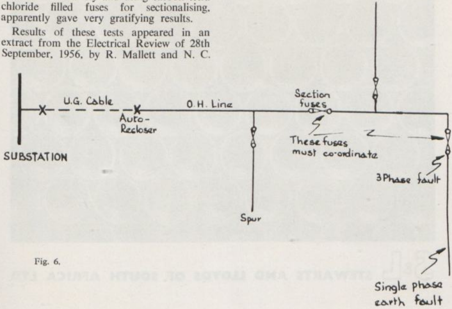


Fig. 6.

three-phase fault level at the start of the line which position would be the logical site for the recloser.

In computing the fault current at this point, the impedance of the recloser trip coil must be included and if the fault level exceeds the rating of the auto-recloser, the latter can be repositioned further along the line if the fall off of fault level is sufficient.

The line being fed from the auto-recloser is then divided up into sections as shown in Fig. 6.

A set of fuses can be inserted half way along a long line and all spurs of any length should always be fused at the tee-off points as shown.

All these "line fuses" should be of the slow burning type, the ratings being determined from tables supplied by the makers of the auto-recloser. It will be found from these tables that a fuse of a particular rating will co-ordinate with an auto-recloser of a particular rating, between two current limits. Beyond the upper current limit, the fuse melts before the first delayed trip portion of the auto-recloser cycle is reached and below the lower current limit, the auto-recloser will complete the full cycle to lock-out without blowing the fuse. Thus, correct co-ordination of fuses with an auto-recloser of a particular rating will be assured providing the maximum three phase fault current for a fault just beyond the fuse and the minimum earth fault current at the end of the particular fuse protected line section, both be within the current limits as given.

In the example given in Fig. 6, it will be noticed that there are two sets of fuses in series in the line. If the three phase fault current for a fault just beyond the second set of fuses is not too high and there is sufficient difference in the ratings of the two sets of fuses, they will co-ordinate with one another, i.e. the smaller fuse in the more remote section will blow without damage to the fuse nearer the source.

Regarding co-ordination between E.H.T. fuses of different ratings, a rule as given in a publication of an American fuse manufacturer, states that co-ordination can be achieved with adjacent N.E.M.A. preferred standard sizes if the prospective fault current is not greater than 24 times the rating of the smaller fuse for slow burning fuses and not greater than 13 times the rating of the smaller fuse for fast burning fuses.

The schedule of sizes used by the Durban Corporation is the N.E.M.A. preferred standard (except for the 5A and 8A sizes) as stated before, which standards appear to have been adopted by certain British manufacturers (i.e. those whose tenders would be acceptable to the Durban Corporation.)

The next problem which faced the Durban Corporation with auto-reclosers was to make them co-ordinate with the substation protection.

We found that, when using I.D.M.T. over-current and/or earth leakage at the substation, for a certain primary current setting of the I.D.M.T. overcurrent relay, the time multiplier setting had to be sufficient to cover the cumulative tripping time for a complete cycle of the auto-recloser taken for several fault currents up to the maximum possible, i.e. for a fault just beyond the auto-recloser. This is necessary as the time/current characteristic curve for the standard I.D.M.T. 3/10 relay and auto-recloser are not the same. The two curves for any particular case are superimposed on graph paper so that at all points the characteristic of the substation protection lies above that of the auto-recloser. In this way, satisfactory time multiplier settings for the substation I.D.M.T. overcurrent and earth leakage relays can be obtained. No allowance is made for partial resetting of the induction discs of the I.D.M.T. protection during the auto-recloser dead times between successive auto-reclosures while a fault is on.

In order to demonstrate the performance of these auto-reclosers at 11 K.V. on the Durban Corporation system, statistics were obtained for two installations, one at New Germany and the other at Botha's Hill. At New Germany, the three-phase 50 A. auto-recloser, since its installation about 26th January, 1959, has had a total of 75 trip operations on all three phases up till 4th January, 1960. These were caused by three permanent faults which correctly caused the appropriate fuses to blow and 36 transient faults, 31 of which were cleared correctly, supply being restored without fuses being blown. In the case of five transient faults, fuses were blown before the first quick trip operation of the recloser. One of these incorrect operations was due to a wrong sized fuse, another was due to excessive fault current during abnormal switching conditions at the substation and the causes of three were unknown.

Therefore, if this auto-recloser had not been installed, there would have been 39 interruptions to the entire overhead line instead of only three interruptions to about half this circuit at any one time; a remarkable improvement in continuity of an essential service for a capital outlay of about £500.

In the case of the 3 phase auto-recloser installed at Botha's Hill, the record is also quite impressive.

From 21st March, 1958 to 31st December, 1959, i.e. a period of 22 months, there were 3 permanent faults which caused fuses to blow correctly, and approximately 113 transient faults, where fuses were quite correctly not blown. The cause of one incorrect operation is unknown.

Unfortunately the number of transient faults as recorded is only approximate since the number of recorded auto-recloser operations includes manual operations for switching purposes. Prior to the installation of this auto-recloser, this overhead line was protected with an auto-reclosing O.C.B. situated in Hillcrest substation. Thus it is difficult to assess the improvement in this particular case.

Apart from pole mounted auto-reclosers for overhead lines, the Durban Corporation uses reclosing O.C.B.'s in substations at E.H.T. and 33 K.V. The protection in these cases consists of the usual I.D.M.T. overcurrent and earth leakage relays and autoreclosing is accomplished by a heavy spring, charged by a motor. In one or two cases, reclosing is effected with a d.c. solenoid supplied from a selenium rectifier. However, tripping is relatively slow and many transient faults develop into permanent faults by shattering insulation or burning away conductors.

The matter of earth fault currents that are too light to operate either I.D.M.T. earth leakage protection at the substation or the auto-recloser feeding an E.H.T. overhead line, have given us of the Durban Corporation a problem for which there seems no solution at present.

This condition sometimes arises when earth wires (which are nearly always used with E.H.T. overhead lines) are stolen and has also occurred at E.H.T. voltages and 33 K.V. when one phase of the overhead line has parted at an insulator, the load side of the parted line falling to ground only.

However, I have no doubt that in the fullness of time, this problem will be solved by the use of transistor or magnetic amplifiers to detect and magnify primary earth fault currents of only a few amps.

One of the difficulties in accurately determining the incidence and possible cause of time faults on the Durban Corporation system is the lack of suitable instrumentation of the recording type connected to the line.

A very successful fault recorder of reasonable cost, known as a "Perturbograph" is on the market but so far has not been used by the Durban Corporation.

This instrument which avoids the use of cumbersome photographic processes, consists of a current operated pen for each of the three phases, recording traces continuously on an inked drum. This record is continuously erased after each revolution of the drum so that under no fault conditions, no recording chart is used. However, when a fault occurs, a current solenoid removes the eraser and engages the recording drum with the paper chart for several seconds after the inception of fault. Thus, traces for three phases are obtained starting a second or two before the occurrence of the fault, indicating how it spreads to other phases and the magnitude of fault current in each phase all up to and beyond the time of clearance of the fault.

Busbar Zone Protection:

At present, the Durban Corporation has only one installation of this sort in operation and that is on the 33 K.V. busbars in Alice Street substation.

There, a single set of busbars is split into two sections by a bus-section breaker.

Currents are summated for all breakers on each of the two sections of the busbars, the current in the bus-section breaker only being common to both summation circuits.

If a busbar fault occurs in one section, an out of balance current is set up in the summation circuit on that section, tripping all breakers associated with that side including the bus-section breaker.

Tripping is instantaneous and in addition, the condenser sections in the busbar insulation are connected to sensitive leakage indicators which give an alarm only, in the event of low current leakage.

Overvoltage Protection:

On the Durban Corporation System and most other electrical systems in South Africa, the majority of overhead line insulation breakdowns due to overvoltage are caused by lightning charging the overhead conductors either by direct striking or in the majority of cases, the steep magnetic flux wavefront originating from the heavy stroke current of a near flash cutting the overhead conductors over a distance of many hundreds of yards.

This causes steep voltage and current surges to travel along the line until a discontinuity or sharp change in surge impedance is experienced, such as a transformer. The surge impedance of a transformer winding, particularly the H.V. winding, is high, resulting in nearly all the surge voltage appearing across the first few turns of the winding.

Rod type spark gaps are often used to protect transformers (and other electrical apparatus), mounted externally across the H.V. bushings but are not entirely satisfactory because apart from the inevitable power follow-through arc, the breakdown characteristics are different from those of other forms of insulation such as oil, paper or porcelain.

Generally, rod gaps have a high initial value of breakdown voltage which falls relatively slowly with time. This means that in order to protect equipment against very steep wavefronts (say 1 micro-sec. to wave-crest) the rod gap would have to be set so small to protect the piece of apparatus concerned, that long duration voltage surges of relatively small magnitude would operate the gap unnecessarily.

Thus in order to protect transformers, etc., which reach a constant value of breakdown voltage after about 3 micro-sec., the valve type arrester or surge diverter consisting of totally enclosed multiple spark gaps and non linear resistor has proved to be most satisfactory, reaching a steady breakdown value in about 1 micro-sec.

This enables a much higher gap setting to be used without danger of unnecessary spark over, the non-linear resistor having a sufficiently high resistance to extinguish the power follow through arc at the gap.

As far as the overhead lines themselves are concerned, the only protection against direct strikes and then only partial protection is to construct the line with a high earth wire connected to an earth mat or counterpoise at each pole or tower. The earth wire, if high enough above the conductors acts as an "umbrella" intercepting the stroke. Insufficiently low tower or pole footing resistance defeats the object of the whole scheme since the stroke current would set up sufficient voltage between earth and the metalwork of the top of the pole to flash over to the line.

However, this scheme alone, when correctly executed, is no protection against induced surges from nearby lightning strokes. This problem can be partially solved for voltages up to about 22 K.V. by constructing the so called "high impulse" line, the poles and cross arms of which consist of treated wood with no electrical bonding between insulator clamps and pins. The earth wire is omitted completely and all stays insulated, with or without a horn gap across this insulator. Therefore, only near strokes of high intensity would cause flashover either between conductors or from conductors to earth down the length of the pole.

This latter form of construction has not been generally adopted by the Durban Corporation because of the danger of fallen lines remaining alive in relatively densely populated areas with the inherently low earth fault currents obtained in the absence of earth wires. Also the widespread use made of the same poles to carry E.H.T. and L.T. circuits as required in suburban areas, would preclude the omission of an earth wire.

However, from all accounts, the high impulse line has been successfully used by other supply authorities in rural areas on account of cheapness and relative rarity of direct lightning strokes to the conductors.

On a 33 K.V. line, horn gaps across each insulator string would discharge surges safely and an auto-reclosing O.C.B. when used to feed the line, would restore the supply after de-ionization of the power follow through arc at the gap. On 11 K.V., and lower, with the use of pin insulators on which spark gaps cannot conveniently be fitted, it is a matter of chance whether the insulator fails from puncture or cracking by heat in the event of flashover.

