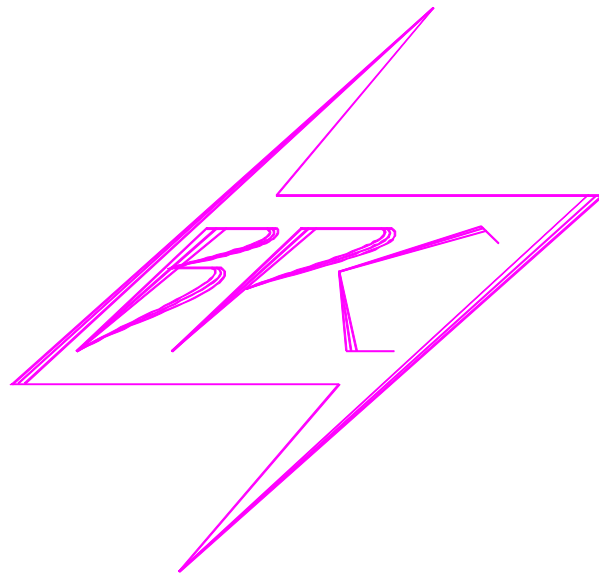


BOTSWANA POWER CORPORATION

STANDARD REQUIREMENTS



FOR

DISTRIBUTION SYSTEMS

Today.....

Tomorrow.....



STANDARD REQUIREMENTS FOR BOTSWANA POWER CORPORATION DISTRIBUTION SYSTEMS

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STANDARD REQUIREMENTS FOR BOTSWANA POWER CORPORATION DISTRIBUTION SYSTEMS

FOREWORD

This document represents the realisation of the need that arose as result of the rapid economic growth in Botswana which brought along with it extensive infrastructural and housing developments in both urban and rural centres in the country. There has been, of late, an influx of Consultants and Contractors of all talents, skills and varied levels of workmanship which necessitated a document of this type.

Botswana Power Corporation has, up to this time, not had its own standard designs and specifications in one specific document. Those that existed had either been continually changed or built upon and their inherent flaws perpetuated. Driven by the economic thrust engaging itself in Botswana it was thought prudent that Botswana Power Corporation should immediately rationalise and present a standard document which could be used to cope with the increasing workload.

This document is divided into four parts thus:

- | | |
|--------|--|
| Part 1 | Design Parameters for Distribution Systems |
| Part 2 | Specifications for Purchasing Materials and Equipment |
| Part 3 | Specifications for the Installation of Equipment and Construction of Systems |
| Part 4 | Standard Drawings. |

It is my belief that standardisation will streamline BPC's Distribution designs and reduce costs to the benefit of all concerned. In addition to this, these designs will enhance and ensure that BPC's Distribution systems are technically sound and able to withstand adverse environmental effects, either due to inclement weather or other related factors.

I would like to express my appreciation and give credit to HKS Consultants for their tireless work in making this document come true. Botswana Power Corporation's own engineers are also highly commended for their contributions and efforts in this initiative.

There is confidence amongst Managers, Senior Engineers and engineering staff in general that the SRDS will now enhance the efficiency and improve the quality of the engineering project designs used by the Corporation.

Mr K Sithole

Chief Executive
Botswana Power Corporation

May 1992

STANDARD REQUIREMENTS FOR BOTSWANA POWER CORPORATION DISTRIBUTION SYSTEMS

STATUS AND COPYRIGHT NOTICE

THIS DOCUMENT IS COPY NO:

REGISTERED HOLDER:

.....
The Standard Requirements for BPC Distribution Systems were compiled by HKS Consultants (Botswana) for the Botswana Power Corporation. Copyright vests in HKS and the Botswana Power Corporation.

REVISIONS

The Standard Requirements are subject to change. Revisions will be issued to Registered Holders. The Registered Holder is responsible for maintaining the document in its current form by inserting all revisions.

The document shall not be reproduced, copied or stored electronically. An unauthorised copy of the document will not be subject to revision by the normal procedures.

REFERENCE

Where required for specifications, tenders or any other purpose, the document should be referred to as:

The Standard Requirements for Botswana Power Corporation Distribution Systems as at dd.mm.yy, Revision R" where dd.mm.yy refers to suitably defined date in the context of the specification; tender or other application; and R refers to the relevant revision number (see Revision Record).

Quotations from the Standard Requirements shall be accompanied by acknowledgement of the source.

TENDERS AND CONTRACTS

A single copy not exceeding ten (10) pages may be made or transmitted electronically for the bona fide preparation of tenders and contracts for work in Botswana.

Up to three (3) photostat copies of the Standard Requirements or relevant portions may be made for inclusion in a contract document for work in Botswana.

PART 1

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

PART	1
SECTION	Index
REVISION DATE	28 Nov 2002

PART 1 INDEX :

DESIGN PARAMETERS FOR DISTRIBUTION SYSTEMS

Section	Description	Old spec	Latest spec	Latest Revision
A	Design parameters for type A distribution	20-May-92	20-May-92	Rev 0
B	Design parameters for type B distribution	20-May-92	09-Jun-93	Rev 1
C	Design parameters for type C distribution	20-May-92	09-Jun-93	Rev 1
D	Design parameters for type D distribution	20-May-92	29-Aug-95	Rev 2
E	Design parameters for type E distribution	20-May-92	09-Jun-93	Rev 1
F	Design parameters for type F distribution	20-May-92	10-Mar-93	Rev 1
G	Design parameters for type G distribution	20-May-92	20-May-92	Rev 0

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION	1.1	REV 0
PAGE	1 of 1	
APPROVED	20 May 1992	

DESIGN PARAMETERS FOR ELECTRIFICATION PROJECTS

Distribution systems have been categorised according to whether underground or overhead systems are used. The choice is partly dependent on the type of consumer supplied by the system and the overall planning for the area. The choice of system type is determined by the Planning Engineer of the Botswana Power Corporation:

The following system types are recognised:

- Type A Overhead HV and ground mounted substations; from which most consumers are supplied directly. This system type is characteristic of urban industrial and commercial areas. See section 1/A.
- Type B Underground cables for both HV and LV systems, with miniature substations including HV switchgear. See section 1/B.
- Type C HV overhead lines supplying miniature substations without HV switchgear. LV distribution by underground cable. See section 1/C.
- Type D HV overhead lines supplying miniature substations without HV switchgear. LV distribution by aerial bundle conductor. See section 1/D.
- Type E HV underground cables supplying miniature substations with HV switchgear. LV distribution by aerial bundle conductor. See section 1/E.
- Type F HV overhead lines (33 or 11 kV) supplying pole-mounted transformers. LV distribution by aerial bundle conductor. See section 1/F.
- Type G Extensions to existing LV overhead bare conductor networks using three-phase, 4 or 5 wire overhead lines as well as single phase, bare conductor extensions from three phase abc lines to isolated consumers. See section 1/G.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION	1.2	REV 0
PAGE	1 of 1	
APPROVED	26 May 1992	

APPROVALS AND WAYLEAVES

1 APPROVALS

Planners shall take into account the requirements of the following organisations in network planning and the design of distribution systems:

- Ministry of Local Government and Lands
- Town councils and other local authorities regarding the existing or future installation of municipal services.
- Botswana Telecommunications Corporation regarding telecommunication line and cable routes and installations sensitive to radio interference.
- Department of Roads regarding road reserves and road crossings.
- Civil Aviation Authority in respect of installations near airfields.
- Department of Water Affairs in respect of pipelines and water storage.

2 WAYLEAVES

- Lines and cables are generally permitted in road reserves.
- Outside road reserves formal application must be made for wayleaves over the property.

3 CLEARANCE

The clearances of line conductors above ground or from buildings shall be in accordance with the requirements of the Electricity (Supply) Regulations. The ground clearances of insulated conductors (aerial bundle cable) shall be as required in the following sections of Part 1.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION	1.3	REV 0
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APPROVED	26 May 1992	

BULK CONSUMER SUPPLIES

1 SUPPLY VOLTAGE

The Corporation shall decide at what voltage a particular bulk supply will be provided and/or metered.

2 LOW VOLTAGE SUPPLIES

Low voltage supply will be limited to the capacity of a single standard transformer, generally 200, 315 or 500 kVA or, if warranted by circumstances, 800 kVA.

Metering will be on the LV side of the transformer - Tariff scale 2. BPC will provide HV equipment, transformer, LV circuit breaker and metering. The consumer will take supply from the outgoing side of the circuit breaker. The consumer may be required to provide space for BPC's LV equipment in his board.

For supplies of 800 kVA the consumer will provide the LV circuit breaker and the metering current transformers.

HV earthing type TN-C-S (protective multiple earthing) in accordance with the Electricity (Supply) Regulations 1988 [Part II - Regulation 4] and the latest edition of the IEE Wiring Regulations.

3 HIGH VOLTAGE SUPPLIES

High voltage supply will be offered for new supplies exceeding 500 kVA (425 kW at 0,85 pf) and for those likely to exceed 500 kVA within a short time.

Metering will be on the HV side of the transformer - Tariff scale 3. BPC will provide a fused HV isolator and metering unit up to 800 kVA and a circuit breaker/metering unit above 800 kVA. The consumer will take supply from the outgoing side of the metering unit or circuit breaker and provide his own transformer(s) and LV circuit breaker(s).

Consumer is responsible for own LV earthing in accordance with the applicable regulations.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION	1/A	REV 0
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APPROVED	20 May 1992	

DESIGN PARAMETERS FOR TYPE "A" DISTRIBUTION

Characteristics	HV : overhead LV : direct consumer connections
High voltage 11 kV	
HV conductor	100 mm ² ACSR "Hare" and 150 mm ² ACSR "Wolf" on wooden pole structures. HV underground cable networks may be installed in special circumstances.
HV cables	Where required for connection into main switching stations or under railway lines, underground cable shall be 150 mm ² copper XLPE/SWA. Cable tiles to be installed at crossings of other services. Route markers to be installed. Yellow cable tape marker to be installed along and at least 250 mm above cable.
HV surge arresters	Fitted to cable ends where connected to overhead lines.
HV section links	Gang-operated load-break isolators to provide for isolation of not more than 4 miniature substations in a section.
Transformers	11/0.4 kV 500 kVA miniature substations without 11 kV switchgear, connected through 40 amp D fuses to overhead line by 35 mm ² copper XLPE/SWA cable.
ADMD per plot	The after diversity maximum demand per consumer (admd) at transformer level shall be 125 A/phase at 400 V, unless otherwise required by the developer in terms of the type of industry expected.
Consumer connections	Standard installation: 200A, 3 phase circuit breaker in the miniature substation (adequate for 150A circuit breaker at consumer's meter) with 70 mm ² copper conductor PVC/SWA cable and 35 mm ² bare copper earthwire to plot boundary + 5 m, end capped and marked with a cable marker. The cable will be terminated in the meter cubicle if the building is established at the time of installation. Large Commercial and Industrial Loads: Bulk supplies at low voltage with a transformer dedicated to a single consumer or at high voltage will be given under the conditions described in SRDS Section 1.3
Protection	Consumers are advised to install single-phasing protection if they require it.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION	1/B REV 1
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APPROVED	9 June 1993

DESIGN PARAMETERS FOR TYPE "B" DISTRIBUTION

Characteristics	HV underground LV underground with distribution kiosks
High voltage	11 kV
HV system	Underground cables with ground-mounted switchgear. Underground cables: 240, 150, 70 and 35 mm ² copper XLPE 150 and 70 mm ² copper PILC Cable tiles to be installed at crossings of other services. Route markers to be installed. Yellow cable tape marker to be installed along and at least 250 mm above cable. Switchgear- Outdoor, ground-mounted isolators and ring-main units of GEC T-type.
Transformers	11/0,4 kV miniature substations of 200, 315 (preferred) or 500 kVA according to requirements, equipped with ring-main unit.
LV distribution	240, 150, 70 and 35 mm ² 4-core copper PVC underground cables to standard distribution and metering kiosks, fitted with circuit breakers of appropriate rating to protect the LV cable.
Consumer connections	Three phase supplies by 4-core 16, 35 or 70 mm ² copper conductor, PVC/SWA underground cable with bare copper earthwire of half conductor rating, minimum 16 mm ² . The consumer will not connect earth to neutral. Domestic consumer connections by 16 mm ² copper PVC underground cable, protected by 80 A single phase circuit breaker. Cable shall be 3-core SWA or split concentric neutral cable.
LV earthing	Protective multiple earthing type TN-C-S in accordance with the conditions of the Electricity (Supply) Regulations 1988 [Part II - Regulation 4] and the latest edition of the IEE Wiring Regulations. No consumer earth spike is required.
Pipe ducts	100 mm dia white PVC pipe ducts shall be provided for LV and HV cables under all tarred roads. Spare duct to be installed in every case. For 240mm ² XLPE cable a 200mm dia pipe shall be used.

ADMD per plot

There are six categories of residential plot. The after diversity maximum demand at the level of 100 plots (admd (100)) shall be used for volt drop and capacity calculations:

Category	admd
Low income	Not defined
Middle income lower	1,5 kVA (where supplied)
Middle income upper	1,5 kVA
High income small	2,5 kVA
High income medium	2,5 kVA
High income large	3,5 kVA

(Categories according to MLGLH Urban Development Standard).

Volt drop and capacity calculations
The diversity factor allowed for loads of N domestic consumers is

Install Equation Editor and double-click here to view equation.

The combined diversity and load unbalance correction factor, applied in volt drop calculations, is

Install Equation Editor and double-click here to view equation.

Where group housing or flats are to be erected on re-zoned high income large plots it may be assumed that the number of consumers will be increased by a factor of 2.5 and the admd (100) will be 2.5 kVA.

The maximum voltage drop from the transformer to a service connection tee-off shall not exceed 6% of declared voltage unless otherwise specified.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION	1/C REV 1
PAGE	1 of 2
APPROVED	9 June 1993

DESIGN PARAMETERS FOR TYPE "C" DISTRIBUTION

Characteristics	HV overhead LV underground
High voltage 11 kV	
HV system	<p>Bare-conductor overhead lines with section links.</p> <p>100 mm² ACSR "Hare" and 50 mm² ACSR "Rabbit" on wooden pole structures. Knife links to provide for isolation of not more than 2 miniature substations in a section.</p> <p>Where required for connection into main switching stations or under railway lines, underground cable shall be 150 mm² copper XLPE/SWA. Cable tiles to be provided at crossings of other services. Route markers and yellow cable tape marker to be installed.</p> <p>HV surge arresters to be fitted to cable ends where connected to overhead lines.</p>
Transformers 11/0.4 kV miniature substations	<p>of 200, 315 (preferred) or 500 kVA according to requirements. Miniature substations without 11 kV switchgear.</p> <p>Miniature substation connected through 40 amp D fuses to overhead line by 35 mm² copper XLPE/SWA cable, maximum length 200 m. Outdoor heatshrink termination onto the D-fuses. Indoor heatshrink termination and fully insulated heatshrink boots for the bushing studs in the miniature substation.</p>
Consumer connections	<p>Three phase supplies by 4-core 16, 35 or 70 mm² copper conductor, PVC/SWA underground cable with bare copper earthwire of half conductor rating, minimum 16 mm². The consumer will not connect earth to neutral.</p> <p>Domestic consumer connections by 16 mm² copper PVC underground cable, protected by 80 A single phase circuit breaker. Cable shall be 3-core SWA or split concentric neutral cable.</p>
LV earthing	<p>Protective multiple earthing type TN-C-S in accordance with the conditions of the Electricity (Supply) Regulations 1988 [Part II - Regulation 4] and the latest edition of the IEE Wiring Regulations. No consumer earth spike is required.</p>
Pipe ducts	<p>100 mm dia white PVC pipe ducts shall be provided for LV and HV underground cables under all tarred roads. Spare duct to be installed in every case.</p> <p>For 240mm² XLPE cable 200mm dia pipe shall be used.</p>

ADMD per plot

There are six categories of residential plot. The after diversity maximum demand at the level of 100 plots (admd (100)) shall be used for volt drop and capacity calculations:

Category	admd
Low income	Not defined
Middle income lower	1,5 kVA (where supplied)
Middle income upper	1,5 kVA
High income small	2,5 kVA
High income medium	2,5 kVA
High income large	3,5 kVA

(Categories according to MLGLH Urban Development Standard).

Volt drop and capacity calculations
The diversity factor allowed for loads of N domestic consumers is

Install Equation Editor and double-click here to view equation.

The combined diversity and load unbalance correction factor, applied in volt drop calculations, is

Install Equation Editor and double-click here to view equation.

Where group housing or flats are to be erected on re-zoned high income large plots it may be assumed that the number of consumers will be increased by a factor of 2.5 and the admd (100) will be 2.5 kVA.

The maximum voltage drop from the transformer to a service connection tee-off shall not exceed 6% of declared voltage unless otherwise specified.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 1/D REV 2
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DESIGN PARAMETERS FOR TYPE "D" DISTRIBUTION

Characteristics	HV overhead LV aerial bundle conductor
High voltage	11 kV
HV system	<p>Bare-conductor overhead lines with section links.</p> <p>100 mm² ACSR "Hare" and 50 mm² ACSR "Rabbit" on wooden pole structures. Knife links to provide for isolation of not more than 2 miniature substations in a section.</p> <p>Where required for connection into main switching stations or under railway lines, underground cable shall be 150 mm² copper XLPE/SWA. Cable tiles to be provided at crossings of other services. Route markers and yellow cable tape marker to be installed.</p> <p>HV surge arresters to be fitted to cable ends where connected to overhead lines.</p>
Transformers	<p>11/0,4 kV miniature substations of 200, 315 (preferred) or 500 kVA according to requirements. Miniature substations without 11 kV switchgear.</p> <p>Miniature substation connected through 40 amp D fuses to overhead line by 35 mm² copper XLPE/SWA cable, maximum length 200 m. Outdoor heatshrink termination onto the D-fuses. Indoor heatshrink termination and fully insulated heatshrink boots for the bushing studs in the miniature substation.</p> <p>A 7m slack should be provided at <u>either</u> end of cable runs in excess of 100m , and at the <u>pole end only</u> for cable runs less than 100m.</p>
LV overhead	<p>Aerial bundle conductor (abc) of supporting core type. Three phase 95 mm² with 54.6 mm² neutral and 25 mm² conductor if required for streetlighting. ABC connected to 70 mm² 4-core copper PVC SWA PVC cable with cable end box and standard tap-off insulation-piercing connectors. Feeder protected by 200A mcb in the miniature substation low voltage compartment.</p> <p>Maximum span length 50 m. Minimum ground clearance in road reserves 5.5 m, elsewhere 3.9 m. No more than two abc circuits to be erected on one pole.</p> <p>Location - generally mid-block or back-of-plot, erected on 7 m or 9 m wood poles. 9 m wood poles to be used where erected in road reserves. LV feeders may be erected under HV lines on the HV poles, with clearance according to the Electricity (Supply) Regulations.</p>

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

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Consumer connection Three phase supplies by 4-core 16, 35 or 70 mm² copper conductor, PVC/SWA underground cable with bare copper earthwire of half conductor rating, minimum 16 mm².
No more than 4 domestic consumer connections to be made from one pole. Service connection will normally be overhead, but BPC or the consumer may request an underground connection. Service connection will be 3 wire. The consumer will not connect the neutral to earth.

LV earthing Protective multiple earthing type TN-C-S in accordance with the conditions of the Electricity (Supply) Regulations 1988 [Part II - Regulation 4] and the latest edition of the IEE Wiring Regulations. No consumer earth spike is required.
The neutral conductor of the abc to be connected by 35 mm² bare copper earth wire (enclosed in 3.5 m galvanised steel pipe conduit fixed to the pole) to a 1.5 m earth spike at the bottom of the pole hole at every terminal, cable fed and tee-off pole.

Pipe ducts 100 mm dia white PVC pipe ducts shall be provided for LV and HV cables under all tarred roads. Spare duct to be installed in every case.

ADMD per plot There are six categories of residential plot. The after diversity maximum demand at the level of 100 plots (admd (100)) shall be used for volt drop and capacity calculations:

Category	admd
Low income	Not defined
Middle income lower	1,5 kVA (where supplied)
Middle income upper	1,5 kVA
High income small	2,5 kVA
High income medium	2,5 kVA
High income large	3,5 kVA

Install Equation Editor and double-click here to view equation.

(Categories according to MLGLH Urban Development Standard).

Volt drop and Capacity The diversity factor allowed for loads of N domestic consumers is

Calculations

Install Equation Editor and double-click here to view equation.

The combined diversity and load unbalance correction factor, applied in volt drop calculations, is

Where group housing or flats are to be erected on re-zoned high income large plots it may be assumed that the number of consumers will be increased by a factor of 2.5 and the admd (100) will be 2.5 kVA.

The maximum voltage drop from the transformer to a service connection tee-off shall not exceed 6% of declared voltage unless otherwise specified.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 1/E REV 1
PAGE 1 of 2
APPROVED 9 June 1993

DESIGN PARAMETERS FOR TYPE "E" DISTRIBUTION

Characteristics	HV underground LV aerial bundle conductor
High voltage	11 kV
HV system	Underground cables with ground-mounted switchgear. Underground cables: 240, 150, 70 and 35 mm ² copper XLPE 150 and 70 mm ² copper PILC Cable tiles to be installed at crossings of other services. Route markers to be installed. Yellow cable tape marker to be installed along and at least 250 mm above cable. Switchgear- Outdoor, ground-mounted isolators and ring-main units of GEC T-type.
Transformers	11/0.4 kV miniature substations of 200, 315 (preferred) or 500 kVA according to requirements, equipped with ring-main unit.
LV overhead	Aerial bundle conductor (abc) of supporting core type. Three phase 95 mm ² with 54.6 mm ² neutral and 25 mm ² conductor if required for streetlighting. ABC connected to 70 mm ² 4-core copper PVC SWA PVC cable with cable end box and standard tap-off insulation-piercing connectors. Feeder protected by 200A mcb in the miniature substation low voltage compartment. Maximum span length 50 m. Minimum ground clearance in road reserves 5.5 m, elsewhere 3.9 m. No more than two abc circuits to be erected on one pole. Location - generally mid-block or back-of-plot, erected on 7 m or 9 m wood poles. 9 m wood poles to be used where erected in road reserves. LV feeders may be erected under HV lines on the HV poles, with clearance according to the Electricity (Supply) Regulations.
Consumer connection	Three phase supplies by 4-core 16, 35 or 70 mm ² copper conductor, PVC/SWA underground cable with bare copper earthwire of half conductor rating, minimum 16 mm ² . No more than 4 domestic consumer connections to be made from one pole. Service connection will normally be overhead, but BPC or the consumer may request an underground connection. Service connection will be 3 wire. The consumer will not connect the neutral to earth.

LV earthing Protective multiple earthing type TN-C-S in accordance with the conditions of the Electricity (Supply) Regulations 1988 [Part II - Regulation 4] and the latest edition of the IEE Wiring Regulations. No consumer earth spike is required.

The neutral conductor of the ABC to be connected by 35 mm² bare copper earth wire (enclosed in 3.5 m galvanised steel pipe conduit fixed to the pole) to a 1.6 m earth spike at the bottom of the pole hole at every terminal and tee-off pole.

Pipe ducts 100 mm dia white PVC pipe ducts shall be provided for LV and HV cables under all tarred roads. Spare duct to be installed in every case.

ADMD per plot There are six categories of residential plot. The after diversity maximum demand at the level of 100 plots (admd (100)) shall be used for volt drop and capacity calculations:

Category	admd
Low income	Not defined
Middle income lower	1,5 kVA (where supplied)
Middle income upper	1,5 kVA
High income small	2,5 kVA
High income medium	2,5 kVA
High income large	3,5 kVA

(Categories according to MLGLH Urban Development Standard).

Volt drop and capacity calculations The diversity factor allowed for loads of N domestic consumers is

Install Equation Editor and double-click here to view equation.

The combined diversity and load unbalance correction factor, applied in volt drop calculations, is

Install Equation Editor and double-click here to view equation.

Where group housing or flats are to be erected on re-zoned high income large plots it may be assumed that the number of consumers will be increased by a factor of 2.5 and the admd (100) will be 2.5 kVA.

The maximum voltage drop from the transformer to a service connection tee-off shall not exceed 6% of declared voltage unless otherwise specified.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 1/F REV 0
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APPROVED 20 May 1992

DESIGN PARAMETERS FOR TYPE "F" DISTRIBUTION

Characteristics	HV overhead with pole mounted transformers LV aerial bundle conductor
High voltage	11 or 33 kV
HV conductor	25 mm ² ACSR "Gopher" or 50 mm ² ACSR "Rabbit" on wood pole structures.
Transformers	HV/0.4 kV pole mounted transformer of capacity to match the load, connected to overhead line by D-fuses. HV surge arresters mounted on the transformer. Integral LV cubicle equipped with circuit breakers. Thermometer contacts to shunt trip one MCB. Preferred transformer sizes, associated HV fuse ratings and LV circuit breakers requirements are:

Voltage	Transformer rating (kVA)	Fuse size (A)	LV circuit breakers
11 kV single phase	25	20	1 x 150A single phase
11 kV three phase	50	20	1 x 150A three phase
	100	20	2 x 150A three phase
	200	40	2 x 150A three phase
	315	40	N/A
	500*	40	N/A
33 kV three phase	50	10	1 x 150A three phase
	100	20	2 x 150A three phase
	200	20	2 x 150A three phase
	315*	20	N/A

* ground mounted transformer

Large consumers	For isolated and/or large consumers, LV system according to agreement, to meet any special requirements.
LV overhead lines	Aerial bundled conductor of supporting core type. Three phase 50 mm ² with 54.6 mm ² neutral. No street lighting conductor. Maximum span length 50 m. Minimum ground clearance : In road reserves 5.5 m, elsewhere 3.9 m. No more than two abc circuits to be erected on one pole.

Location: mid-block or back-of-plot, erected on 7 m or 9 m wood poles where permitted by plot layout. 9 m wood poles to be used where erected in road reserves. LV feeders may be erected under HV lines on the HV poles, with clearance according to the Electricity (Supply) Regulations.

LV earthing

Protective multiple earthing type TN-C-S in accordance with the conditions of the Botswana Electricity (Supply) Regulations 1988 [Part II - Regulation 4] and the latest edition of the IEE wiring Regulations.

The LV neutral to be earthed separately and remotely from the earth for the substation steelwork and earth terminals of HV surge arresters.

The neutral conductor of the LV ABC to be connected by 35 mm² bare copper earth wire (enclosed in 3.5 m galvanised steel pipe conduit fixed to the pole) to a 1.6 m earth spike at the bottom of the pole hole at every terminal and tee-off pole.

Consumer connections

Three phase supplies by 4-core 16 or 35 mm² copper conductor, PVC/SWA underground cable with 16 mm² bare copper earthwire.

No more than 4 domestic consumer connections to be made from one pole. Service connection will normally be overhead, but BPC or the consumer may request an underground connection.

No consumer earth spike is required. The consumer will not connect the neutral to earth.

Voltage drop

The maximum voltage drop from the transformer to a service connection tee-off shall not exceed 6% of declared voltage unless otherwise specified.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

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DESIGN PARAMETERS FOR TYPE "G" DISTRIBUTION

Characteristics	<p>Existing LV overhead bare conductor lines</p> <p>Single phase extensions from abc lines to isolated consumers.</p>
High voltage	Existing.
Transformers	Existing.
LV overhead lines	<p>Four or five wire (depending on system earthing), bare conductor, in vertical arrangement. Street lighting conductor where needed for streetlights operated by BPC.</p> <p>Single phase extensions from 3 phase ABC lines shall be by three-wire bare conductor in vertical arrangement.</p> <p>Location: In road reserves, erected on 9 m wood poles. LV feeders may be erected under HV lines on the HV poles, with clearance according to the Electricity (Supply) Regulations.</p> <p>Minimum ground clearance: In road reserves 5,5 m.</p>
LV earthing	Earthing in accordance with the conditions of the Botswana Electricity (Supply) Regulations 1988 [Part II - Regulation 4] and the latest edition of the IEE Wiring Regulations. Four wire systems shall be installed as type TN-C-S (protective multiple earthing). Five wire systems shall be installed as type TN-S (separate earth).
Consumer connections	<p>Three phase supplies by 4-core 16 or 35 mm² copper conductor, PVC/SWA underground cable with 16 mm² bare copper earthwire.</p> <p>No more than 4 domestic consumer connections to be made from one pole. Service connection will normally be overhead, but BPC or the consumer may request an underground connection. Service connection will be 3 wire.</p> <p>No consumer earth spike is required. The consumer will not connect the neutral to earth.</p>
Voltage drop	The maximum voltage drop from the transformer to a service connection tee-off shall not exceed 6% of declared voltage unless otherwise specified.