Valve type arresters are essential at all points of connection between underground cables and overhead lines, the breakdown characteristic of an underground cable being similar to that of a transformer for steep voltage wave-fronts.

Miscellaneous forms of Overhead Line Protection:

To conclude this paper, I would like to deal very briefly with some more advanced forms of high voltage transmission line protection of which I have had experience.

One fairly popular form is impedance protection using beam relays.

A beam mounted on jewel bearings is operated by a current solenoid energised from the line C.T.'s and is restrained by a voltage solenoid energised from voltage transformers. When the ratio of the line voltage to line current in any phase drops below a certain value as predetermined by the current settings of the relay, the beam tips and completes the breaker trip circuit. Thus it can be seen that the relay senses the impedance of the line from the breaker position to the point of fault. One of these elements is situated in each phase and is adjusted to trip instantaneously for phase faults occuring over a distance of up to 80% of the line length to the next substation. This is termed the "reach" of the relay.

As a back up, a similar but time delayed relay element is situated in each phase to reach about 120% of the line length, that is beyond the next substation in the line. Usually, a second set of back up elements with longer time delay is fitted to reach to about 150% of the line length.

Thus the whole relay has a 3 step characteristic as shown in Fig. 7.

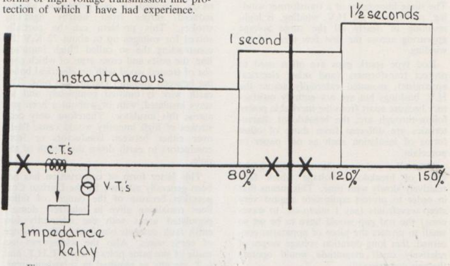


Fig. 7.

This impedance relay is also made directional so that tripping will not occur for a fault on the busbar side of the line breaker when such line is either part of a ring feed or a tie line between power stations.

A more refined version of this protection is that which uses admittance or "mho" relays, consisting of induction cups operated by a certain predetermined ratio of line current to line voltage. These elements are inherently directional, and operate most readily, or reach furthest, for faults of a predetermined power factor. The power factor setting of this relay would naturally be the same as the line power factor. This relay also has a 3 step characteristic similar to that of the impedance relays.

When this form of protection is installed at both ends of a line used as a ring feed or tie, and the relays adjusted to operate for faults within the line length, instantaneous tripping over 100% of the line or unit protection can be obtained, provided a pilot or carrier link is set up between the two relay positions at the ends of the line. This causes tripping to occur simultaneously at both ends, only if both relays have operated and blocks tripping at both ends in the event of only one relay operating, which latter circumstances would indicate a fault external to the line in question.

Another form of protection which provides unit coverage and instantaneous tripping for an overhead line is "phase comparison" protection. This consists of high frequency transmitters and receivers situated at each end of the line, the transmitters being started by a relay which operates for certain values of negative or zero sequence current in the line. From the end. 50 pulses per second of high frequency (about 200 KC) are transmitted, corresponding to the positive half cycles of specially summated line current.

These pulses are then compared at both ends in identical terminal equipment with similar pulses transmitted from the other end, corresponding to the negative half cycles of similarly summated line current at that end.

If the pulse summation is as shown in Fig. 8(a), no tripping takes places at either end of the line indicating a fault external to the protected line but if the pulses overlap by more than about 30° as in Fig. 8(b), tripping occurs instantly at both ends indicating a fault in the protected line section.

I have seen 132 K.V. installations of this type combined with high speed auto-reclosing breakers at both ends capable of clearing a fault in about 4 cycles. The dead time of these single shot auto-reclosers is about 20 cycles, this apparently being quite sufficient for arc de-ionization at this voltage. The result is a faintly discernable dip in supply for a transient line fault.

"Out of Step" Protection:

This is used on tie lines between two systems or power stations.

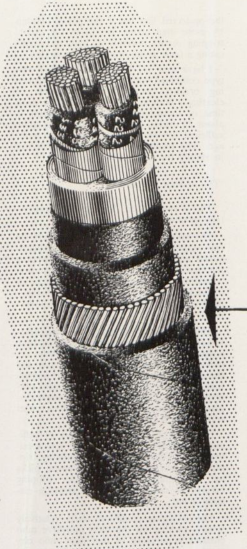
The object is to allow swing between the two stations to reach a certain predetermined angular displacement before tripping the breaker in the tie line. Thus connection is maintained between the two stations up to the point of no recovery or "out of step," after which it is pointless to retain connection.

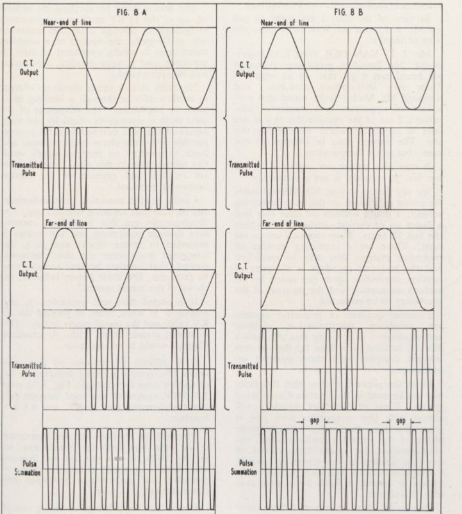
This is achieved by two similar non-directional "mho" relay elements similar to those already described, one set very lightly, i.e. pick-up for small current/voltage ratio and the other set to trip the breaker after a small time delay for a current/voltage ratio corresponding to the critical phase angle displacement between the two stations, after which there is loss of synchronism.

However, if a line fault occurs of sufficient admittance to pick up the less sensitive "mho" element used for initiating tripping, the more sensitive mho element picks up simultaneously and blocks tripping before the delay time of the tripping element is up.

The swinging condition starts relatively slowly, picking up the more sensitive mho element in advance of the other mho element, making the trip blocking feature inoperative.

In conclusion, I would like to thank the City Electrical Engineer and the City Council of Durban for the privilege of presenting this paper.





Power stable, indicating an external fault.

Protection operates, fault within protected section of line.

THE PRESIDENT: Thank you very much, Mr. Michel-Smith for that very interesting contribution to our Proceedings.

In view of the time I am going to call on Mr. J. L. van der Walt to propose the vote of thanks.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, gentlemen: Although we heard last night that we as engineers know very little about economics, and although Mr. Michel-Smith stated that protection of apparatus is a matter of economics, I am of the opinion that this is one field in economics where we can say our say. The answers may be different in this case—but so are the questions.

It may also reduce our profits if carried too far. It certainly is not a monopoly.

We say thanks to you, Mr. Michel-Smith, for giving us a paper on this very interesting subject. I doubt whether we have ever had a paper on protection—certainly not within the last 12 years, if my memory serves me right. There are a confusing number of protective systems that may be employed and the best one to adopt is a matter of opinion, depending upon (as stated by the author) economics, and the purpose of the machinery to be protected.

Essential qualities of protective systems are simplicity, discrimination, stability and sensitivity. It is a pity that our author did not indicate to us how far their system selected complies with these essential requirements.

From the paper it is clear that simplicity was the keynote in the Durban Corporation system. Some of the Reef members will almost with glee sympathise with you in your difficulties experienced with the complying of the second essential quality, viz. discrimination, due to the limits placed on the time settings by the Electricity Supply Commission; but I will leave that for Mr. Milton to defend. I think he is quite capable of doing so.

Due to this limit, however, I have come to the conclusion that it is a waste of money to design schemes with the auto recloser relays with a view to obtaining discrimination. We are therefore compelled to revert back to what is now referred to as the old-fashioned system, O.C.B's with overload clip coils, for any apparatus beyond the second substation from the E.S.C. supply point.

The reason given for earthing the neutral of one of the 33 KV earthing compensators at Springfield, through a 12 ohm resistance was at Congella, the neutral of a coupling transformer is solidly connected to earth, is not clear, and a more detailed explanation will be appreciated.

Normally it is a vexed question whether to earth solidly or through a limiting resistance or impedence. The advantage of the solid earth is given as its simplicity, the magnitude of the fault currents to earth is comparable with inter-phase fault currents, and there is therefore no need to supply sensitive relays. Due to this also, clearing times are reduced and expense of the current limiters is excluded.

Lastly, graded insulation on transformers can be used thus reducing size and cost. The disadvantages are that large fault currents may damage equipment and the system is subjected to severe shocks and in a star connected transformer the third harmonic currents that circulate between neutrals may be excessive. Did these factors influence the choice of this mixed system?

It is stated that unit protection is also employed in some cases to protect the 33 KV cable and the transformers jointly. This statement sounds rather Irish. A schematic diagram would be of assistance.

It is difficult to visualise all apparatus under this system as being included in the protective zone for example, Fig. 3(b) page 206 6 KV. equipment was used between current transformers, and 33 KV. and 6.6 KV bussbars.

I noticed the readiness of the Department to use open type links for transformers up to 500 KVA. Is this practise not frowned upon today—especially taking the safety of operating and maintenance personnel into consideration?

I have had the privilege of seeing one of your new buss-zone protection relay panels, and I am of the opinion, sir, that you have been done out of approximately 12 relays, because somewhere in the back of my mind, I remember a lecture given at Kelvin House where the opinion was expressed by an expert that approximately 32 relays are required for a really fool-proof buss-zone protection system. Your board only had 20, sir!

With buss-zone protection, economics really come into the picture. How far must one go? There appears to be no end to the number of relays possible, and your one essential quality, simplicity, is lost. Is the price paid for this insurance not too high?

It gives me great pleasure, Mr. President and gentlemen, to propose a hearty vote of thanks on the valuable paper by Mr. Michel-Smith.

I trust that as he has decided to become an educationist, he will deliver to us products of a high standard which our industry is bound to require more and more in the future, due to our present day phenomenal technological advancement. We are indeed indebted to him for this instructive lecture. (Applause).

THE PRESIDENT: Thank you Mr. Van der Walt.

I now call on Mr. Giles, of East London to second the vote of thanks.

Mr. P. A. GILES (East London): Mr. President, I wish to congratulate the author on the excellence of his paper.

This paper sets out very clearly the calculations and investigation involved in selecting an economic and effective protection system for a large electricity undertaking. I must stress the economic angle, because this is a matter which is possibly the theme of this conference.

The paper describes also the method evolved to provide co-ordinated operation where necessary. The protection of a distribution system against internal and external faults is a vital part of the general management of a distribution system, whose main requirement, apart from adequacy and cheapness, is continuity of supply. Under modern conditions, an interruption of electricity supply can be extremely inconvenient and costly to the consumers.

The author has indicated the precautionary measures to be taken to deal with faults once they have taken place, but I submit that there are two other aspects of protection which are not mentioned, and which apparently are beyond the scope of the paper, but they seem to me to have considerable significance.

The first concerns the design and the operation of a power system under normal conditions of supply where no disturbance is at present. I am thinking of overload and transfers of power.