PART 2

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

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SECTION Index of Sections
PAGE 3
DATE 18 November 1996
Revised 28 November 2002

SPECIFICATIONS FOR PURCHASING MATERIALS AND EQUIPMENT

Section	Description	Old spec	Latest spec	Latest Revision
ABC	Aerial Bundled Conductor	20-May-92	09-Jun-93	1
ABC-comp	Connectors and fittings for ABC	20-May-92	03-Apr-96	3
ABC-endcap	Aerial Bundled conductor end cap	20-May-92	19-Nov-97	0
Arrest11	11kV surge arrestors	20-May-92	09-Jun-93	1
Arrest33	33kV surge arrestors	20-May-92	09-Jun-93	1
Arrestlv	Low voltage surge arrestors	20-May-92	Jun-95	2
Barbwire	Barbed wire	20-May-92	09-Jun-93	1
C-11pe	Polyethylene insulated 11kV cable	20-May-92	20-May-92	0
C-11pilc	Paper insulated lead covered 11kV cable	20-May-92	20-Sep-96	2
C-xlpe	Cross linked polyethylene 11kV cable	20-May-92	20-Sep-96	2
C-blbox	Compound filled cable boxes	20-May-92	09-Jun-93	1
C-bljt-pi	cable joints for PILC cables	20-May-92	09-Jun-93	1
C-ctrl	Control cable	20-May-92	20-May-92	0
C-lvpvc	Low voltage PVC cable	20-May-92	20-May-92	0
C-pilot	Pilot cable	20-May-92	15-Jun-93	1
C-service	XLPE concentric service cable	20-May-92	09-Jun-95	2
Cbljt-xl	Cable joints for XLPE cables	20-May-92	20-May-92	0
Cbljt-xp	Cable joints for 11kV XLPE & PILC cables	20-May-92	20-Feb-95	2
Cblstrap	Cable strapping	20-May-92	20-May-92	0
Cbltape	Cable marking tape	20-May-92	20-May-92	0
Cblterm	Cable termination	20-May-92	09-Jun-93	1
Con-acsr	ACSR conductor	20-May-92	20-May-92	0
Con-comp	Components for conductors	20-May-92	20-May-92	0
Con-tie	Conductor tie	20-May-92	20-May-92	0
Crimplug	Crimping lugs	20-May-92	20-May-92	0
Disc	Phase identifying discs	20-May-92	09-Jun-93	1
Earthcop	Copper earth conductor	20-May-92	09-Jun-93	1
Earthrod	Earth rod	20-May-92	09-Jun-93	1
Fuselink	H V fuse holders and links	09-Jun-93	18-Sep-96	6
FuseHV	HV HRC striker pins	20-May-92	17-Nov-95	1
FuseLV	LV fuse holders and links	20-May-92	07-Jun-95	1
Gec-K	HV GEC switchgear - K type	17-Nov-95	17-Nov-95	0
Gec-T	HV GEC switchgear - T type	20-May-92	09-Jun-93	1
Ins-comp	High Voltage composite insulators	28-Apr-95	28-Apr-95	0
Ins-HV	High Voltage insulators	16-Jun-92	09-Jun-93	1
Ins-LV	Low Voltage insulators	20-May-92	09-Jun-93	1
Ins-stay	Stay insulators	16-Jun-92	05-Jul-95	2
Ins-trid	HV composite insulators	04-Oct-95	04-Oct-95	0

Isolator	High Voltage Isolators	16-Jun-92	Nov-93	2
Kiosks	Distribution Kiosks and Pillar boxes	09-Jun-93	27-Jun-01	2
Mcb	Moulded case circuit breakers	09-Jun-93	27-Jun-01	2
Minisub	Maniature substations	20-May-93	09-Jun-93	1
Mtr-1	Single phase kWh meter	29-Mar-93	27-Jun-01	2
Mtr-3	Three phase kWh meter	Nov-93	27-Jun-01	2
Mtr-3md	Three phase maximum demand meter	Nov-93	Nov-99	2
Mtr-bec	Moulded case circuit breakers	07-Jun-94	07-Jun-94	0
Mtr-bec3	3 phase budget energy controller	12-Aug-97	27-Jun-01	1
Mtr-bec1k	Single phase budget energy controller-keypad	12-Aug-97	27-Jun-01	2
Mtr-bec1m	Single phase budget energy controller-Magnet card	12-Aug-97	12-Aug-97	0
Mtr-bkr	11kV circuit breaker with metering	16-Jun-92	08-Jun-95	2
Mtr-box	Single and three phase meter boxes	27-Jun-01	27-Jun-01	0
Mtr-ctlv	Low Voltage metering current transformers	09-Jun-93	27-Jun-01	2
Mtr-md 500A+	500 and 800Amps low voltage supplies	27-Jun-01	27-Jun-01	0
Mtr-pr	3 phase programmable electronic energy demand meter	27-Feb-95	27-Jun-01	1
Mtr-unit	11kV metering unit	09-Jun-93	27-Jun-01	5
Nec11	11kV neutral earthing compensator	16-Jun-92	09-Jun-93	1
Notice	Danger notice	20-May-92	09-Jun-93	1
Pipe	Protective pipes and ducts	20-May-92	09-Jun-93	1
Pole-No	Pole number plates	20-May-92	09-Jun-93	1
Polewood	Wooden poles	20-May-92	07-Apr-97	2
Recloss11	11kV Auto Reclosers	20-May-92	09-Jun-93	1
Recloss33	33kV Auto Reclosers	20-May-92	09-Jun-93	1
Saddle	Saddles for pipes	20-May-92	09-Jun-93	1
Stay	Stays	20-May-93	09-Jun-93	1
Testblk	13 way meter test block	07-Jun-95	07-Jun-95	0
Tr11-LV1	11/0.4kV single phase transformers	20-May-92	09-Jun-93	1
Tr11-LV2	11/0.4kV pole mounted transformers	09-Jun-93	27-Jun-01	2
Tr11-LV3	11/0.4kV ground mounted transformers	20-May-92	09-Jun-93	1
Tr11-vt	11kV three phase voltage transformers	20-May-92	09-Jun-93	1
Tr22-11	22/11kV transformers	18-Sep-95	18-Sep-95	1
Tr33-11	33/11kV transformers	20-May-92	09-Jun-93	1
Tr33-ct	33kV current transformers	20-May-92	09-Jun-93	1
Tr33-LV2	33/0.4kV pole mounted transformers	20-May-92	09-Jun-93	1
Tr33-LV3	33/0.4kV ground mounted transformers	20-May-92	09-Jun-93	1
Xarmstl	Steel crossarms	20-May-92	09-Jun-93	1
Xarmwood	Wooden crossarms	20-May-92	07-Apr-97	2

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/ABC REV 1
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APPROVED 09 June 1993

AERIAL BUNDLE CABLE

1 SCOPE

This specification covers the manufacture, testing, supply and delivery of aerial bundle cable. The following BPC Stock Items shall comply with this specification:

DL2281	Cable ABC 4 Core 95 mm ²
DL2282	Cable ABC 5 Core 95 mm ² + ST LT
DL2284	Cable ABC 4 Core 50 mm ²
DL2285	Cable ABC 5 Core 50 mm ² + ST LT

2 STANDARD SPECIFICATIONS

The cable shall comply with the requirements of a national or international specification. The supplier shall identify the relevant specification.

Cable complying with the following specifications and the requirements of this specification are acceptable:

SABS 1418	Parts 1 and 2
French Standard	HN33.209

3 CONSTRUCTION

3.1 The cable shall be of the supporting core system and the supporting core shall be the neutral conductor.

3.2 The three phase conductors shall be of hard drawn stranded compacted aluminium of cross-sectional area:

DL2281 and DL2282	95 mm ²
DL2284 and DL2285	50 mm ²

3.3 The neutral conductor shall be of aluminium alloy of 54,6 mm² cross-sectional area.

3.4 In 5 core cables, the street lighting conductor shall be of hard drawn stranded compacted aluminium of cross-sectional area 25 mm².

4 INSULATION

- 4.1 The cable shall be suitable for operation with a voltage of 1000 V between phases and 600V between phase and an earthed neutral.
- 4.2 The insulation shall be of XLPE, black carbon stabilised for UV protection.
- 4.3 The neutral conductor shall be identified by one longitudinal rim 0.5 mm x 1.0 mm along the surface of the insulation. The phase conductors shall be clearly marked by indented markings.

5 TESTS

- 5.1 The cable shall be tested in accordance with E-2 of SABS 1418: Part II for installation under bare overhead high voltage conductors.
- 5.2 The cable shall be tested in accordance with E-3 of SABS 1418 : Part II for installation in locations with a high incidence of lightning.
- 5.3 Records of routine tests shall be provided by the manufacturer.

6 DELIVERY

- 6.1 The maximum drum size shall be 2500 diameter, 1500 width.
- 6.2 The maximum weight of cable and drum shall be 5000 kg.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/ABC-COMP REV 3
PAGE 1 of 3
APPROVED 03 April 1996

CONNECTORS AND FITTINGS FOR AERIAL BUNDLE CONDUCTOR

1 SCOPE

This specification covers the manufacture, testing, supply and delivery of connectors, fittings and tools for use with aerial bundle cable.

The following BPC Stock Items shall comply with this specification:

CODE	DESCRIPTION	
DL2410	Assembly Strain ABC EAS54-10	CS10 + PA54-1500
DL2411	Assembly Suspension ABC	EHS54 (CS14 + PS54 + LM)
DL2414	Connector Tap Off ABC 35/95	35/95 Insulated (Main Line)
DL2416	Connector Tap Off ABC 25/95	2.5/25 Insulated (Service Con)
DL2417	Connector Tap Off ABC 16/95	1.5/6 Insulated (St Light)
DL2418	Joint ABC Full Tension	MJPT-54N (Neutral - Mid Span)
DL2419	Joint ABC Partial Tension	MJPT-95 (95 mm ² Mid Span)
DL2420	Joint ABC Partial Tension	MJPT-50 (50 mm ² Mid Span)
DL2421	Joint ABC Partial Tension	MJPT-25 (25 mm ² Mid Span)
DL2422	End Cap ABC (Large)	50-95 mm ² CE35-70 or GPE5
DL2423	End Cap ABC (Small)	25 mm ² CE16-25 or GPE3
GT6106	Pulley Stringing ABC	For 95 mm + 54.6 mm Neutral
GT6108	Socket Cable ABC	With Steel Cable Swivel Hook
GT6109	Socket Cable Steel ABC	Neutral Strain Cond TRS8012
GT6111	Come Along ABC	For 54,6 mm Neutral
GT6113	Separator ABC	For Separating Phases

2 STANDARD SPECIFICATIONS

Connectors and fittings shall comply with the requirements of a national or international specification. The suppliers shall identify the relevant specification.

3 CONNECTORS

- 3.1 Connectors are required for the connection to each other of conductors of the aluminium aerial bundle cable and for connection of copper earths and service cables to the aerial bundle cable.
- 3.2 The connector shall be of the insulation piercing type, able to penetrate the conductor insulation to establish a good contact without the need to strip the insulation. The teeth of the contact plate shall be of a material which will not cause corrosion; if necessary, connectors for copper and aluminium conductors shall be bi-metallic.
- 3.3 The parts of the connector shall be fixed together so that they shall not be separated when the connector is opened to fix it to the conductors.
- 3.4 The connector bolt head shall be fitted with a non-ferrous device which will shear off when good contact has been made between the connector and conductors. The bolt shall be of stainless steel and the bolt head shall remain intact to enable subsequent removal of the connector.
- 3.5 The connectors shall be insulated with reinforced plastic preventing the ingress of moisture and air. They shall be suitable for installation on live lines operating at low voltage.
- 3.6 No energised parts shall be accessible or exposed.
- 3.7 The connector when installed shall be able to withstand a voltage of 3,5 kV rms for five minutes under water 0.3 m deep.

4 SUSPENSION AND STRAIN ASSEMBLY

- 4.1 The fittings used to support the aerial bundle cable shall require only one size of the suspension and strain assembly respectively for a range of cable size.
- 4.2 No damage shall be made to the insulation of the conductors when clamping the bundle to a suspension or strain assembly.
- 4.3 There shall be no movement between the conductor insulation and the conductor when the bundle cable is in tension.
- 4.4 The strain clamp shall be of the conical wedging type, and suspension and strain clamps shall support the aerial bundle cable by a single neutral conductor of XLPE insulated, 54 mm² aluminium alloy.
- 4.5 Suspension and strain clamps shall be made of plastic or plastic-covered aluminium.
- 4.6 The suspension and strain assemblies shall be designed for the following loads (in kN):

	Vertical	Horizontal	Transverse
Suspension	7	15	2,5 <L<6
Strain	7	15	-

- 4.7 The suspension assembly shall be suitable for use at supports where the deviation angle of the bundle cable does not exceed 30 degrees.

5 JOINTS

- 5.1 The outside diameter of each joint shall be 20 mm to allow the same crimping die to be used for all sizes.

6 END CAPS

End caps shall fit securely on the end of a square-cut conductor and form a waterproof seal.

7 TOOLS

One suitable spanner, or similar device, that fits the non-ferrous shear device fitted to the connectors, shall be provided with every 100 connectors.

8 INFORMATION TO BE SUBMITTED WITH TENDER

- 8.1 Type test certificates showing compliance with the relevant standard specification.
8.2 Outline drawings.

9 APPROVED SUPPLIERS

The following are approved suppliers and applicable catalogue numbers:

CODE	SICAME SOUTH AFRICA (PTY) LTD	7EBERHARDT MARTIN (PTY) LTD
DX00631	TTD201XF	PC3WP1CF - (Wef Mar 96)
DL2416	TTD121XF	PC2-1 - (Wef Mar 96)
DL2417	TTD051XF	PC1WP1F - (Wef Mar 96)
DL2418	MJPT-54N	-
DL2419	MJPT-95	-
DL2420	MJPT-50	-
DL2421	MJPT-25	-
DL2422	GPE5	CE35-70
DL2423	GPE3	CE16-25

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/ABC-END CAP REV 0
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APPROVED 19 Nov 1997

AERIAL BUNDLED CONDUCTOR END CAP

1 SCOPE

The specification covers the manufacture, testing, supply and delivery of end caps for aerial bundled conductor. The following BPC stock items shall comply with this specification.

GIBB022 ABC end cap 25mm²

2 STANDARD SPECIFICATIONS

- 2.1 The conductor end caps shall comply with the requirements of a national or international specification. The supplier shall identify the relevant specification.
- 2.2 Conductor end caps complying with the following specifications and the requirements of this specification are acceptable.

French Standard HN33-S63

3 CONSTRUCTION

- 3.1 The conductor end caps shall be manufactured from UV stabilised rubber type material.
- 3.2 The conductor end caps shall seal the conductor ends and stay in place without the use of adhesive.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/ARREST11 REV 1
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APPROVED 9 June 1993

11 kV SURGE ARRESTERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DP4006 Arrestor 11 kV

2 GENERAL

The following arresters comply

2.1 McGraw Edison type AZX Distribution Class Arrester.

KV : 12
MCOV : 10.2
CAT. NO : 87A3VZ12

Item to be supplied complete with belly band packaged as a unit.

2.2 Joslyn type ZQ MOV Distribution Class Arrester.

KV : 12
MCOV : 10.2
CAT. NO. : 8133C0012J011

Item to be supplied complete with belly band packaged as a unit.

3 INFORMATION TO BE SUBMITTED WITH TENDER

3.1 Outline drawing.

3.2 Type test certificate demonstrating compliance with an IEC, BS, SABS or other national standard.

33 kV SURGE ARRESTERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DP4016 Arrestor 33 kV

2 GENERAL

The arresters shall be of the hermetically sealed, outdoor, gapless, zinc oxide type, 10 kA duty class.

The maximum continuous operating voltage shall be 30 kV rms, phase to neutral.

3 STANDARD SPECIFICATION

Surge arresters shall comply with IEC 99-1 as far as it is applicable to the zinc oxide type.

4 MOUNTING

The arrester shall be suitable for mounting by a belly-band, which is part of the arrester, with a single bolt onto a crossarm.

5 INFORMATION TO BE SUBMITTED WITH TENDER

5.1 Outline drawing.

5.2 Type test certificate demonstrating compliance with an IEC, BS, SABS or other national standard.

LV SURGE ARRESTERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DP4005	Arrestor LV	SAL Indoor Lightning Arrester
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2 GENERAL

- 2.1 The arresters shall comply with the applicable requirements of BS 2914.
- 2.2 The arresters shall be indoor type for 400/230V, 50 Hz earthed neutral systems and rated at 375V.
- 2.3 Heineman type SALA001 TNIM complies.
- 2.4 The maximum dimensions for the arrester shall be height - 85mm, width - 30mm, depth - 70mm

3 INFORMATION TO BE SUBMITTED WITH TENDER

- 3.1 Outline drawing.
- 3.2 Type test certificate showing compliance with BS 2914.

4 APPROVED MANUFACTURER CBI

BARBED WIRE

1 SCOPE

The following BPC Stock Items shall comply with this specification:

GE6138	Wire Barbed	Double in 50 kg
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2 GENERAL

Wire shall be galvanised to general purpose standard.

POLYETHYLENE INSULATED 11 kV CABLE

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DC2293	Cable Insulated 35 mm ² 11 kV	Red
DC2294	Cable Insulated 35 mm ² 11 kV	Yellow
DC2295	Cable Insulated 35 mm ² 11 kV	Blue

2 CONDUCTOR

2.1 The cable shall be of stranded copper conductor, single core construction, unshielded.

3 INSULATION

3.1 The cable insulation shall be medium density polyethylene. The outer covering shall be UV stabilised, pigmented PVC. The black cable shall be stabilised with carbon.

3.2 The cable shall be rated for use on 11 kV systems with effectively earthed neutral.

4 TESTS

4.1 The conductor shall be subject to a routine spark test in accordance with SABS method 524. The test voltage shall be 15 kV.

4.2 Records of routine tests shall be provided by the manufacturer.

5 DELIVERY

5.1 The maximum drum size shall be 2500 mm dia, 1500 mm width.

5.2 The maximum weight of cable and drum shall be 5000 kg.

6 APPROVED SUPPLIER

The following are approved suppliers:

GEC Electrical Products
Siemens
Aberdare Cables

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

PAPER INSULATED LEAD COVERED (PILC) 11 kV CABLES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DC2306	Cable PILC 35 mm ² 3 Core	11 kV
DC2307	Cable PILC 70 mm ² 3 Core	11 kV
DC2308	Cable PILC 150 mm ² 3 Core	11 kV

2 STANDARDS

The following specifications are applicable:

SABS 97 / 1991 : Impregnated paper-insulated dielectric cables

3 CONSTRUCTION

Unless otherwise specified, the construction of paper insulated, lead covered cable shall be as follows.

Conductor : Stranded annealed copper

Insulation rated voltage : Helically applied paper tapes impregnated with Poly-Iso-Butylene compound for a rated voltage of 6.35/11kV.

Conductor Screen : Belted, 3 - core cable

Sheath : Lead

Armour : A double layer of galvanised steel tape armour coated with a suitable water proof compound

Overall Sheath : Bitumenized and jute served overall.

4 CABLE IDENTIFICATION

Identification tape with the Botswana Power Corporation Logo shall be placed under the Lead covering throughout the length of the cable.

5 INSPECTION AND TESTS

A functional bending test shall be conducted on a sample of each type and size of cable.

During manufacture and prior to despatch the cable may be inspected at the manufacturer's works by the Engineer.

Records of routine tests shall be provided by the manufacturer.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/C-11PILC REV 2
PAGE 2 of 2
APPROVED 20 Sept 1996

6 DELIVERY

6.1 Maximum drum size: 2500 mm diameter, 1500 mm width.
Maximum weight of cable and drum : 5000 kg.
Standard cable length/drum : 300 m.

6.2 Cable ends to be sealed with lead cap plumped onto end.

7 APPROVED SUPPLIER

The following are approved suppliers :

Aberdare Cables.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/C-11XLPE REV 2
PAGE 1 of 2
APPROVED 20 Sept 1996

CROSS LINKED POLYETHYLENE (XLPE) 11 kV CABLES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DC2311	Cable XLPE 240 mm ²	3 Core 11 kV
DC2312	Cable XLPE 150 mm ²	3 Core 11 kV
DC2313	Cable XLPE 70 mm ²	3 Core 11 kV
DC2314	Cable XLPE 35 mm ²	3 Core 11 kV

2 STANDARDS

The following specifications are applicable:

SABS 1339 / 1992 : Cross-linked polyethylene - insulated electric cables.

3 CONSTRUCTION

Rated Voltage	:	E ₀ /E = 6,35/11 kV
Type	:	A
No. of Cores	:	3
Conductor	:	Stranded Annealed Copper
Insulation	:	XLPE cured by a process that does not make use of steam or water.
Screening	:	Individual
Semiconductor Layer	:	Outer extruded semiconductive layer to be freely strippable without the use of special tools.
Armouring	:	Galvanised Steel Wire, PVC bedded and sheathed.

4 CABLE IDENTIFICATION

The outer sheath shall be embossed and or printed with the Botswana Power Corporation Logo at intervals of 500mm throughout the length of the cable.

5 INSPECTION AND TESTS

In process testing - the cores shall be subjected to partial discharge scanning prior to further processing.

A "functional" bending test shall be conducted on a sample of each type and size of cable.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/C-11XLPE REV 2
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During manufacture and prior to despatch the cable may be inspected at the manufacturer's works by the Engineer.

Records of routine tests shall be provided by the manufacturer.

6 DELIVERY

- 6.1 Maximum drum size : 2500 mm diameter, 1500 mm width.
Maximum weight of cable and drum : 5000 kg.
Standard cable length/drum : 300 m.

- 6.2 Cable ends to be sealed with a heat shrunk cap.

7 APPROVED SUPPLIER

The following are approved suppliers:

Aberdare Cables

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CBLBOX REV 1
PAGE 1 of 1
APPROVED 9 June 1993

COMPOUND FILLED CABLE BOXES

1 SCOPE

The following BPC Stock Items shall comply with this specification.

DT3238	Box Compound
DC2286	Box Terminal 16 mm ² LXAC116
DC2287	Box Terminal 70 mm ² LXAC170 - Polyflor Bloemfontein

2 STANDARD SPECIFICATIONS

Cable boxes shall comply with BS542.

Compound shall comply with BS1858.

3 CABLE BOXES

A cable end box shall be of indoor metal clad type or outdoor metal clad inverted type as specified. It shall be fitted with armour clamps and brass or gunmetal conical wiping glands for lead covered cables armoured with steel tape or wire, complete with all bolts, nuts, washers, gasket and earthing braid. Indoor boxes shall be suitable for vertical panel mounting; outdoor boxes for wall or pole mounting. Unless otherwise specified, cable boxes for T3/0F switchgear as used in miniature substations shall be:

Cable box	: GEC Part Number 562302
Cable gland	: GEC Part Number 562578

The cable box shall be suitable for cable up to 150 mm² conductor. The cable gland shall be insulated.

4 COMPOUND

Compound shall be non-hygroscopic and have high dielectric strength. It shall adhere to cast iron and be suitable for ambient temperatures up to 50 deg C.

Cold filling compound, consisting of a compound and a hardening agent supplied in separate containers in the correct proportions ready for mixing, shall be an acceptable alternative. The compound shall be used at atmospheric pressure and without the application of heat. Shrinkage shall be small and the topping up of boxes shall be unnecessary.

5 INFORMATION TO BE SUBMITTED WITH TENDER

5.1 For cable boxes: outline drawing.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CBLJT-PI REV 1
PAGE 1 of 1
APPROVED 9 June 1993

CABLE JOINTS FOR PILC CABLE

Replaced by CBLJT-XP.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CBLJT-XP REV 2
PAGE 1 of 1
APPROVED 20 Feb 1995

CABLE JOINTS FOR 11 KV XLPE AND PILC CABLE

1 SCOPE

See attached table.

2 GENERAL

Joint kits shall be based on heat-shrink insulation.

Instructions for installation shall be supplied with the joint kit.

3 MANUFACTURER.

RAYCHEM.

DJ01101	JOINT KIT XLPE 16-50 SQ MM	RAYCHEM EPKJ-3090
DJ01103	JOINT KIT XLPE 70 SQ MM	RAYCHEM EPKJ-3091
DJ01105	JOINT KIT XLPE 150 SQ MM	RAYCHEM EPKJ-3092
DC2150	JOINT KIT XLPE 240 SQ MM	RAYCHEM EPKJ-3093

DC2151	JOINT KIT PILC 16-50 SQ MM	RAYCHEM EPSJ-12A
DC2152	JOINT KIT PILC 70 SQ MM	RAYCHEM EPSJ-12B
DC2153	JOINT KIT PILC 150 SQ MM	RAYCHEM EPSJ-12C
DC2154	JOINT KIT PILC 240 SQ MM	RAYCHEM EPSJ-12D

DC2109	JOINT KIT TRANSITION 16-50 MM	RAYCHEM EFSJ-12A/T6
DC2110	JOINT KIT TRANSITION 70 MM	RAYCHEM EFSJ-12B/T7
DC2111	JOINT KIT TRANSITION 150 MM	RAYCHEM EFSJ-12C/T8
DC2112	JOINT KIT TRANSITION 240 MM	RAYCHEM EFSJ-12D/T9

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/C-CTRL REV 0
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APPROVED 20 May 1992

CONTROL CABLE

1 SCOPE

The following BPC Stock Items shall comply with the specification:

DC2298	Cable Underground 2.5 mm ²	4 Core PVC SWA
DC2299	Cable Underground 2.5 mm ²	12 Core PVC SWA

2 STANDARD SPECIFICATIONS

The cable shall comply with the requirements of SABS 1507: 1990 PVC insulated electric cables.

3 GENERAL

Cables shall be stranded copper conductor, 2.5 mm² cross sectional area. Insulation shall be 600/1000V general purpose grade.

Core identification for 4-core cables shall be by red, white, blue and black colouring. The colouring shall be complete and a colour stripe is not adequate.

Core identification shall be by printed numerals for 12 - core cables.

The cables shall be steel wire armoured, bedded and served with black PVC.

4 TESTS

Records of routine tests shall be provided by the manufacturer.

5 APPROVED SUPPLIER

The following are approved suppliers:

Aberdare Cables

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/C-LVPVC REV 0
PAGE 1 of 2
APPROVED 20 May 1992

LOW VOLTAGE PVC CABLE

1 SCOPE

The following BPC Stock Items shall comply with the specification:

	Cable Underground	16 mm ²	2 Core PVC SWA
	Cable Underground	16 mm ²	3 Core PVC SWA
DC2300	Cable Underground	16 mm ²	4 Core PVC SWA
DC2301	Cable Underground	35 mm ²	3 Core PVC SWA
DC2302	Cable Underground	35 mm ²	4 Core PVC SWA
DC2303	Cable Underground	70 mm ²	4 Core PVC SWA
	Cable Underground	120 mm ²	4 Core PVC SWA
DC2304	Cable Underground	150 mm ²	4 Core PVC SWA
DC2305	Cable Underground	240 mm ²	4 Core PVC SWA
	Cable Insulated	Triplex	3 Core PVC

2 STANDARD SPECIFICATIONS

The cable shall comply with the requirements of SABS 150: PVC insulated electric cables or BS 6346: PVC insulated cables for electricity supply. (revised now applicable SABS 1507)

3 GENERAL

Cables shall be stranded copper conductor, of appropriate cross sectional area. The cores of triplex cable shall be 16 mm² cross section with a 10 mm² earth continuity conductor. Insulation shall be 600/1000 V general-purpose grades.

Core identification shall be by solid colouring of the insulation and a colour stripe is not adequate. The colours shall be as follows:

2 core cable: red, black
3 core cable: red, white, blue
4 core cable: red, white, blue, black
Triplex cable: red, black, with bare earth continuity conductor embedded in the PVC sheath.

Underground cables shall be steel wire armoured, bedded and served with black PVC.

The cores of triplex cable shall be laid in a flat plane with the earth conductor between the insulated cores. The PVC outer sheath shall be UV stabilised.

4 TESTS

The manufacturer shall provide records of routine tests.

5 DRUM SIZES

The maximum dimension of cable drums shall be:

2500 mm diameter
1500 mm width
5000 kg weight

Triplex cable shall be supplied 500 m lengths unless otherwise specified.

6 APPROVED SUPPLIER

The following are approved suppliers:

Aberdare Cables
GEC Electrical Products
BICC (Africa)

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/C-PILOT REV 2
PAGE 1 of 2
APPROVED 15 June 1993

PILOT CABLE

1 SCOPE

The following BPC Stock Items shall comply with this specification.

DC2310 Cable Underground Pilot - 19 Pair 0.9 mm 5 kV

2 STANDARD SPECIFICATION

The cable shall comply with the requirements of the South African National Rationalized Specification NRS 011: 1991.

3 GENERAL

19 pairs
Galvanized steel wire armoured.
Induced voltage not exceeding 5kV
Conductor Dia 0.9 mm
Average resistance per km: 28,19 OHM (MAX)

High voltage test: 5 kV RMS for 1 minute between conductors and between conductors and armour.

Insulation resistance (Megger) Test: 5 000 m OHM (500 volt DC for 1 minute).

Over sheath shall comprise extruded black PVC drum length 500 m.

Overall diameter 27 mm.

4. PAIR COLOURS

The pair colours as per the NRS 011: 1991 shall be used as follows:

Conductor colours (19 pair cable)

1	2	3	4	5
Pair number	Layer	Insulation Colour		Notes
		A wire	B wire	
1	Centre (1 pair)	Orange	White	
.....
2	First (6 pairs)	Orange	White	Marker pair
3		Red	Grey	
4		Blue	Brown	
5		Red	Grey	
6		Blue	Brown	
7		Green	Black	
.....
8	Second (12 pairs)	Orange	White	Marker pair
9		Red	Grey	
10		Blue	Brown	
11		Red	Green	
12		Blue	Brown	
13		Red	Grey	
14		Blue	Brown	
15		Red	Grey	
16		Blue	Brown	
17		Red	Grey	
18		Blue	Brown	
19		Green	Black	

5 APPROVED MANUFACTURER

The following are approved Manufacturers:

- Aberdare Cables
- Siemens
- GEC

NOTES

1. Recommended joint kit for this cable is: 3m: - 91 - A3
(BPC Stores Code DC2282)

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/C-SERVICE REV1
PAGE 1 of 1
APPROVED 09 June 1995

XLPE CONCENTRIC SERVICE CONNECTION CABLE

1 The following cable shall meet the Standard Specifications.

DC2292	Cable Concentric Service 16mm ²	3 Core XPLE Airdac
DC2291	Cable Concentric Service 10mm ²	3 Core XLPE Airdac

2 GENERAL

Circular stranded hard drawn copper phase conductor, XLPE insulated with identified neutral and bare earth conductors arranged concentrically around it. Polythene sheathed 600/1000 volts service connection cable.

3 SPECIFICATION

Phase conductor cross-section:	16mm ²
Neutral conductor cross-section:	16mm ²
Earth conductor cross-section:	10mm ²

4 DRUM SIZES

The maximum dimension of cable drums shall be:

2500mm Diameter
1500mm Width
5000kg Weight

Cable shall be supplied in 500m lengths unless otherwise specified.

5 APPROVED SUPPLIER

The following are approved suppliers:

Aberdare Cables-name of cable "AIRDAC"

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CBLJT-XL REV 0
PAGE 1 of 1
APPROVED 20 May 1992

CABLE JOINTS FOR XLPE CABLE

1 SCOPE

The following BPC Stock Items shall comply with the specification:

DC2144	Joint Kit XLPE SWA 16-35 mm ²	Scotch Tex 1
DC2150	Joint Kit XLPE SWA 240 mm ²	
DC2145	Joint Kit XLPE SWA 70 mm ²	
DC2147	Joint Kit XLPE SWA 150 mm ²	

2 GENERAL

Joint kits shall be based on heat-shrink insulation.

Appropriate kits for the size of cable indicated shall be approved by cable manufacturers.

Instructions for installation shall be supplied with the joint kit.

3 APPROVED SUPPLIER

The following are approved suppliers:

Electric Cable Accessories

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CBLSTRAP REV 0
PAGE 1 of 1
APPROVED 20 May 1992

CABLE STRAPPING

1 SCOPE

The following BPC Stock Items shall comply with the specification:

DM5061	Strap Cable 92 x 2.6 mm Insulock T18R Weather Resistant Black
DM5062	Strap Cable 140 x 3.6 mm Insulock T30R Weather Resistant Black
DM5063	Strap Cable 197 x 4.9 mm Insulock T50R Weather Resistant Black
DM5064	Strap Cable 390 x 7.6 mm Insulock T120R Weather Resistant Black

2 STANDARD SPECIFICATIONS

Cable strap shall comply with the relevant requirements of South African standard NRS 020.

3 APPROVED SUPPLIER

The following are approved suppliers:

Keens Electrical Wholesalers

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CBLTAPE REV 0
PAGE 1 of 1
APPROVED 20 May 1992

CABLE MARKING TAPE

1 SCOPE

The following BPC Stock Items shall comply with the specification:

GE6227 Tape Cable Warning PVC 50 m roll - yellow with red 100 micron

2 GENERAL

The plastic sheeting shall be not less than 300 mm wide and 100 micron thick. It shall be yellow with the lightning strike insignia and the word "DANGER" printed in red at 300 mm intervals.

3 APPROVED SUPPLIER

The following are approved suppliers:

Inlec

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CBLTERM REV 1
PAGE 1 of 1
APPROVED 9 June 1993

CABLE TERMINATIONS

1 SCOPE

See attached table

2 GENERAL

Termination kits shall be suitable for use on impedance earthed 11 kV systems.

A set of instructions shall be supplied with each termination kit.

3 APPROVED MANUFACTURER

RAYCHEM

DC2113	TERMINAL KIT XPLE 16-25 MM	INDOOR RAYCHEM EPKT-17A3XI-H1
DC2114	TERMINAL KIT XLPE 35-70 MM	INDOOR RAYCHEM EPKT-17B3XI-H1
DC2115	TERMINAL KIT XLPE 150-240 MM	INDOOR RAYCHEM EPKT-17C3XI-H1
DC2116	TERMINAL KIT XLPE 16-25 MM	OUTDOOR RAYCHEM EPKT-17A3XO-H4
DC2117	TERMINAL KIT XLPE 35-70 MM	OUTDOOR RAYCHEM EPKT-17B3XO-H4
DC2118	TERMINAL KIT XLPE 150-240 MM	OUTDOOR RAYCHEM EPKT-17C3XO-H4
DC2119	TERMINAL KIT PILC 16-25 MM	INDOOR RAYCHEM EPKT-17A3MI-H1
DC2120	TERMINAL KIT PILC 35-70 MM	INDOOR RAYCHEM EPKT-17B3MI-H1
DC2121	TERMINAL KIT PILC 150-240 MM	INDOOR RAYCHEM EPKT-17C3MI-H1
DC2122	TERMINAL KIT PILC 16-25 MM	OUTDOOR RAYCHEM EPKT-17A3XO-H4
DC2123	TERMINAL KIT PILC 35-70 MM	OUTDOOR RAYCHEM EPKT-17B3XO-H4
DC2124	TERMINAL KIT PILC 150-240 MM	OUTDOOR RAYCHEM EPKT-17C3XO-H4

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CON-ACSR REV 0
PAGE 1 of 1
APPROVED 20 May 1992

ACSR CONDUCTOR

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2272	Conductor wire ACSR Gopher 25 mm ²
DL2273	Conductor wire ACSR Rabbit 50 mm ²
DL2274	Conductor wire ACSR Hare 100 mm ²
DL2275	Conductor wire ACSR Wolf 150 mm ²

2 STANDARD SPECIFICATIONS

The conductor shall comply with the requirements of SABS 182 : Conductors for overhead transmission lines : Part II : Stranded aluminium conductors.