The second concerns the causes and effects of disturbances and the precautionary measures taken to reduce these faults to a minimum—insulation values and clearance distances fall within this aspect of the matter.

It may be said that these two aspects which are mentioned are the concern of the planning staff, but it would be of considerable interest to know the relative values assigned by the author to these closely related aspects of continuity of supply.

The author has listed the main types of protection, installed and used in Durban, and has indicated the choice of any particular system depends largely on the degree of continuity expected for any load. The extent of continuity expected depends again very much on the nature of the load, and the economic importance to the supplier. It would therefore be of considerable value if the author would mention the background of the value of the importance of the loads protected by the various types of systems described in the paper.

I should say from the economic angle, a basic feature of a distribution system is that it is required to be used to the fullest extent and the protective system is a vital factor in this regard.

It is agreed that the function of a protective system is to discover the fault and locate it. The circuit breaker, which then should speedily operate, is a strong arm which isolates and removes the fault from the systems workings. The joint function of these two components is mainly to minimise the thermal damage done to the site of the fault, as stated by the author. However, the total system should also ensure that healthy pieces of equipment are not damaged or infected.

Lastly the system should avoid dislocation of the power system through instability.

The integrity of the protective system is largely dependent on the maintenance given to the various components as given by the author, and further information on this point would be of value, because protective systems which are sound in principle may be easily restricted in application owing to limitations of relay performance, but whether this is due to design or otherwise cannot be ascertained unless an adequate maintenance programme is carried out.

The author's views on back-up protection and the necessity or otherwise, would be of value, especially on 33 KV cables. The author has demonstrated that back-up protection is adequate, but to the conservative engineer back-up protection has value, especially as a pilot cable is vulnerable. Distribution engineers are always hopeful that satisfactory schemes will be prepared for the protection of distribution circuits without the necessity of using pilot cables.

Consider for example the case for the protection of a comparatively short underground cable system. Pressurised cables with 33 KV. working have their cable sheaths protected by means of rubber covering which although primarily to prevent corrosion of cable reinforcements provide insulation between the cable sheath and the earth.

Considering an all insulated joint type system, I would ask the author if discriminatory backup protection could be adopted without the use of pilots by the position of a simple leakage to frame type system, the sheath of the cable being treated as the frame, and connected to earth through a current transformer at the sub-station end? This type of protection could possibly apply to cables in general provided the joints are insulated from the general mass of the earth.

In conclusion, Mr. President, I wish to say I have read the paper with great interest and appreciation and have very much pleasure in seconding the vote of thanks proposed by Mr. Van der Walt (Applause).

THE PRESIDENT: Thank you Mr. Giles.

Mr. Michel-Smith, would you care to reply now?

Mr. MICHEL-SMITH (Natal University): Mr. President, gentlemen:

In reply to Mr. Van der Walt's question concerning the apparent simplicity of the Durban Corporation's electrical protection system I must say that with the bulk of the 6.6 KV., 11 KV. and 33 KV Durban systems underground, protection need only be simple due to the fact that earth faults are almost always heavy, giving positive operation of relatively insensitive protection and there is also very little auto reclosing required. Almost all feeders are radial or dead ended with not often more than about two substations along a route between any two successive stepdown transformer positions, thus simplifying the requirements for time discrimination between tripping of breakers. This further simplifies the protection required.

Replying to Mr. Giles' question regarding the use of frame earth leakage protection by the Durban Corporation I can only state that this method has apparently never been seriously considered and the installation of such protection on existing switchgear would be uneconomic. I dare say that satisfactory operation would have been achieved, especially with our system of cable feeders terminating on iron-clad gear, if this method had been used from the beginning. I think that is about all gentlemen.

THE PRESIDENT: Thank you Mr. Michel-Smith. Just one or two points that I might help with.

I think Mr. Van der Walt raised the question of steps being taken to overcome some of the troubles. I presume he was referring to the high fault incidence on our high voltage lines. In many cases our lines were constructed with safety as the main factor and the close proximity of an earth guard fitted to earth falling wires has given a very high fault incidence. The introduction of Auto Reclosers and a higher impulse type of construction is being introduced as re-construction takes place.

Mr. Giles commented about maintenance: I quite agree that one of the best forms of protection is an adequate maintenance programme and correct checking of relays, both of these must proceed all the time.

Thank you, Mr. Michel-Smith.

The paper is open for discussion.

Mr. C. LOMBARD (Germiston): Mr. President, gentlemen: I would like to thank Mr. Michel-Smith for his very fine paper which I am sure will give rise to considerable discussion. I fully endorse the author's introductory remarks to the effect that complicated protection schemes should be avoided as far as possible in the interests of reliability. This does not mean that I advocate cheapness, Mr. President.

I am rather puzzled by one of the author's remarks under protection of "underground cables."

He quotes typical earth fault relay settings for distribution cables, which are the minimum obtainable in order to provide sensitive earth fault protection for transformers situated in kiosks and then goes on to say that they are bound to co-ordinate satisfactorily with low voltage protection in the kiosk. Surely low voltage, phase to phase, or earth faults, will not affect the earth fault protection provided on the high voltage side of the transformer.

With regard to restrictive earth fault protection I would mention that with this type of protection, care should be taken to avoid instability under tension and true fault conditions. Stability can be ensured by providing a suitable stabilising resister in series with restrictive earth fault relay. Lower fault settings can be obtained by using compensated or bias type relays.

The author mentions that the most popular type of protection for large transformers belonging to the Delta Star or Star Delta group is the bias differential type, the induction type, inverse time delay relays being used to ensure stability with switching surges.

He also states that this type of protection is used at Alice Street Substation. I would like to ask that author for his views on, and whether the use of high speed percentage differential protection, with harmonic current restraint was considered. This would provide instantaneous protection with its attendant advantages.

The author has given us some details of the fault record for E.H.T. Overhead lines on the Durban Corporation system. It is quite understandable that lush vegetation in the Durban area must be a serious source of trouble to the Durban Electricity Department. Can the author tell us whether any attempt has been made to control brush growth underneath power lines by chemical spraying?

The author mentions in his paper that valve type arresters are essential at all points of connection between underground cables and overhead lines. According to the (Analok) Computer studies made by Witschuur & Bliss of the Westinghouse Company some years ago, depending on certain factors, such as size and length of cable, etc, reverse protection is often necessary at both ends of a cable connected to an overhead line. This should be borne in mind, as it is normal practice to provide surge protection at the junction of the overhead line and cable only.

The author has remarked on the difficulty of obtaining earth fault protection as small percentages of line current using the usual inductive relays. According to a recent article, a range of equipment has recently been introduced which incorporates polarised relays. Such relays need only .20VA. for operation, the value one fifteenth of that taken by induction relays, thus considerably reducing the demand on the associated current transformers, and thereby increasing the sensitivity. A simple circuit is used for this protection.

A current transformer or the residual circuit of three current transformers, feeds the full wave bridge rectifier, whose output passes through a low consumption relay operating at about 1.3 times the setting current. Its operation applies D.C. to a series resistance capacity circuit, which acts as a time delay, the polarised relay being connected across the capacitor to actuate the control circuits. By varying the series resistance any time delay between .5 to 10 seconds can be obtained. Three ranges are available for earth fault protection, the choice being in the groups 2½—10%, 5—20% and 10—40%.

I understand that a more sensitive unit is under design, which will need only about .02VA. This may supply the answer to some of our problems.

In conclusion, Mr. President, I would just like to put another question to the author (this does not really relate to protection), but I would very much like to know whether the demands of Durban's three supply points are summated for accounting purposes or not?

THE PRESIDENT: Thank you, Mr. Lombard.

Mr. A. R. SIBSON (Bulawayo): Mr. President, since this paper by Mr. Michel-Smith is of a very specialist nature, I took the opportunity of inviting my distribution engineer to comment on it, and he has prepared a rather lengthy contribution which I have handed to the Secretary. The matters that it discusses are perhaps of more direct interest to the Durban Corporation itself than the Convention as a whole, so I do not propose to read the whole paper out.

I think the main point made by my distribution engineer is the tendency in large power undertakings to earth the neutral too infrequently, and when the notes have been prepared are in the Proceedings, they will, I am sure, be of particular interest to the Durban Corporation, and perhaps to some of the other members of the Conference.

CONTRIBUTION BY
Mr. H. E. SUMMERS,
Distribution Engineer, Bulawayo.

I am extremely interested in Mr. Smith's paper describing the protection used on the Durban system, and although it forms a subject on which so many technical papers have been written, it is apparent that as systems develop and depart from a series of simple radial feeders, a complete understanding of protective measures enables an economic power network to be designed, whereas if the same security of supply is to be obtained from a network, which was not designed initially to deal with the problems of protection, an impractical or uneconomic layout will be achieved.

The main impression given by Mr. Smith is one which is unfortunately found in so many Government, Local Government Undertakings and power utilities, namely the old bogey of earthing too few neutral points. I suggest that with one 33 kV. neutral neutral earthed at the coupling transformer at Congella Power Station and only one earthing transformer used effectively at Springfield Substation, the Durban undertaking is accepting unnecessary risks. If major faults which have occurred in the United Kingdom during the 1930's are examined, it will be seen that the resultant widespread multiple faults, due to a single disturbance, have been caused by inadequate neutral earthing and, if this state of affairs is to be avoided, it is only necessary to follow the simple rule, which calls for an earthed neutral point to be associated with each section of busbar, at all sources of supply. This is particularly essential at Durban, where the system is sectionalized to limit fault power. Admittedly, multiple neutral earthing increases the severity of inductive co-ordination, and if it is contrary to current Post Office Regulations, then the regulations should be modernised, so that they are compatible with the needs of modern day power networks. If the real fear, however, is the limitation of earth fault current, then a common resistor at one source of supply should be used, and as an example both earthing transformers at Springfield should be connected to one 12 ohm resistor, and moreover there will then be no trouble with harmonic circulating currents.

I note on Page 203 and from Fig. 2, that 6,600/380 volt transformers of 50 to 500 KVA capacity are not provided with local H.V. protection. The writer has experienced faults on the L.V. terminals of similar transformers, which due to arc resistance have only raised two and a half times full load current, and since breaker F in Fig. 2 may control 5 or more transformers, there is a grave risk of a fire occurring, if an arcing fault should develop on the L.V. side of a transformer. I would therefore, like to ask the author whether in his opinion the savings incurred in using an isolator in place of a breaker or fuse, justify the acceptance of this risk, and whether the isolator has a making capacity equal to the system fault level.

I assume that delta-star connected distribution transformers are employed, therefore the co-ordination of H.V. and L.V. fuses described on Page 205 should not be based on the symmetrical three phase fault, but

on a phase to phase fault on the L.V. side of the transformer, when a 2/1/1 fault current distribution is experienced on the H.V. side of the transformer.

The schematic arrangements of protection for parallel transformer feeders shown in Fig. 3a and 3b are of interest, since if system development permits their adoption, this form of transmission is most economic, but I would like to ask the author why IDMT 33 kV earth fault relays are employed, because the zero phase sequence circuit is restricted by the delta-star transformers and a more robust attracted armature relay could be used, which would result in high speed tripping times. Secondly, if it can be assumed that the 33 kV cables are screened, earth faults may generally be anticipated and there will then be no power to drive the 6.6 kV reverse power relays. Therefore, does the author consider their installation is justified by the probability of phase faults internal to the transformer? I would like to mention that although 33 kV neutral displacement protection at the receiving-end substation is not completely necessary due to the intertripping facilities, I would point out that if it were installed and operated from a 33 kV voltage transformer connected star/open delta, it could be equipped with damping resistors to prevent high transient voltage occurring on the 33 kV cables when the 33 kV O.C.B. opens before the 6.6 kV O.C.B., under earth fault conditions. This protection would, under earth fault conditions also prevent the cables from being continuously energised from the 6.6 kV busbars via the 33 kV delta winding of the main transformer, if the pilot cables were damaged. These undamped transient voltages are no doubt the cause of the 3.36 faults per annum experienced in Durban on the 33 kV cable system and I would suggest the installation of neutral displacement protection with the damping resistors or to slug the 33 kV tripping, so that the 6.6 kV breaker opens before the 33 kV breaker.

I now wish to refer to the schematic arrangement shown in Fig. 5a and 5b for the Coedmore-Mobeni 132 kV connection and I agree with the author that Fig. 5b is a much better arrangement, but I would suggest the following additions.

1. In view of the limited thermal rating of the earthing transformer and resistor at Mobeni, either negative phase sequence relays should be installed at Coedmore or 33 kV IDMT standby earth fault relays energised by the 33 kV neutral current transformers, be installed at Mobeni.
2. A normally closed auxiliary switch in each 132 kV transformer isolator should be connected in series and then this circuit connected in shunt with the Solkor pilots, to allow the Solkor equipment to operate only one feeder end, when the transformer 132 kV isolators are open.
3. It would seem that in lieu of a IDMT earth fault relay at Coedmore, it would be better to install a high speed earth fault directional relay, and if 132 kV voltage transformers are not available at Coedmore, it could be polarised from the current transformer in the 132 kV neutrals of the 45 MVA 132/88 kV Coedmore/Congella transformers.

I would point out that since the Mobeni 45 MVA transformers will act as a zero phase sequence generator under earth fault conditions, it may be expedient to install a IDMT standby 132 kV fault relay at Mobeni, which would be energised from the 132 kV neutral current transformer to prevent the Mobeni transformers feeding earth fault current into Coedmore's busbars, if the protection on the Escom's system should fail to operate.

With regard to the earth fault protective problems referred to on Page 201, I would suggest that as far as the high resistance earth fault condition is concerned, a saturable current transformer be connected in the residual circuit of the protective current transformer to operate a sensitive d.c. relay, and in order to achieve transient stability, it should trip the associated circuit breaker via a time delay relay. The problem of the broken phase conductor may be readily overcome on a radial feeder, by installing neutral displacement protection at the most remote substation and allowing this relay to operate a fault throwing switch. Both components may be operated without the use of batteries and therefore, they may be installed on a pole mounting substation.

There are many other points in connection with the paper which could be mentioned, but no doubt, they will be raised by other Engineers and be the subject of extremely useful discussion. I would therefore, conclude by congratulating the author on his very informative paper.

THE PRESIDENT: Thank you Mr. Sibson.

As time is limited, we will have to conform strictly to the programme this morning, and not carry on past 12.30 so I will ask Mr. Michel-Smith if he will reply in writing to the questions which have been raised. There have been quite a number put forward by both proposer and seconder, and by Mr. Lombard, these have been recorded and will be passed to him in draft, he will then be in a position to reply through the journal.

If there is time tomorrow, we will continue with this discussion.

With those few remarks, I would like to join the other speakers and thank Mr. Michel-Smith for the trouble he has taken in producing this paper. There is a lot of useful information there, and a number of very useful contributions should arise from it. If anybody else would like to contribute in the way of questions, will you please do so in writing.

Will you please join me in according Mr. Michel-Smith a hearty vote of thanks for his paper in the usual manner. (Applause).

CONVENTION ADJOURNED AT

12.30 p.m.

FOURTH DAY

Convention resumed at 9.30 a.m.

THE PRESIDENT: Good morning. Please be seated gentlemen.

I hope I find you all well this morning. You all seem to be smiling, which is a good thing.

We will now proceed with the business of the Convention. We must wind up the Convention at 11.30. Apparently this hall has been let for an Eisteddfod which starts at 2.30 this afternoon, and they have got to get the place tidied up, so we will finish at 11.30.

During the first session this morning, we will continue with further discussions on the papers that have been read.

We will start off firstly with the symposuim, and I think Mr. Masson has a contribution he would like to add.

Mr. G. MASSON (Johannesburg): Mr. President, gentlemen:

I will not read my contribution entitled "House Wiring and Service Connections in Bantu Townships" but would like to make the following remarks about this contribution.

In Johannesburg we have endeavoured to provide an installation that the average tenant can afford. If some tenants require a better installation they should be able to get it but they must be prepared to pay for it.

The installations we have provided are I feel quite safe but very austere. It has been suggested that the austerity installation might be responsible for illegal wiring. From enquiries I have made it seems that other authorities who have provided complete installations with centrally mounted lights and individual switching are also having trouble with illegal wiring. In European townships we get illegal wiring and few people can resist the temptation to run flex around the skirting board but it is very worrying when consumers use bell wires as flexibles.

The austerity installation can be criticised because of its austerity but then we have people who say that the houses now being built will be slums in 20 years time.

The question of load building has been given much thought and the Johannesburg City Council has decided that in order to assist tenants to use electricity, particularly for cooking and bearing in mind the smog problem, to buy a small type of plug-in stove of the order of less than 3 kW capacity, and to sell these to native tenants on a hire purchase scheme. There will be a 10% deposit and the balance repayable over 12 months and the interest chargeable will be 6%.

The township where the wiring installations have been carried out is Orlando East. It is a sub-economic scheme for people in the lowest income group. The rate of connection has been slower than anticipated but it will no doubt very soon become very popular. We are however embarking upon the wiring of houses in a better class township and the results there will no doubt be interesting.

House Wiring and Service Connections in Bantu Townships

By G. Masson

INDEX

1.0 INTRODUCTION

Local Authorities and Authorities established by the Government for the purpose have performed almost unbelievable feats in their task of providing decent housing and the training of Native building workers. Large townships with neat houses, administrative buildings, etc., have arisen but one wonders whether the absence of adequate lighting in the homes and the streets is not perhaps responsible for the creation of a residential jungle with a climate of crime and conflict, delinquency and decadence.

2.0 PROBLEMS TO BE FACED IN THE PROVISION OF SERVICES

The Authorities have laid down that:—

(i) The cost of the bulk supply of electricity may be charged to the Natives Service Levy.

(ii) That the Local Authority must finance reticulation schemes out of its own loan funds, and

(iii) the provision of domestic installations must be on an economic basis.

Since the cost of wiring and service cables has to be paid by the tenant who can probably ill afford to pay an economic rental, it is essential that the installation be designed at a price that will not be a hardship to the consumer. The notes that follow are based on the assumption that:—

(a) The installation is to be provided at the least possible cost consistent with safety, and that

(b) it meets the consumer's requirements even though it is on an austerity basis.

3.0 RECOVERY OF LOAN CHARGES

If the Local Authority has to recover the cost of domestic electrical wiring it must either be in the form of rent or a monthly surcharge to users of electricity. Tenants

who have been paying a determined house rent will resist any increase in their rent to cater for the cost of wiring even though this amenity has been provided and a monthly surcharge to consumers appears to be the answer.

The Johannesburg City Council has laid down in its tariff that where it wires and connects to a main supply a private house built on land owned by the Council and provision for such cost has not been made in the rental, a charge of 6d. per month for every £5.0.0 of such cost shall be made additional to the tariff charges for electricity consumed.

It has been assumed that the life of the installation provided is 30 years and reference to an annuity table shows that the repayment of a loan of £100.0.0 at 4⅞% interest, requires an annual contribution of £6.378 for a period of 30 years. This works out at approximately 6½d. per month for a £5.0.0 loan and for convenience of application the cost has been taken to the nearest penny.

4.0 HOUSE WIRING

4.1 *Installation Design*

The basic requirements appear to be a lighting point in each room and a 15 amp. socket outlet for each house. The provision of only one socket outlet can be criticised if it is proposed to encourage the use of electrical appliances but it is assumed that for some years to come the consumer will not be able to afford many appliances.

In Johannesburg we are faced with the problem of wiring houses built more than 10 years ago. These houses, in common with those being built today, have no ceiling provided but we find that many tenants have constructed ceilings which are not strong enough to support even a lighting point. We have therefore decided on the wall bracket which is cheaper in both first cost and maintenance than the centrally mounted pendant light.

4.2 *Wiring Methods and Materials*

Reduction in the cost of an installation can be effected by making the best use of skilled and semi-skilled labour, mechanisation and possibly by the use of alternative wiring materials.

The Native houses are of standard types and there is every incentive to use mass production methods. Mass production has the advantage that semi-skilled labour can be used for repetition work and waste is rigidly controlled.

The prefabricated wiring harness is therefore the answer to the problem and the decision to be made is what type of installation and materials should be used. It is therefore proposed to discuss the advantages and disadvantages of the materials available.

(a) Mineral Insulated Metal Sheathed Cable.

The cost of this excellent cable is comparable with the cost of an equivalent length of conduit and insulated wire. It is quicker to erect than conduit but it has the disadvantage that the gland necessary to terminate a cable run is expensive. Bearing in mind the relatively short length of run required for lighting points in Native houses, it is found that this method of wiring is too expensive.

(b) Tought Rubber or P.V.C. Sheathed and Flexible Wire Braided Cables.

The advantages and disadvantages of these materials are:—

Advantages:

(i) Cheap in first cost even allowing for the extra cost of the special terminating fittings and the earth wire required for the cables with an insulated sheath.

(ii) Wiring kits can be made up very cheaply and without the necessity for special workshops equipment.

Disadvantages:

(i) The cable is not very rigid and must be closely supported where it is run on vertical walls. Due to the soft bricks used for internal walls, fixings are difficult. Alternatively, it can be encased in conduit which provides both support and mechanical protection for cable within reach. These requirements are expensive and can, for certain installations make this type of wiring equally as expensive as standard conduit wiring.

(ii) The cable lends itself to tampering by unauthorised persons and tee connections can readily be made in the length of a run.

(c) Conduit and V.I.R. or P.V.C. Insulated Conductors.

If a conduit installation has to be made up on site then the cost of screwing and bending makes it expensive.

It is appreciated that similar rooms in in different houses are not absolutely identical but any small variations in the fixing of fittings or switches is not important. Wiring harnesses can therefore be made up using standard manufactured lengths of conduit to the best advantage and with little waste. On this basis it is proved that this method of wiring is competitive in cost with the other wiring methods available.