3 GENERAL

Conductor shall be of the size and type specified separately.

4 TESTS

Records of routine tests shall be provided by the manufacturer.

5 APPROVED SUPPLIER

The following are approved suppliers:

Hulleys Aluminium
Siemens

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CON-COMP REV 0
PAGE 1 of 2
APPROVED 20 May 1992

COMPONENTS FOR CONDUCTORS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2552	Clamp Strain 120 - 105 mm EA4	5 - 14,5 Dia Conductor
DL2553	Clamp Strain 105 - 200 mm EA8	14 - 22 mm Dia Conductor
DL2555	Clamp Suspension ELC Type EA23	
DL2556	Clamp Aluminium 100 mm	PG 1556/2B
DL2557	Clamp Aluminium PG 2674-3B	
DL2558	Clamp Bi Metal 100 mm PG1556-2B	
DL2559	Clamp Bi Metal 100 mm PG1556-1G	1 Bolt PG Clamp
	Clamp Crosby	10 mm Galvanised
	Clamp Crosby	20 mm Galvanised
DL2560	Line Tap 9 mm M02	
DL2561	Line Tap 5.5 mm M06	
DL2563	Clevis Adaptor Tongue RC 65ELC	
DL2564	Strap Twist Shackle VC30 (ELC)	
DL2565	D Iron 505/MD (ELC)	
DL2367	Dead End Gopher 25 mm ² (ADE 280)	
DL2368	Dead End Rabbit 50 mm ² (ADE 396)	
DL2369	Dead End Hare 100 mm ² (ADE 558)	
DL2373	Splice Full Tension 25 mm ² Gopher	CAT ALS 280
DL2374	Splice Full Tension 50 mm ² Rabbit	CAT ALS FT 396
DL2375	Splice Full Tension 100 mm ² Hare	CAT ALS FT 558
DL2376	Splice Full Tension 150 mm ² Wolf	CAT ALS FT 714
DL2377	Clevis Thimble PLP	CAT CAB 100

2 STANDARD SPECIFICATIONS

Non-current carrying line fittings shall comply with the requirements of SABS 178.

3 STRAIN CLAMPS

The clamps shall be made of malleable cast iron to BS 310 and manufactured in compliance with SABS 178.

Tension clamps shall not permit slipping of or cause damage to or failure of the complete line conductor or any part thereof at a load less than 95% of the ultimate strength of the line conductor for which it is intended. The ultimate breaking strength of fittings specified for tension application shall not be less than 70 kN.

The tension clamps shall be designed so that relative movement between individual conductor layers shall not occur during assembly.

All bolts or U-bolts shall be provided with locknuts. All nuts shall be backed with flat steel washers.

4 SUSPENSION CLAMPS

Suspension clamps shall be galvanised malleable cast iron.

The clamps shall be constructed with a smoothly waved cable seat and keeper to accommodate the conductor being used. The clamp seat diameter shall be large enough to include the conductor for which the clamp is specified.

5 CORROSION PROTECTION

All fittings made of steel or malleable iron, including nuts and the threaded portions of bolts, shall be hot-dip galvanised in accordance with SABS 763.

All split pins shall be of phosphor bronze or stainless steel and shall be backed by flat steel washers. All washers shall be hot bitumen dipped or red lead finished.

6 INFORMATION TO BE SUBMITTED WITH TENDER

6.1 Outline drawings.

6.2 Type test certificates showing compliance with specification.

7 APPROVED SUPPLIER

The following are approved suppliers:

Cullinan Electrical
Keens Electrical Wholesalers
Sprang Tool Co
Crescom Distributors
Hardware Assemblies

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CON-TIE REV 0
PAGE 1 of 1
APPROVED 20 May 1992

CONDUCTOR TIES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2370	Wraplock 11 kV Gopher	(AWT 280)
DL2371	Wraplock 11 kV Hare	(AWT 558)
DL2372	Wraplock 11 kV Wolf	(AWT 714)
	Wraplock 33 kV Gopher	(AWT 280/J)
	Wraplock 33 kV Rabbit	(AWT 396/J)
	Wraplock 33 kV Hare	(AWT 558/J)

2 GENERAL

The following manufacturer's code is appropriate for WRAPLOCK ties:

BPC PART NO	MANUF. CODE	CONDUCTOR	INSULATOR
DL2370	AWT 280F	Gopher	HT 1014/40
DL2371	AWT 558F	Hare	HT 1014/40
DL2372	AWT 714F	Wolf	HT 1014/40
DX00044	AWT 280/J	Gopher	HT 1018
DX00045	AWT 396/J	Rabbit	HT 1018
DX00046	AWT 558/J	Hare	HT 1018

3 APPROVED SUPPLIER

The following are approved suppliers:

Cullinan Electrical
Cu-AI Engineering

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/CRIMPLUG REV 0
PAGE 1 of 1
APPROVED 20 May 1992

CRIMPING LUGS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DC2218	Lug Crimping Tinned 35 x 8 mm	Non Insulated
DC2219	Lug Crimping Tinned 35 x 10 mm	Non Insulated
DC2221	Lug Crimping Tinned 35 x 16 mm	Non Insulated
DC2223	Lug Crimping Tinned 70 x 12 mm	Non Insulated
DC2224	Lug Crimping Tinned 70 x 16 mm	Non Insulated
DC2250	Lug Crimping Tinned 70 x 20 mm	Non Insulated
DC2225	Lug Crimping Tinned 95 x 12 mm	Non Insulated
DC2228	Lug Crimping Tinned 95 x 16 mm	Non Insulated
DC2229	Lug Crimping Tinned 120 x 12 mm	Non Insulated
DC2267	Lug Crimping Tinned 150 x 12 mm	Non Insulated
DC2268	Lug Crimping Tinned 150 x 16 mm	Non Insulated
DC2269	Lug Crimping Tinned 150 x 20 mm	Non Insulated
DC2270	Lug Crimping Tinned 240 x 16 mm	Non Insulated
DC2271	Lug Crimping Tinned 240 x 20 mm	Non Insulated
DC2272	Lug Crimping Tinned 240 x 24 mm	Non Insulated

2 APPROVED SUPPLIER

The following are approved suppliers:

Keens Electrical Wholesalers
Inlec
Diazo Electrical

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/DISC REV 1
PAGE 1 of 1
APPROVED 9 June 1993

PHASE IDENTITY DISCS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2566	Disc Phase Yellow	100 mm Diameter
DL2567	Disc Phase Blue	100 mm Diameter
DL2568	Disc Phase Red	100 mm Diameter

2 GENERAL

The discs shall be made of steel.

There shall be one hole, 3 mm diameter, 15 mm from the edge.

The discs shall be enamel or epoxy coated.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/EARTHCOP REV 1
PAGE 1 of 1
APPROVED 9 June 1993

COPPER CONDUCTOR FOR EARTHING

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2292	Conductor Wire Copper 16 mm ²	Bare annealed 7 strand
DL2293	Conductor Wire Copper 25 mm ²	Bare annealed 19 strand
DL2294	Conductor Wire Copper 35 mm ²	Bare annealed 19 strand
DL2295	Conductor Wire Copper 70 mm ² HD	Bare hard drawn 19 strand
DL2296	Conductor Wire Copper 70 mm ²	Bare annealed 19 strand
	Conductor Wire Copper 150 mm ²	Bare annealed 37 strand

2 STANDARD SPECIFICATIONS

The conductor shall comply with SABS 182 : Conductors for overhead electrical transmission lines : Part I : Copper wires and stranded copper conductors.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/EARTHROD REV 1
PAGE 1 of 1
APPROVED 9 June 1993

EARTH ROD

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2496	Rod Earth Extensible Cadweld	Cadweld CAD SI 5 mm 16L 1.5 m
DL2497	Rod Earth O/H R1.9 SHE	
DL2498	Coupling Earth Rod	Cadweld Cad SI 5 mm 16L 1.5 m
DZ00022	Bolt Driving Cadweld DH M16	
DL2340	Clamp Rod Earth CM16 Cadweld	

2 STANDARD SPECIFICATIONS

The following standard specification is applicable.

SABS 1063 : Earthrods, couplers and clamps.

3 INFORMATION TO BE SUBMITTED WITH TENDER

3.1 Outline drawings

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/FUSELINK REV 6
PAGE 1 of 1
APPROVED 18 Sept 1996

HV FUSES AND LINKS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DP4065	Fuse Element 5A	11KVD Fast Blow Univ Double TL
DP4066	Fuse Element 10A	11KVD Fast Blow Univ Double TL
DP4067	Fuse Element 20A	11KVD Fast Blow Univ Double TL
DP4068	Fuse Element 40A	11KVD Fast Blow Univ Double TL
DP4069	Fuse Element 60A	11KVD Fast Blow Univ Double TL
DP4070	Fuse Element 5A	33KVD Fast Blow Univ Double TL
DP4071	Fuse Element 10A	33KVD Fast Blow Univ Double TL
DP4072	Fuse Element 20A	33KVD Fast Blow Univ Double TL
DP4074	Fuse Link HRC 20A 254 mm Pin	Jos Pin Type 11 kV
DP4008	Link Operating 11 kV A3120	Knife Switch
DP4009	Link Operating 33 kV 4149P	Knife Switch KARG 400 Amp
DP4010	Cut Out 11 kV Mount & Carrier	Karg Series 21 Explusion D Fuse
DP4113	Fuse D 33 kV LEL A3480	
DP4127	Link D Solid Type D 11/22 kV	
DP4128	Tube Paxolin for GEC Type D	11/22KV
DP4105	Fuse HRC Oil 25A - T Range	KEBXO 25
DP4109	Fuse HRC Air 25A - K Range	KEMXO 36
DP4106	Fuse HRC Oil 36A - T Range	KEBXO 36
DP4110	Fuse HRC Air 36A - K Range	KEMXO 40
DP4107	Fuse HRC Oil 45A - T Range	KEBXO 45
DP4111	Fuse HRC Air 45A - K Range	KEMXO 50
DP4108	Fuse HRC Oil 80A - T Range	KEBXO 80
DP4112	Fuse HRC Air 80A - K Range	KEMXO 90

2 INFORMATION TO BE SUBMITTED WITH TENDER

2.1 For fuses: Characteristic curve and type test certificate showing compliance.

2.2 For insulating elements:

- outline drawing
- type test certificates showing voltage withstand in accordance with an appropriate IEC, BS or SABS specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/FUSEHV REV 1
PAGE 1 of 1
APPROVED 17 Nov 1995

HV 11KV HRC STRIKER PIN

1 SCOPE

The following BPC Stock Items shall comply with the specification

Fuse 25A	GEC Type K-KEMXO
Fuse 36A	GEC Type K-KEMXO
Fuse 45A	GEC Type K-KEMXO
Fuse 80A	GEC Type K-KEMXO

2 STANDARD SPECIFICATIONS

The fuse elements and fuse carrier shall comply with the requirements of BS88 : Part 1 : 1975.

3 GENERAL

The fuse element and copper link shall have off-set tags which will clip into the fuse carrier, type NS-H(S), without the use of fixing screws.

The fuse holders shall be made from high grade flame retardant non-hygroscopic phenolic moulding. The contacts shall be self-aligning, self-cleaning and the contact pressure maintained by a solid non-distortable fixed base contact.

The fuse holder shall be for front wiring at both ends and fitted with sealing clipsto enable the fuse carrier to be sealed against unauthorised removal.

4 TESTS

The fuse elements shall be ASTA certified at 80kA, 415 volts A.C.

5 APPROVED MANUFACTURER

GEC

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/FUSELV REV 1
PAGE 1 of 1
APPROVED 07 June 1995

LV FUSES HOLDERS AND FUSE LINKS

1 SCOPE

The following BPC Stock Items shall comply with the specification

DP4082	Fuse element 2A	415V HRC GEC Type NS2
	Fuse element 4A	415V HRC GEC Type NS4
DF02004	Fuse element 6A	415V HRC GEC Type NS6
DP4084	Fuse element 10A	415V HRC GEC Type NS10
	Fuse element 16A	415V HRC GEC Type NS16
DP4085	Fuse element 20A	415V HRC GEC Type NS20
DF02011	Fuse element 25A	415V HRC GEC Type NS25
	Fuse element 32A	415V HRC GEC Type NS32
DL2290	Off-set copper link	Link for white fuse holder
DP4103	Fuse carrier 76mm	GEC Type NS-H(S) Black
DP4104	Fuse carrier 76mm	GEC Type NS-H(S) White

2 STANDARD SPECIFICATIONS

The fuse elements and fuse carrier shall comply with the requirements of BS88 : Part 1 : 1975.

3 GENERAL

The fuse element and copper link shall have off-set tags which will clip into the fuse carrier, type NS-H(S), without the use of fixing screws.

The fuse holders shall be made from high grade flame retardant non-hygroscopic phenolic moulding. The contacts shall be self-aligning, self-cleaning and the contact pressure maintained by a solid non-distortable fixed base contact.

The fuse holder shall be for front wiring at both ends and fitted with sealing clipsto enable the fuse carrier to be sealed against unauthorised removal.

4 TESTS

The fuse elements shall be ASTA certified at 80kA, 415 volts A.C.

5 APPROVED MANUFACTURER

GEC

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/GEC.K Rev 0
PAGE 1 of 3
APPROVED 17 Nov 1995

HV GEC SWITCHGEAR (K TYPE)

1. SCOPE

The following BPC stock items shall comply with this specification:

DT3186	Switch Oil Fused , GEC K3/Off	with Clamps for Dry Cable
	Ring Main Unit K3 GEC type K	Non-Exten/Ring Main Oil Switch
DT3187	Ring Main Unit K3/OFF GEC K	Non-Exten/RMU with K/OFF fuse
DT3188	Ring Main Unit Indoor	Type NX3/KBA/K3/OFF
DT3189	Switch Oil GEC K3	With clamps for dry type clamps
DT3190	Switch Oil K1 GEC type	Exten/Auto Oil Switch
DT3191	Switch Oil GEC K1	With clamps for Dry Cable
DT3192	Switch Oil fused K1/OFF GEC	Exten/Auto Oil Fuse Switch
DT3258	Comp cable box type K280/381	For oil switch/isolator
DT3250	Comp cable box type K315/372	For fuse switch unit
DT3251	Air cable box type K262/374	For oil switch/isolator
DT3252	Air cable box type K345/369	For fuse switch unit
DT3252	Air cable box LH type K178541	K1 Busbar end
DT00006	Air cable box RH type K178542	K1 Busbar end
DT3254	Comp cable box LH type K178168	K1 Busbar end
DT3255	Comp cable box RH type K178169	K1- Busbar end
DT3256	Busbar unit type K178543	K1 GECA-unit to unit
DT3257	Busbar end cap type K178544	K1 GECA

2. GENERAL

HV OIL SWITCHES

HV oil switches and K-off switch fuse units shall be metal clad and pedestal or Panel mounted. Each HV oil switch shall be fitted with interlocks, integral earthing, test sockets and switch position indication.

HV oil switches shall be of the three pole, fault make load break type with "ON" "OFF", and "EARTH" positions. Each HV oil switch shall be so constructed that it is not possible to switch from the "ON" to the "EARTH" position without first switching to the "OFF" position. Provision shall be made for locking the switch in the "OFF" position. Interlocking shall be provided on each HV oil switch to ensure that the HV oil switch cannot be opened for inspection unless it is in the "EARTH" position. Each HV oil switch shall be so designed that it is possible to insert a cable test probe only when the switch is on the "EARTH" position.

Oil in HV oil switches or intended for filling HV oil switches shall be insulating oil that complies with the requirements of SABS 555.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/GEC.K REV 0
PAGE 2 of 3
APPROVED 17 Nov 1995

3. FITTINGS AND ACCESSORIES

- 3.1 K1 - Supplied without cable box. No busbar end caps or busbar cable end boxes supplied.
- K1/AF - Supplied without cable box. No busbar end caps or busbar cable end boxes supplied.
- K3 - Supplied without cable box.
- K3/AF - Supplied without cable box.
- 3.2 Cable test facilities are required as follows :-
- K1 - Required.
- K1/AF - Not required.
- K3 - Required on ring main and tee off switches.
- K3/AF - Required on ring main switches only.
- 3.3 On K1 and K1/AF units 300mm pedestal height required.
- 3.4 Operating handles to be included.
- 3.5 Oil, compound and fuses not to be supplied.
- 3.6 Colour Dark Admiralty Grey, standard shade 532 to BS381C, or Avocado C12 to SABS 1091.
- 3.7 All units to be for outdoor free standing installation.

4. CABLE BOXES

- 4.1 Outgoing cable boxes to fit GECA Type K oil switches. (Isolators K1 or K3).
- 4.1.1 For PILC cables (compound filled boxes) item 5 above.
- 4.1.2 For XLPE cables item 7 above.
- 4.2 Outgoing cable boxes to fit GECA type K/AF will be as follows :-
- 4.2.1 For PILC cables (compound filled boxes) item 6 above.
- 4.2.2 For XLPE cables item 8 above.
- 4.3 Cable boxes to fit on the busbars of a GECA K1 or K1/AF will be as follows :-
- 4.3.1 For PILC cable, compound filled box items 10a and 10b above.
Suitable for up to 150mm² PILCSTA.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/GEC.K REV 0
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- 4.3.2 For XLPE cable, air cable box items 9a and 9b above. Suitable for up to 150mm² XLPE SWA.
- 4.4 All cable boxes specified above are to be complete with glands and all necessary gasketing.

5. TESTS AT FACTORY PRIOR TO DELIVERY

Routine high voltage tests are to be carried out at the factory on all components and materials.

Test certificates shall be supplied in respect of each such component and material as proof that the tests have been carried out and that the component or material complies with the requirements of the relevant specification.

6. INFORMATION TO BE SUBMITTED WITH TENDER

- 6.1 Outline drawing

7. APPROVED SUPPLIER

The following are approved suppliers: GEC Switchgear Co.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/GEC.T REV 1
PAGE 1 of 3
APPROVED 9 June 1993

HV GEC SWITCHGEAR (T.TYPE)

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3230	End Cap B-BA T1 GEC	Type T
DT3232	Plate Fish T1 GEC	Type T
DT3233	Gland Cable Isolator Box GEC	Type T 95 x 86 Hole CRS 054305
DT3234	Gland Cable GEC P/No.053627	Type T 76 x 76 Hole CRS
DT3239	Insulator Busbar End Cable Box	GEC T1 No 528188 For PILC Cable
DT3240	Busbar End Cable Box GEC	T1 Insulator No 528196 for XLPE
DT3193	Ring Main Unit T3 GEC	Type T Non-Exten/Ring Main Oil Switch
DT00030	Ring Main Unit T3/OF GEC	T Non-Exten/RMU with T-Off Fuse
DT00040	Switch Oil T1 GEC	Type Exten/Non-Auto Oil Switch
DT3199	Switch Oil Fused T1/OF GEC	Exten/Auto Oil Fuse Switch

2 GENERAL

HV Oil Switches

HV oil switches and T-off switch-fuse units shall be metal clad and pedestal- or panel-mounted. Each HV oil switch shall be fitted with interlocks, integral earthing, test sockets and switch position indication.

HV oil switches shall be of the three pole, fault make/load break type with "ON", "OFF", and "EARTH" positions. Each HV oil switch shall be so constructed that it is not possible to switch from the "ON" to the "EARTH" position without first switching to the "OFF" position. Provision shall be made for locking the switch in the "OFF" position. Interlocking shall be provided on each HV oil switch to ensure that the switch cannot be opened for inspection unless it is in the "EARTH" position. Each HV oil switch shall be so designed that it is possible to insert a cable test probe only when the switch is in the "EARTH" position.

Oil in HV oil switches or intended for filling HV oil switches shall be insulating oil that complies with the requirements of SABS 555.

3 FITTINGS AND ACCESSORIES

Cable boxes required as follows:

- T1 - Out way suitable for 150 mm² PILCSTA.
No box or end caps required on in ways.
- T1/OF - Out way suitable for 35 mm² XLPESWA.
No box or end caps required on in ways.
- T3 - All ways suitable for 150 mm² PILCSTA.
- T3-OF - Ring switches : 150 mm² PILCSTA.
- Fused switch : 35 mm² XLPESWA.

3.2 Cable test facilities are required as follows:

- T1 - Required
- T1-OF - Not required
- T3 - Required on ring main and tee off switches.
- T3-OF - Required on ring main switches only.

3.3 On T1 and T1/OF units, aluminium ring (part 562602) and neoprene gasket (part 5626;10) to be supplied on in ways.

3.4 On T1 and T1/OF units, 632 mm pedestal height required.

3.5 Operating handles to be included.

3.6 Oil, compound and fuses not to be supplied.

3.7 Colour Dark Admiralty Grey, standard shade 632 to BS 381C, or Avocado C12 to SABS 1091.

3.8 All units to be for outdoor free standing insulation.

4 CABLE BOXES

Cable boxes to fit on the busbars of a GEC T1 isolator shall be as follows:

4.1 Box for PILC cables (compound filled)

BPC Stock Code : DT3239
GEC Part Number : 528188

To be supplied complete with bus-bar extensions

Part Nos. 2 x 058203 and
Part Nos. 1 x 058211

Cable gland to be insulated and be suitable for cables up to 150 mm² PILCSWA.

4.2 Box for XLPE cables

BPC Stock Code : DT3240

GEC Part Number : 528196

To be supplied complete with monobloc and busbar fish-plates for compounding the band joint.

Cleats to be suitable for cables up to 150 mm².

5 TESTS AT FACTORY PRIOR TO DELIVERY

Routine high voltage tests are to be carried out at the factory on all components and materials.

Test certificates shall be supplied in respect of each such component and material as proof that the tests have been carried out and that the component or material complies with the requirements of the relevant specification.

6 INFORMATION TO BE SUBMITTED WITH TENDER

6.1 Outline drawing.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/INS-COMP REV 0
PAGE 1 of 1
APPROVED 28 April 1995

HV COMPOSITE INSULATORS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2320 Insulator 66 KV Long Rod Type Thiel -Lite Cat No. 1170

2 GENERAL

Insulators shall be of composite manufacture. Thiel -lite Cat No. 1170 with the following specification:

Number of Sheds		17
Disc equivalent (254 x 146 mm)		5
Coupling Length L (mm)		734
Creepage Distance		1597
Dry Arcing Distance		618
Power Frequency Flashover Voltage	Dry (kV)	245
	Wet (kV)	214
Power Frequency 1 minute Withstand Voltage	Dry (kV)	226
	Wet (kV)	182
Impulse Critical Voltage	Positive (kV)	407
	Negative (kV)	388
Impulse Withstand Voltage	Positive (kV)	383
	Negative (kV)	349
Approximate Mass (kg)		3,0
Rating		66kV

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/INS-HV REV 1
PAGE 1 of 2
APPROVED 9 June 1993

HV INSULATORS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2309	Insulator Pin HT 1014/40 11 kV	
DL2310	Insulator Pin HT 1018/40 33 kV	
DL2311	Insulator Toughened Glass	U70BL BS137
DL2603	Spindle 11 kV M2 x 50 mm long	45 mm Thread
DL2304	Spindle Insulator 11 kV M2 x 178	100 Rural
DL2570	Spindle M3 Length 33 kV	
DL2315	Insulator Disc B/S HT1110	
DL2316	Insulator Disc T/C HT1010	
DL2317	Insulator Post 33 kV Porcelain	
DL2318	Spindle Post Insulator 33 kV M20	- For DL2317
DL2319	Insulator Long rod 33 kV Type 520	

2 STANDARD SPECIFICATIONS

The insulators shall comply with SANS 60383: 1993/ SANS IEC 60383 - Insulators for overhead lines of nominal voltage exceeding 1000V.

3 GENERAL

Insulators shall be of porcelain manufacture. Glass insulators will only be used in areas with abnormal air pollution.

Insulators, complete with all fittings, shall not exhibit excessive or localised corona formation at voltages less than 1,3 times nominal phase to neutral voltage.

Insulators shall be designed to limit radio interference and the marking "RIF" shall appear on the insulator. A semi-conductive glaze coating and cemented-in metal thimbles may be employed for this purpose.

4 PIN INSULATORS

Pin insulators shall comprise a porcelain insulator mounted on a steel pin.

The minimum wet power frequency flashover voltages shall be 48 kV for 11 kV pin insulators and 90 kV for 33 kV insulators. The minimum dry lightning impulse withstand voltage shall be 120 kV and 185 kV for 11 and 33 kV insulators respectively.

The pins of pin insulators shall be straight and shall be complete with washers and nuts. The shank and threaded length shall be as specified.

5 DISC INSULATORS

Disc insulators shall be tongue and clevis type. They shall be supplied with bolt, washers and split pins.

The minimum wet power frequency flashover voltage shall be 58 kV when used in the horizontal plane. The minimum dry lightning impulse withstand voltage shall be 146 kV (negative).

6 LONGROD INSULATORS

The ultimate tensile strength shall not be less than 40 kN.

The minimum wet power frequency flashover voltage shall be 100 kV. The minimum dry lightning impulse level shall be 200 kV.

7 POST INSULATORS

Post insulators shall comprise a porcelain insulator of tie top type with cantilever strength of not less than 4 kN.

The minimum wet power frequency flashover voltage shall be 90 kV. The minimum dry lightning impulse withstand voltage shall be 200 kV.

The spindle shall be M20, 180 mm long with 100 mm thread.

8 INFORMATION TO BE SUBMITTED WITH TENDER

8.1 Outline drawing.

8.2 Type test certificates demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/INS-LV REV 1
PAGE 1 of 1
APPROVED 9 June 1993

LV INSULATORS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2306 Insulator LV Reel EP 194

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/INS-STAY REV 2
PAGE 1 of 1
APPROVED 5 July 1995

STAY INSULATORS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2305	Insulator Stay Type 21-0522	
DL2313	Insulator Stay High BIL 4 Shed	LAPP CAT. No.151001A 11 KV
DL2314	Insulator Stay High BIL 6 Shed	LAPP CAT. No. 151001A-90 33KV

1.1 The following BPC stock items shall be included in the Assembly

DL2601	Tongue Eye Link High BIL INS	CULLINAN CAT. No. VC23
DL2602	Shackle High BIL INS	CULLINAN CAT. No. VC10

2 FLASHOVER VOLTAGES

2.1 The minimum characteristics of compression insulators shall be:

Dry Flashover Voltage kV	Wet Flashover kV	Breaking strength kN
35	30	110

2.2 High BIL stay insulators shall have ultimate breaking strength not less than 65 kN and impulse withstand insulation of not less than 170 kV. They shall be supplied with a clevis at one end and tongue at the other end.

2.3 Refer to BPC Drawing No BP2000/02 for details of DL2313 and DL2314.

3 INFORMATION TO BE SUBMITTED WITH TENDER

3.1 Outline drawing.

3.2 Type test certificates demonstrating compliance with the specification.

Approved Manufacturer:

LAPP (Electrical Moulded Components (Pvt) Ltd)

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/INS-TRID REV 0
PAGE 1 of 1
APPROVED 04 October 1995

HV COMPOSITE INSULATORS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2320 Insulator 66 kV Long Rod Thiel -Lite Cat No. 1170 17 Shed
DL2321 Insulator 66 Kv Trident Mace-Tech M077028SX03 5 Shed

2 GENERAL

Insulators shall be of composite manufacture. Thiel -lite Cat No. 1170 with the following specification:

Number of Sheds		17
Disc equivalent (254 x 146 mm)		5
Coupling Length L (mm)		734
Creepage Distance		1597
Dry Arcing Distance		618
Power Frequency Flashover Voltage	Dry (kV)	245
	Wet (kV)	214
Power Frequency 1 minute Withstand Voltage	Dry (kV)	226
	Wet (kV)	182
Impulse Critical Voltage	Positive (kV)	407
	Negative (kV)	388
Impulse Withstand Voltage	Positive (kV)	383
	Negative (kV)	349
Approximate Mass (kg)		3,0
Rating		66kV

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/ISOLATOR REV 2
PAGE 1 of 2
APPROVED November 1993

HV ISOLATORS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DP4028	Isolator Rocking 11 kV	C/W Int Head & Permal Insert
DP4036	Isolator Rocking 33 kV	C/W Int Head & Permal Insert
DP4029	Isolator Rocking 11 kV	D.N.O
DP4037	Isolator Rocking 33 kV	D.N.O

2 STANDARD SPECIFICATION

Isolators shall comply with BS 3078.

3 RATING

Isolators shall be rated for use on 3 phase 50 Hz impedance earthed systems.

Isolators for 11 kV systems shall have a BIL of 95 kV

Isolators for 33 kV systems shall have a BIL of 200 kV

The continuous current rating shall be 400 A.

The short-time current rating shall be 12 kA for 3 seconds.

4 OPERATING RODS AND MECHANISM

4.1 The isolators shall be gang-operated isolators.

4.2 Isolators to be supplied as complete individual units with all loose equipment firmly attached. An exception to this requirement are the operating rods which may be supplied separately but must be securely bundled in sets (one set per isolator).

4.3 Operating rods shall be suitable for a minimum mounting height of 10 m above ground level.

4.4 The operating rod shall have an insulating insert with a dry power frequency withstand voltage of 2 x rated phase to earth voltage.

5 ARC-INTERRUPTER HEADS

Where specified, arc-interrupter heads shall be fitted, rated 400 A.

6 INFORMATION TO BE SUBMITTED WITH TENDER

6.1 Outline drawing.

6.2 Type tests demonstrating compliance with the specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/KIOSKS REV 2
PAGE 1 of 2
Revision Date 14 August 2000
Approved 27 June 2001

DISTRIBUTION KIOSKS AND PILLAR BOXES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3185	Pillar LV GEC 6 Way	Dwg SD2A
DM5070	Pillar Service LV	Dwg D23/75.1006
DM5071	Kiosk Metering MD	Dwg BP20000/01/A

2 CONSTRUCTION

2.1 Kiosks and pillar boxes shall be fabricated of cold rolled mild steel, painted an approved BPC avocado colour (C12 to SABS 1091), applied using wet sprayed and air dried or of glass reinforced polyester (GRP)

2.2 Cold rolled mild steel units

The cold rolled mild steel plate shall be of nominal thickness 1,8 mm.

The unit shall have a full width opening with a door at the front and a door at the back. A rubber or plastics closer strip shall be so fitted to the edges of each door as to provide a seal that is capable of keeping rain water and dust out of the unit. Each door shall have three robust solid brass hinges each of length at least 100 mm.

Two ventilation openings shall be provided in one side, one at the bottom and one at the top. The design of each ventilation opening shall be such that

- a) it is not possible to push a steel wire through it into the interior of the unit, and
- b) it prevents the entry of vermin.

A mild steel unit shall have a pitched roof that slopes downwards at the front and at the back and the roof shall have an overhang of at least 75 mm all round.

2.3 GRP Units

GRP consumer distribution units shall comply with the requirements of South African standard CKS 493 for Type A kiosks of depth 550 mm.

2.4 General Constructional Requirements

Fixing bolt holes shall be provided in the bottom of each unit.

A distribution board shall be centrally positioned in each unit. The board shall be fixed to angle supports and shall be fully accessible from both openings.

A separate stud for the attachment of an earth wire shall be provided on the angle support frame in each unit.

The phase division in each unit shall be as follows, from the top to the bottom, in sequence;

Red
Yellow
Blue
Black (neutral)

3 INFORMATION TO BE SUPPLIED WITH TENDER

3.1 Outline drawing.

3.2 An appropriate type test certificate indicating resistance to impact and water penetration.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MCB REV 2
PAGE 1 of 2
Revision date 10 Aug 1997
Approved 27 June 2001

MOULDED CASE CIRCUIT BREAKERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DP4045	Circuit Breaker 5A 5kA SP White	Heinemann SF1G3 Curve 2
DP4047	Circuit Breaker 60A 5kA SP White	Heinemann SF1G3 Curve 2
DP4048	Circuit Breaker 80A 5kA SP Orange	Heinemann SF1G3 Curve 1
DF04026	Circuit Breaker 150A 5Ka SP	Heinemann JS25 Curve 1
DP4050	Circuit Breaker 60A 5kA TP White	Heinemann SF3G3 Curve 2
DP4051	Circuit Breaker 80A 5kA TP Orange	Heinemann SF3G3 Curve 1
DP4052	Circuit Breaker 100A 25kA TP	Heinemann J25S Curve 2
DP4055	Circuit Breaker 150A 25Ka TP	Heinemann J25S Curve 2
DP4056	Circuit Breaker 200A 25kA TP	Heinemann J25S Curve 2
DP4057	Circuit Breaker 300A 20kA TP	Heinemann L20Y Curve 2
DP4059	Circuit Breaker 500A 25Ka TP	Heinemann M25B Curve 2
DP4060	Circuit Breaker 800A 25kA TP	Heinemann M25B Curve 2
DP4025	Isolator 500A	Heinemann L20YN
DP4026	Isolator 800A	Heinemann MBN

2 STANDARD SPECIFICATIONS

The circuit breakers shall comply with SABS 156.

3 GENERAL

- 3.1 Each moulded case circuit breaker shall be of the single or triple pole, free handle, panel mounting, air break type, housed in a moulded phenolic or glass fibre reinforced polyester case. The contacts shall be of silver alloy and arc chutes or magnetic blow-outs shall be provided.
- 3.2 Each moulded case circuit breaker shall be hermetically sealed and shall have magnetic /magnetic mechanisms with time delay tripping on low overload and high speed tripping on short circuit. The circuit breaker shall be so constructed that the switch cannot be held closed against overloads.
- 3.3 Terminals shall in all cases be of the pressure type in which the wire is inserted into the terminal and held in position by a pinching screw that covers the full width of the aperture.
- 3.4 5kA breakers shall be designed for clip mounting on a mini rail.

4 ISOLATORS

Isolators shall be supplied complete with a shunt trip accessory, rated 230V.

5 INFORMATION TO BE SUBMITTED WITH TENDER

5.1 Outline drawing.

5.2 Type test certificate.

5.3 Characteristic tripping curve.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MINISUB REV 1
PAGE 1 of 3
APPROVED 9 June 1993

MINIATURE SUBSTATIONS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3125	Minisub 200 kVA with T3/0F
DT3126	Minisub 200 kVA without T3 RMU
DT3127	Minisub 315 kVA C/W T3/0F
DT3128	Minisub 315 kVA without T3 RMU
DT3129	Minisub 500 kVA C/W T3/0F
DT3130	Minisub 500 kVA without T3 RMU

2 STANDARD SPECIFICATIONS

The following standards are applicable.

SABS 555	:	Insulating oil for transformers switchgear
SABS 780	:	Distribution transformers
SABS 1029	:	Miniature Substations

3 CONSTRUCTION

- 3.1 The substation arrangement shall be type B and shall include a steel base.
- 3.2 The roof, walls and doors of the substation shall be made of metal. The final paint colour shall be C12 Avocado to SABS 1091.
- 3.3 The substation design shall be such that the transformer compartment can be removed in its entirety and replaced for equipping the substation with a transformer of capacity 200 kVA to 500 kVA, without disturbing the HV and LV cabling to the substation.
- 3.4 The galvanised steel base of the miniature substation shall be coated with black epoxy tar paint.

4 TRANSFORMER

- 4.1 The transformer shall be a three phase, two winding transformer suitable for operation at 50 Hz supply frequency, 11000/400 volts on nominal tap, vector group Dyn 11.
- 4.2 Notwithstanding the requirements of SABS 1029 the transformer shall be equipped with constant kVA tapplings and a five position, off-circuit tap switch complying with requirements of SABS 780.
- 4.3 Drain valves or plugs shall be fitted to transformers on which covers are sealed by bolting.

- 4.4 Bushings shall all be standard size and the neutral terminal shall have the same current rating as the line terminals.
- 4.5 A thermometer pocket and an indicating thermometer with adjustable alarm contacts for tripping purposes shall be provided in a position where top oil temperature can be measured.
- 4.6 The liquid insulant shall be a mineral oil complying with SABS 555.
- 4.7 The losses shall be within the limits specified in Tables 6 and 8 of SABS 780.

5 HIGH VOLTAGE COMPARTMENT

- 5.1 The high voltage compartment shall have side and back plates removable for jointer access.
- 5.2 GEC type T3/0F oil fuse switch shall be provided as follows:
 - a) Ring cable bushings to be open type suitable for up to 150 mm² XLPE cable. Brackets complete with wooden cleats for cables to both ring switches to be supplied. (The cable bushings must accept 35 and 70 mm² PILC cable).
 - b) Cable test facilities required on ring switches.
 - c) Operating handle and 60 amp HRC striker fuses to be included.
 - d) Shunt trip operated by thermometer contacts, supplied from HRC fuses mounted on the LV busbars.
 - e) Oil not to be included with supply of equipment.
- 5.3 Where specified instead of a type T3/0F switch, a GEC Type T1/0F and busbar cable end box or Hawker Siddeley XIF fused isolator shall be supplied.
- 5.4 Where no HV oil fuse switch is specified, only brackets complete with wooden cleats for terminating two XLPE insulated cables, up to 150 mm² size, shall be provided.

6 LOW VOLTAGE COMPARTMENT

Low voltage compartment shall be equipped as follows;

- (a) Three phase busbars rated 800 amps, 20 kA
- (b) One neutral busbar rated 400 amps, 20 kA
- (c) One earth bar, 20 kA
- (d) Pre-drilled tray to accommodate two Heinemann LY603 and six JSO-0 circuit breakers. Circuit breakers not to be supplied.

- (e) Three ammeters with instantaneous reading plus 15 minute time lag maximum demand and resettable point required for substation load monitoring.

The ammeters shall have reversible scale plates suitable for use with either CT ratio as specified in (f) below.

- (f) Three current transformers of ratio 800/600/5 A, class 3.0, 5 VA.
- (g) Gland tray suitably located relative to (d) above to be supplied. Tray to be insulated from substation frame.
- (h) One 15 amp and one 13 amp single phase socket outlet protected by a Heinemann 15 amp type SA12A earth leakage circuit breaker to be supplied in LV compartment and connected to busbar via 20 amp GEC type NS20 HRC fuse.
- (i) Where no HV isolator is specified, a main LV isolator shall be installed on the side panel of the minisub. The isolator shall be type Heineman LJ603 (for 300 and 500 A) or MAN (for 800 A) as appropriate, complete with shunt tripping initiated by the transformer oil temperature thermometer. The shunt trip supply shall be taken from the 20 A HRC fuse and a test trip button provided.

7 GENERAL

- 7.1 The supply and installation of the miniature substation shall include all accessories as specified, except for the low voltage feeder circuit breakers described in 6(d).
- 7.2 One door on each of the HV and LV compartments to be suitable for padlocking from the outside by means of a Barker and Nelson type 25130 padlocking device. All doors to be secured by means of three point locking.
- 7.3 All doors to be equipped with wind stays that prevent the doors from opening more than 90°.
- 7.4 The busbars are to be shrouded by means of metal plates, which are removable for easy access when cabling of the MCB's is required.
- 7.5 Eight individual gland plates are to be provided which are easily removable for drilling and are to be manufactured from 3CR12 steel. At least four gland plates shall be adequately dimensioned to accommodate No 6 glands.
- 7.6 Access doors are to be fitted with stainless steel danger signs.

8 TESTS

The manufacturer's certificate of routine tests shall be provided on delivery of the miniature substation.

9 INFORMATION TO BE SUBMITTED WITH TENDER

- 9.1 Outline drawing and drawing of LV compartment.
- 9.2 Type test certificate for the transformer.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-1 REV 2
PAGE 1 of 1
Revision Date 12 February 2001
Approved 27 June 2001

SINGLE PHASE kWh METER

1 Scope

The following BPC Stock Items shall comply with this specification:

DM5040 Meter kWh Single Phase 20/80A House Meter

2 Standard Specifications

The meter shall comply with the requirements of IEC521 or BS5685.

3 General

Each meter shall:

- 3.1 Be of rating 20/80 Amperes at 230 Volts 50 Hz
- 3.2 Comply with the requirements for a watt-hour meter of Class 2
- 3.3 Have a large 6 digit cyclometric register, the right-hand digit indicating tenths of a kWh.
- 3.4 Be provided with a tamperproof cover device in addition to the normal meter sealing facilities.
- 3.5 Be labelled "PROPERTY OF BOTSWANA POWER CORPORATION", preferably on the meter name plate.
- 3.6 Have no reverse running stop fitted to the rotor disc.
- 3.7 Have the potential link fitted behind the terminal cover
- 3.8 Be accompanied with its test results for F.L. (UPF and 0.5 lag) intermediate load (UPF) and low load (UPF).
- 3.9 All meter types shall be subjected to BPC evaluation.

4 INFORMATION TO BE SUBMITTED WITH TENDER

- 4.1 Outline drawings
- 4.2 Type test certificate demonstrating compliance with the specification.
- 4.3 Full details of meter including manufacturer and country of manufacture.
- 4.4 Details of test facilities and traceability to a standard.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-3 REV 2
PAGE 1 of 1
Revision date 14 August 2000
Approved 27 June 2001

THREE PHASE kWh METER

1 Scope

The following BPC Stock Items shall comply with this specification:

DM4051 Meter kWh T/P 3 x 230/400V 25/100A

2 Standard Specifications

The meter shall comply with the requirements of IEC521 or BS5685.

5 General

Each meter shall:

- 3.1 Be of rating 25/100 Amperes at 230/400 Volts 50 Hz
- 3.2 Comply with the requirements for a watt-hour meter of Class 2
- 3.3 Have a large 6 digit cyclometric register, the right-hand digit indicating tenths of a kWh.
- 3.4 Be provided with a tamperproof cover device in addition to the normal meter sealing facilities.
- 3.5 Be labelled "PROPERTY OF BOTSWANA POWER CORPORATION", preferably on the meter nameplate.
- 5.6 Have no reverse running stop fitted to the rotor disc.
- 5.7 Have the potential link fitted behind the terminal cover
- 5.8 Be accompanied with its test results for F.L. (UPF and 0.5 lag) intermediate load (UPF) and low load (UPF).
- 5.9 All meter types shall be subjected to BPC evaluation.

6 INFORMATION TO BE SUBMITTED WITH TENDER

- 4.5 Outline drawings
- 4.6 Type test certificate demonstrating compliance with the specification.
- 4.7 Full details of meter including manufacturer and country of manufacture.
- 4.8 Details of test facilities and trace ability to a standard.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

Section 2/MTR-3MD REV 2
Page 1 of 1
Approved November 1999

THREE PHASE MAXIMUM DEMAND METER

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DM5016	Meter Set MD T/P 3 x 230 V 5A	Landis & Gyr TG
DM5018	Meter Set MD T/P 3 x 110 V 5A	Landis & Gyr TG

2 DM01044

- 2.1 Brief Description: Landis & Gyr Tarigr 400 3 phase 3 wire maximum demand and energy meter set.
- 2.2 Rated Voltage: 3 x 400/230 volts 50 Hz
- 2.3 Rated Current: 3 x 5 amps
- 2.4 Active Meter: KWh meter with Tarigr 400 display. Type : ML200xhm401f6-3/6.
- 2.5 Reactive Meter: KVArh meter with impulsing contact. Type : ML220ö1xhr11.5f6-3/6.

3 DM01046

- 3.1 Brief Description: Landis & Gyr Tarigr 400 3 phase 3 wire maximum demand and energy meter set.
- 3.2 Rated Voltage: 3 x 110 volts 50 Hz
- 3.3 Rated Current: 3 x 5 amps
- 3.4 Active Meter: KWh meter with Tarigr 400 display. Type : ML200xhm401f6-3/6.
- 3.5 Reactive Meter: KVArh meter with impulsing contact. Type : ML220ö1xhr11.5f6-3/6.

4. APPROVED SUPPLIER

The following are approved suppliers:

Siemens
Ash Brothers Measurements

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-BEC REV 0
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APPROVED 07 June 1994

SINGLE PHASE BUDGET ENERGY CONTROLLER

1 BPC CODE

DM5025	Budget Energy Controller	BEC11M-Conlog
DM5027	BEC11M Wall Unit	Conlog
DM5028	BEC11M Adaptor Plate for BEC1	Conlog

2 SPECIFICATION

DM5025 - Model BEC11M V5.07H
Part No: 70 0011 900 102 V01
230 Volt 20A(60A) 50HZ 1P41
Constant : 2560 I/KWH Class 2 ERR

DM5027 - E-K BEC11M Wall Unit with S-A
Part No:70 011 901 000 V00

DM5028 - Adaptor for matching BEC11M with BEC1 Wall Unit

3 MANUFACTURER

Conlog

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-BEC1M REV 0
PAGE 1 of 1
APPROVED 12 Aug 1997

SINGLE PHASE BUDGET ENERGY CONTROLLER-Magnet card

1 Scope

The following BPC Stock Items shall comply with this specification:

DM5025	Budget Energy Controller-BEC22M	Conlog
DM5027	Wall Base - BECWB11	Conlog

2 Standard Specifications

DM5025	- Model BEC 22M - Part No: 700030901000 - 230 Volts, 20 A (60 A), 50Hz, Class 2.
DM5027	- Wall Base - Part No: 70001901000

The device must be fitted with a 3 (three) terminal neutral bar.

3 Standards

This SRDS must be read in conjunction with:-

SABS 1524
Licensed Standard Transfer System (STS) documents

4 Information to be submitted with tender

4.1 Outline drawing.

4.2 Type test certificate demonstrating compliance with specification.

Approved supplier

Conlog

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-BEC3 REV 1
PAGE 1 of 1
Revision Date 14 August 2000
Approved 27 June 2001

THREE PHASE BUDGET ENERGY CONTROLLER

1 Scope

The following BPC Stock Items shall comply with this specification:

DM5029	Budget Energy Controller-BEC32M BEC Cashpower 2000 - 3 Phase	Conlog Spescom
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2 Standard Specifications

Model BEC 32M
Part No: 70002991400
230 Volts (Phase to neutral), 100 A, 50Hz, Class 2.

DM5029	Model Cashpower 2000 - 3Phase Part No: 20-00309 230 Volts (Phase to neutral), 80A, 50HZ, Class 2.
--------	---

The device must be fitted with a 3 (three) terminal neutral bar.

3 Standards

This SRDS must be read in conjunction with:-

Licensed Standard Transfer System (STS) documents

4 Information to be submitted with tender

4.1 Outline drawing.

4.2 Type test certificate demonstrating compliance with specification.

Approved supplier

Conlog
Spescom

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-BEC1K REV 2
PAGE 1 of 2
Revision Date 08 August 2000
Approved 27 June 2001

SINGLE PHASE BUDGET ENERGY CONTROLLER - Keypad

1 Scope

The following BPC Stock Items shall comply with this specification:

DM5026 Budget Energy Controller / Energy Dispenser
DM5027 Wall Base

2 Standard Specifications

DM5026 - 230 Volts, 20 A (60 A), 50Hz, Class 2.

DM5027 - Wall Base - terminals to MC171

The device must be fitted with a 3 (three) terminal neutral bar. The neutral-earth shall not be linked in the base

3 Standards

This SRDS must be read in conjunction with:-

SABS 1524
Licensed Standard Transfer System (STS) documents

MC171
Base units and surge arrestors

MC195
Internal contactor specification for indoor BEC/ED.

4 Requirements

The BEC/ED shall consist of two parts. The metering part is referred to as the "Active" unit and the base is the "Passive" unit. The base will be of the Plug-in type as specified by MC171 and will incorporate the 5kA surge arrestor. It shall not be possible to disconnect the surge arrestor without removing the terminals.

In the event that the supply is connected to the load side of the meter the breaker within the meter must trip and can only be reset when the connections are corrected. No special equipment shall be required to reset the breaker on site.

No earth leakage protection circuitry shall be fitted.

The BEC/ED shall be sent with the Botswana Supply Code

Upon delivery the BEC/ED shall have 40kW credit installed.

Remaining credit shall be clearly indicate

The overload shall be set for 13.8kW (60Amps, 230Volts).

The unit shall be provided with sealing facilities to prevent unauthorised access.

All new products must be submitted to BPC for evaluation. Note - BPC reserve the right to re-evaluate any product at any time.

- 5 Information to be submitted with tender
 - 5.1 Outline drawing.
 - 5.2 Type test certificate demonstrating compliance with specification.
 - 5.3 Non compliance to any part of this specification must be outlined.
 - 5.4 Full details of meter including manufacturer and country of manufacture.
 - 5.5 Details of test facilities and traceability to a standard

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-BKR Rev 2
PAGE 1 of 2
APPROVED 08 June 1995

11 kV CIRCUIT BREAKERS WITH METERING FOR LOADS OF 1MVA AND ABOVE

1 SCOPE

The following items shall comply with this specification:

DT3203	Breaker 11 kV with Metering Unit
DT3204	Breaker 11 kV Ring Isolator - Mtr/Unit
DT3205	Breaker Dual 11 kV ring Isolator with Metering Unit

These items will normally be supplied by consumers in accordance with the requirements of BPC.

2 RATING

The switchgear shall be rated as follows:

Nominal voltage	11 kV
Continuous current	400A
Fault current	18,3 kA three phase
Interrupting medium	SF6 or vacuum

3 CONSTRUCTION

- 3.1 The switchboard shall be completely self contained and equipped as indicated in Drawing No. BP 3000/BP 3001/BP 3002.
- 3.2 All hinged doors shall be lockable with a standard 40 mm Viro padlock.
- 3.3 Protection relays shall be mounted behind a hinged door, but the following equipment shall be mounted on the front panel:
 - a) electrical trip switch
 - b) ammeters - on red phase only 96 x 96 mm instantaneous and 15 minutes maximum demand indication with re-settable maximum demand pointer, scaled 0-120% of primary current.
 - c) voltmeter and selector switch - 96 x 96 mm, selectable phase-to-phase and phase-to-earth, scaled 0-12 kV.
 - d) healthy trip circuit lamp and "on-demand" test button.
- 3.4 All switchgear, controls, relays and indications shall be labelled as specified separately.
- 3.5 Cable boxes for incoming BPC cables and for the consumer cable shall be specified separately.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-BKR Rev 2
PAGE 2 of 2
APPROVED 08 June 1995

4 PROTECTION AND METERING

4.1 Voltage transformer to be 3 phase Yy0

- 11000/110 volt, 100 VA, class 1.0 for metering.

4.2 The following current transformers shall be fitted:

CT1 : Metering : R and B phases : 10 VA, class 0.5
CT2 : Protection : R,Y,B phases : 10 VA, class 5P20
CT3 (on two incoming feeders) : Indication : R phase : 10 VA, class 2

The turns ratio shall be as specified separately.

The rated secondary current of all CTs shall be 5A.

The metering CTs shall be installed on the load side of the protection CTs.

4.3a) The protection relays shall be 2 x OC and 1 x EF IDMT 5A current relays with normal inverse characteristic. The current setting range shall be 50-200% for overcurrent and 10-40% for earth fault.

4.3b) A master trip relay shall be provided with hand reset indication for remote tripping.

4.4 The tripping mechanism shall be 30V DC tripping, with manual closing. A battery trip unit supplied from the VT shall be provided. An on-demand healthy trip circuit test button and lamp shall be incorporated in the panel.

4.5 VT and CT supplies for metering shall be provided to a terminal block in a separate wall mounted, lockable cubicle in which BPC will install the meters.

5 TOOLS

Operating and earthing equipment shall be supplied, with and in containers or racks mounted on the wall.

6 APPROVAL BEFORE MANUFACTURE

Drawings shall be submitted to BPC for approval prior to manufacture. The drawings shall show details of cable boxes, CT ratios and labelling.

7 INFORMATION TO BE SUBMITTED WITH TENDER

7.1 Outline drawing.

7.2 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/METERBOX REV 0
PAGE 1 of 2
Revision Date 20 Sept 1996
APPROVED 27 June 2001

Meter box

1. Scope

The following BPC stock items shall comply with this specification

DM5067 Single phase meter box MB1
DM5068 Three phase meter box MB3

Meter box requirements

1. Window

- 1.1 Not effected by UV.
- 1.2 Mechanically strong.
- 1.3 Scratch proof.
- 1.4 No age discolouration.

(Possible transparent medium - 'Polycarbonate' 4mm)

2. Weatherproof

- 2.1 Box to be completely sealed against the elements and vermin.
- 2.2 Window to be securely fixed to the door and sealed as above.
- 2.3 The top of the box to be fitted with an overhanging roof.
- 2.4 The box to be made of 1,8 mm galvanized sheet which shall comply with the requirements of SABS 934 (revised now applicable SANS ISO 4998)

3. Security

- 3.1 The door must be provided with a means of locking using a VIRO padlock 302/40mm.
- 3.2 The meter box must have a 'lip' at the front 30mm wide.
- 3.3 The door to be flush with the box with internal hinges.

4. Earthing

- 4.1 The box to be fitted with a non-corrosive earthing bolt.
- 4.2 All metal parts to be earthed.

5. General

- 5.1 All holes to be drilled 3,5mm .
- 5.2 The door shall have an engraved label permanently fixed to it as shown below

Warning

The meter box door may only be opened by an
authorized person from BPC
Do not remove the lock

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/METERBOX REV 0
PAGE 2 of 2
APPROVED 20 Sept 1996

- 5.3 The meter register shall not be less than 1,3 metres or more than 1,6 metres from ground level.
- 5.4 The mounting plate to be fitted with a clipping rail for the circuit breaker.
- 5.4 A 3-way connector block, for earthing, suitable to receive 16mm cable to be fitted.
- 5.6 All manufacturers must submit a prototype of their product for BPC acceptance.
- 5.6 Meter boxes to comply with BPC drawing BP2000/02/A (single phase) and BP2000/03/A (three phase).

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-CTLV REV 2
PAGE 1 of 1
Revision Date 14 August 2000
Approved 27 June 2001

LV METERING CTs

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DM5040	Transformer current 100/150/5	7.5VA CL 0.5
DM5043	Transformer current 200/300/5	7.5VA CL 0.5
DM5046	Transformer current 800/500/5	15VA CL 0.5

2 STANDARD SPECIFICATIONS

The equipment shall comply with the applicable requirements of BS3938 or IEC185 and read in conjunction with BPC drawing BP20000/01/B

APPLICATION

This specification will be used for maximum demand supplies in the range 100 to 800amps inclusive at 400 volts.

RATIO, CLASS AND DIMENSIONS

CT ratio	Burden	Class	Min. Int. Dia.	Max. Ext. Dia.	BPC stock number
100/150/5	7.5VA	0.5	30mm	150mm	DM5040
200/300/5	7.5VA	0.5	50mm	150mm	DM5043
800/500/5	15VA	0.5	60mm	150mm	DM5046

The overall dimension of the C.T. shall be determined by the manufacturer's design.
The form of construction of the CT shall be RING type.

5 INFORMATION TO BE SUBMITTED WITH TENDER

- 5.1 Outline drawings
- 5.2 Type test certificate demonstrating compliance with the specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-MD 500A+ Rev 0
PAGE 1 of 1
Revision date 17 October 1997
Approval date 27 June 2001

500 amp and 800 amps L.V. supplies

1 Scope

The following BPC Stock Items shall comply with this specification:

DM5046	500/800/5 Current transformer
DT04048	500A Circuit breaker
DT04050	800A Circuit breaker
DM5017	Enermax meter

2 Standard Specifications

The equipment shall comply with the applicable requirements of

Standard	Description
BS3938	Current Transformers
SABS156	Circuit breakers
IEC1036	Meter

3 Application

The requirement will be used for maximum demand supplies of 500A and 800A at 400V

4 General

If required the consumer shall supply a lockable kiosk to accommodate the metering, current transformers, circuit breaker etc. The drawings of the kiosk must be submitted to BPC prior to manufacture of the kiosk for approval and upon completion of the kiosk, inspected by BPC, for acceptance before installation. The kiosk shall be sized to accommodate the following equipment and allow for the safe bends of the cables.

500A supply

500A Circuit breaker	25kA
Current transformer 500/800/5A	15 VA Class 0.5

800A supply

800A Circuit breaker	25kA
Current transformer 500/800/5A	15 VA Class 0.5

Cable size

The cable shall be sized for a 2% voltage drop with a minimum size of :-

500A 2 x 150 sq mm 4 core PVC SWA PVC plus 2 x 70 sq mm HDC earth wires.
800A 2 x 240 (or 3 x 150) sq mm 4 core PVC SWA PVC plus 3 x 70 sq mm HDC earth wires.

Meter tray

The meter tray shall have a minimum dimension of :-

Length = 750 mm

Height = 350 mm

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-PR REV 1
PAGE 1 of 2
Revision Date 14 August 2000
Approved 27 June 2001

3 PHASE PROGRAMMABLE ELECTRONIC ENERGY AND DEMAND METER

.Scope

The following BPC stock items shall comply with this specification.

DM5017	Meter MD	3 x 230volt 5 amp	3PH 4W
DM5018	Meter MD	3 x 110volt 5amp	3PH 3W
DM5019	Meter MD	3 x 110volt 1amp	3PH 3W

- 1.1 Brief description - 3phase 3 or 4 wire solid state energy and demand meter
- 1.2 Rated voltage - 110V, 50Hz
- 1.3 Rated current - 1A or 5A

2.Meter description

- 2.1 Class 1 for balanced and unbalanced loads.
- 2.2 Suitable for 4 quadrant metering with each quantity registered separately and at no time must the import and export register together.
- 2.3 Capable of producing kW and kVA demands.
- 2.4 The total block kVA must be derived from the summation of the active and reactive energies of each phase prior to calculating the kVA. The meter must be capable of simulating thermal maximum demand.
- 2.5 The device must record the current demand equivalent to each register as specified in sections 2.2 and 2.3.
- 2.6 The meter must be capable of supplying an integration period for demand of either 30 or 60 minutes.
- 2.7 The meter must display instantaneous values for amperes, voltage, kW, kVArh, kVA and power factor.
- 2.8 The meter must store in memory at least 3 previous billing kWh, maximum demands and time and date of maximum demand.
- 2.9 The meter must be capable of using its own internal real time clock for end of billing and integration period and also have the facility to receive external pulses for synchronising with other equipment.
- 2.10 The meter must have a LCD and register scroll button situated on the front case of the meter for normal manual meter reading.
- 2.11 In addition the meter must be fitted with an optically coupled read/write port for electronic data transfer using the IBS Radix FW60 hand held unit and laptop computer.
- 2.12 The manufacturer must supply all necessary Windows based software that will allow for transfer and manipulation of data. Proof that the software is Y2K compliant must be demonstrated.
- 2.13 The end of billing period will be initiated by any one of the following methods
 - 2.13.1 Sealable push button accessible from the front of the meter.
 - 2.13.2 Automatically at midnight on specified dates.
 - 2.13.3 On command via the optical communication port
- 2.14 The meter shall be fitted with output contacts to give pulses proportional to the energy being measured, end of billing and end of integration period.
- 2.15 The meter shall be fitted with input relays to accept end of billing and end of integration period from remote devices.
- 2.16 The meter shall be able to store in memory 2 channels for 40 days of 30 minute data for load profiling which can be retrieved using a computer.
- 2.17 *The meter must perform self diagnostic checks to ensure correct operations of the ROM, EEPROM, clock and battery.*
- 2.18 All programmed data and all register data must be retained in a non-volatile memory that does not require power to retain it. Register data must be written into the non-volatile memory at least once per day, and every time there is a power failure.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-PR REV 1
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Revision Date 14 August 2000
Approved

3 Information to be submitted with tender

- 3.1 Outline drawings
- 3.2 Type test certificate demonstrating compliance with the specification
- 3.3 Full details of meter including manufacturer and country of manufacture.
- 3.4 Details of test facilities and traceability to a standard

If required a demonstration of the complete working system must be given in Gaborone, Botswana.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/MTR-UNIT REV 5
PAGE 1 of 1
Revision date 12 February 2001
Approval date 27 June 2001

11kV METERING UNIT – FOR LOADS OF 800kVA OR LESS

1 Scope

The following BPC Stock Items shall comply with this specification:

DM5069 Metering Unit 11 kV

2 Standard Specifications

The equipment shall comply with the applicable requirements of BS 3941: Voltage transformers and BS 3938: Current transformers.

3 General

- 3.1 The supply to be given via an outdoor type fused isolator
- 3.2 Unit to be free standing and painted avocado C12 to SABS 1091.
- 3.3 Metering unit cable boxes to be suitable for up to 70 mm² XLPE SWA cable.
- 3.4 CT/VT metering chamber to be supplied oil-filled.
- 3.5 Secondary wiring to be brought into the meter cubicle which should be capable of taking the following:-

Energy /demand meter, test block, 3 x 5A secondary fuse holders and
2 x lightning arrestors
No meter or ancillary equipment to be supplied.

- 3.6 To be read in conjunction with drawings: BP902/07/A and BP920/01/A.

4 Ratings

The metering unit to have 25/50/5A 10VA class 0,5 current transformers on the red and blue phases and 11000/110V class 1 VT, rated at 100VA per phase.
The VT vector grouping shall be Yyo with the secondary phases and star point connections provided.
Neither the star point nor any of the secondary phases shall be connected to earth.
Primary fuses are required.

5 Information to be submitted with tender

- 5.1 Outline drawings
- 5.2 Type test certificate demonstrating compliance with the specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/NEC11 REV 1
PAGE 1 of 2
APPROVED 9 June 1993

11 kV NEUTRAL EARTHING COMPENSATOR

1 SCOPE

The following item shall comply with this specification:

DT3207 Transformer 11 kV NEC with 400/230V Auxiliary

2 STANDARD SPECIFICATIONS

The equipment shall comply with the requirements of the following specifications:

SABS 780 : Distribution Transformers
ESKOM NWS 1590 N11 : Earthing Compensators

3 GENERAL

The equipment shall be outdoor type with conservator and ONAN coding.

4 RATING

4.1 Rated voltage shall be 11000 volts, 50 Hz.

4.2 The resistance and reactance, in ohms per phase of the NEC shall be as follows:

Resistance : Minimum 54.2 Maximum 57.0
Reactance : Minimum 23.8 Maximum 28.5

The rated current in the neutral shall be 355 amp for 10 seconds.

4.3 The auxiliary transformer shall be three phase, 50 kVA 11000/400V on nominal tap and no load, vector group Dyn11. A five position, off-circuit tapping switch shall select ratios of 95, 97.5, 100, 102.5 and 105% of rated primary voltage.

4.4 The current transformer in the neutral of the earthing compensator shall be rated 300/100/1A, 7.5 VA, 5P20.

5 TERMINATIONS

5.1 HV outdoor bushings shall be provided, without arcing horns.

5.2 LV bushings shall be housed in a weatherproof compartment with one 100A MCB. The LV neutral bushing shall have the same current rating and be of the same type as the phase terminals. The base of the compartment shall be pre-drilled for two 35 mm² 4-core copper PVC/SWA cables and sealed by compression glands with stoppers. The door of the compartment shall be hinged.

6 ACCESSORIES

The following accessories are required:

- conservator, oil filling pipe, drain plug, silica breather
- gas- and oil-actuated (Buchholz) relay
- thermometer pocket and indicating thermometer with tripping contact.

7 BASE

Flat type underbase to be provided.

8 COLOUR

Avocado C12 to SABS 1091.

9 TESTS

The manufacturer's certificate of routine tests shall be provided at the same time as the delivery.

10 INFORMATION TO BE SUBMITTED WITH TENDER

10. Outline drawing.

10.2 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/NOTICE REV 1
PAGE 1 of 1
APPROVED 9 June 1993

DANGER NOTICES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2449	Notice Danger Steel Black	Drawing SD15
DL2450	Notice Caution No Backing	Drawing SD16
DL2451	Notice Danger 55 x 250 mm	Drawing SD21

2 GENERAL

The notice shall be of sheet steel of the dimensions shown on the drawings. It shall be vitreous enamelled with 30 x 30 mm red lettering on a white background unless otherwise specified.