4.3 *Cost of Wiring Installations Completed*

Figures 1 to 4 show the floor plan of the various types of houses wired and details of the points provided and the costs using conduit construction (4.2C) are shown.

Type	Number of Lights	Number of Socket Outlets	Cost of Wiring
Fig. 1	2	1	£3.10.0d.
Fig. 2	3	1	£4.15.0d.
Fig. 3	3	1	£5.10.0d.
Fig. 4	4	2	£5.13.0d.

The work complied with the following requirements:—

(i) The installation was carried out by European wiremen.

(ii) Lighting points are mounted at an average height of 7′ 6″ and angle batten holders are mounted back to back as indicated in Figure 5. The conduit through the wall is used to carry wiring and to support the lights to the wall.

(iii) Although a switch is provided for each light, the light switches are grouped as shown on Figures 1 to 4.

(iv) The lights and socket outlets are independently wired but are controlled by a single circuit breaker.

5.0 COST OF METERS, METER BOXES AND MAIN SWITCH

It has been found that difficulty has been experienced in obtaining access to houses for meter reading. A galvanised sheet metal box mounted on an outside wall has therefore been provided to house the meter, miniature circuit breaker and service cable terminal blocks. The cost of this equipment is:—

Meter box		19	0
Hardboard meter board		2	0
Meter	£3	13	4
M.c.b. and terminal blocks		15	0
	£5	9	4

6.0 SERVICE CABLES

Underground service cables have been installed with one connection from the overhead mains to serve from 6 to 12 houses. The connection from the pole is taken to the centre of the group of houses to be fed and from this point loop connections are provided. The service cables were laid in ground where the digging was roughly 60% soil and 40% hard digging (shale and sandstone) and the installed costs averaged as follows:—

(a) Service from mains to 1st house. Average length 106 ft. 0225 x 2 £14.8.1d.

(b) Loop cable house to house £10.0.5d.

Due to the layout of stands it was found that on average 8 houses were fed from each connection to the mains. The average cost per house for service connections thus amounted to

$\frac{£14.8.1d. + £10.0.5d.}{8}$ =£11.16.8d. per house.

It should be noted that in many cases the loop service cable forms its own feeder cable and does in fact reduce slightly, the cost of street mains. Since, however, poles are required for street lighting the saving is

FIG. 1

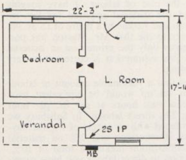
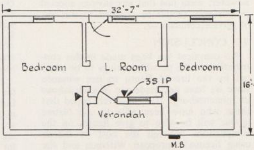


FIG. 3



LEGEND

◀ LIGHTING BRACKET

S LIGHTING SWITCH

P SOCKET OUTLET

▬ MB METER RECEPTACLE

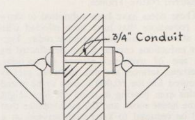


FIG 5

BACK TO BACK WALL BRACKETS.

FIG. 2

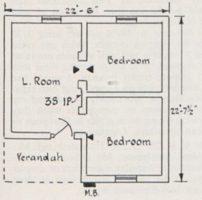
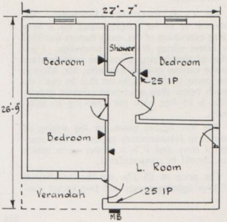


FIG. 4.



mainly in the cost of conductor. It would, however, seem just that any savings effected in this way should be credited to the cost of service connections.

7.0 CONCLUSION

No comment has been made in this contribution to the possible savings to be effected by the use of Bantu trainee wiremen since we have not made use of such labour in Johannesburg. It is, however, hoped that those who have been able to use Native labour will be able to give figures on the comparisons between the cost of labour using licensed European Wiremen and the registered Native Trainee.

These notes have been submitted to show the reductions that have been effected with the standard materials available today. Further reductions can no doubt be effected by the use of overhead service connections. Overhead services are not, however, greatly favoured for the 60,000 houses to be wired in this area bearing in mind the low height of the house roofs, and the maintenance that will be required to keep such services in a safe condition.

The author's thanks are due to Mr. R. W. Kane, General Manager and Chief Electrical Engineer of the City of Johannesburg, for permission to use the information presented in this contribution to the symposium.

THE PRESIDENT: Are there any members who would like to discuss Mr. Masson's contribution?

Mr. G. F. BROWNE (Salisbury): Mr. Masson is to be congratulated on a very clear exposition of the many factors involved in house wiring in Native townships. I am pleased that having given due consideration to the various systems available, Mr. Masson has come to the conclusion that he can't do much better than a screwed conduit system. This is in line with our thinking in Salisbury.

The low figures given for the wiring of houses in Johannesburg appear to be a matter of envy and it is a matter upon which you should be congratulated.

The price of £5 13s. for the installation of four lighting points and two socket outlets as shown in Fig. 4 appears low if it includes the cost of labour. I have roughly checked the material required for this installation and I come to a figure of £5 3s. 4d. It occurs to me that Mr. Masson has possibly given only the prime cost of material and if this assumption is correct it is very misleading.

I feel that a reasonable amount of labour for this set up would be equivalent to 4 European man hours at say 8s. per hour making 32s. direct labour. In Salisbury we are burdened with an oncost of 7% for buying and storekeeping and 3% on material for administration making a total of 10%. In addition to direct labour you have supervision, indirect labour and oncosts of various sorts such as holiday and sick leave, Workmen's Compensation, etc. Experience generally is that you can't manage with an oncost on labour of much less than 125%.

Making due allowances for these things plus transport and the cost of travelling to and from the site I come to a figure of about £16 per house which I think is very reasonable. If you do it for that cost I think it is very creditable.

A further point about the installations described is that you have four lighting points and two 15 ampere socket outlets on one circuit. I think you are allied to the Blue Book if my memory serves me correctly, you should not have anything larger than a 5 ampere socket outlet on a lighting circuit. It seems to me that you conflict very strongly with the general principles of safety inasmuch as your conductor size should not be less than the rating of your fuse or circuit breaker.

In this case no doubt you are using 3/20 wires for lighting circuits which are rated about 8 amperes and your switches are rated at 5 amperes. You are protecting these with a 15 ampere circuit breaker. I would like to know how you get around your own regulations because presumably you do enforce these regulations on contractors when they are doing wiring work either in European or African townships. (Applause)

Mr. C. L. DE BEER (Johannesburg): Mr. President, gentlemen: My difficulty on this occasion is to consider some form of simpler wiring, in the internal installations of these cheaper Non-European houses.

I feel that our wiring regulations do make provision for an appreciable number of types of cheaper wiring such as cab tyre sheaths, lead covered, and things of that nature. I fully realise the majority of Supply engineers raise up their hands in horror at a thought such as this, because they feel that this type of installation would be unsafe in the type of house you have under consideration. I would, however, in support of my request, draw your attention to the illustration on Page 122 in which you have a photograph of the main board in Langa Township in Cape Town. You have on the left hand side, two very robust, very strong conduits to switches and socket outlets, while immediately below the meter you have unprotected conductors going into the meter and coming out of the wall in to the main fuses.

If it is perfectly safe in an installation such as that to have unprotected conductors going into the meter (and I assume that it has been found safe, otherwise you would not have used that), I see no reason why we should not at least try, in some selected localities, some of the cheaper forms of wiring on the outgoing side of the meter as well.

THE PRESIDENT: Thank you Mr. De Beer.

Written contribution by Dr. H. D. EINHORN (University of Cape Town): The task of providing electrical lighting for Bantu houses at a bearable cost is formidable and the ingenuity which brings the wiring cost for three lighting points and a socket into the region of five pounds is admirable.

It is nevertheless difficult for an illuminating engineer to accept the angle batten holder with conical shade. A light point at 7 ft. 6 ins. without shielding must be glaring. The following questions should be considered: —

Would outlets facing downward e.g. by means of a bent or swan-neck fitting with a suitable shade increase the cost excessively? Alternately is it quite impracticable to fix a short length of horizontal conduit with a vertical outlet at ceiling level?

Since a higher light source would give better light distribution is there any advantage in bringing it down to 7 ft. 6 ins.

Quite robust plastic shades with about 20% cut off angle are obtainable for a few shillings but the illumination with a bare lampholder would hardly be worse than that provided by a conical shade. The tenant can later on provide a shade to suit his taste, provided the light source faces downward, since most shades of use against glare are designed for a vertical lamp axis.

Regarding layout, fixing above a door is unfunctional, since this is bound to be a "movement area" and outlets on the opposite wall would light the living space better.

The extra cost of these improvements will look less alarming if compared with the total cost of providing electricity including reticulation and distribution.

Poor lighting design which ignores glare will encourage the use of low power lamps thereby inhibiting energy consumption and creating dismal conditions.

Mr. R. W. KANE (Johannesburg): Arising out of the comment by Mr. Browne regarding infringement of regulations, I don't know, but I believe in the Federation they are actually going to make the Regulations law. In some cases this may be a very good thing, but we are hoping in our own Wiring Regulations, when a third edition comes out, to follow the practice of the overseas Institute and have a short compulsory first section, and the second section will be used as a guide to meet the requirements of the first edition. For those provinces or towns in the Union that feel that they must have promulgation, the first section will be simple to promulgate and the second section is a code of practice. As a code of practice we can use our common sense in its application to different installations. One of the questions in the Forum referred to the mixture of plugs and lights on one circuit. We are actually doing that in certain buildings in Johannesburg, because it seems illogical— one light, one plug, one room, two circuits, particularly when there are metering problems.

THE PRESIDENT: Thank you Mr. Kane.

I take it then there are quite a number of authorities that are in the process of adopting these 1960 regulations as a code of practice if they have not already done so?

I take it that generally, in Transvaal and Natal, they would have to be adopted as a Code of Practice.

Would Mr. Masson like to reply to the comments?

Mr. G. MASSON (Johannesburg): Replying to Mr. Browne, Salisbury:

The prices quoted for wiring are those paid for house wiring carried out by a private contractor last year. The price includes for labour and materials and the prices quoted by the same contractor during this year are basically the same as quoted in my contribution.

I think the reasons for the low prices can be summarised as follows:

(i) Mass production methods.

(ii) A reasonable profit on a large turnover.

(iii) Low prices for large quantities of materials purchased.

The standard of workmanship is good and all wiring work on site is carried out by licensed European wiremen. I cannot say what type of labour is used for making up wiring kits since this work is not done on site.

As far as the two-roomed houses are concerned I understand that as many as eight installations are done per day by one licensed wireman. I agree with Mr. Browne that lights and sockets on one circuit is not entirely satisfactory. Where one socket is provided a 10 ampere circuit breaker is used for protection and this is below the current rating of the 3/20 S.W.G. wire used for the lighting circuit (if one uses the rating for this size of cable as specified in the latest issue of the I.E.E. Regulations). We have provided space on the main board to instal separate protection for the lighting circuit if this is found to be necessary. As far as the Regulations are concerned the Local Authority has of course the right to relax the regulations in regard to wiring installations on Council owned property!