3 INFORMATION TO BE SUBMITTED WITH TENDER

Outline drawing.

4 APPROVED SUPPLIER

The following are approved suppliers:

Screen Print
Sprang Tool Co

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/PIPE REV 1
PAGE 1 of 1
APPROVED 9 June 1993

PROTECTIVE PIPES AND DUCTS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DF1016	Pipe Kicker DWG SS 21	In House Assembly
GE6151	Conduit 25 mm MS Galvanised	4 Metre Lengths
GE6152	Conduit 50 mm MS Galvanised	
DZ00017	Conduit 30 mm MS Galvanised	Kicker Pipe
GE6293	Pipe PVC 100 mm x 6 Metre	

2 PVC PIPE

The PVC pipe shall be white PVC Class 4.

3 STEEL PIPE

Steel pipes shall be heavy duty galvanised mild steel.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/POLE-NO REV 1
PAGE 1 of 1
APPROVED 9 June 1993

POLE NUMBER PLATES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DB00100	Plate Pole Number 0	Aluminium 60 x 120 mm
DL2546	Plate Pole Number 1	Aluminium 60 x 120 mm
DL2547	Plate Pole Number 2	Aluminium 60 x 120 mm
DL2548	Plate Pole Number 3	Aluminium 60 x 120 mm
DB00104	Plate Pole Number 4	Aluminium 60 x 120 mm
DL2549	Plate Pole Number 5	Aluminium 60 x 120 mm
DL2550	Plate Pole Number 6	Aluminium 60 x 120 mm
DL2551	Plate Pole Number 7	Aluminium 60 x 120 mm
DB00108	Plate Pole Numebr 8	Aluminium 60 x 120 mm
DB00109	Plate Pole Number 9	Aluminium 60 x 120 mm

2 GENERAL

The plate shall be of aluminium 60 mm wide x 120 mm high. It shall be stamped with a number 40 x 40 mm.

3 INFORMATION TO BE SUBMITTED WITH TENDER

Outline drawing.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/POLEWOOD REV 2
PAGE 1 of 2
APPROVED 07 April 1997

WOODEN POLES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2341	Pole Wood 7 m	TD 140 mm (min)
DL2342	Pole Wood 9 m	TD 160 mm (min)
DL2343	Pole Wood 11 m	TD 160 mm (min)
DL2344	Pole Wood 13 m	TD 160 mm (min)
DX00211	Pole Wood 15 m	TD 160 mm (min)

2 STANDARD SPECIFICATIONS

2.1 Poles and preservative treatment shall comply with the requirements of:

- 2.1 a) SABS 538 : High temperature wood preserving creosote.
- 2.1 b) SABS 539 : Wood preserving creosote.
- 2.1 c) SABS 753 : Pine poles and crossarms for power transmission, low voltage reticulation and telephone systems, or
- 2.1 d) SABS 754 : Eucalyptus poles and crossarms for power transmission, low voltage reticulation and telephone systems, or
- 2.1 e) CAS 120 : Pine and eucalyptus poles.

3 GENERAL

- 3.1 Poles shall be of strength group A. Fibre stress in bending : 55 MPa
- 3.2 The length and minimum top diameter (TD) shall be as detailed in the description of the pole.
- 3.3 The top shall be cut square to the longitudinal axis of the pole.
- 3.4 The poles shall be pressure impregnated with creosote and shall not be cut to a shorter length or smaller diameter after impregnation. The moisture content at the time of impregnation shall be less than 170 g/kg.
- 3.5 Poles shall be fitted with gang nail on each end.
- 3.6 Poles shall not deviate from straight to a greater extent than specified in SABS 753.
- 3.7 Poles shall be marked in accordance with BPC drawing No. BP700/21 .

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/POLEWOOD REV 2
PAGE 2 of 2
APPROVED 07 April 1997

4 INFORMATION TO BE SUBMITTED WITH TENDER

4.1 The supplier shall indicate clearly whether poles are pine or eucalyptus and identify the specie.

4.2 The supplier shall state clearly that he complies totally with this specification.

5 APPROVED SUPPLIER

The following are the approved suppliers :-

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/RECLOS11 REV 1
PAGE 1 of 1
APPROVED 9 June 1993

11 kV RECLOSER

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3165 Recloser 11 kV

2 MAKE AND TYPE

The recloser shall be a McGraw Edison Type KFE. It shall be supplied complete with the following accessories:

- | | | |
|----|---------------------------|-----------------|
| a) | Remote lockout 24V dc | Part KRK 409 FA |
| b) | Junction Box | Part KRK 433 FA |
| c) | Lockout indicating switch | Part KRK 412 FA |
| d) | Remote close 120 Vac | Part KRK 414 FB |

3 CHARACTERISTICS

3.1 Overcurrent tripping:

- a) Minimum trip 200 amps.
- b) 3 reclose operations before lockout.
- c) Sequence : 2 curve A, 2 curve B (4 trips to lockout).

3.2 Ground fault tripping:

- (a) Minimum trip 5 amps.
- (b) 3 reclose operations before lockout.
- (c) Sequence : 4 curve 7 (constant time delay 5 seconds).

3.3 Reclose time (dead time) : 4 seconds.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/RECLOS33 REV 1
PAGE 1 of 1
APPROVED 9 June 1993

33 kV RECLOSER

1 SCOPE

The following items shall comply with this specification:

DT3175 Recloser 33 kV

2 MAKE AND TYPE

The recloser shall be a McGraw Edison Type RV. It shall be supplied complete with the following accessories:

- a) Remote shunt lockout solenoid 24v dc part KA475R3.
- b) Remote shunt close solenoid 24v dc.
- c) Auxiliary switch 3 stage.

3 CHARACTERISTICS

3.1 Overcurrent tripping:

- a) Series trip coil rating 100 amps (min trip 200 amps).
- b) 1 reclose operation before lockout.
- c) Sequence : 2 curve B. (2 trip operations to lockout).

3.2 Electronic ground fault tripping:

- a) Minimum trip 5 amps.
- b) 1 reclose operation before lockout.
- c) Sequence : 2 curve 1 (constant time delay 0.1 sec).
- d) Ground trip blocking connections to be brought out to terminals 3 and 4 in junction box.
Ground trip blocking switch not to be supplied.

3.3 Reclose time (dead time) : 4 seconds.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/SADDLE REV 1
PAGE 1 of 1
APPROVED 9 June 1993

SADDLES FOR PIPES

1 SCOPE

The following BPC Stock Items shall comply with this specification:

GE6105	Saddle MS Galvanised 20 mm
GE6106	Saddle MS Galvanised 25 mm
GE6107	Saddle MS Galvanised 30 mm
GE6108	Saddle MS Galvanised 40 mm
GE6109	Saddle MS Galvanised 50 mm

2 GENERAL

The saddles shall be of mild steel and galvanised in accordance with the requirements of SABS 763.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/STAY REV 1
PAGE 1 of 1
APPROVED 9 June 1993

STAYS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2464	Stay Assembly SR B6 Perten Rod, Staybow, Baseplate.
DL2605	Thimble Stay 20 mm Rope Galv
GT6114	Ring Oeticker 13/15 mm
DL2360	Grip Guy 7/8 Staywire PLP CAT GSDE 472
DL2361	Grip Guy 7/10 Staywire PLP CAT GSDE 384
DL2362	Poletop 7/10 CAT PT 384-6
DL2363	Poletop 7/8 CAT PT 480-6
DL2364	Grip Guy Double Wrap 7/10 PLP CAT DWGG 384
DL2378	Wire Stay Steel Bare 7/16
DL2379	Wire Stay 7/8 Galvanised
DL2380	Wire Stay 7/10 Galvanised

2 STANDARD SPECIFICATIONS

Equipment shall comply with the requirements of :

BS 16
BS 183
SABS 182 Part V

3 GENERAL

Stay wire shall be galvanised, multi-strand steel wire with the number and size of strands detailed in the description. Individual steel strands shall have a breaking stress of not less than 500 MPa and shall comply with SABS 182 Part V.

Stay rods shall be 2400 mm long x 20 mm diameter and shall comply with BS Pattern 1. The rod shall be supplied complete with staybow and base plate. Stay plates shall be of galvanised steel, 450 x 450 x 6 mm, complete with stay plate washers.

Stay thimbles shall be deep contoured and of heavy duty construction.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TESTBLK Rev 0
PAGE 1 of 1
APPROVED 07 June 1995

13 WAY METER TEST BLOCK

1 SCOPE

The following BPC Stock Items shall comply with the specification:

DM5055 13 Way meter test block GEC Type KP0023008

2 STANDARD SPECIFICATIONS

The test block shall be constructed in such a manner to allow meters to be tested in accordance with SABS01 and BS5685.

3 GENERAL

The dimensions of the test block shall be as shown on drawing number BP 10005/01/A

The test block shall have the following features:-

Surface mounting, front connected for mounting on meter panels.

All terminals and screws shall be made of brass and plated against corrosion.

The terminals shall have cable holes of 5.55mm and rated for up to 660V and have a current rating of 50A continuous.

The terminal arrangement shall consist of four voltage terminals and three groups of current terminals. Each group of current terminals shall be fitted with two links to short circuit current transformer secondaries.

The linking arrangement shall be such as to allow the testing of meters without disturbing the normal load circuit.

The base and cover shall be robust mouldings of an insulating material with barriers moulded integrally with the base extended the full width to provide protection against flash-over between terminals.

The cover shall be secured by two knurled nuts that can be sealed against unauthorised access.

4 TESTS

Records of tests shall be provided by the manufacturer.

5 APPROVED MANUFACTURER

GEC

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR11-LV1 REV 1
PAGE 1 of 1
APPROVED 9 June 1993

11 kV/LV SINGLE PHASE TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3101 Transformer 25 kVA 11/0.23kV Single Phase

2 STANDARD SPECIFICATIONS

Equipment shall comply with the requirements of :

SABS 780 : Distribution transformers

3 GENERAL

The voltage rating shall be 11000/231 V single phase, 50 Hz on nominal top. Tappings shall be by external connections on the LV side, corresponding to 95%, 100% and 105% of rated primary voltage.

The transformer shall be sealed.

The transformer shall be suitable for installation outdoors at an altitude of 1000 m. The maximum ambient temperature is 40°C. Cooling type ONAN.

Outdoor bushings shall be provided for HV and LV windings. No arcing horns are required. Provision shall be made for mounting surge arresters on the transformer close to the HV bushings.

A weatherproof cubicle with hinged door shall be installed over the LV bushings, containing one 150A 5 kA MCB. The base of the cubicle shall be pre-drilled for one 35 mm² 3-core PVC/SWA cable and sealed by a compression gland with stopper.

The colour shall be Avocado C12 to SABS 1091.

Pole mounting clamps shall comply with SABS 780, section 3.19 and Table 1 item 14.

4 TESTS

The manufacturer's certificate of routine tests shall be provided at the same time as delivery.

5 INFORMATION TO BE SUPPLIED WITH TENDER

5.1 Outline drawing.

5.3 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR11-LV2 REV 2
PAGE 1 of 3
Revised Date 30 May 2001
APPROVED 27 June 2001

11/0.4 kV POLE MOUNTED TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3107	Transformer 50 kVA 11/0.4 kV	Three Phase
DT3109	Transformer 100 kVA 11/0.4kV	Three Phase
DT3111	Transformer 200 kVA 11/0.4kV	Three Phase
DT3115	Transformer 315 kVA 11/0.4kV	Three Phase

2 STANDARD SPECIFICATIONS

Equipment shall comply with the requirements of the following specification:

SABS 780 : Distribution Transformers

3 GENERAL

Transformers shall be outdoor type, with covers sealed by welding. The rating shall be as detailed in the description, with ONAN cooling.

4 VOLTAGE

Rated voltage shall be 11000/400V on nominal tap, three phase, 50 Hz vector group Dyn 11. The HV system prospective fault level in 15 kA.

A five position, off-circuit tapping switch shall select ratios of 95, 97.5, 100, 102,5 and 105% of rated primary voltage. The impulse withstand voltage of the HV windings shall be 95 kV.

5 TERMINATIONS

5.1 HV and LV outdoor bushings shall be provided, without arcing horns.

5.2 The LV neutral bushing shall have the same current rating and be of the same type as the phase terminals.

- 5.3 Provision shall be made for mounting surge arresters on the transformer close to the HV bushings. 3 No. M10 studs welded to the Transformer tank shall be provided vertically under each surge arresters mounting position for connections of flexible earth tails. Each stud shall be provided with plated M10 nut, washer and spring washer.
- 5.4 A weatherproof cubicle with hinged door shall be installed over the LV bushings on transformers up to 200 kVA. The cubicle width and height shall be as large as possible and shall approximate the overall size of the Transformer tank. Cubicle depth shall suit the equipment contained within.

The cubicle door shall be equipped with a neoprene weather seal and a catch suitable for a 40mm Viro padlock.

A bottom entry removable cable gland tray shall be provided. The tray shall be as large as possible and shall incorporate a 25mm diameter gauze covered breather hole in one corner away from expected cable entry locations. Maximum possible clearance shall be provided between the cable gland tray and the circuit breaker terminals to facilitate ease of termination, such clearance in any event being less than 200mm.

The cubicle shall be equipped with a circuit breaker mounting plate pre drilled to accommodate 3 No. CBI JSO-O 150A circuit breakers as follows

50 kVA	1 x 150A
100 kVA	2 x 150A
200 kVA	2 x 150A

The design shall be such that additional circuit breakers can be installed without undue difficulty.

A 30 x 6mm or nearest equivalent copper neutral earth bar on stand off insulators shall be provided. The bar shall be installed horizontally below the circuit breakers and shall be as long as cubicle width permits. The bar shall be located to avoid a clash with incoming bottom entry cables. The bar shall be drilled with 6 No. 11mm diameter holes equally spaced. Each hole shall be provided with a plated 40mm long M10 bolt with nut, washer and spring washer. Two 70mm² green insulated stranded copper connections to the neutral earth bar shall be provided, one from the Transformer neutral bushing and the other from an M10 stud welded to the Transformer tank within the cubicle. The Transformer tank connection shall be accessible to allow removal of same on site depending on the Substation earthing design.

It shall be possible to terminate cables in the load side of the circuit breakers or on the main LV bushings of the Transformer.

The base of the circuit breaker cubicle shall be pre-drilled for the following cables and sealed with compression glands with stoppers:

50KVA	1 x 35 mm ² 4core	PVC/SWA cable
	2 x 50 mm ²	ABC cable
100KVA	1 x 70 mm ² 4core	PVC/SWA cable
	3 x 50 mm ²	ABC cable
200KVA	1 x 150 mm ² 4core	PVC/SWA cable
	3 x 95 mm ²	ABC cable

6 ACCESSORIES NOT REQUIRED

The following accessories are not required.

- Oil filling pipe, drain valves, drain plugs, detachable oil pipe connections or conservator.
- Current transformers, gas- and oil-actuated relays, thermometer pockets, indicating thermometers and oil level gauges.

7 COLOUR

Avocado C12 to SABS 1091.

8 BASE

The under-base shall be suitable for pole platform mounting. The position of fixing holes shall be

- at 500 mm centres on the long side of the base
- at 350 or 400 mm centres only in the transverse direction.

9 TESTS

The manufacturer's certificate of routine tests carried out shall be provided at the same time as the delivery.

10 INFORMATION TO BE SUBMITTED WITH TENDER

- 10.1 A dimensioned general arrangement drawing of the transformers offered shall be provided. In particular details of the LV kiosk shall include elevation and cross section with all main equipment, connections and principle dimensions shown.
- 10.2 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR11-LV3 REV 1
PAGE 1 of 2
APPROVED 9 June 1993

11/0.4 kV GROUND MOUNTED TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3117	Transformer 800 kVA 11/0.4 kV	Three Phase
DT3118	Transformer 630 kVA 11/0.4 kV	Three Phase
DT3119	Transformer 500 kVA 11/0.4 kV	Three Phase

2 STANDARD SPECIFICATIONS

Equipment shall comply with the requirements of the following specification:

SABS 780 : Distribution Transformers

3 GENERAL

Transformers shall be outdoor type, sealed with bolted covers. The rating shall be as detailed in the description, with ONAN cooling.

4 VOLTAGE

Rated voltage shall be 11000/400 V on nominal tap, three phase, 50 Hz vector group Dyn 11. The HV system prospective fault level is 16 kA.

A five position, off-circuit tapping switch shall select ratios of 95, 97.5, 100, 102,5 and 105% of rated primary voltage. The impulse withstand voltage of the HV windings shall be 95 kV.

5 TERMINATIONS

HV and LV cable boxes shall be provided.

HV bushings and cable box shall have air clearance and be suitable for terminating one 35 mm² conductor per phase of XLPE SWA cable.

LV bushings and cable box shall have air clearance and be suitable for terminating PVC SWA cables with up to three 240 mm² conductors per phase or neutral. The LV neutral bushing shall have the same current rating and be of the same type as the phase terminals.

6 ACCESSORIES

A thermometer pocket shall be provided.

An oil gauge shall be provided on 800 kVA transformers.

The following accessories are not required:

- oil filling pipe, drain valves, drain plugs, detachable oil pipe connections or conservator.
- current transformers, gas- and oil-actuated relays, indicating thermometer, oil level gauge on transformers less than 800 kVA rating.

7 COLOUR

Avocado C12 to SABS 1091.

8 BASE

Flat type underbase to be provided.

9 TESTS

The manufacturer's certificate of routine tests shall be provided at the same time as the delivery.

10 INFORMATION TO BE SUBMITTED WITH TENDER

10.1 Outline drawing.

10.2 Type test certificates demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR11VT REV 1
PAGE 1 of 1
APPROVED 9 June 1993

11 kV THREE PHASE VOLTAGE TRANSFORMER

1 SCOPE

The following non-stock item shall comply with this specification:

DT3200 Transformer Voltage 11 kV 3 Phase

2 STANDARD SPECIFICATIONS

Equipment shall comply with the requirements of the following specification:

BS 3941 : Voltage Transformers

3 RATINGS AND CLASS

The voltage transformer shall be electromagnetic type.

The ratio shall be 11000/110 volts, three phase, vector group Yyn0.

The rating shall be 100 VA.

The voltage factor shall be 1.2.

The accuracy class shall be 1.0.

4 TERMINATIONS

Three HV outdoor bushings shall be provided suitable for connection of bare conductors.

Four LV bushings (three phase and one neutral) shall be provided in a terminal box suitable for the termination of four core PVC SWA cable with 2,5 mm² conductors.

5 COLOUR

Avocado C12 to SABS 1091.

6 INFORMATION TO BE SUBMITTED WITH TENDER

6.1 Outline drawing.

6.2 Type test certificate demonstrating compliance with the specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR22-11 REV 1
PAGE 1 of 2
APPROVED 18 Sept 1995

22/11 kV TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3110	Transformer 1000 kVA 22/11 kV	Three Phase
DT3112	Transformer 500 kVA 22/11 kV	Three Phase
DT3113	Transformer 200 kVA 22/11 kV	Three Phase

2 STANDARD SPECIFICATIONS

The equipment shall comply with the requirements of the following specification:

SABS 780 : Distribution Transformers

3 GENERAL

Transformers shall be outdoor type. The rating shall be as detailed in the description with ONAN cooling.

Transformers up to 500 kVA shall be sealed with bolted covers.

Transformers exceeding 500 kVA shall be breathing transformers.

The HV system prospective fault level is 16 kA.

4 VOLTAGE

Rated voltage shall be 22000/11000 V on nominal tap, three phase, 50 Hz, vector group Dyn 11. The impulse withstand voltage of the 22 kV winding shall be 150 kV and of the 11 kV winding 95 kV.

A five position, off-circuit tapping switch shall select ratios of 95, 97.5, 100, 102.5 and 105% of rated primary voltage.

5 TERMINATIONS

HV and LV outdoor bushings shall be provided, without arcing horns.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR22-11 REV 0
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APPROVED 18 Sept 1995

6 ACCESSORIES

On sealed transformers a thermometer pocket shall be provided but the following accessories are not required:

- oil filling pipe, drain valves, drain plugs, detachable oil pipe connections, gas- and oil-actuated relays or conservator.
- indicating thermometer, oil level gauge.

Breathing transformers shall be equipped with:

- silica gel breather, conservator, oil level gauge, drain plugs and provision for fitting a gas- and oil-actuated relay.
- thermometer pocket and indicating thermometer.
- the gas- and oil-actuated relay is not required.

7 CURRENT TRANSFORMERS

15 VA class 5 current transformers shall be provided on all three phases of the 11 kV winding in the main tank for remote thermal ammeters. The following ratio shall apply:

Transformer rating [kVA]	1500	1000	500
Ratio [A]	100/5	75/5	30/5

8 COLOUR

Avocado C12 to SABS 1091.

9 BASE

Skid type base shall be provided.

10 TESTS

The manufacturer's certificate of routine tests shall be provided at the same time as the delivery.

11 INFORMATION TO BE SUBMITTED WITH TENDER

11.1 Outline drawing.

11.2 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR33-11 REV 1
PAGE 1 of 2
APPROVED 9 June 1993

33/11 kV TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3150	Transformer 1000 kVA 33/11 kV	Three Phase
DT3151	Transformer 200 kVA 33/11 kV	Three Phase
DT3152	Transformer 500 kVA 33/11 kV	Three Phase
DT3153	Transformer 1500 kVA 33/11 kV	Three Phase

2 STANDARD SPECIFICATIONS

The equipment shall comply with the requirements of the following specification:

SABS 780 : Distribution Transformers

3 GENERAL

Transformers shall be outdoor type. The rating shall be as detailed in the description with ONAN cooling.

Transformers up to 500 kVA shall be sealed with bolted covers.

Transformers exceeding 500 kVA shall be breathing transformers.

The HV system prospective fault level is 16 kA.

4 VOLTAGE

Rated voltage shall be 33000/11000 V on nominal tap, three phase, 50 Hz, vector group Dyn 11. The impulse withstand voltage of the 33 kV winding shall be 200 kV and of the 11 kV winding 95 kV.

A five position, off-circuit tapping switch shall select ratios of 95, 97.5, 100, 102.5 and 105% of rated primary voltage.

5 TERMINATIONS

HV and LV outdoor bushings shall be provided, without arcing horns.

6 ACCESSORIES

On sealed transformers a thermometer pocket shall be provided but the following accessories are not required:

- oil filling pipe, drain valves, drain plugs, detachable oil pipe connections, gas- and oil-actuated relays or conservator.
- indicating thermometer, oil level gauge.

Breathing transformers shall be equipped with:

- silica gel breather, conservator, oil level gauge, drain plugs and provision for fitting a gas- and oil-actuated relay.
- thermometer pocket and indicating thermometer.
- the gas- and oil-actuated relay is not required.

7 CURRENT TRANSFORMERS

15 VA class 5 current transformers shall be provided on all three phases of the 11 kV winding in the main tank for remote thermal ammeters. The following ratio shall apply:

Transformer rating [kVA]	1500	1000	500
Ratio [A]	100/5	75/5	30/5

8 COLOUR

Avocado C12 to SABS 1091.

9 BASE

Skid type base shall be provided.

10 TESTS

The manufacturer's certificate of routine tests shall be provided at the same time as the delivery.

11 INFORMATION TO BE SUBMITTED WITH TENDER

11.1 Outline drawing.

11.2 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR33CT REV 1
PAGE 1 of 1
APPROVED 9 June 1993

33 kV CURRENT TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DM5048	Transformer Current 33 kV Outdoor
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2 STANDARD SPECIFICATIONS

Equipment shall comply with the requirements of the following specification:

BS 3938 : Current transformers

3 GENERAL

The ratios, burden and accuracy class shall be as specified separately.

4 INFORMATION TO BE SUBMITTED WITH TENDER

4.1 Outline drawing.

4.2 Type test certificates demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR33-LV2 REV 1
PAGE 1 of 3
APPROVED 9 June 1993

33/0.4 kV POLE MOUNTED TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3155	Transformer 50 kVA 33/0.4 kV	Three Phase
DT3156	Transformer 100 kVA 33/0.4 kV	Three Phase
DT3157	Transformer 200 kVA 33/0.4 kV	Three Phase

2 STANDARD SPECIFICATIONS

The equipment shall comply with the requirements of the following specification:

SABS 780 : Distribution Transformers

3 GENERAL

Transformers shall be outdoor type with covers sealed by welding. The rating shall be as detailed in the description, with ONAN cooling.

4 VOLTAGE

Rated voltage shall be 33000/400V on nominal tap, three phase, 50 Hz, vector group Dyn11. The HV system prospective fault level is 16 kA.

A five position, off circuit tapping switch shall select ratios of 95, 97.5, 100, 102.5 and 105% of rated primary voltage.

The impulse withstand voltage of the HV windings shall be 200 kV.

5 TERMINATIONS

5.1 HV and LV outdoor bushings shall be provided, without arcing horns.

5.2 The LV neutral bushing shall have the same current rating and be of the same type as the phase terminals.

5.3 Provision shall be made for mounting surge arresters on the transformer close to the HV bushings.

5.4 A weatherproof cubicle with hinged door shall be installed over the LV bushings on transformers up to 200 kVA. It shall be provided with the following three phase 5 kA circuit breakers:

50 kVA	1 x 150A
100 kVA	2 x 150A
200 kVA	2 x 150A

It shall be possible to terminate cables in the load side of the circuit breakers or on the main LV bushings of the transformer.

The base of the circuit breaker cubicle shall be pre-drilled for the following cables and sealed with compression glands with stoppers:

50 kVA	1 x 35 mm ² 4c	PVC/SWA cable
	2 x 50 mm ²	ABC cable
100 kVA	1 x 70 mm ² 4c	PVC/SWA cable
	3 x 50 mm ²	ABC cable
200 kVA	1 x 150 mm ² 4c	PVC/SWA cable
	3 x 70 mm ²	ABC cable

6 ACCESSORIES NOT REQUIRED

The following accessories are not required.

- oil filling pipe, drain valves, drain plugs, detachable oil pipe connections or conservator.
- current transformers, gas- and oil-actuated relays, thermometer pockets, indicating thermometers and oil level gauges.

7 COLOUR

Avocado C12 to SABS 1091.

8 BASE

The underbase shall be suitable for pole platform mounting. The position of fixing holes shall be

- at 500 mm centres on the long side of the base
- at 350 or 400 mm centres only in the transverse direction.

9 TESTS

The manufacturer's certificate of routine tests carried out shall be provided at the same time as the delivery.

10 INFORMATION TO BE SUBMITTED WITH TENDER

10.1 Outline drawing.

10.2 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/TR33-LV3 REV 1
PAGE 1 of 2
APPROVED 9 June 1993

33/0.4 kV GROUND MOUNTED TRANSFORMERS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DT3158	Transformer 315 kVA 33/0.4 kV	Three Phase
DT3159	Transformer 630 kVA 33/0.4 kV	Three Phase

2 STANDARD SPECIFICATIONS

Equipment shall comply with the requirements of the following specification:

SABS 780 : Distribution Transformers

3 GENERAL

Transformers shall be outdoor type, sealed with bolted covers. The rating shall be as detailed in the description, with ONAN cooling.

4 VOLTAGE

Rated voltage shall be 33000/400 V on nominal tap, three phase, 50 Hz vector group Dyn 11. The HV system prospective fault level is 16 kA.

A five position, off-circuit tapping switch shall select ratios of 95, 97.5, 100, 102.5 and 105% of rated primary voltage. The impulse withstand voltage of the HV windings shall be 200 kV.

5 TERMINATIONS

HV outdoor bushings shall be provided, without arcing horns, suitable for connection of bare conductor. Provision shall be made for mounting surge arrestors on the transformer close to the HV bushings.

An LV cable box and bushings with air clearance shall be suitable for glanding and terminating up to three, 4-core 240 mm² PVC SWA cables. The LV neutral bushing shall have the same current rating and be of the same type as the phase terminals.

6 ACCESSORIES

A thermometer pocket shall be provided.

The following accessories are not required:

- oil filling pipe, drain valves, drain plugs, detachable oil pipe connections or conservator.
- current transformers, gas- and oil-actuated relays, indicating thermometer, oil level gauges.

7 COLOUR

Avocado C12 to SABS 1091.

8 BASE

Flat type underbase to be provided.

9 TESTS

The manufacturer's certificate of routine the tests shall be provided at the same time as the delivery.

10 INFORMATION TO BE SUBMITTED WITH TENDER

10.1 Outline drawing.

10.2 Type test certificate demonstrating compliance with specification.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/XARMSTL REV 1
PAGE 1 of 1
APPROVED 9 June 1993

STEEL CROSSARMS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DF1002	Crossarm 11 kV Intermediate	In House Assembly
DF1002	Bracket S/Pole Fuse and Arrestor	DWG BP700/6
DF1006	Bracket Transformer Crossarm	DWG BP700/10
DF1007	Bracket D Fuse Crossarm	DWG BP700/10
DF1008	Bracket S/Pole Links	DWG BP700/5
DF1009	Bracket Autorecloser	BP700/9
DF1010	Crossarm H Pole A/R Link	BP700/8
DF1011	Platform S Pole Gang Switch	BP700/7
DF1014	Strap Crossarm 11 kV	DWG BP700/1
DF1015	Crossarm Transformer and D Fuse	DWG BP700/10
DF1017	Clamp Gang Switch Platform	BP700/7
DF1018	Platform H/Pole Gang Switch	DWG BP700/4
DF1019	Crossarm H/Pole Arrestor	DWG BP150/19

2 STANDARD SPECIFICATIONS

Crossarms shall be manufactured from mild steel complying with the requirements of SABS 221 or grade 43 of BS 4360.

3 GENERAL

Crossarms, brackets and braces shall be manufactured in accordance with the relevant drawing.

Crossarms, brackets, braces, nuts, bolt and washers shall be hot dip galvanised after all manufacturing operations including drilling and the removal of all burrs and welding slag. The galvanising shall comply with the requirements for general purpose coating according to SABS 763.

4 PAINTING

As an alternative to hot dip galvanising all steel may be cleaned and given one coat of red primer (Type 2 to SABS 312) at least 35 microns thick, and two coats of light grey paint (shade G29 to SABS 1091) to give a minimum total thickness of 100 microns.

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 2/XARMWOOD REV 2
PAGE 1 of 1
APPROVED 07 April 1997

WOODEN CROSSARMS

1 SCOPE

The following BPC Stock Items shall comply with this specification:

DL2345	Crossarm Wood Inter 2.5 m min dia 100 mm
DL2346	Crossarm Wood Strain 2.5 m min dia 120 mm
DL2347	Crossarm Wood Inter 3.5 m min dia 100 mm
DL2348	Crossarm Wood Strain 3.5 m min dia 120 mm

2 STANDARD SPECIFICATIONS

2.1 Crossarms shall comply with one of the following specifications:

- 2.1 a) SABS 753 : Pine poles and crossarms for power transmission, low voltage reticulation and telephone systems.
- 2.1 b) SABS 754 : Eucalyptus poles and crossarms for power transmission, low voltage reticulation and telephone systems.
- 2.1 c) CAS 120 : Pine and eucalyptus poles.

3 GENERAL

- 3.1 Crossarms shall be cut and drilled as shown on Drawing BP700/11 prior to preservative treatment.
- 3.2 A template shall be used for drilling holes to ensure the correct spacing and alignment.
- 3.3 The crossarms shall be pressure impregnated with creosote complying with the requirements of SABS 538 or SABS 539.
- 3.4 The moisture content at the time of impregnation shall not exceed 170 g/kg.
- 3.5 Crossarms shall be of strength group A. Maximum fibre stress shall be 55 MPa.
- 3.6 Crossarm shall be marked with the approving authority mark and in accordance with SABS 754 Section 4.

4 INFORMATION TO BE SUPPLIED WITH TENDER

Tenderers shall identify the specie of wood offered.