In reply to Dr. EINHORN, Cape Town: As stated in Paragraph 4 of my contribution we were faced with wiring premises, many of which have flimsy ceilings not strong enough to support a lighting point. The height and presence of these ceilings therefore was the main factor that dictated the installation of the wall bracket light and the mounting height of 7 ft. 6 ins. The non-European Affairs Department was not willing to instruct the tenants to demolish these ceilings, but if it could have been arranged then centrally mounted lights could have been fixed to the roof timbering at an extra cost of approximately £1 10s. per house.

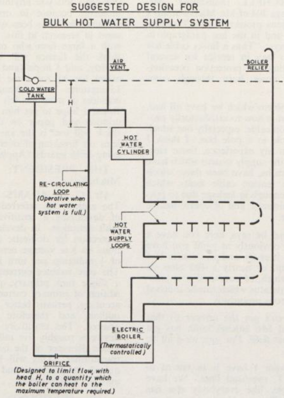
Swannecked brackets could be provided instead of angle batten holders at an extra cost of a few shillings per lighting point. I think such a bracket would require much more maintenance than the batten holder and I do not think it would really reduce the glare unless you provide a satisfactory shade. Cheap shades will however generally reduce the light output out of proportion to their value in reducing glare. I do not favour plastic shades because I have not yet seen a cheap one that could be considered satisfactory for Native housing.

The criticism that the light fixed above a door is unsatisfactory because this is a movement area and is not a serious one bearing in mind that there is not much traffic in and out of a bedroom. It would add considerably to the cost of the installation if the lights were mounted on the opposite walls.

It is agreed that the extra cost of the improvements suggested by Dr. Einhorn are not alarming when considered in relation to the total cost of reticulation, etc. In Johannesburg the tenants are not expected to pay for the cost of reticulation but they do have to bear the cost of the house wiring installation. The amount of money allocated yearly for electrical work in Native townships is restricted.

Our aim has been to provide some services for as many as we can out of the capital available in the shortest possible time. If we use up our valuable capital for luxury installations or on methods other than mass production, then many will have to continue using candles for years to come.

Mr. A. R. SIBSON (Bulawayo): Mr. President, just one small word, in reference to Mr. Browne's contribution, in which he



described systems of communal electricity services, I have prepared a small diagram indicating a method of water heating for blocks of that sort, which might be of interest to members of this Convention. The purpose of this scheme is to avoid the pumping system that Mr. Browne described and to obtain hot water supplies at the lowest cost without this complication.

This diagram depicts a water-heating system designed for multi-storey domestic accommodation. The principle of operation ensures that hot water taps produce hot water or nothing at all; since only hot water can emerge from the boiler and the system is always circulating, either through the upper reservoir filling, or by thermo-syphon when this reservoir is full. This prevents an enormous loss of both water and electricity at times of peak demand by avoiding the running to waste of lukewarm water by persons in the hope that it will get hotter in time. The system is the same in principle as that of the controlled-entry hot water cylinder and is of particular value in hotels.

All hot water pipes, the boiler and the upper reservoir should, of course, be lagged. The dimensions of all components and pipework would be appropriate to each individual installation.

Mr. J. MITCHELL (Salisbury): Mr. President, on Page 204 of Mr. Michel-Smith's paper he mentions protection of LT underground cables, and in the last paragraph in that paper he says: "Thus a faulty cable has been known to stay in service for several months, operating the protection occasionally until the cores burn through completely."

That is a problem which we have all had, I think, and that is how to satisfactorily protect a low tension cable, especially one which climbs up a pole to a pole box. I think I can say that in my experience, those electrical faults on the supply system which have caused more deaths, have been those which have been low tension cable faults which have been low enough in leakage due to possibly higher resistance, and of course unable to blow the fuse.

As you realise, he says, here you have a 400 amp. fuse, obviously at night you have got no load on it at all, and you can in fact pass a 400 amp. or nearly a 400 amp. as fault current, which, of course, if it is passing into any apparatus which can be touched is a very dangerous procedure.

We still haven't got the answer to that problem, and if Mr. Michel-Smith has got any ideas in that field, I'm sure we'd all be very interested.

The other point I have is in regard to faults on E.H.T. overhead lines. We have had this trouble, like everybody else has had, of lines falling, and unless you go to the expensive procedure of putting guards or V-guards underneath the EHT overhead lines all over the country you can have wires come down on the ground, on to high resistance earth, which passes so little fault current that nothing is tripped, and electrocutions can take place.

Both Mr. Downey and Mr. Van der Walt who have been in Salisbury recently have seen a relay which a gentleman in my department has produced, tested and found to be quite stable. This apparatus with its relay can in fact operate down to as low as 30 milliamps and still carry a completely short circuit through fault. It even will operate if there is no earth leakage at all, but if one wire is broken.

I can't tell you anything about it at the moment, because in order to repay the amount which has been spent by the Department in research in this, we are negotiating with a large firm who makes relays, but I think the licence will be organised very shortly, and I hope (and Mr. Lombard has asked for it) for some kind of paper for Livingstone, and although this protection engineer of mine has left the Federal Power Board I hope to get him to give a full description and paper on that relay which I think will find is the answer to your problems on breaking of overhead lines without using earth guards. (Applause)

THE PRESIDENT: Thank you Mr. Mitchell.

Mr. C. H. ADAMS (Somerset West): The author has referred to the possibility of developing a sensitive device for earth fault detection. In developing core balance protection for domestic and other applications on low voltage networks, a sensitivity of $\frac{1}{2}$ milliamp per turn has been achieved. The core balance current transformer, with a single turn primary, performs a Vector edition of primary currents with very great accuracy, perhaps better than one part in a million, and therefore good stability is assured. The sensitivity possible from this device is roughly five milliamps per foot of inside diameter of the core balance current transformer. This will be better than required in practice, and should meet the author's requirements.

THE PRESIDENT: Thank you Mr. Adams.

Are there any further comments on Mr. Michel-Smith's paper?

Mr. Sibson, in a previous discussion you made comment on a particular sketch you had on a scheme of water heating. I take it that will also be put forward to be included in the Proceedings?

CONVENTION ADJOURNED FOR TEA

WRITTEN REPLIES BY MR. J. E. P. MICHEL-SMITH

Replying to Mr. Adams:

Owing to Mr. Adams' obviously superior knowledge on this matter of devices for extremely light earth fault protection, I make no comment except to say that the Durban Corporation Electricity Department has up to the present not taken advantage of such protection.

Replying to Mr. J. Mitchell of Salisbury:

I notice that Mr. Mitchell appears to stress the importance of L.T. protection with the purpose of avoiding electrocution. Now, on the Durban Corporation's System, as in all other undertakings dealing with the reticulation of L.T. power, the first requirement is to protect the system from thermal damage arising from heavy fault currents. Thus it is essential to use a fuse or other comparably cheap device, with a rating a little in excess of cable or line feeder capacity and rely entirely on the integrity of our earthing to give us the necessary earth fault currents to operate this protection.

To afford protection against fallen L.T. lines involving very low earth fault currents, use would have to be made of magnetic amplifiers and/or transistorised relays, etc., the actual settings of which would have to be low enough to trip for fallen wires and yet be high enough not to be an embarrassment with unnecessary tripping caused by harmless sources of leakage, e.g. moisture on insulators, low cable insulation resistance, vegetation touching overhead lines, induced lightning surges, etc. Then in order to work such a system satisfactorily where consumers were teed off a common L.T. circuit, each consumer would have to install similar protection with lower settings, to co-ordinate with the supplier's substation protection.

However, I feel sure that members of the Durban Corporation Electricity Department staff would be most interested in the details, when available, of this new relay Mr. Mitchell mentions.

Replying to Mr. Summers of Bulawayo:

Experience on the Durban Corporation system has shown that the number of 33 K.V. earths provided is satisfactory and it has always been the practice to earth the neutral point at each 33 K.V. point of supply, whether such point be a generator or transformer. All such points are under the control of our suppliers, namely Escom, and they have always decided the location and number of earthing points. I presume Mr. Summers, when referring to multiple earthing, has in mind more than one earthed neutral point on the same portion of the 33 K.V. network. With our relatively short underground 33 K.V. feeders, rarely exceeding 3 or 4 miles in length, with the consequent freedom from atmospheric disturbances, we have felt it unnecessary to provide more than one earthing point on each section of the 33 K.V. system.

In any case our practice has been to use star point sources for all separate portions of the 6.6 K.V. and 11 K.V. network with each transformer star point earthed, since there is no interconnection on the L.V. side of these transformers. This makes the use of delta windings desirable on the 33 K.V. side of each transformer, hence the difficulty in having additional 33 K.V. earthed neutral points.

I know of no objection from the Post Office to multiple 33 K.V. earthing.

There appears to be no point in having both neutrals of the earthing transformers on each unit of a parallelled bank of transformers at Springfield earthed as Mr. Summers suggests since a fault on any one main unit or earthing transformer would clear the entire bank electrically from the system, leaving one without an earthed centre point, in any case.

In cases where transformers of 500 KVA and over are installed we have started to instal local transformer H.V. protection where the transformer is fed from a ring main panel comprising two oil immersed disconnects and an O.C.B., although in the past, so little trouble has been experienced with arcing faults on the L.V. side of substation transformers supplied via isolators, that we regard it as a justifiable risk. The 6.6 K.V. and 11 K.V. isolators in use, have on occasion been accidentally closed onto faults but no harm to any person has resulted since they are enclosed in a metal box, being operated externally. Actually, it has been our experience that the most common error is a human one, namely the wrong set of disconnects being opened while under load, resulting in flashover and a fright for the operator.

With regard to the matter of co-ordination of transformer protection raised by Mr.

Summers, three phase faults have been considered in order to make the fuses on the L.V. side of the delta-star distribution transformers co-ordinate with those on the H.V. side, since they would give rise to maximum L.V. currents, thus making co-ordination most difficult. However, I think Mr. Summer's suggestion of basing this co-ordination on phase to phase L.V. faults might prove to be the wisest since the phase current distribution on the H.V. side of the transformer is 2:1:1 for this type of fault, as stated.

Regarding Mr. Summers' questions dealing with the two types of 33 K.V. cable/transformer feeder protection used by the Durban Corporation, I.D.M.T. 33 K.V. earth fault relays are used as back up to the main protection i.e. "Overall Translay" in some cases and instantaneous earth leakage in other cases. This, I think was largely a matter of convenience since I.D.M.T. relays consisting of two overcurrent and one earth leakage element in the same case have always been readily obtainable, but this was the mutual choice of Escom and the Corporation as Escom control these 33 K.V. breakers.