5 APPROVED SUPPLIERS

The following are approved suppliers:-

PART 3

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

PART 3
SECTION Index
DATE 28 November 2002

SPECIFICATIONS FOR THE INSTALLATION OF EQUIPMENT OR CONSTRUCTION OF SYSTEMS

Section	Description	Old spec	Latest spec	Latest Revision
A	General arrangements for works (Deleted)	20-May-92	09-Jun-93	Rev 1
B	Overhead lines on wooden poles	16-Jun-92	09-Jun-93	Rev 1
C	11 and 33kV overhead lines	20-May-92	09-Jun-93	Rev 1
D	Low voltage ABC lines	20-May-92	09-Jun-93	Rev 1
E	Low voltage bare wire lines	16-Jun-92	09-Jun-93	Rev 1
F	High voltage cables	20-May-92	09-Jun-93	Rev 1
G	Low voltage cables	20-May-92	09-Jun-93	Rev 1
H	Civil engineering works associated with the installation of underground cables	16-Jun-92	09-Jun-93	Rev 1
J	Maniature substations	20-May-92	09-Jun-93	Rev 1
L	Proposed drawing specs for SRDS	17-Nov-95	17-Nov-95	Rev 0
M	Proposed as-built drawing spec for SRDS	17-Nov-95	17-Nov-95	Rev 0
P	Test records and as-built drawings	20-May-92	20-May-92	Rev 0
R	Standard consumers generators	Jan-95	28-Feb-97	Rev 3
S	Interlocking consumers generators	Jan-95	Jul-95	Rev 1
T	Typical 11kV satellite substations	14-Dec-00	27-Jun-01	Rev 1

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SECTION 3/A Rev 1
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APPROVED 9 June 1993

GENERAL REQUIREMENTS FOR WORKS

DELETED

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 3/B Rev 1
PAGE 1 of 9
APPROVED 9 June 1993

OVERHEAD LINES ON WOODPOLES

B1 SCOPE

- B1.1 This specification covers the supply, installation and commissioning of overhead lines on wooden poles.
- B1.2 An overhead line shall comprise the poles, cross-arms, stays, struts, conductors, insulators and any other auxiliary equipment specified for mounting on the line structures.
- B1.3 Conductors, insulators and auxiliary equipment are specified separately.

B2 STANDARDS

The following specifications are applicable.

SABS 1200 D : Standardised Specification for Civil Engineering Construction.

Code of Practice for Overhead Lines for Conditions Prevailing in South Africa.

B3 GENERAL

B3.1 Span Lengths

On approval of the Engineer, pole positions may be altered to suit site conditions provided no span length shall exceed 100 m.

B3.2 Clearances

The Electrical Contractor shall ensure that the minimum clearances required by the Electrical (Supply) Regulations 1988 are adhered to.

B3.3 Same Make

Similar items shall be of the same make throughout the installation.

B3.4 Tree Felling

The Contractor shall obtain prior approval from the Engineer before any trees are removed or branches cut.

B4 EARTHWORKS

B4.1 Approval to Commence

The Contractor shall obtain permission from the Engineer to commence excavation of pole and stay holes.

B4.2 Excavations

- B4.2.1 Care is to be exercised in excavation to ensure that the minimum of damage is done to the surrounding surfaces and to buildings, kerbs, paving stones, gates and fence foundations, etc.
- B4.2.2 Excavations for poles, stays and trench earths shall remain open for as short a period as possible. The Contractor shall erect and maintain barriers, warning notices and lights at open excavations and soil heaps.
- B4.2.3 All holes situated in privately owned land, or which as may be dangerous by reason of proximity to roads, etc shall not be left open overnight, but shall be covered over with material capable of sustaining, in the first case mentioned, the weight of livestock, and in the second, the weight of a man. Alternatively, the hole may be barricaded, or in the case of privately owned land not used for grazing, the holes may be left open providing written permission is obtained from the landowner or lessee. In all cases the contractor shall be liable for any claims arising from damage sustained as a result of excavations or spoil heaps.
- B4.2.4 The Contractor shall be responsible for all damage sustained as a result of his excavations and all excavations shall be carried out in a manner that no walls, earth banks, hedges and trees will be damaged or removed without the written consent of the Engineer.
- B4.2.5 Water must not be allowed to accumulate at any part of the work. The Contractor shall take all risks from water, whatever the source or cause may be, and shall at his own expense effectively drain and keep dry all the works during construction and take care to prevent surplus water from soaking in. All side channels, sumps or temporary excavations for dewatering purposes, shall be properly filled in when their need ceases.

DELETED

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 3/C Rev 1
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APPROVED 9 June 1993

11 AND 33 kV OVERHEAD LINES

CI. SCOPE

C1.1 This specification covers the installation of insulators and conductors for 11 and 33 kV bare conductor overhead lines.

C1.2 The supply and erection of poles, crossarms and stays and the commissioning of the line are specified separately.

C2 STANDARDS

The following specifications are applicable.

Code of Practice for Overhead Lines for Conditions Prevailing in South Africa.

C3 INSULATORS AND HARDWARE

C3.1 General

The overhead line poles shall be dressed with insulators and hardware as indicated on the drawings.

C3.2 Fittings

C3.2.1 The mechanical strength of insulators and fittings shall provide a factor of safety of at least 2,5 based on the guaranteed minimum failing load when they are subjected to the maximum design tension in the conductor or earth wire to which they are attached. The ultimate breaking strength of insulators and fittings specified for tension application shall in any event not be less than 70 kN.

C3.2.2 Adequate bearing areas between fittings shall be provided. Point or line contacts shall be avoided where possible without adversely affecting the flexibility of the fittings.

C3.2.3 DELETED

C3.2.4 Bolts and Nuts

Bolts and nuts shall be of steel with hexagonal heads. Where metal parts are secured by bolts and nuts, single flat mild steel washers shall be used at both the bolt head and nut sides.

Bolts shall be locked by means of locknuts or other approved methods.

No line, earth conductor or staywire fittings shall employ screw threads loaded in tension with the exception of crossarm eye bolts and turnbuckle type stay rods.

Tapered washers of suitable dimensions, shall be used wherever components are bolted onto channel-iron with the nut or head located internally on the flange.

C3.2.5 Tension Clamps

The clamps shall match the clevis and tongue string insulator units without additional adaptors and shall also be suitable for the specified conductor type and size.

Thimble clevises shall be used with preformed dead-ends. The radii of the thimble clevis shall be suitable to accept the preformed dead-ends. The thimble clevises shall match the clevis and tongue string insulator units without additional adaptors.

C3.3 Suspension Clamps

The clamp seat diameter shall be large enough to include the conductor which is to be inserted.

C3.4 Crossarm and Tower Attachments, Shackles, Links, Adaptors, Tongue Nuts and Yoke-Plates

C3.4.1 These fittings shall be made of malleable cast iron to BS 310 and manufactured in compliance with SABS 178 (revised now applicable SANS 61284)

C3.4.2 The fittings shall match the specified immediate adjacent fitting or string insulator unit without the use of additional adaptors.

C4 CONDUCTORS

C4.1 Conductors of overhead electrical transmission lines shall be of the size and type specified.

C4.2 Stringing

C4.2.1 BPC's Sag/Tension Charts should be used for stringing conductors.

DELETED

The maximum operating tension shall not exceed 40% of the ultimate tensile strength of the conductor.

The manufacturer's final stringing and tensioning charts shall, in addition to the safety factor requirements, be based on not more than 25% of the breaking strength of the conductor at +5°C with no wind.

The conductors shall be tensioned by one of the two following methods:

- (1) The conductors shall be tensioned to the manufacturer's initial tension and sag charts when, after the conductors have been subjected to the worst conditions assumed in the preceding paragraph the resulting tensions and sags will correspond to those shown in the manufacturer's final charts. These final charts shall be used for determining clearances.
 - (2) The conductors shall be tensioned to 50% of their ultimate tensile strength and kept under this tension for a period of not less than 20 minutes. The tension is then to be reduced to that shown in the manufacturer's final tension and sag charts.
- C4.2.2 The conductors shall be erected in such a manner as to avoid over tensioning, bird caging or damage due to being dragged over stony ground or sharp objects.
- C4.2.3 Conductor running blocks shall be installed on all pole positions to run out the conductors. Conductors shall not be dragged along the ground. All conductors shall be tensioned simultaneously using suitably rated chain-ratchet pullers and "come-alongs" specially designed for the particular conductor.
- C4.2.4 The stringing and tensioning charts shall form part of the operating and maintenance manual.
- C4.3 Joints
- C4.3.1 Joints must have a load and fault current carrying capacity and breaking strengths at least equal to the conductor joined.
- C4.3.2 DELETED
- C4.3.3 DELETED
- C4.4 Terminations
- C4.4.1 Cold compression joints shall be used for all current-carrying connections.
- C4.4.2 Where aluminium to copper connections are made, friction welded bi-metallic joints shall be used. Aluminium conductor or aluminium lugs may be terminated on tinned copper terminals.
- C4.5 Binding In
- C4.5.1 Line conductors shall be bound onto pin and post insulators in an approved and recognised manner, eg as laid down in the Aluminium Company's handbook or other approved instructions.
- C4.5.2 Where aluminium conductors are used a chafer tape of soft aluminium shall be wrapped around the conductor at the insulator contact area and 5 mm diameter hard drawn aluminium wire shall be used for binding.

Suitably sized preformed wrap lock ties with pads may be used as an alternative method where appropriate.

C5 VIBRATION DAMPERS

DELETED

C6 JUMPERS

C6.1 Jumpers shall be so shaped as to maintain the required minimum phase to earth and phase to phase clearances specified. Where this cannot be attained the Engineer shall authorise the use of additional line insulators to maintain the clearances.

C6.2 Jumpers shall be of the same conductor as that specified for the overhead line.

C7 DELETED

C7.1 DELETED

C7.2 DELETED

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 3/D Rev 1
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ABC LINES

DI. SCOPE

D1.1 This specification covers the installation of aerial bundled conductor for systems operating at voltages not exceeding 600/1000V, together with support fittings and connections to the line.

D1.2 The supply and erection of poles, struts and stays, and the commissioning of the line are specified separately.

D2 STANDARDS

The following specifications are applicable.

SABS 0198 : The selection, handling and installation of electric power cables not exceeding 33 kV.
SABS 1418 : Aerial bundled conductor systems.

D3 AERIAL BUNDLED CONDUCTOR

D3.1 Cable ties or straps are to be used to tie the bundle adjacent to supports to prevent unravelling of the bundle. These ties or straps shall be UV stabilised and shall be of adequate strength to contain the bundle under all weather conditions.

D4 FITTINGS

D4.1 All strain and suspension hardware fittings for the aerial bundle conductor shall be bolted to the pole in order to prevent the bracket sliding down the pole as a result of stay tension.

D4.2 All steel hardware shall be hot dipped galvanised to Table 1 of SABS 763, or treated with an approved alternative coating, or manufactured from an approved corrosion resistant material.

D5 TERMINATIONS

D5.1 The exposed ends of the conductors shall be capped so as to effectively insulate them and protect the cable against ingress of moisture.

D5.2 Insulation piercing connectors shall be installed in accordance with the recommendation of the manufacturer.

D6 JOINTS

D6.1 Mid-span joints shall be by pre-insulated aluminium sleeves for phases and aluminium alloy for neutral carriers.

D6.2 For the purposes of measurement it shall be assumed that the rate given in the bills for aerial bundled conductor shall include any mid-span joint that the installation may require.

D7 CONNECTION TO MINIATURE SUBSTATIONS

D7.1 Except where otherwise specified, each LV abc circuit shall be fed by a 4-core, 70 mm², copper conductor, PVC SWA PVC PVC cable from the miniature substation and protected with a 200 Amp MCB.

D7.2 The cable and earth wire shall be enclosed in a galvanised steel pipe of suitable diameter to a height of 2 m above and 250 mm below finished ground level. The pipe is to be fixed to the pole at 1 m intervals by saddles.

D7.3 All PVC insulation must be taped with black tape to avoid ultra violet light damage to the PVC.

D8 LABELS

D8.1 All cables leaving a miniature substation are to be provided with copper labels or approved equal, strapped to the cable immediately below the cable support with copper wire, onto which the following information shall be punched in 6 mm high letters:

Cable no or route description, sizes and no of cores, destination.

D9 INSTALLATION

D9.1 The aerial bundled conductor shall be installed in accordance with SABS 0198 : Part XIV and the bundle manufacturer's recommendations.

D9.2 The Contractor shall provide all the necessary tools and fittings for the installation of the bundle and the bundle shall be installed by qualified personnel using the specialised equipment recommended by the bundle manufacturer.

D9.3 The minimum bend radius of the bundle is to be respected at all times. Running-out blocks of adequate diameter shall be used to ensure this during installation.

D9.4 The bundle is to be tensioned in accordance with the bundle manufacturer's tension and sag tables.

D9.5 No span length shall exceed 50 m. The minimum ground clearance in road reserves shall be 5,5 m and elsewhere 3,9 m.

D9.6 The Contractor shall state his experience in the installation of aerial bundled conductor. Should his experience, in the opinion of the Engineer, be inadequate the Contractor shall employ an experienced aerial bundled conductor erector to train his erection crew in the necessary skills.

D10 EARTHING

D10.1 The system shall comply with the requirements for TN-C-S earthing (protective multiple earthing).

D10.2 The neutral conductor shall be earthed to a 1500 mm earth spike at every terminal, cable fed and T-off pole by a 35 mm² bare copper earthwire, enclosed in a galvanised steel pipe.

D11 TESTING

- D11.1 The Contractor shall give the Engineer at least 7 days notice in writing of tests that are to be carried out.
- D11.2 A physical inspection of the installation shall be carried out to ensure compliance with the specification.
- D11.3 A test voltage of 1000 V dc shall be applied between conductors and between each conductor and the earthed surroundings of the cable. The voltage should be increased to the above value and maintained at this value for at least one minute.
- D11.4 Measure the earthing resistance of the earth at the end of each feeder, disconnected from the neutral, as well as the earthing resistance of the neutral conductor earth at the start of each feeder with all earths connected. Acceptable values are 20 ohms and 5 ohm respectively. If higher values are recorded an instruction must be requested from the Engineer.
- D11.5 Phase connections are to be checked at each termination to ensure continuity and consistency of phase rotation throughout the installation.
- D11.6 The results of tests shall be submitted to the Engineer in writing within 7 days.

D12 ACCEPTANCE TESTS

Acceptance tests in the presence of the Engineer shall comply with the requirements of section 3/B clause B13.

D13 DELETED

D13.1 DELETED

D13.2 DELETED

D13.3 DELETED

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

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LV BARE WIRE LINES

E1. SCOPE

- E1.1 This specification covers the requirements for the installation of insulators and conductors for low voltage bare conductor overhead lines.
- E1.2 The supply and erection of poles, crossarms and stays and the commissioning of the line are specified separately.

E2 STANDARDS

Code of Practice for Overhead Lines for Conditions Prevailing in South Africa.

E3 INSTALLATION

- E3.1 No span length shall exceed 50 m.
- E3.2 The distance between strain points shall not exceed 500 m.
- E3.3 The minimum ground clearance in road reserves is 5.5 m and elsewhere 4.9 m.

E4 EARTHING

- E4.1 On type TN-C-S systems the neutral conductor shall be earthed using 35 mm² copper conductor to a 1500 mm earth spike at the foot of the pole hole at the first pole and at every terminal or branch pole and at every third intermediate pole between these points.
- E4.2 On type TN-S system the earth conductor shall be earthed using 35 mm² copper conductor to an 1500 mm earth spike at the foot of the pole hole at the first and every terminal pole. The earth conductor along the line shall be of the same size as the phase conductor.

E5 CONNECTION TO SUPPLY

- E5.1 Where LV lines are connected to the supply by cable, the cable shall be of the copper conductor size specified below, installed with bare copper earth wire (BCEW) and protected by the specified circuit breaker:

LINE CONDUCTOR	PVC/SWA/PVC	CABLE	BCEW	MCB
Gopher	16 mm ²	4 C	35 mm ²	100 A TP (DP4052)
Rabbit	70 mm ²	4 C	35 mm ²	200 A TP (DP4056)
Hare	150 mm ²	4 C	70 mm ²	300 A TP (DP4057)

E6 TESTING

- E6.1 The Contractor shall give the Engineer at least 7 days notice in writing of tests that are to be carried out.
- E6.2 A physical inspection of the installation shall be carried out to ensure compliance with the specification.
- E6.3 A test voltage of 2000 Vac (rms) shall be applied between conductors and between each conductor and earth. The voltage shall be maintained at this value for at least one minute.
- E6.4 Measure the earthing resistance of the earth at the end of each feeder, disconnected from the neutral, as well as the earthing resistance of the neutral conductor earth at the start of each feeder with all earths connected. Acceptable values are 20 ohms and 5 ohms respective. If higher values are recorded, an instruction must be requested from the Engineer.
- E6.5 Phase connections are to be checked at each termination to ensure continuity and consistency of phase rotation throughout the installation.
- E6.6 The results of tests shall be submitted to the Engineer in writing within 7 days.

E7 ACCEPTANCE TESTS

Acceptance tests in the presence of the Engineer shall comply with the requirements of section 3/B clause B13.

E8 DELETED

E8.1 DELETED

E8.2 DELETED

E8.3 DELETED

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

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PILC OR XLPE INSULATED 11 kV CABLES

FI. SCOPE

This specification covers the delivery to site of 11 kV cables and general requirements for installation, jointing and testing.

F2 STANDARD SPECIFICATIONS

The following specifications are applicable.

SABS 0198 : The selection, handling and installation of electric power cables

F3 INSTALLATION

In addition to the requirements for installation described in the standard specifications the following shall apply.

- F3.1 The cables shall be laid in the position indicated on the drawing or wayleave plan. At street or road crossings, they shall be pulled through protective ducts.
- F3.2 Cables crossing voids shall be suitably supported in an approved manner, and be protected against damage.
- F3.3 Where cable ends are to be left buried the ends shall be adequately sealed to prevent the ingress of moisture.
- F3.4 Sufficient cable slack shall be left in the immediate vicinity of all joints to permit the future remaking of the joints.
- F3.5 Joints shall be made off only by experienced cable jointers and particular attention shall be given to maintaining the earth continuity of the lead or aluminium sheath, as applicable, and armour, tapering of the conductor insulation, butting together of the conductor strands and prevention of voids.
- F3.6 The installation work shall be carried out strictly in accordance with statutory and municipal regulations and any special requirements of the local supply authority.

F4 LAYING CABLES IN PREPARED TRENCHES

- F4.1 Cables shall be laid at a depth in the prepared trench to provide a cover of at least 1000 mm.
- F4.2 Before the cables are laid, the bottom of the trench shall be covered with a 75 mm layer of well compacted earth which shall have been passed through a sieve with a maximum mesh of 12 mm. The Contractor shall lay the cables on the prepared bed carefully to avoid cuts and damage. Cable rollers shall be used.

- F4.3 Cables shall be covered with at least 100 mm of earth sieved through a mesh of not more than 12 mm.
- F4.4 The trench shall be back-filled as soon as possible after cable has been laid. To avoid theft and possible damage, long lengths of cable shall not be left exposed in an open trench overnight.
- F4.5 Water shall not be allowed to accumulate at any part of the works. The Contractor will ensure that no cable laying is carried out until the trenches are free from water.
- F4.6 All side channels, sumps or temporary excavations for dewatering purposes shall be filled in after use.
- F5 PLASTIC CABLE WARNING SHEETING
- All cables shall be covered with a plastic cable warning sheet 300 mm above the top of the cables.
- F6 CABLE WARNING TILES
- Where specified, cables shall be covered with concrete tiles 600 mm long x 225 mm wide x 50 mm thick of approved design, or with approved toughened plastic tiles. The cable tile shall be 200 mm above the cable.
- F7 MARKERS
- F7.1 Cable markers shall be concrete truncated pyramid with a base of 300 mm x 300 mm and a height of not less than 250 mm. The top shall be 120 mm x 120 mm. The marker shall protrude between 50 mm above the finished ground level.
- F7.2 All joints shall be marked by a cable marker.
- F7.3 Where specified the routes of all underground cables and duct ends shall be marked by means of approved concrete markers having cast insert the words "Electric Cables". They shall be positioned at every change of direction, every point of crossing another cable or service, and at spacings 50 m and 100 m of straight run.
- F8 SITE TESTS
- F8.1 Tests shall be carried out on each completed section of laid and jointed cable as follows:
- (a) The insulation resistance shall be tested with an approved "Megger" type of instrument of not less than 2000V. An acceptable value is 20 M ohms; if a lower value is recorded an instruction is to be requested from the Engineer.
 - (b) Phase connections and continuity are to be checked at each termination to ensure consistency of phase rotation throughout the installation.

- F8.2 The results of all the tests shall be recorded and submitted to the Engineer in writing.
- F8.3 A high voltage test shall be carried out in accordance with Table 4 of SABS 1339 if specified separately or instructed by the Engineer.
- F9 DELETED
- F10 DELETED
- F10.1 DELETED
- F10.2 DELETED
- F10.3 DELETED
- F10.4 DELETED

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 3/G Rev 1
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LOW VOLTAGE POWER CABLES

G1 SCOPE

This specification covers the delivery to site of low voltage power cables and general requirements for installation, jointing and testing.

G2 STANDARD SPECIFICATIONS

The following specifications are applicable.

SABS 0198 : The selection, handling and installation of electric power cables not exceeding 33 kV.

G3 INSTALLATION

In addition to the requirements for installation described in the standard specifications, the following shall apply.

- G3.1 The cables shall be laid in the position indicated on the drawing or wayleave plan. At crossings of sealed roads (bitumen or concrete), cables shall be pulled through pipes. At other road crossings they shall be buried directly.
- G3.2 Cables shall be laid on a 75 mm thick bed of well compacted sifted soil. The cable shall be covered by a 100 mm layer of sifted soil before backfilling with other material and compacting in layers.
- G3.3 All cables shall be covered with a plastic cable warning sheet. The warning sheet shall be placed 250 mm above the top of the cables.
- G3.4 Where cable ends are buried, the ends shall be adequately sealed to prevent the ingress of moisture. Where cable ends are to be left buried for location by others, they shall be marked by a steel marker looped around and extending from the cable end to 100 mm under the finished ground level.

G4 TERMINATIONS AND JOINTS

- G4.1 Cables shall be terminated in metal, non-rusting, compression glands of the type which provide anchorage for the armour wires. The gland shall be completely encased by a PVC or rubber shroud.
- G4.2 Joints shall be waterproof. In joints between cables, the mechanical and electrical integrity of the armouring shall be maintained. In joints from armoured to unarmoured cables, the armouring shall be connected to a 1500 mm earth spike using a bi-metallic connector and bare stranded copper conductor of cross-section equal to at least half that of the phase conductors.
- G4.3 Not more than one joint shall be permitted in runs which are less than the length of cable supplied on a drum.

G4.4 Joints shall be marked by an approved concrete cable marker. Cable markers shall be concrete truncated pyramid with a base of 300 mm x 300 mm and a height of not less than 250 mm. The top shall be 120 mm x 120 mm. The marker shall protrude between 50 mm above the finished ground level.

G5 TESTS

The following electrical tests shall be performed after installation and the results recorded in writing :

- a) The insulation resistance shall be tested with an approved "Megger" type of instrument of not less than 1000V. The insulation shall exceed 50 Mohm/1000 m of cable. If lower values are recorded an instruction must be requested from the Engineer.2
- b) Phase connections and continuity are to be checked at each termination to ensure consistency of phase rotation throughout the installation.

G6 DELETED

G6.1 DELETED

G6.2 DELETED

G6.3 DELETED

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

SECTION 3/H Rev 1
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CIVIL ENGINEERING WORKS ASSOCIATED WITH THE INSTALLATION OF UNDERGROUND CABLES

HI. SCOPE

This specification covers

- the excavation and backfilling of trenches
- the provision of ducts at road crossings
- the reinstatement of road surfaces

H2 WAYLEAVES, PLANS AND DRAWINGS

- H2.1 The Employer will arrange for the procuring of the necessary approvals and wayleaves from the road authorities, municipalities or other authorities concerned, unless otherwise agreed.
- H2.2 The Employer shall provide the Contractor with copies of all wayleaves and shall draw his attention, in writing, to any special conditions which may be stipulated therein.
- H2.3 The location of pipes/ducts/cables along the roads/streets specified in relation to the road/street centre line or boundary fence/building line shall be in accordance with the wayleave drawings and conditions stipulated by the authorities concerned.
- H2.4 The Engineer will provide the Contractor with such plans/drawings as are necessary for the proper execution of the work. All plans/drawings shall be returned to the Engineer on completion of the work.

H3 CORRECTNESS OF PLANS AND DRAWINGS

- H3.1 The Contractor shall carefully examine all plans and drawings and if any inaccuracy, discrepancy or inconsistency is detected, he shall immediately bring it to the notice of the Engineer and obtain a decision.

H4 MAINS AND SERVICES

- H4.1 The recorded position of sewers, drains, gas and water-mains, electricity cables and conduits, telephone and telegraph cables, or such services or their appurtenances as exist within the limits of an order will be shown on the wayleave or services plan. The accuracy of the services plan is not guaranteed, and the Contractor shall not make any discrepancy in the information given the basis of a claim against the Employer.
- H4.2 The Contractor shall be solely responsible for contacting the authorities concerned whenever any work on or in the vicinity of services is required to be done.

H5 DELETED

H5.1 DELETED

H5.2 DELETED

H5.3 DELETED

H5.4 DELETED

H5.5 DELETED

H5.6 DELETED

H5.7 DELETED

H6 TRENCHING

H6.1 Trenches for pipelines, ducts and cables shall be excavated in a straight line between manholes in accordance with the wayleave plan except where obstructions or other conditions require bends as permitted by the Engineer.

H6.2 The width of trenches shall be no greater than is necessary for satisfactory execution of the work. The onus shall be on the Contractor to satisfy the Engineer of the necessity where a trench, wider than that called for in the specification associated with the order, is excavated. Any reinstatement costs arising from the excavation of an unnecessarily wide trench shall be borne by the Contractor.

H6.3 Underground plant such as gas, telephone cables and ducts, water or sewerage mains, electricity supply cables and stormwater drains which obstruct the construction of the pipe/duct lines shall be brought to the notice of the Engineer. Where there is no other alternative, these must be moved at the Employer's expense in consultation with the owning authority.

H6.4 Where removal of services is necessary but cannot be undertaken by the owning authority, the work shall be undertaken by the Contractor or as the Engineer may decide.

- H6.5 Any warning of protective material encountered in the course of excavation shall be carefully opened up to avoid damage and, where necessary, removed. Services which are exposed shall be protected against damage and, where necessary, shall be supported to avoid subsidence.
- H6.6 Trigonometrical and other survey beacons or pegs may not be removed or altered. Where this becomes necessary the Engineer must be advised in order that suitable action may be taken.
- H6.7 Tree roots exposed in the course of trenching shall be protected and shall not be cut unless this is unavoidable.
- H6.8 The trench in which cables and/or ducts are laid shall have a minimum depth to provide a cover between the cable or duct and finished grade of not less than for:
- | | |
|---------------------|-----------|
| High voltage cables | - 1000 mm |
| Low voltage cables | - 600 mm |
- H6.9 Where this depth cannot be maintained owing to the nature of the ground, the depth may be varied at the discretion of the Engineer, or as otherwise noted. In all cases where the cable and/or duct has coverages less than that stated in this clause, it shall be covered by means of concrete slabs having a minimum thickness of 40 mm and a width equal to 400mm plus the diameter of the duct and/or cable it protects unless otherwise noted or directed by the Engineer.
- H6.10 The trench shall be excavated in such a position that cables/pipes/ducts may be laid at least 300 mm from power cables. Where this is not possible, cables/ducts/pipes shall be separated from power cables by concrete or paving slabs placed vertically or as otherwise directed.
- H6.11 The base of all trenches shall be suitably levelled before pipes/ducts are laid to ensure that they are supported along their full length. Where trenches are excavated in rocky ground, the base of such trenches shall be covered with a 75 mm layer of compacted soil to ensure that cables/pipes/ducts will not come into direct contact with sharp projections.
- H6.12 If the trench is to contain pipes/ducts, the base of the trench shall slope in order that water may drain from the pipes/ducts. The level of the base of the trench shall fall at least 75mm per 30m.

H7 SAFETY OF BUILDINGS AND FOUNDATIONS

- H7.1 The Contractor shall ensure that excavation of trenches will not endanger the foundations of adjacent buildings and shall, where necessary, take such action as may be necessary to prevent any subsidence of soil which could result in damage to foundations.

For measurement purposes, unless otherwise specified, the trench shall be assumed to be 600 mm wide for a single cable and an additional 300 mm wide for each additional cable.

H8 DUCTS AT ROAD CROSSINGS

- H8.1 Duct requirements are detailed in Drawing BP750/1/A.
- H8.2 All ducts shall be laid to have a minimum depth to provide a cover of not less than 700 mm between the top of the pipe and the surface of the road for LV cables and 1100 mm for HV cables.

- H8.3 Duct crossings shall be continued to within 1500 mm inside the edge of the road reserve.
- H8.4 DELETED
- H8.5 Ducts shall have the dimensions shown and shall be asbestos cement class "T" or uPVC Class 4 unless otherwise noted.
- H8.6 All duct ends are to be blocked off with rubber end caps to prevent the ingress of water and mud.
- H8.7 Particular care shall be taken to keep the ducts clear of concrete or any substance during the course of construction.
- H8.8 A 10 SWG drawwire or nylon drawcord shall be provided in each duct.
- H9 BACKFILLING OF TRENCHES
- H9.1 Backfilling shall be consolidated in layers of not more than 200 mm at a time. Filling around and over the pipes/ducts/cables to a depth of 50 mm shall be carefully carried out with fine materials, and the Contractor shall ensure that the pipes/ducts/cables are not damaged in any way by such backfilling and consolidation.
- H9.2 Where, in the opinion of the Engineer, there is no material excavated suitable for use, even after screening, as bedding and the first layer of backfill, the Contractor shall obtain suitable material and deliver it to the trench side for use. The onus shall be on the Contractor to prove to the satisfaction of the Engineer the actual quantities required.
- H9.3 For purposes of payment, the quantity of material refilled shall be taken as being equal to the amount excavated and no allowance shall be made for increased bulk due to excavation.
- H9.4 All surplus spoil from any excavation that cannot, in the opinion of the Engineer, be spread evenly over the surface, shall be removed by the Contractor at no extra cost to the Employer.
- H10 REINSTATEMENT
- H10.1 Where work requires the installation of ducts/cables under tarred or made-up sections of roads, streets or side-walks, reinstatement of the surface the work shall be carried out as directed by the authorities concerned. Full reinstatement costs shall be borne by the Contractor. The Contractor shall execute and maintain interim restoration.
- H10.2 Where ducts or cables are laid in the slopes of road cuttings or in the fill of embankments, the surface and slope shall be restored to the satisfaction of the responsible Roads Engineer.
- H11 PIPE/DUCT ENTRIES TO BUILDINGS & MANHOLES
- H11.1 Holes required to be made in the walls of existing buildings or manholes to provide a new pipe/duct entry shall be neatly made without cracking or otherwise damaging the surrounding structure.
- H11.2 The point of entry of underground pipes/ducts into buildings, manholes or jointing pits shall be effectively closed and sealed with cement to prevent ingress of water between the pipe/duct and the wall of the structure.

H12 DEGREE OF COMPACTION

- H12.1 All layers shall be compacted by plant approved by the Engineer and the Contractor shall satisfy the Engineer that all the specified requirements regarding compaction can be achieved.
- H12.2 Compaction shall only be carried out when the material in a layer contains the specified moisture content evenly distributed throughout the entire layer, subject to an allowable tolerance in moisture content of plus or minus 5%.
- H12.3 After compaction the mean dry density of the section or layer shall be equal to or exceed the specified values.
- H12.4 In addition, if in the opinion of the Engineer there is excessive scatter in any group of consecutive test results, the section or layer may not be accepted even though the mean dry density equals or exceeds the specified value.
- H12.5 The degree of compaction in open ground for each completed and compacted layer of filling shall conform to the following requirements:

Depth of Filling below final surface level (metres)	% Mod. AASHTO Density
0 - 0,450	95
Greater than 0,450	90

- H12.6 The degree of compaction in roadways for each completed and compacted layer of filling and foundation material shall conform to the following requirements :-

Layer	% Mod. AASHTO Density
Gravel wearing course	98
Basecourse	98
Subbase	95
Selected Subgrade	93 (100)
Filling if less than 300 mm below top of subgrade	93 (100)
Filling if more than 300 mm below top of subgrade	90 (98)

- H12.7 Where the material is on a non-plastic 'single sized' sand the degree of compaction for the layer shall be not less than 98% and the figures shown above in brackets shall apply.
- H12.8 The moisture content of the material at the time of compaction shall be the optimum moisture content for the material as determined from the Modified AASHTO Compaction Test, within the allowable tolerances. The moisture content for compaction may be altered subject to the approval of the Engineer.
- H12.9 Should the material be too wet due to rain or any other cause, it shall be allowed to dry out to the correct moisture content before compaction is begun, and the Engineer may instruct the Contractor to harrow the layer to ensure that there is not unequal evaporation.

H13 TESTS

The Contractor shall submit in writing to the Engineer the results of compaction tests for excavations in roadways made after the road is constructed and for at least one test per 1000 m of trench excavation.

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MINIATURE SUBSTATIONS

J1 SCOPE

This specification covers the installation of miniature substations of rating 200-500 kVA.

J2 INSTALLATION

J2.1 The miniature substation shall be mounted on a concrete base. The top of the concrete base shall be not less than 100 mm and not more than 250 mm above the finished ground level. The Contractor shall be responsible for ascertaining the finished ground level prior to installation.

J2.2 The top of the base shall slope from the inside to the outside, to prevent the accumulation of water inside the base. The base shall extend at least 50 mm beyond the edge of the miniature substation.

J2.3 The substation shall be placed on a layer of malthoid or similar material.

J2.4 Whether the miniature substation is delivered and/or placed in position by the Contractor or by others, the Contractor shall carefully inspect the transformer for faults such as oil leaks, cracks in insulator bushings, cracks in welds, cracks in gauge glasses, bent, dented or otherwise damaged cooling, breather or conservator pipes, loose bolts, externally damaged packing etc, and report any such occurrence to the Engineer.

J2.5 The LV neutral bar shall be earthed separately and not less than 5 m from the earth of the substation earth bar.

J2.6 Low voltage circuit breakers as specified shall be installed and connected to the busbars by droppers with a current rating of not less than 400A or the capacity of the circuit breaker, whichever is larger. The circuit breakers shall be labelled with engraved plastic labels.

J2.7 Where an HV oil fuse switch is fitted, the Contractor shall fill it with oil complying with SABS 555, supplied by the Contractor.

J3 LABELLING

Each substation shall be labelled externally in 70 mm high stencilled black letters. The number or name shall be designated by the Supply Authority.

J4 TESTS

J4.1 The Contractor shall test for earth continuity within the substation and measure the resistance of the earthing of the earth bar and neutral bar on completion of the installation. A value of 20 ohms is satisfactory; if higher values are measured an instruction is to be requested from the Engineer.

J4.2 The insulation between phases of the transformer and bushbars to earth measured with a 1000V megger-type instrument with the neutral earth disconnected shall exceed 50 M Ohm.

J4.3 The Contractor shall ensure that the transformer, the oil fuse switch (if applicable), isolator switches (if applicable) and the thermometer pocket are filled with oil to the correct level before energising the substation.

J4.4 The results of the tests shall be recorded and submitted to the Engineer in writing.

J4.5 On the indicating thermometer for measuring top oil temperature, the adjustable contacts shall be set for tripping at 70^oC.

J5 MEASUREMENT

J5.1 The installation of low voltage feeder circuit breakers in the miniature substation shall include supply, mounting, connection to busbars and labelling of circuits.

J5.2 The plinth shall include laying out, the supply of all material, excavation, casting, and the installation of malthoid or similar material.

J5.3 The earthing of the substation shall include the supply and installation of all trench earths, earth spikes and earth mats as specified including excavation, connections and testing at each substation.

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Proposed Drawing Specifications for SRDS

- 1 All drawings to be prepared using AutoCAD R12 for Windows/Dos format compatible with current BPC drawing office requirements. Drawings to be supplied in both digital and hard copy. Hard copy to be dated and signed.
- 4 Drawings to be supplied with data in diskette format. No data compression applications are to be employed without the prior approval of BPC. All files that exceed standard disk capacities can be transferred via laptop computer and BPC approved software.
- 3 Original (As Built) drawings to be supplied as per SRDS Section 3/M
 All CAD drawings to follow the standard format and to comply with the following symbol set and layer specifications. Drawing sheet sizes - A4 (290x210mm)
 A3 (420x297mm)
 A1 (782x554mm)

All dimensions specified above are plotted maximums including title block.

Layers

Layer Name	Description	Colour	Linetype	Width
LV Underground	Low Voltage Reticulation Underground	Yellow	Border	.3
LV Overhead	Low Voltage Reticulation Overhead	Yellow	Border 2	.3
LV ABC	Low Voltage Reticulation Aerial Bundled Conductor	Yellow	Border X2	.3
11KV Underground	11kV Reticulation Underground	Blue	Centre	.5
11KV Overhead	11kV Reticulation Overhead	Blue	Centre 2	.5
33KV	33kV	Green	Phantom	.5
66KV	66kV	Magenta	Dashdot2	.5
132KV	132kV	Blue	Divide	.5
220KV	220kV	Red	Centre	.75
TITLE	Title Block	White	Continuous	0
FRAME	Border	White	Continuous	0
XFORMER	Transformers	White	Continuous	0
MSUBS	Minisubs	White	Continuous	0
SCHEDULE	Bills Of Quantities/Schedules	White	Continuous	0
DIMS	Dimensions	White	Continuous	0
TEXT	Text	White	Continuous	0

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Symbols

The following symbology is to be adhered to as far as possible. All other symbology is to be as per NRS (National Rationalized Specification) NRS 002-1990 Graphical Symbols for Electrical Diagrams.

SYMBOL	DESCRIPTION	BLOCK	ATTRIBUTES	SYMBOL	DESCRIPTION	BLOCK	ATTRIBUTES
	METERING UNIT	MU	NAME LOCATION DESCRIPTION GROUP RATINGS FACTORY		EARTH FAULT LOCATOR (AUTOMATIC RESET)	EFLA	
	RING MAIN UNIT		NAME LOCATION DESCRIPTION		EARTH FAULT LOCATOR (MANUAL RESET)	EFLM	
	RING MAIN UNIT (FUSED)		NAME LOCATION DESCRIPTION		OIL SWITCH WITH ISOLATING GLAND	NONE	
	RING MAIN UNIT (LINK)	RMU	NAME LOCATION DESCRIPTION		ISOLATOR		
	MINISUB WITH RMU	MINI	NAME LOCATION DESCRIPTION		STAR DELTA TRANSFORMER		
	TAIL END MINISUB	TRX	NAME LOCATION DESCRIPTION		EARTHING TRANSFORMER		
	TRANSFORMER C/W FUSE	PMT	NAME LOCATION DESCRIPTION		CABLE TERMINATION	ENDBOX	
	CIRCUIT BREAKER	CIRB	NAME LOCATION DESCRIPTION		NORMALLY OPEN POINT	OPENPT	
	OIL SWITCH	OS	NAME LOCATION DESCRIPTION		LOCKED OFF POINT, CLOSED WITH PERMISSION FROM CONTROL	LDP	
	FUSED OIL SWITCH		NAME LOCATION DESCRIPTION				
	AUTO RECLOSER	AREC	NAME LOCATION DESCRIPTION		LV UNDERGROUND	LAYER LV UNDERGROUND	
	DROP OUT LINKS	DOL	NAME LOCATION DESCRIPTION		LV OVERHEAD	LAYER LV OVERHEAD	
	DROP OUT FUSE	FUSE	NAME LOCATION DESCRIPTION		LV ABC	LAYER LV ABC	
	KNIFE/SOLID 'D' LINKS		NAME LOCATION DESCRIPTION		11KV RETICULATION - UNDERGROUND	LAYER 11KV UNDERGROUND	
					11KV RETICULATION - OVERHEAD	LAYER 11KV OVERHEAD	
	GANGED LINK WITH INTERRUPTOR HEADS	ABRG	NAME LOCATION DESCRIPTION		33KV RETICULATION	LAYER 33KV	
	GANGED LINKS WITHOUT INTERRUPTOR HEADS	GANGL	NAME LOCATION DESCRIPTION		66KV RETICULATION	LAYER 66KV	
					132KV RETICULATION	LAYER 132KV	

This drawing is available separately from BPC Drawing - C:/./Symbol.dwg

Drawings are to be supplied in the following categories -

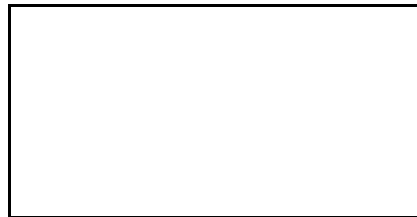
- A) Single line Control Schematics
- B) Urban Map Layouts
- C) Rural Map Layouts
- D) General Mechanical Drawings
- E) Line Diagrams
- F) GIS Datasets

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

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A) Single Line Control Schematics

- A1 Single line control schematics should be submitted with accompanying map layouts.
- A2 Not to Scale
- A3 Layers and Symbology to be as above.
- A4 All conductor types and sizes to be clearly indicated.
- A5 All substations, PMTs, transformers and mini's to have attribute information attached as follows:



- A6 All schematics to have attribute extract files attached in the following DBF format:

BL:NAME	C008000
BL:X	N007001
BL:Y	N007001
NAME	C022000
PHASES	C005000
NO	C005000
RATING	C005000
TYPE	C005000
AREA_CODE	C003000

B Urban Map Layouts

- B1 Urban map layouts should be submitted with accompanying single line control schematics.
- B2 All urban map layouts to be supplied in 1:2500 or 1:5000 scale.
- B3 Layers and Symbology to be as above.
- B4 All conductor types and sizes to be clearly indicated.
- B5 All substations, PMTs, transformers and mini's to have data set information attached as above.
- B6 Accuracy to be within 1 millimetre on the drawing when plotted.
- B7 All drawings to have a grid displayed in UTM format with relevant Grid Line Co-ordinates displayed where appropriate.
- B8 All drawings to be oriented with the true North pointing from the bottom of the drawing to the top aligned with the drawing sides.

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C Rural Map Layouts

- C1 All rural map layouts to be supplied in 1:25000 or 1:50000 scale.
- C2 Layers and Symbology to be as above.
- C3 All conductor types and sizes to be clearly indicated.
- C4 All substations, PMTs, transformers and mini's to have data set information attached as above.
- C5 All angle and in-line strain points to be included.
- C6 Accuracy to be within 1 millimetre on the drawing when plotted. Hence the scale of the drawing should be used to determine its accuracy. Scale 1:50000 implies accuracy within 50m; 1:25000 implies accuracy within 25m etc.
- C7 All drawings to have a grid displayed in UTM format with relevant Grid Line Co-ordinates displayed where appropriate.
- C8 All drawings to be oriented with the true North pointing from the bottom of the drawing to the top aligned with the drawing sides.

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Proposed As Built Drawing Specifications for SRDS

Section 1 - Supply of Drawings

1. Drawings to be supplied in one of 2 (two) formats:
 - a) Hand drafted hard copy.
 - b) CAD generated digital copy.
2. Drawings to be supplied in both map and schematic form following the format below:

a) Hand Drafted

- a.1 Schematics
 - a.1.1 All schematics to be supplied on media specified and in the sizes specified in Section 3/L . Schematics to comply with SRDS Part 3/L with respect to symbology and format.
 - a.1.2 Hard copy to be dated and signed checked and approved by contractor and/or consultant.
- a.2 Maps.
 - a.2.1 Maps to be submitted in the following scales
Urban -1: 2500 (containing HV and LV reticulation)
Rural - 1: 5000 (village reticulation small scale LV and HV)
1: 10000 (large scale rural LV and HV)
1: 50000 (long distance)

b)CAD Digital Copy

- b.1 Drawings to be supplied with data in diskette format. No data compression applications are to be employed without the prior approval of BPC. All files that exceed standard disk capacities can be transferred via laptop computer and BPC approved software. No DXF or any other exchange format is acceptable without the prior approval of BPC.
- b.1 BPC reserve the right to alter or modify digital drawings without the approval of the consultant or contractor.

c)GPS Survey Drawings

- c.1 GPS Co-ordinates to be in UTM / UPS format in metres. South African Lo System is acceptable with the prior approval of BPC. Relevant Lo used must be indicated on all drawings.
- c.2 All GPS surveyed line drawings are to be supplied superimposed on hard copy maps as well as in digital format. Should the digital map be available this is to be supplied in conjunction with the co-ordinates.

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- c.3 All drawings to have a grid displayed in UTM format with relevant Grid Line Co-ordinates displayed where appropriate.
- c.4 All hard copy maps to indicate points of reference for the co-ordinates to enable future surveys to properly aligned.
- c.5 Co-ordinates to have attributes and descriptions where possible.

This specification to be read in conjunction with SRDS Section 3L

STANDARD REQUIREMENTS FOR BPC DISTRIBUTION SYSTEMS

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TESTS, RECORDS AND AS-BUILT DRAWINGS

P1 DEFINITIONS

- P1.1 Commissioning procedures: The documented method whereby the contractor shall ensure that the installation is constructed in accordance with the requirements of the applicable manufacturers' specifications, the engineer's specification and design, regulations and codes of practice.
- P1.2 Performance tests: The physical testing in the manufacturing works or on site of the equipment or systems as needed to demonstrate the ability to reach the performance levels specified or required.
- P1.3 Acceptance tests: The physical testing and inspection on site of the system or sub-system to show that it is supplied, installed and operates generally in accordance with the specifications, design and regulations.

P2 COMMISSIONING

- P2.1 The Contractor shall supply, as part of the contract documentation and for approval before implementation, the commissioning procedures to be used on the project.
- The commissioning procedure will cover in detail all the major items of equipment and sub-systems of the works.
- P2.2 The procedures must allow for the recording in writing and the signing off by a qualified person in terms of applicable regulations for any inspections or tests made in accordance with the procedures. The records and signed documents will form part of the as-built records.

P3 PERFORMANCE TESTS

- P3.1 Where required in terms of the commissioning procedure, specification or an instruction, a supplier or Contractor shall carry out on site or at the manufacturer's premises, performance tests on selected equipment or portions of the works. Type test certificates in accordance with appropriate standard specifications will be accepted as performance tests unless otherwise specified.
- P3.2 On-site performance tests will always be carried out on the following:
- Voltage withstand tests of all cabling, wiring and distribution boards.
 - The mechanical operation and tripping and control of all LV circuit breakers and all HV switchgear.
 - Earth continuity and resistance.
 - The operating threshold of all earth leakage units.

- Polarity and phase rotation of three phase circuits.
- Rigidity of all fastenings.

P3.3 The results of all tests shall be recorded in writing by the Contractor.

P3.4 Only a representative sample of performance tests on site will be witnessed.

P4 ACCEPTANCE TESTS

P4.1 Acceptance tests will be carried out in terms of the commissioning procedure and in particular the following:

- all switching procedures.
- repetition of selected performance tests on a random basis.
- operation of the most important control, protection and emergency systems.

P4.2 On completion of acceptance tests, a test certificate shall be signed by the Contractor and taking-over authority to the effect that the tests specified on the certificate have been completed successfully.

P5 RESPONSIBILITY OF CONTRACTOR

P5.1 The Contractor shall provide not less than seven days notice in writing of all performance and acceptance tests so that they may be witnessed if considered necessary.

P5.2 Notwithstanding the attendance at or failure to attend performance or acceptance tests by any witness, the Contractor is responsible for the correctness of the installation in terms of the manufacturers' requirements, the design and specification and applicable regulations and for the preparation of a written record of the tests and test results.

P6 AS-BUILT RECORDS

P6.1 The Contractor shall supply, after approval of the works, three bound sets of operating instructions, parts lists and maintenance manuals covering all items of equipment forming part of the contract.

P6.2 The Contractor shall supply two bound copies of the records of all inspections and tests carried out in accordance with the commissioning procedures, performance tests and acceptance tests, not later than two weeks after completion of the acceptance tests.

P6.3 The Contractor shall supply marked up original size, transparency drawings of the as-built installation. The original drawings may be used as the basis for the as-built record provided that the marking up is neat and clearly understandable.

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Standard consumers supplies

R1 Supply capacities

R1.1 LV service connection (400/230V)

R1.1.1A **60A 1 Phase TN- C-S overhead service with kWh meter**

For high and medium cost houses and small business. 16 sq. mm Airdac up to 80 metres. Support poles to be used for road crossings and span lengths over 25 metres

Standard specification

DP4048 Pole mounted circuit breaker, 80A, 5kA, SP - Orange, Heinemann curve 1
DC2292 Cable concentric service - 16 sq. mm, 3 core, XLPE Airdac
DM5010 Meter kWh single phase 20/80A - House service meter

Standards

This SRDS must be read in conjunction with:-

SRDS - Design parameters Section 1/G
SRDS - 2/C-SERVIC
SRDS - 2/MCB

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement - Drawing number BP 910/01/A
Meter box - drawing number - BP2000/02/C

R1.1.1B **60A 1 Phase TN-S overhead service with kWh meter**

For high and medium cost houses and small business.
16 sq mm Airdac up to 80 metres.
Support poles to be used for road crossings and span lengths over 25 metres.

Standard specification

DP4048 Pole mounted circuit breaker, 80A, 5kA, SP - Orange, Heinemann curve 1
DC2292 Cable concentric service - 16 sq. mm, 3 core, XLPE Airdac
DM5010 Meter kWh single phase 20/80A - House service meter

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Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/G
SRDS 2/C-SERVIC
SRDS 2/MCB

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement - drawing number BP 910/02/A
Meter box - drawing number - BP2000/02/C

R1.1.1C

60A 1 Phase TN-C-S underground service with kWh meter

For high and medium cost houses and small business.
16 sq. mm Airdac up to 80 metres

Standard specification

DP4048	Pole mounted circuit breaker, 80A, 5kA, SP - Orange, Heinemann curve 1
DC2292	Cable concentric service - 16 sq. mm, 3 core, XLPE Airdac
DM5010	Meter kWh single phase 20/80A - House service meter
DF1016	Kicker pipe

Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/B
SRDS 2/C-SERVIC
SRDS 2/MCB

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement - Drawing number BP 910/03/A
Meter box - drawing number - BP2000/02/C

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R1.1.1D

60A 1 Phase TN-S underground service with kWh meter

For high and medium cost houses and small business.
16 sq. mm Airdac up to 80 metres
Support poles to be used for road crossings and span lengths over 25 metres

Standard specification

DP4048	Pole mount circuit breaker, 80A, 5kA, SP - Orange, Heinemann curve 1
DC2292	Cable concentric service - 16 sq. mm, 3 core, XLPE Airdac
DM5010	Meter kWh single phase 20/80A - House service meter
DF1016	Kicker pipe

Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/B
SRDS 2/C-SERVIC
SRDS 2/MCB

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement - Drawing number BP 910/04/A
Meter box - drawing number - BP2000/02/C

R1.1.1E

60A 1 Phase TN-C-S underground service with BEC

For high, medium and low cost houses and small business.
16 sq. mm Airdac up to 80 metres
Support poles to be used for road crossings and span lengths over 25 metres

Standard specification

DP4048	Pole mount circuit breaker, 80A, 5kA, SP - Orange, Heinemann curve 1
DC2292	Cable concentric service - 16 sq. mm, 3 core, XLPE Airdac
DM5030	Budget Energy Controller (BEC)
DM1022	BEC wall base
DF1016	Kicker pipe

Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/B
SRDS 2/C-SERVIC
SRDS 2/MCB
SRDS 2/MTR-BEC1

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Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement - Drawing number BP 910/05/A
BEC connection diagram - Drawing number BP 902/01/A

R1.1.1F60A underground service to more than one consumer on the same plot using BEC

For high, medium and low cost houses and small business.
16 sq. mm Airdac up to 80 metres from pillar to dwelling

Standard specification

DC2292	Cable concentric service - 16 sq. mm, 3 core, XLPE Airdac
DM5030	Budget Energy Controller (BEC)
DM5026	BEC wall base

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B
SRDS 2/C-SERVIC
SRDS 2/KIOSK
SRDS 2/MTR-BEC1

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

Service pillar

The consumer will be required to supply a lockable pillar fitted with 80A circuit breakers curve 1, one for the supply to each dwelling. The pillar will also contain a main isolator, which will be rated depending on the number of consumers being fed. The pillar will comply to BPC standard 2/KIOSK. At the time of application the consumer must supply the relevant specifications along with the drawings of the pillar for BPC approval.

BPC drawings

General arrangement - Drawing number BP 910/06/A
BEC connection diagram - Drawing number BP 902/01/A

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R1.1.1G **60A underground service to more than one consumer**

For high, medium and low cost houses and small business.
16 sq. mm Airdac up to 80 metres from pillar to dwelling

Standard specification

DC2292 Cable concentric service - 16 sq. mm, 3 core, XLPE Airdac
DM5010 Meter kWh single phase 20/80A - House service meter
DM5070 LV service pillar

Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/B
SRDS 2/C-SERVIC
SRDS 2/KIOSK
SRDS 2/MTR-1

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement - Drawing number BP 910/07/A
1Phase kWh meter connection diagram – Drawing number BP 902/02/A
Pillar box - drawing number D23/75/1006

R1.1.1H **60A consumer service using composite meter board**

For apartments, townhouses etc.
Incoming cable size to composite meter board to be rated according to load.

Standard specification

DM5010 Meter kWh single phase 20/80A - House service meter

Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/B
SRDS 2/C-LVPVC
SRDS 2/MTR-1

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

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Composite meter board

The consumer will be required to supply a lockable composite meter board fitted with 80A circuit breakers curve 1, one for the supply to each dwelling. The board will also contain a main isolator, which will be rated depending on the number of consumers being fed. At the time of application the consumer must supply the relevant specifications along with the drawings of the board for BPC approval.

BPC drawings

General arrangement - Drawing number BP 910/08/A
1 Ph kWh meter connection diagram - Drawing number BP 902/02/A

R1.1.1I

3 Phase 60A consumer TN-C-S service

For large domestic consumers use 16sq mm 4 core PVC SWA cable up to 80 metres plus a single core 16sq mm HDC earth conductor.

For small businesses cable should be sized for 2% volt drop with a minimum size of 35sq mm 4 core PVC SWA cable plus a 35sq mm HDC earth conductor.

Standard specification

DM5011	Meter kWh three phase 25/100A - House service meter
DP4051	Pole mounted circuit breaker, 80A, 5kA, TP - Orange, Heinemann curve 1

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B

SRDS 2/C-LVPVC

SRDS 2/MTR-3

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement – Drawing number BP 910/09/A
3 Ph kWh meter connection diagram - Drawing number BP 902/03/A
Meter box - drawing number - BP2000/03/C

R1.1.1J

3 Phase 60A consumer TN-S service

For large domestic consumers use 16sq mm 4 core PVC SWA cable up to 80 metres plus a single core 16sq mm HDC earth conductor.

For small businesses cable should be sized for 2% volt drop with a minimum size of 35sq mm 4 core PVC SWA cable plus a 35sq mm HDC earth conductor.

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Standard specification

DM5011 Meter kWh three phase 25/100A - House service meter
DP4051 Pole mounted circuit breaker, 80A, 5kA, TP - Orange, Heinemann curve
1

Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/B
SRDS 2/C-LVPVC
SRDS 2/MTR-3

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

General arrangement - Drawing number BP 910/10/A
3 Ph kWh meter connection diagram - Drawing number BP 902/03/A
Meter box - drawing number - BP2000/03/C

R1.1.1K

3 Phase 100A consumer

For businesses :-
Cable should be sized for 2% volt drop with a minimum size of 35sq mm 4 core PVC SWA cable plus a 35sq mm HDC earth conductor.
Minimum transformer size 100kVA.

Standard specification

DM5017 kWh and kW meter
DM5040 100/150/5A CT
DP4052 Circuit breaker 100A TP - Heinemann JSO
DM5071 MD metering kiosk

Standards

This SRDS must be read in conjunction with:-
SRDS Design parameters Section 1/B
SRDS MTR - PRSPC
SRDS MTR - CTLV
SRDS MCBSPC
SRDS KIOSKSPC

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

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BPC drawings

CT metering kiosk - BP20000/01/B
Metering equipment layout - BP20000/01/B (detail ' B ')
Wiring diagram - BP910/01/0

R1.1.1L **3 Phase 150A consumer**

For businesses :-

Cable should be sized for 2% volt drop with a minimum size of 70sq mm 4 core PVC SWA PVC cable plus a 35sq mm HDC earth conductor.
Minimum transformer size 100kVA.

Standard specification

DM5017	kWh and kW meter
DM5040	100/150/5A CT
DP4055	Circuit breaker 150A TP - Heinemann JSO
DM5071	MD metering kiosk

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B
SRDS MTR - PRSPC
SRDS MTR - CTLV
SRDS MCBSPC
SRDS KIOSKSPC

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

CT metering kiosk - BP20000/01/B
Metering equipment layout - BP20000/01/B (detail ' B ')
Wiring diagram - BP910/01/0

R1.1.1M **3 Phase 200A consumer**

For businesses :-

Cable should be sized for 2% volt drop with a minimum size of 150sq mm 4 core PVC SWA PVC cable plus a 70sq mm HDC earth conductor.
Minimum transformer size 200kVA.

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Standard specification

DM5017 kWh and kW meter
DM5043 200/300/5A CT
DP4056 Circuit breaker 200A TP - Heinemann JSO
DM5071 MD metering kiosk

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B
SRDS MTR - PRSPC
SRDS MTR - CTLV
SRDS MCBSPC
SRDS KIOSKSPC

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

CT metering kiosk - BP20000/01/B
Metering equipment layout - BP20000/01/B (detail ' B ')
Wiring diagram - BP910/01/0

R1.1.1N

3 Phase 300A consumer

For businesses :-

Cable should be sized for 2% volt drop with a minimum size of 240sq mm 4 core PVC SWA PVC cable plus a 70sq mm HDC earth conductor.
Minimum transformer size 200kVA.

Standard specification

DM5017 kWh and kW meter
DM5043 200/300/5A CT
DP4057 Circuit breaker 300A TP - Heinemann LY603
DM5071 MD metering kiosk

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B
SRDS MTR - PRSPC
SRDS MTR - CTLV
SRDS MCBSPC
SRDS KIOSKSPC

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Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

CT metering kiosk - BP20000/01/B
Metering equipment layout - BP20000/01/B (detail ' B ')
Wiring diagram - BP910/01/0

R1.1.10

3 Phase 500A consumer

For businesses :-

Cable should be sized for 2% volt drop with a minimum size of 2 x 150sq mm 4 core PVC SWA PVC cable plus a 2 x 70sq mm HDC earth conductor.
Minimum transformer size 315kVA.

Standard specification

DM5017	kWh and kW meter
DM5046	500/800/5A CT

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B
SRDS MTR - PRSPC
SRDS MTR - CTLV

Installation

The consumer shall supply a lockable enclosure for the breaker and current transformers. The enclosure shall be of sufficient dimensions to allow for the minimum bending radii of the load and earth conductors. A compartment for the metering equipment shall also be supplied. Prior to the installation a working drawing of the enclosure shall be submitted to BPC for approval.
BPC shall supply and fit the current transformers and breaker prior to the installation of the load and earth conductors

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

Wiring diagram - BP910/01/0

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R1.1.1P **3 Phase 800A consumer**

For businesses :-

Cable should be sized for 2% volt drop with a minimum size of 2 x 240sq mm 4 core PVC SWA PVC cable plus a 3 x 70sq mm HDC earth conductor.

Minimum transformer size 500kVA.

Standard specification

DM5017 kWh and kW meter

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B

SRDS MTR - PRSPC

SRDS MCB

Installation

The consumer shall supply a lockable enclosure containing the breaker and current transformers. The enclosure shall be of sufficient dimensions to allow for the minimum bending radii of the load and earth conductors. A compartment for the metering equipment shall also be supplied. Prior to the installation a working drawing of the enclosure shall be submitted to BPC for approval.

The current transformers shall have a ratio of 800/5A with a class of 0.5 and a burden of 15VA. The breaker shall be rated for the circuit load with a maximum value of 800A.

Earthing

The consumer shall not be required to supply an earth spike / mat but shall use the earth supplied by BPC, which shall be terminated in the meter box.

BPC drawings

Wiring diagram - BP910/01/0

R1.1.1Q **3 Phase H.T supply up to 1000kVA**

For businesses :-

The supply shall be given via an outdoor type fused isolator and CT/VT metering transformer unit.

The consumer shall take supply from the outgoing terminals of the metering unit.

Standard specification

DM5018 kWh and kW meter

DM5069 11kV metering unit

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Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B

SRDS MTR - PRSPC

SRDS MTR - UNIT

BPC drawings

Wiring diagram - BP902/07/A

Metering equipment layout - BP920/01/A

R1.1.1Q

3 Phase H.T supply up to 1000kVA

For businesses :-

The supply shall be given via an indoor type circuit breaker with CT/VT metering transformers.

The consumer shall supply a suitable room for the switch gear and shall take supply from the outgoing terminals of the circuit breaker.

Standard specification

DM5018 kWh and kW meter

Standards

This SRDS must be read in conjunction with:-

SRDS Design parameters Section 1/B

SRDS MTR - PRSPC

SRDS MTR - BKR

BPC drawings

Wiring diagram - BP902/05/A

Metering equipment layout - BP920/02/A

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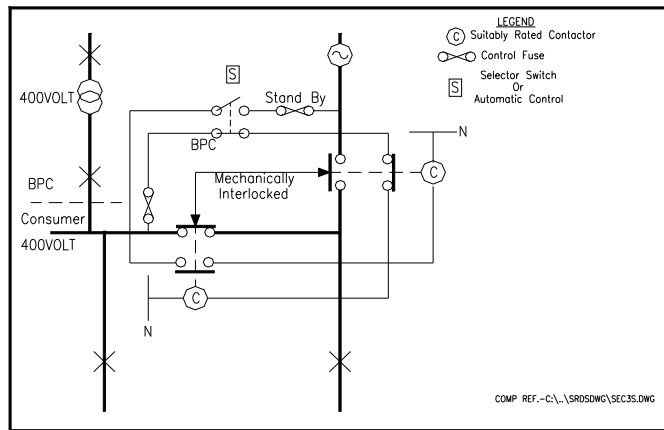
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INTERLOCKING CONSUMERS GENERATORS

In order to prevent dangerous feed backs from a consumer's generator onto the BPC system, it is essential that suitable arrangements are made to disconnect the BPC supply from the consumers system during periods of consumer's generator operation.

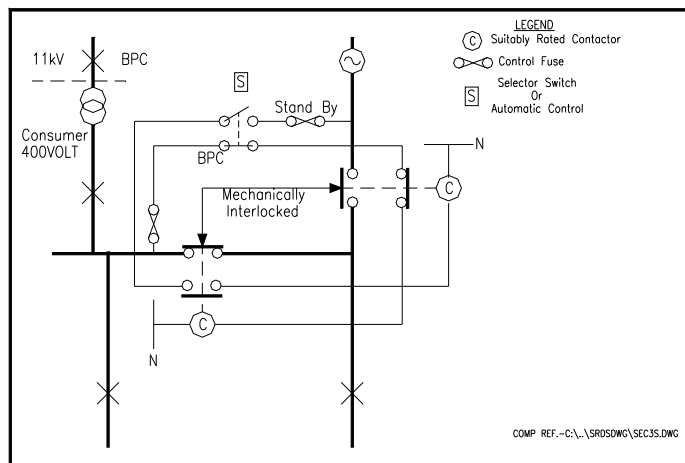
The following BPC supply arrangements are shown with the minimum requirements.