In my opinion, the use of reverse power relays on the 6.6 K.V. side is hardly justified particularly in the case of intertripping being installed to operate the 33 K.V. O.C.B. Neutral displacement protection is, I think, in our case an unjustifiably expensive item necessitating the use of 33 K.V. voltage transformers. I would not say that the undamped transient voltages referred to by Mr. Summers are responsible for many faults on the Durban Corporation system. The great majority of 33 K.V. cable faults have been traced to insulation deterioration under normal service conditions, e.g. ingress of moisture at joints, loss of compound at the site of cracks or holes in the sheaths of solid type cables, and mechanical damage, etc.

Also, I cannot see our suppliers, namely Escom being in agreement with slugging of their 33 K.V. breakers to allow our 6.6 K.V. breaker to open first on the cable/transformer feeders so as not to energise such transformers from the L.V. side, even momentarily, as Mr. Summers suggests. There would be the risk of our breaker not tripping at all, with disastrous results for Escom.

Commenting on Mr. Summers' suggestions for the Coedmore-Mobeni 132 K.V. connection, I agree that perhaps it is justifiable to supply at small extra cost, back up time delayed earth fault relays energised from the 33 K.V. neutral C.T.'s to operate in the event of failure of the 33 K.V. bus-zone or 33 K.V. feeder protection at Mobeni in view of the limited thermal rating of the 33 K.V. neutral apparatus. I don't think Escom would agree to protecting our neutral apparatus by installing negative sequence protection at their Coedmore end.

I can't think of any occasion when the 132 K.V. isolators at Mobeni would be open for any length of time with their respective 33 K.V. O.C.B.'s closed thus making it unnecessary in my opinion to shunt the Solkor pilots with the isolator auxiliary contacts, the already suggested arrangement appearing to me to be quite adequate.

Mrs. Summers' suggestion of a high speed directional earth fault relay at Coedmore is very sound but this matter would have to be taken up with Escom. Agreement may perhaps be reached, using the 132 K.V. neutral on the 132/88 K.V. Coedmore-Congella transformer as suggested.

The Mobeni 45 M.V.A. transformers will certainly act as zero phase sequence current sources under fault conditions but I hardly think it is justified in installing 132 K.V. neutral protection at Mobeni to protect our 45 M.V.A. transformers against line faults uncleared from the Coedmore end since we should assume that complete failure of all earth fault protection at Coedmore would indeed be remote.

To overcome the difficulty of clearing very light earth faults on H.T. distribution lines, a sensitive rectifier driven D.C. relay energised from a saturable C.T. situated in the normal C.T. residual circuit could be used but up to the present, has not been considered because of our lack of experience with such equipment, regarding its reliability and our possible embarrassment with undue tripping resulting from leakage through unflashed but damp bark, twigs, etc., between line and earth, which ordinarily would dry off and char away without faulting.

Neutral displacement fault detection could be used on radial feeders as suggested by Mr. Summers, but the fault throwing method of obtaining a trip would, I understand, not be acceptable to the Durban Corporation even though very simple.

On Resuming at 11.00 *a.m.*:

THE PRESIDENT: Just before introducing the Closing Session of the Convention, there are one or two announcements.

Mr. Newcombe, Engineer of George about 7 years ago, who has been living in Knysna, died last Tuesday. I thought the Convention might like to know that.

(CONVENTION ANNOUNCEMENTS FOLLOWED)

We now come to the closing session of this Convention, and, as is customary, greetings are expressed and thanks, and I will leave it to you now.

Mr. H. P. ALEXANDER, Escom (Natal): Mr. President, I take this opportunity of thanking you very much indeed for the very kind invitation to my colleagues and myself to attend this convention, which we have attended and enjoyed very much. Mr. Milton has also asked me to give you appreciation for his own attendance here, and greetings from Escom as a whole.

While I am on my feet, I also thank you for the invitation to those members of the Natal Centre of the S.A. Institute of Electrical Engineers to attend the Convention (which they have all enjoyed so much.)

(Applause)

Mr. C. L. DE BEER (Johannesburg): Mr. President, Mr. Mayor, ladies and gentlemen:

It is my very great privilege and pleasure, on behalf of the affiliates to thank the City of Durban through you, Mr. Mayor, for the wonderful time we have had over the past week. On the weather side it has been marvellous. I don't think it could have been improved upon even by electrical engineers!

On the hospitality side, on the amusement side, we, as commercial engineers, feel that very great consideration will have to be given to the suggestion earlier in this convention, that Durban be made the perpetual venue of the Convention itself. I would now also include in our thanks the names of your present President and our Immediate Past President, Mr. Simpson and Mr. Kane for the wonderful work that they and their staffs have done in preparing the meat which we as affiliates will take back to our drab offices over the next week—we will study in detail, digest it, and try our very best to increase the sales of those magic little things called units, and by so doing increase the standard of living of all the peoples in our various countries.

And finally, but by no means least, I would like to thank the ladies of Durban for the wonderful way in which they have looked after our wives.

Mr. Mayor, I can assure you that on more than one occasion we mere delegates to this convention have felt like "delegates at large." (Applause)

Mr. C. BOOTH (Durban): On behalf of the Institute of Certified Engineers, I just want to express my thanks to you for having invited me here. I have been very impressed with the excellence of the arrangements made for this Convention. I can only say that it is a new experience to me. I was particularly impressed with the very excellent spirit that ruled at this meeting.

Mr. J. P. ANDERSON, S.A. Railways (Johannesburg): I am very glad to have this opportunity of thanking you for inviting me to this Convention. I have enjoyed it, and I am quite sure that all the opportunities I have had to meet old friends, and make new friends, must be of inestimable value for the future.

I would also like to thank you and the City of Durban for the very generous hospitality which my wife and myself have enjoyed. (Applause)

Mr. G. C. MOLYNEAUX (Rhodesian Railways): I hope, by following my friend here, Mr. Anderson, that I won't convey the impression that this is a Railway Convention, but I would like to thank you very much indeed, Mr. President, for the very fine time we have had here, and for the most interesting papers and discussions we have heard. I will take back with me a lot of very useful information. (Applause).

Mr. D. FYALL, The Northern Rhodesia African Housing Board (Lusaka): Mr. President, Mr. Mayor, ladies and gentlemen, I'm afraid I missed the bus on the greetings section, but now I would like to thank you very much indeed for accepting me as a visitor to your Convention. My main interest was, of course, your symposium, and I must congratulate the various gentlemen who presented the papers and those who added their knowledge and opinions in the discussions.

I am very pleased indeed that you are following up this rather complex question, and as we—the Government of Northern Rhodesia has set up a working party to discuss the problem, I would like it if you could keep us in touch.

Finally, Mr. President, my thanks again, and congratulations on choosing Durban as the venue of this Convention. It is my home town and I have been nearly killed with kindness both in the Convention and around the town. I would like to meet you all again next year at Livingstone, and hope to show you our two wonders of the Zambesi, Victoria Falls and Kariba.

Clr. R. BROWN (Livingstone): Mr. President, Mr. Mayor, ladies and gentlemen: On behalf of Livingstone I would like to thank you for the most wonderful week we have had down here. I only hope that next year we can match the hospitality, which you have shown us here in Durban, when you come to Livingstone.

Mr. President, yesterday, I think it was when Mr. McNeil was speaking, you had some difficulty in interpretation I think, with the Scottish dialect. Actually you said "scotch." The word is "Scot." They tell me ("scotch" comes out of a bottle)

(Applause).

THE PRESIDENT: You were introduced to both of "it" yesterday though!

Clr. R. H. MAIN (Johannesburg): Mr. President, Mr. Deputy-Mayor, Mesdames Past, Present and Future, immediately in front of me, ladies and gentlemen:

I have indeed a very pleasant task today in that I have been asked to propose a vote of thanks to the Mayor and the Council and the citizens of Durban for the wonderful time we have had during this term of the Convention, but before doing so, and with your permission, Mr. President, I must put in an explanatory note to start with in case you pull me up on a point of order at going off on a tangent . . . there are a few little events that I would like to recapitulate, and I think that right belong to me as I stand right here.

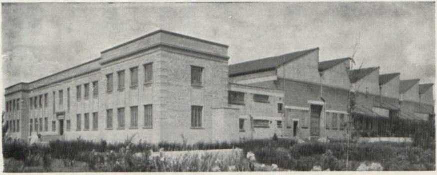
The one thing that struck me, and I must apologise of course for my lack of sagacity at the moment, and that was when we had a very fine gentleman, Mr. Jimmy Mitchell, appearing as Quizmaster at the other night's Forum.

I was very slow on the uptake at the time, but on reflection I think it was done very deliberately. Mr. Mitchell was referred to by, I believe, one of the Rhodesian delegates, first of all as Mr. Market Master! And all through the proceedings, when we were discussing this particular item, of whether or not local authorities should pursue in their policy of undertaking electricity supply, he kept asking for contributions to the discussion from councillors, and I noticed that he looked at me quite a few times, and eventually I got up.

Mr. President, I take this matter seriously, naturally, but I believe that what was really behind the Federation's mind in that little matter I think it was possibly whether or not they are not feeling the task of the Kariba scheme very heavy indeed, and I wonder in fact if Mr. Mitchell was not paving the way for the City Council of Johannesurg to take over the Kariba Scheme.

Now let me say that, with Mr. Robert Kane, our very able General Manager of Electricity in Johannesburg, and—perhaps in a slightly lower tone, myself as Chairman of that Committee—I think that we are certainly open to negotiations, but Mr. President we have what is commonly known, and I think well-known to most delegates here today . . . we have what is called an O & M Division, and this O & M Division is substantially non-technical, although in our experience they are very ready indeed to plunge into matters that are very much technical.

In order to satisfy on this particular item, I think it would be necessary for the present governing body of the Kariba Scheme to in fact seriously consider doubling up on the size of that bridge, or roadway across the



Kariba Dam because you know, once you get an O & M Division on the job, they must have ready access to both south and north banks.

Having said that, Mr. President, we have heard a lot from the Federation at this Conference, and I am certainly very grateful for the very valuable contributions that have been made, but I really feel that *The* Federation as it is always referred to (I always thought that "the" precedes only A, E, I, O, and U), but I have heard it referred to as The Federation—but I say this, that *The* Federation, that little tract of land north of Johannesburg, may well in time be incorporated in the City Council of Johannesburg itself.

But of course, we don't just accept things like that. We have what is called a Peri-Urban Board, and I would say for a start anyway, this Federation would probably be well treated if it were incorporated in our Peri-Urban areas, and what is probably more interesting, serve for a time under this Peri-Urban Board!

Mr. President, we have been treated to some very fine shows here in Durban, but I want to sound a note of warning. Mr. Deputy-Mayor, I address these words to you, and that is this: that when delegates to a convention of this kind are subjected to the sort of E.H.T. treatment that we had in the "Hey Diddle Diddle" the other evening, then I think, Mr. Deputy-Mayor, you should consider this matter very seriously indeed, because I have chatted to a few of the more elderly members of this convention, and they have said that, following on that particular show, they had some measure of deep regret, they were at this time of life, relying more on memory than anything else. We heard mention earlier on, of these I.D.M.T. protection units, and I suggest if we are going to be subjected to that form of entertainment, both old and young should in fact be fitted with that type of protection in future.

Then I have heard a few other little complaints, and I think it is as well, in an address of this nature, to make mention of them, and that is that there was so much laid on for us that we could not in fact make use of them all. I think I have a complaint in that line, too, but one of the finest suggestions—and the end of it leaves me rather flummoxed in fact; it is slightly north of me—that is that why could it not have been arranged that we saw "Hey Diddle Diddle" on the Boat in the Bay, during the evening. I say that is a very fine suggestion; but then we had another contributor, I think from the Federation as a matter of fact, and he said, "On one condition of course, that we go out on the incoming tide."

Now that is, what I say is slightly north of me, and I think that your Executive committee, which is not really loaded to the Plimsoll line at the present time, could well consider that and give us the answer at the next convention.

Mr. President, I think I am voicing the opinion of everybody when I say that all delegates who have attended this convention have been very, very pleased indeed with the venue, and I would like, on behalf of every delegate, together with the wives (it is not my function here today to thank the Convention on behalf of the good ladies), but I want to convey this to you, in all seriousness, we have all, each, individually and collectively, enjoyed very much indeed this particular Convention, and I ask you, Mr. Deputy-Mayor, to convey on behalf of this Convention, to His Worship the Mayor of Durban and its citizens our sincere thanks for a very fine convention indeed. Thank you.

THE PRESIDENT: Mr. Mitchell, when I kept you to the last, I don't think you really realised the opportunity you were getting. (Laughter)

Jimmy, as you know, usually so very ably handles the ladies, that we always ask him to very ably support them and speak for them.

Mr. J. E. MITCHELL (Salisbury): Mr. President, Mr. Deputy Mayor, ladies and gentlemen:

After listening to Clr. Main I feel rather like the man who married the widow with 12 children—he has left me very little to do! (Laughter)

As I came up on to the stage I was reminded of course, that the Federation is greater than the size of the Union of South Africa, and there has been talk of incorporating Johannesburg into Krugersdorp. There was a little jealousy and Springs thought they should have it first.

Mr. President, Shakespeare said that some achieve greatness and some have greatness thrust upon them. I, for some hidden reason (to me) always have the job thrust upon me of thanking the host town on behalf of the ladies. Now that is a very pleasant duty, I must say.

His Worship the Mayor stated that there were actually two kinds of male delegates, but in my opinion there are two kinds of female delegates, too. Those are the wives of the normal delegates and the others are the "wives at large" of the delegates on the Executive Committee.

I was a little disturbed the other morning in noticing my own wife going off. A car drew up and picked her up on the kerb—kerb edge, mind you, while I went off to work. Mind you, I did notice it was one of the affiliates who might have been coming to the Convention—but I don't think he was. This business of picking up you know, reminds me of Kruschev's visit to America. He had been going round some of the factories, and he got hold of one of the factory workers, and he said, "Now what do you think about this capitalist system?"

"Ah," said the worker, "Capitalist system's fine, marvellous. For instance, I may be going home, and the boss will come along in his big car, see me walking home, and he will pick me up and take me along and say 'What about going for a drink?' So we go for a drink, and stand drinking for a bit, in a nice lounge, and then, he says, 'Well, it's getting a bit late; what about going out for dinner?' So he takes me out for dinner, and then of course it is later still, and he says, 'What about coming home for a spot?' So we go home for a spot and then it is too late to go home at all, and he says, 'Will you stop the night,' "

So Kruschev said, "Well, that's marvelous. Do you mean that happened to you?" "Oh, no," he said, "it didn't exactly happen to me, but it happened to my sister." (laughter)

At these conventions where our ladies grace the proceedings with their very charming and picturesque presence, I thought it might be a good idea if we established a club for them, but when I mentioned it to one member of the Executive and asked him if he was in favour of clubs for women, he said, "Not unless every other form of persuasion had failed!"

Now our ladies have been right royally entertained. The delightful cocktail party on Monday evening, in the company of the Chain Gang—we have another member of it with us today. At the show on Tuesday night (and this is rather interesting) two of our ladies were so enamoured of the Can-can girls that they decided they could do the same thing, and to prove it they had a couple of photographs taken. I am going to suggest to the Executive that they appear in the journal—I think it would sell many more copies. (Applause)

There seems to be a general opinion among councillors that engineers are so overpaid that there should always be a fashion show at these Conventions for the ladies to go and get ideas! And even Durban got into my own wife's hair. She went to somebody called Louis in the Edward and had a new hairdo. When I got back to the Eden Roc I happened to give her a wolf whistle. I have had awful difficulty trying to persuade her I knew all the time it was her!

Now a woman of course, is just a female man, but I did come across a definition of "lady" the other day and it appears that it originally meant "a keeper of house; and entertainer of guests; and a baker of bread."

Now there *may* still be keepers of houses; they may still be entertainers of guests; but believe me they are still "kneaders of dough." (Applause and laughter)

Durban is an exciting place, and with the growth of our Association, His Worship the Mayor's suggestion that all Conventions should be held in Durban may be nearer than he knows. Durban has quite a number of those only things that I find today that give you more for your money as the years go—those are weighing machines.

Durban's traffic, which we read so much about in the local press, reminds me of certain definitions too. Confusion: one woman and one right hand turn. Excitement: two women with one secret. Bedlam: three women and one bargain; and chaos is four women and one lunch check!

To resume, the ladies had a delightful drive around the Bluff, and I must say that, from what I have heard, we must be very grateful to Dickie Dawson and Charlie Sellars (and I don't know the name of the other one) who were the conductors and drivers of these tours. The men themselves are very grateful for all the stories that their wives have retailed to them to tell in their clubs and to dine out for many nights in the future. I understand they had a very delightful morning, and a very delightful morning tea with your charming Mayoress.

Finally, of course, last night's dinner dance. At this dinner there are always more men than women, and men, for a change, become the wallflowers.

However, in South Africa, the bars are only for men, so the men can always find a salubrious and legal sanctuary away from the female sex.

I must also thank the ladies behind the scenes for minstering to our wants at tea time.

I also realise that I have been discourteous in recent years in not mentioning Mrs. Simms. Now Mrs. Simms is the lady who works up to 18 hours per day, producing those type scripts of what she knows we said but what quite surprises us when we see what we did say. Mrs. Simms' efficiency in this regard is only exceeded by her own charm and the pleasant and cheerful way in which she carries out her onerous task.

Mrs. Simms is producing these typescripts now at such a rate that she will have them done before we've actually said anything, and then there won't be any need for a conference at all!

The ladies thank you and your Council sir, for having provided a most pleasant week and also thank their husbands with really old-world courtesy for their kindness in bringing them here. (Applause)

HIS WORSHIP THE DEPUTY MAYOR OF DURBAN: Mr. President, Members of the Executive Council, and Delegates of the Association of Municipal Electricity Undertakings of Southern Africa, ladies and gentlemen:

It is gives me very, very great pleasure indeed to be able to deputise for His Worship the Mayor, who is not able to be here today, and I am particularly grateful for the praises thanks and plaudits that you have accorded to this city. They will be conveyed to our Council and to the citizens.

We are particularly pleased to have had you here, and you have also, by your testimony, added to our belief and understanding and certainty that our city of Durban is the finest in the Union, and that it is one of the finest watering places and seaside resorts in the world.

I hope that you found the hotels to be all that we said they were, and I'm sure that you were satisfied.

I must congratulate you, Mr. President, on what I hear has been a most successful conference. According to Mr. De Beer, one of the objects of the conference is to increase the "units." I hope that can be done in Durban as well as elsewhere, but I also hope that in your deliberations, you were able to or may be able to, in the coming year, devise some scheme whereby you can reduce the cost of the "units", because that is what our ratepayers want. However, they can't always get what they want, and as long as they get, as I said the other day, "night turned into day by the magicians of the electrical conference" they cannot complain.

From what I have seen, even the ladies have enjoyed Durban. I say "even the ladies" because they have had to go about quite a lot on their own, and I'm very glad that our ladies and our Entertainment Committee have been able to look after them.

I hope they liked our shops, and I also hope they didn't buy too much at the expense of those poorly paid City Electrical Engineers.

I must also, on hearing Mr. Mitchell, compliment the ladies hairdresser that did such a wonderful job on Mrs. Mitchell, and I must also compliment Mrs. Mitchell on being such a beautiful woman as to evoke from her husband a wolf whistle. That bears out the old adage that what you have you must keep, and your own possession is the best.

I hope you found our transport system good and I also hope that you liked our luxury tour coaches. It took a lot of getting that vote through the finance committee I can assure you!

Well, ladies and gentlemen, you are now going back home to the various distant points of Southern Africa, and I know that you will go back and take the memories of Durban with you, and so when next you need a holiday please come back to us. We are always pleased to see you, and even though it may not be a conference, we will do our very best for you.

I now wish you all who go by road a happy journey and those who go by air a happy landing, and I thank you again and wish you all Godspeed. (Applause)

THE PRESIDENT: Thank you Mr. Deputy-Mayor.

Mr. Deputy-Mayor, ladies and gentlemen:

I have heard other Presidents say, when they were working up for the Convention they hoped it would arrive and when it does arrive, they feel they are going to miss something that has turned out to be extremely interesting and not quite so onerous as they thought it was going to be.

I would like to make one or two little comments. I would recommend Clr. Main to use surge diverters—they might be a little better.

Another point that is worrying me is where Durban is going to go. It might be pushed into the sea from what we hear, if we get Johannesburg and the Federation vieing with each other, but joking apart, ladies and gentlemen, the time has come to close this Convention, and also to thank all those who have helped to make it a success, which apparently it has been.

I would particularly like to thank the City Council, His Worship the Mayor and Councillors for assisting me in getting this going and providing what was necessary for your entertainment.

I also particularly want to thank the members of my staff who have so ably supported me in handling this affair. It is not a one-man job to run a Convention. It is a team that has to do it, and believe me I have had the full support of an excellent team.

After dealing with a Convention like this one realises very strongly what an important part in a Convention the delegates play. It has been a pleasure for me to be President of this Convention. I really mean that—it has been a pleasure. You have all gone out of your way to make it a success in the pleasant way in which you have dealt with me and co-operated with me, and once again, these things are not run by one man, and this Association has once again proved that it is a very wonderful team, and as such must go on to very great heights.

With those remarks, ladies and gentlemen, we now come to the final closing of the Convention. Just before I do so I would like to warn members of the Executive that there will be a meeting at the Eden Roc just before 12, and we have laid on 3 cars which will be outside the City Hall to take them down to the Eden Roc. I thought I'd better do that, particularly after last night, as you might be a little brittle, and bouncing about on our bad roads—as the ratepayers tell the City Council we have got—might upset you!

But, ladies and gentlemen, with those comments, and once again thanking you for helping to make this Convention such a friendly and happy affair, I now declare this convention closed. (Applause)

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