1. Low voltage supply from BPC.
 Consumer generating onto low voltage busbars.
 A. Manually operated change-over switch.
 B. Electrically Operated and Electrically and Mechanically Interlocked



Electrically Operated and Electrically and Mechanically Interlocked

2. High voltage supply from BPC
 Consumer generating onto low voltage busbars.
 A. Manually operated change-over switch
 B. Electrically Operated and Electrically and Mechanically Interlocked

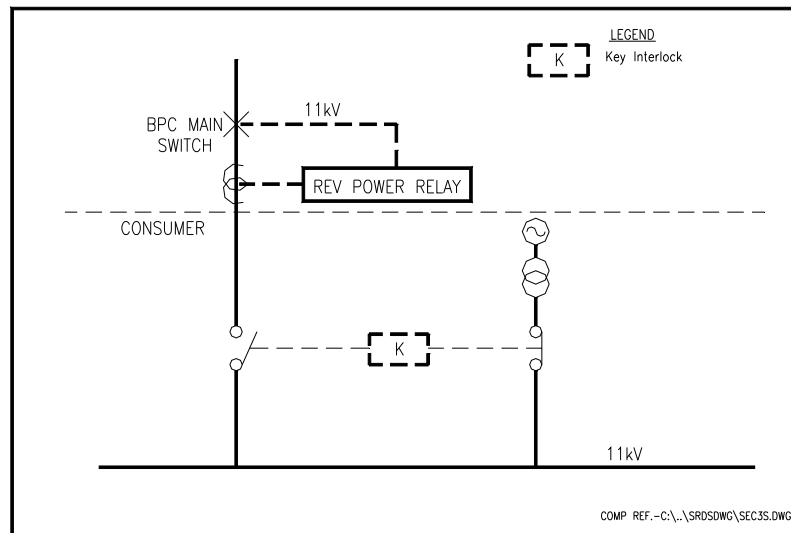


Electrically Operated and Electrically and Mechanically Interlocked

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3. High voltage supply from BPC.



Consumer generating onto high voltage busbars.

- a) Reverse power relay to be incorporated into BPC's incoming panel to trip supply circuit breaker.
- b) Key interlocking between consumers incoming 11KV isolator and generator 11KV isolator.

4. Schemes where consumers require to run in parallel with BPC require specific authority from the distribution manager.

Note In all cases, the consumer should submit his proposed generating arrangements to the BPC Distribution Technical Services Engineer for approval prior to the installation being connected.

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TYPICAL 11 KV SATELLITE SUBSTATION

1. A) GENERAL

This 11 kV Switching Substation is a typical requirement for the Botswana Power Corporation. The Board will have up to 13 Panels and Circuit Breakers as detailed below and the Substation building should be designed to accommodate an additional 2 Panels on either end of the Board for future requirements.

B) SUBSTATION BUILDING

The Substation building should be designed to be generally in accordance with the following Drawings :

BP800/01/0 - STANDARD SATELLITE SUBSTATION ARRANGEMENT
BP800/02/0 - ROOM EQUIPMENT AND ELECTRICAL LAYOUT

2. SWITCHBOARD

Refer to Drawing No. BP810 " Single Line Schematic - Typical 11kV Satellite Substation "

11kV 500MVA 1250 Amp Single Bus-Bar Equipped with 13 x 11kV Circuit Breakers (SF6 or Vacuum) rated at 500MVA (25KA for 3 secs) and comprising of the following:

Up to 4 Incomers (630 Amp)
Up to 8 Feeders (630 Amp)
1 Bus - Section (1250 Amp)

The arrangement of the Breakers and their designations, Cable sizes and types, CT Ratio's, Protection Requirements Ammeters and Metering will be as per the attached table.

NOTE:

BUSBAR EARTHING TO BE PROVIDED ON BUS - SECTION CIRCUIT BREAKER AND ALSO ON ONE INCOMER PER BUS-SECTION.

3. VOLTAGE TRANSFORMERS (MOUNTED ON INCOMERS 1 AND 2)

Two VT's will be provided mounted on either side of the Bus - Section on Incomers 1 and 2 and connected to the **BUSBAR**.

Three Phase 11000/110 Volt 100VA CI 1.0 (Y-Y)

The VT's will supply a 4 way Selector Switch plus Voltmeter for Bus-Bar Voltage indication and for kWh Metering.

4. BUS-BAR PROTECTION

high Impedance Bus-Bar Protection to be installed and to comprise of two or three zones as appropriate :

Zone A: Left Bus-Bar Section
Zone B: Right Bus-Bar Section Plus Bus-Section Switch.
Zone C: Reserve or rear Bu-sbar section where appropriate.

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5. BATTERY CHARGER

230 Volt A/C supplied from Auxiliary Supply
Output: 110 Volt DC 10 Amp
Rating: 60 Amp-Hour (5 Hour Discharge Rate)
Preferred Cell Type - NICAD

Local and Remote Alarm indications

Mains fail
D.C High volts
D.C Low volts
Charge fail
D.C Earth fault

6. NOTES:

- A) All Panels are to have digital (microprocessor based) IDMTL OC/EF and INST Relays with remote (SCADA) indication.

Panels which control overhead line feeders to be fitted with Auto-reclose relay and a switch for selecting AUTO/NON-AUTO.

- B) Solkor Differential Protection is to be installed on the Incomers complete with Pilot Wire Supervision and provision for Telecontrol (SCADA) Indication.

- C) Ammeters with combined instantaneous and MD indications are to be provided on all Panels as follows:

Incomers and Bus-Section:	R Y B Phases (Separated Meters)
Feeders:	Y Phase only

- D) kWh Meters - Enermax Programmable Meter - 3 Phase 3 Wire 110 Volt. BPC Stores Code DM01049 as per Spec: MTR-PR.SPC.

- E) Voltmeters and 4 way Selector Switches from VT's to be mounted on the Bus-Section Switch Panel 0.

- F) Transducers (0 - 10 mA) are to be installed on all Circuit Breaker Panels for Remote Amperage Indication and on the Voltmeter for Remote Voltage Indication.

- G) Telecontrol Outputs for a future SCADA System are to be installed as separate terminal blocks at the rear of the following functions;

- i) Breaker open/ closed Indication.
- ii) Telecontrol open/ close
- iii) Transducer Amps and Volts
- iv) Trip circuit healthy
- v) Enermax Meter kWh pulse output
- vi) Circuit Breaker in "Service" position
- vii) Circuit Breaker in "Circuit Earth" position (All other panels except the Bus section)

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- viii) Circuit breaker in "Right Busbar Earth" position (Bus Section)
 - ix) Circuit breaker in "Left Busbar Earth" position (Bus Section)
 - x) Local/Supervisory indication
 - xi) Charge Spring Free indication
- H) Capacitor tapped bushings for all cables for Neon Indication of Voltage to be provided.
- I) All Circuit Breakers to have automatic spring charging supplied from the battery charger.
- J) All Circuit Breakers to have operation counter.
- K) All Panels to have a trigger handle for open/ close operation and a handle knob for local / remote selection.
- L) All Panels to have a trip supply healthy indication lamp.
- M) Each Panel to have a suitable test block for CT secondary injection testing.

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TYPICAL 11KV SATELLITE SUBSTATION

PANEL ARRANGEMENT

	ZONE A						ZONE B						
PANEL NO	11	9	7	5	3	1	0	2	4	6	8	10	12
DESIGNATION LABEL	FEEDER	FEEDER	INCOMER	FEEDER	FEEDER	INCOMER	BUS-SEC	INCOMER	FEEDER	FEEDER	INCOMER	FEEDER	FEEDER
CABLE SIZE TYPE	150mm	150mm	240mm	150mm	150mm	240mm	-	240mm	150mm	150mm	240mm	150mm	150mm
CT 1 CL. X SOLKOR			RYB 400/1			RYB 400/1	-	RYB 400/1			RYB 400/1		
CT2 10VA 10P10 IDMT OC/EF & INST	RYB 400/200	RYB 400/200	RYB 400/200	RYB 400/200	RYB 400/200	RYB 400/200	RYB 600/200	RYB 400/200	RYB 400/200	RYB 400/200	RYB 400/200	RYB 400/200	RYB 400/200
CT3 15VA CL10 KWH & KWM	R.B 400/200	RB 400/200	RB 400/200	R.B 400/200	R.B 400/200	R.B 400/200	-	R.B 400/200	R.B 400/200	R.B 400/200	R.B 400/200	R.B 400/200	R.B 400/200
AMMETERS INST & MDI	Y PHASE	Y PHASE	RYB	Y PHASE	Y PHASE	RYB	RYB	RYB	Y PHASE	Y PHASE	RYB	Y PHASE	Y PHASE

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7. INPUT AND OUTPUT SIGNALS FOR SCADA

All SCADA wiring shall be based on Standard ferruling for Input and Output Signals (Alarms and Indications), Telecontrol Signals (commands) and Measurands as shown in the three tables below:

1.1 ALARMS AND INDICATIONS

1.2

PROPOSED FERRULE No.	SIGNAL DESCRIPTION
X1	+ 48 VDC common for I/O Signals
X5	Circuit Breaker Closed Indication
X7	Circuit Breaker Open Indication
X6	SF 6 Gas Low Alarm
X11	Spring Free Alarm
X17	Circuit Breaker Earth Position Indication
X19	Frame Leakage Zone A Operated Alarm
X20	Frame Leakage Zone B Operated Alarm
X21	Local Selector Switch Indication
X22	Supervisory Selector Switch Indication
X33	Under frequency Operated Alarm
X37	Trip Circuit Supervision Fail Alarm
X53	Auto Reclose Selector Switch OFF Indication
X54	Auto Reclose Selector Switch ON Indication
X61	Frame Leakage Selector Switch OFF Alarm
X75	Capacitor Bank on Auto Indication
X83	Overcurrent Operated Alarm
X84	Earth Fault Operated Alarm
X85	Protection Inoperative Alarm
X86	Overcurrent High Set Operated Alarm
X91	Solkor Protection Operated Alarm
X95	Supervision send supply fail Alarm
X97	Pilot wire faulty
X99	Sensitive Earth Fault Operated Alarm
X103	Auto Reclose Relay Lockout Operated Alarm
X107	Capacitor Bank PLC Fail Alarm
X109	Service Position racking switch Indication
X110	Battery Charger Fail Alarm
X111	Battery Volts Low Alarm
X112	Battery Volts high Alarm
X113	D.C Earth fault Alarm
X114	Batter mains fail

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1.2 COMMANDS

PROPOSED FERRULE No.	SIGNAL DESCRIPTION
W1	+ 48 VDC Common for command
W2	- 48 VDC Common for command
W3	Supervisory Open Relay command
W5	Supervisory Close Relay command
W7	Auto Reclose Relay ON command
W9	Auto Reclose Relay OFF command
W11	+ 48 VDC Common for command (Auto Reclose)
W12	- 48 VDC Common for command (Auto Reclose)

1.3 MEASURANDS

PROPOSED FERRULE No.	SIGNAL DESCRIPTION
S1	+ Output terminal for Current transducer
S2	- Output terminal for Current transducer
S3	+ Output terminal for Voltage transducer
S4	- Output terminal for Voltage transducer
S5	+ Output terminal for Power transducer
S6	- Output terminal for Power transducer
S11	Billing Period Reset
S12	MD Period Reset
S13	Common
S15	kVARh
S16	Common
S17	KWh

PART 4

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SECTION	DESCRIPTION
4.1	BPC drawing numbering system
4.2	Signing of drawings

DRAWING SCHEDULE

SECTION	DESCRIPTION	FILE VOLUME No.
4BP101	LV Aerial bundle construction	2
4/BP150	11kV Structures for Rabbit and Hare conductors	2
4/BP151	11kV Structures for Wolf conductor	2
4/BP250	33kV Structures	3
4/BP350	66kV Structures	3
4/BP700	Standard items for overhead distribution lines	4
4/BP750	Cable ducts	4
4/BP800	Civil	4
4/BP801/802/810	Substations	4
4/BP3000/3001/3002	Ring Main Units	4
4/BP20000	General	4

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BPC DRAWING NUMBER SYSTEM

- 1 All BPC drawing numbers will be prefixed BP to prevent confusion with other drawing numbers shown on drawings received from government departments, developers, consulting engineers, contractors and suppliers.
- 2 Drawings will be categorised and a drawing number series allocated to each category. The following categories are allocated:

BP1	-	BP29	Key drawings
BP30	-	BP34	Single line control drawings of interconnected networks.
BP35			Single line control drawings of 66 kV feeders.
BP36			Single line control drawings of 33 kV distribution feeders.
BP37			Reserved.
BP38			Single line control drawings of 11 kV distribution feeders.
BP6	-	BP10	Spare.
BP50	-	BP54	Impedance drawings - interconnected networks.
BP55	-		Impedance drawings of 66 kV feeders.
BP56	-		Impedance drawings - 33 kV distribution.
BP57	-		Reserved.
BP58	-		Impedance drawings - 11 kV distribution.
BP59	-	BP99	Spare.
BP100	-	BP149	LV overhead line structures
BP150	-	BP199	11 kV overhead line structures.
BP200	-	BP249	Reserved.
BP250	-	BP299	33 kV overhead line structures
BP300	-	BP349	Mixed HV and LV line structures
BP350	-	BP399	66 kV overhead line structures.
BP400	-	BP699	Overhead line structures 132 - 400 kV.
BP700	-	BP749	Stock items, fabricated parts for overhead lines.
BP750	-	BP799	Installation of cables, etc.
BP800	-	BP899	Standard substation arrangements, protection etc.
BP900	-	BP999	Metering, CT's, VT's, single line diagrams
BP1000	-	BP2999	Overhead line profiles.
BP3000	-	BP4999	Specific substation arrangements.
BP5000	-	BP6999	Network layouts; EHV, HV, LV geographic layout indicating planned Or as-built.
BP7100	-	BP9999	North South Carrier Project.
BP10000+			Project and supplier drawings received from outside BPC, including substations, switchgear, lines and cables, power station, etc.
BP10000	-	BP19999	Network layout drawings.
BP20000	-	BP29999	Distribution equipment drawings : switchgear lines and substations.
- 3 Many of the drawings from BP1000 will be based on drawings received from outside BPC and maintained in unaltered form in BP10000+. Provision must be made for adding a BPC number and title to the original drawings. Details of source drawings, ie. the original drawing, must be added to the BPC drawing used in BP1000 - BP9999.
- 4 All drawings will be A1 size unless the requirements of the application require a special drawing size.
- 5 The drawing record system will be maintained by BPC.

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SIGNING OF DRAWINGS

A drawing which has not been signed has no validity.

When a CAD drawing is plotted as a new drawing or after revision, any signatures will be lost.

FIRST DRAWING

On a new drawing, the names of the responsible persons shall be entered in the "drawn", "checked" and "approved" portions of the title block. The first issue of a drawing shall be Revision A. The revision block is to be signed manually by the persons responsible for checking and approving the drawing.

REVISED DRAWINGS

When a drawing is revised and a new plot prepared the original signatures will be lost. Therefore, when a revision is made, the initials of the persons responsible for the previous revision will be inserted in the CAD drawing where the previous drawing was signed. The new revision block is to be signed manually by those persons responsible for the new revision. The drawing number of the revised drawing will correspond to the signed revision record.

Unsigned drawings shall be regarded as checking plots only.

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DRAWING SCHEDULE

BP101 LV AERIAL BUNDLE CONDUCTOR CONSTRUCTION

Drawing No.	Description	Size	Revision
BP101/1/A	Terminal connection to underground PVC cable	A3	A
BP101/2/A	Suspension connection to underground PVC cable	A3	A
BP101/3/A	Typical bundle termination	A3	A
BP101/4/A	Typical bundle suspension	A3	A
BP101/5/A	Tee-off from suspension structure	A3	A
BP101/6/A	Typical earthing and stay detail	A1	A
BP101/7/A	Typical connection to pole mounted transformer	A1	A

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DRAWING SCHEDULE

BP150 11 kV STRUCTURES FOR RABBIT AND HARE CONDUCTOR

Drawing No.	Description	Size	Revision
BP150/1/A	Single pole terminal	A1	A
BP150/2/A	Cable fed terminal single pole	A1	A
BP150/3/B	Intermediate suspension pole, $A=0$	A1	B
BP150/4/A	Intermediate angle pole, $0 < A \leq 5$	A1	A
BP150/5/A	Intermediate angle pole $5 < A \leq 15$	A1	A
BP150/6/A	In-line strain, single pole $A=0$	A1	A
BP150/7/A	Angle strain single pole $0 < A \leq 60$	A1	A
BP150/8/A	Angle strain single pole $60 < A \leq 90$	A1	A
BP150/9/A	Angle strain H, $0 < A \leq 60$	A1	A
BP150/10/A	Angle strain H, $60 < A \leq 120$	A1	A
BP150/11/A	Swinging angle, $15 < A \leq 90$	A1	A
BP150/12/A	Vertical angle, $15 < A \leq 90$	A1	A
BP150/13/A	Tee-off vertical	A1	A
BP150/14/A	Tee-off from in-line strain single pole	A1	A
BP150/15/A	Single pole gang link structure	A1	A
BP150/17/A	Single pole D-link structure	A1	A
BP150/18/A	Single pole knife link structure	A1	A
BP150/19/B	Auto recloser structure	A1	B
BP150/20/A	Pole-mounted transformer	A1	A
BP150/21/B	Minisub Tee-off from single intermediate pole	A1	B
BP150/22/A	Minisub Tee-off from single terminal pole	A1	A
BP15/23/A	Excavation for poles and stays	A1	A
BP150/24/A	Long span structures	A1	A
BP150/25/A	Cable fed terminal double pole	A1	A

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DRAWING SCHEDULE

BP 151 11kV STRUCTURE FOR WOLF CONDUCTOR

Drawing No.	Description	Size	Revision
BP151/3/A	Intermediate suspension pole, $A=0$	A1	A
BP151/4/A	Intermediate angle pole, $0 < A \leq 5$	A1	A
BP151/5/A	Cable fed terminal double pole	A1	A
BP151/7/A	Angle strain H, $0 < A \leq 60$	A1	A

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DRAWING SCHEDULE

BP250 33kV STRUCTURES FOR RABBIT CONDUCTOR

Drawing No.	Description	Size	Revision
BP250/1/A	Intermediate suspension pole	A1	A
BP250/2/A	Intermediate angle pole, 0 - 5	A1	A
BP250/3/A	Intermediate angle pole, 5 - 15	A1	A
BP250/4/A	H' pole terminal	A1	A
BP250/5/A	H' pole in-line strain	A1	A
BP250/6/A	H' pole angle strain 0 - 60	A1	A
BP250/9/A	Pole-mounted transformer	A1	A
BP250/11/C	Auto recloser on 'H' pole	A1	C

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DRAWING SCHEDULE

BP350 66kV STRUCTURES

Drawing No.	Description	Size	Revision
BP350/1/B	66kV Trident intermediate pole	A1	B
BP350/2/B	0 - 15 angle Trident angle strain - general arrangement	A1	B
BP350/3/B	H' pole 66kV Trident terminal	A1	B
BP350/4/A	15 - 60 angle Trident angle strain - general arrangement	A1	A

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DRAWING SCHEDULE

BP700 STANDARD ITEMS FOR OVERHEAD DISTRIBUTION LINES

Drawing No.	Description	Size	Revision
BP700/1/A	Steel strap for 11 and 33kV crossarms	A3	A
BP700/2/A	Steel crossarms for overhead distribution lines	A3	A
BP700/4/B	H/pole 11kV gang switch platform	A1	B
BP700/5/A	Operating link crossarm for single pole structures	A1	A
BP700/6/B	Fuse and arrester crossarm for single pole structures	A1	B
BP700/7/A	Single pole 11kV gang switch platform	A1	A
BP700/8/A	Mounting for operating links on Auto recloser structures	A3	A
BP700/9/A	Support bracket for Auto recloser	A3	A
BP700/10/E	Platform for transformer structures	A1	E
BP700/11/C	Standard drilling for wooden crossarms	A3	C
BP700/12/A	33kV Auto recloser platform	A1	A
BP700/13/B	Bracket outrigger stay	A1	B
BP700/14/A	Danger notice/Caution notice	A1	A
BP700/15/O	Bracket/crossarm details - SRDS non-standard	A3	O
BP700/16/C	Bracket strut pole	A1	C
BP700/17/O	Telephone line crossing cradle	A1	O
BP700/18/D	Standard overhead service connection - general arrangement	A1	D
BP700/19/B	Low cost wiring details	A1	B
BP700/20/A	Stay wire protection - general arrangement	A1	A

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DRAWING SCHEDULE

BP750 CABLE DUCTS

Drawing No.	Description	Size	Revision
BP750/1/A	Typical cable duct cross-section	A1	A

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DRAWING SCHEDULE

BP800 **CIVIL**

Drawing No.	Description	Size	Revision
BP800/1/A	Typical 11kV Satellite substation building	A1	A
BP800/2/A	Typical 11kV Switching station room equipment & electrical layout	A1	A
BP800/3/B	11kV BPC Switchgear/meter room consumer substation	A3	B
BP800/4/O	Typical 'A' frame structure - general arrangement	A1	A

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DRAWING SCHEDULE

BP801 & 802

SUBSTATIONS

Drawing No.	Description	Size	Revision
BP801/1/B	Plan and elevation 33/11kV - Rural Substation layout	A1	B
BP801/2/O	Plan and elevation 33/11kV - Substation layout	A1	O
BP802/1/A	Cross Border substation	A1	A

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DRAWING SCHEDULE

BP900 TYPICAL METERING ARRANGEMENTS

Drawing No.	Description	Size	Revision
BP901/1/A	Multiple supplies greater than 5MVA	A3	A
BP901/2/A	Multiple supplies greater than 3MVA but less than 5MVA	A3	A
BP901/3/A	Multiple supplies less than 3MVA	A3	A
BP901/4/A	Single supply over 5MVA	A3	A
BP901/5/A	Single supply greater than 3MVA but less than 5MVA	A3	A
BP901/6/A	Single supply less than 3MVA	A3	A
BP902/1/A	Conlog BEC connection diagram	A3	A
BP902/2/A	Single phase KWH meter connection diagram	A3	A
BP902/3/A	3 phase KWH connection diagram	A3	A
BP902/4/A	Enermax 400V (L.T.) 5Amp	A3	A
BP902/5/A	Enermax 110V (H.T.) 5Amp	A3	A
BP902/6/A	Enermax 110V (H.T.) 1Amp	A3	A
BP902/7/A	Enermax 110V (H.T.) 5Amp fitted in an 11kV metering unit	A3	A
BP902/8/A	Wiring diagram for L & G Tarigr 230V (L.T.) meter	A3	A
BP902/9/A	Wiring diagram for L & G Tarigr 110V (H.T.) meter	A3	A

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DRAWING SCHEDULE

BP910 SERVICE ARRANGEMENTS

Drawing No.	Description	Size	Revision
BP910/1/A	TN-C-S (PME) O/H service with KWH single phase meter	A3	A
BP910/2/A	TN-S O/H service with KWH single phase meter	A3	A
BP910/3/A	TN-C-S (PME) underground service with KWH single phase meter	A3	A
BP910/4/A	TN-S underground service with KWH single phase meter	A3	A
BP910/5/A	TN-C-S underground service with BEC	A3	A
BP910/6/A	60A underground service to more than one consumer using BEC	A3	A
BP910/7/A	60A underground service to more than one consumer	A3	A
BP910/8/A	Typical layout for 6 way 1 phase consumer composite meter board	A3	A
BP910/9/A	3 phase 60A consumer TN-C-S service	A3	A
BP910/10/A	3 phase 60A consumer TN-S service	A3	A

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DRAWING SCHEDULE

BP920 METERING PANEL LAYOUT ARRANGEMENT

Drawing No.	Description	Size	Revision
BP920/1/A	H.T. meter in 11kV metering unit	A3	A
BP920/2/A	M3 meter box layout	A3	A

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DRAWING SCHEDULE

BP2000 DISTRIBUTION SYSTEMS

Drawing No.	Description	Size	Revision
BP2000/2/C	BPC single phase meterbox MB1	A1	C
BP2000/3/C	BPC three phase meterbox MB3	A1	C

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DRAWING SCHEDULE

BP3000 RING MAIN UNITS

Drawing No.	Description	Size	Revision
BP3000/1/A	11kV circuit breaker/metering without ring isolator	A3	A
BP3001/1/A	11kV circuit breaker with ring isolator	A3	A
BP3002/1/A	11kV dual circuit breaker/metering	A3	A

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DRAWING SCHEDULE

BP20000 GENERAL

Drawing No.	Description	Size	Revision
BP20000/1/C	Current transformer metering Kiosk	A3	C
BP20000/2/C	BPC high bill stay insulator	A3	C
BP20000/3/A	Typical Ring Main Unit	A3	A

APPENDIX

1.1

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BYE-LAW

SERVICE CONNECTION

- 7.(5) No owner shall be entitled to more than one service connection for a supply for any premises even if it comprises or occupies of more than one plot. The Corporation may, subject to such conditions as it thinks fit to impose upon the owner, provide more than one service connection to any premises.

METER CABINET BOX

8. Before a medium or low voltage supply is given the applicant or owner shall if required so to do by the Corporation, at his own expense and in a position approved by the Corporation, provide a cabinet or box of approved design and construction for the accommodation of the Corporation's service connection.

EQUIPMENT TO BE PROVIDED BY CONSUMER

- 9.(1) The consumer shall at his own expense provide, erect, connect up, operate and maintain in good order all circuits from the point of supply to his installation and all apparatus necessary for controlling the said circuits, including efficient apparatus and switchgear to the approval of the Corporation for the protection of the apparatus of the Corporation and the installation of the consumer of the consumer against overload, faults and lighting.
- 9.(3) Every consumer shall ascertain from the Corporation the nature of the protection provided on the supply and should provide adequate means for the protection of his own equipment.

HIGH VOLTAGE ELECTRICAL INSTALLATIONS

- 10.(1) All the apparatus used in connection with a high voltage electrical installation shall be of approved design and construction.
- 10.(2) Every person who wants to make a new high voltage installation or an extension to an existing high voltage installation shall submit to the Corporation a site plan and a drawing showing in detail the particulars and layout of electrical apparatus together with full technical information.
- 10.(7) No person shall connect to the electrical supply a newly altered, extended or installed high voltage apparatus without the written permission of the Corporation.

ENCLOSURE FOR SUPPLY EQUIPMENT

- 11.(1) When required by the Corporation an owner shall at his own expense provide and maintain an approved enclosure for accommodating the Corporation's and consumer's supply equipment in a position determined the Corporation.

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- 11.(3) Every medium or low voltage enclosure associated with a high voltage enclosure shall be kept locked by the consumer and a key thereto shall, if required by the Corporation, be deposited with it or provision made for fitting of an independent lock by the Corporation which shall be entitled to access to the enclosure at all times.
- 11.(4) The consumer or owner of the premises shall at all times provide and maintain safe and convenient access to a medium or low voltage enclosure and such enclosure shall at all times be kept clean and tidy by the consumer to the satisfaction of the Corporation and shall be used for no other purpose save the accommodation of equipment and apparatus associated with the supply.
- 11.(5) The consumer or owner of the premises shall at all times provide and maintain safe and convenient access to high voltage enclosure, such access to be direct to that part of the enclosure into which the high voltage supply is led and not through the medium or low voltage enclosure or through any door or gate the lock of which is controlled by the consumer or the owner of the premises.
- 11.(6) The Corporation shall have the right to use any enclosure for supply equipment in connexion with a supply to consumers on premises other than those on which that enclosure is situated.

PROVISION OF CIRCUIT BREAKERS

- 12.(1) When required by the Corporation the owner shall supply and install one or more approved supply circuit breakers in a manner and position determined by the Corporation.
- 12.(2) An owner shall supply and install to the Corporation's satisfaction an earth rod and an earth leakage circuit breaker at each supply point.

WAYLEAVES

- 13.(3) If any alteration is required by the consumer to the Corporation's overhead line or service cable or the position of Corporation's equipment or meter, or is required by reason of the modification of the owner's consent, the expenses incurred by the Corporation in effecting the alteration or removal shall be borne and paid for in advance by the consumer. If the consumer's or the owner's consent is withdrawn the Corporation may call upon the consumer to provide an approved meter kiosk at a convenient point on the boundary of the premises and the supply will be delivered and metered by the Corporation at the meter kiosk.

CONTRACTOR'S NOTICES

- 14.(3) The Corporation may require a contractor to submit to it for approval a wiring diagram and specifications covering any proposed construction or alteration, extension or repair to any electrical installation and where the Corporation requires such a diagram and specifications the proposed work shall not be commenced until they have been submitted and approved.

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LIABILITY OF CORPORATION AND CONTRACTORS

- 17.(1) The Corporation's approval of an electrical installation after making any inspection of test thereof or the granting by it of permission to connect the installation to the supply shall not be taken as constituting for any purpose any guarantee by the Corporation that the work has been properly executed or the materials used in it are sound or suitable for the purpose of any warranty whatsoever as relieving the contractor from liability, whether civil or criminal, for executing the work improperly or using faulty material therein.
- (2) The Corporation shall not be under any liability in respect of any wiring or other work or for any loss or damage caused by fire or other accident arising wholly or partly from the condition of an electrical installation.

METERS

19. The Corporation shall, in respect of each scale of the tariff governing a supply, provide such number of meters as it deems necessary.

LOADING AND CARE OF CORPORATION'S EQUIPMENT AND APPARATUS

- 27.(1) The consumer shall not at any time load in excess of its rated capacity the distribution line or cable, equipment or apparatus provided by the Corporation and the Corporation may provide and install automatic apparatus designed and arrange to interrupt the supply to the consumer in the event of an overload occurring.
- 27.(2) The Corporation may call upon the consumer to install such power factor correction apparatus as may be necessary to ensure a power factor not lower than 0.85 lagging at normal maximum load, in which event the consumer shall take prompt action to procure and install the required apparatus:
- 27.(3) The consumer's load shall be balanced between the 3 phases to the reasonable approval of the Corporation.

APPENDIX

3.1

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TECHNICAL INSTRUCTIONS

LV RETICULATION DESIGN - CALCULATION OF VOLT DROP

The attached paper sets out a guide to the calculation of voltage drop on LV distributor. Although there is no single correct method of calculating such a variable quantity, a standard approach will enable everyone connected with LV Reticulation design to work with confidence because less guesswork and opinion are involved.

This circular is based on ESC (Zimbabwe) Engineering Instruction 36/7 to whom Credit is due.

VOLT DROP CALCULATIONS FOR LV RETICULATIONS

Since H. Cropland's IEE paper in 1950 on the theoretical design of LV networks for housing estates much work has been done on the subject in UK. The approach outlined borrows much from that experience.

AFTER DIVERSITY MAXIMUM DEMAND ADMD

The ADMD per consumer can be defined as one hundredth of the maximum load of 100 consumers. In areas where air conditioning is installed in houses and in other special cases the ADMD may be high. In other low income areas where supplies are provided through load limiters the ADMD is likely to be low. Measurements need to be taken on a number of networks to establish typical ADMDs. Until that time a judgement has to be made as to the likely ADMD that will be achieved, and it is suggested that a figure of 2 KV is adopted for high density housing.

DIVERSITY FACTOR DF

The peak loads taken by individual consumers are unlikely to coincide if the group is large. The diversity between loads effectively reduces the total. The diversity factor in a small group is not so effective. As a consequence to the voltage drop using an assumed ADMD figure the result has to be increased to allow for the Diversity Factor. The accepted formula for the DF is $1 + 8/(3N)$ where N is the number of consumers.

UNBALANCE FACTOR UF

The loads over the three phase vary from moment to moment. At a typical moment the load is not likely to be perfectly balanced over the three phases. If a group of houses were supplied from one phase and neutral the volt drop would be six times that produced by the same load perfectly balanced over the three phases. The unbalance in practice is unlikely to be so extreme.

A factor of $1 + 4,14/N$ is used to increase the volt drop to allow for unbalance.

REDUCTION IN SEVERITY 0,85

The UK supply industry found that measured volt drops were not as great as those calculated using the accepted diversity and unbalance factors. Another factor of 0.85 was introduced.

FINAL VOLT DROP

The final volt drop is obtained by multiplying the volt drop produced by balanced load a combination of the factors $DF \times UF \times N \times 0,85$. The declared voltage to consumers should be 230 + 10% According to regulation 36 of the electricity (supply regulations, 1984. This results in a voltage range of 207 to 253 volts. It is proposed that a design limit of voltage drop attributable to the LV distributor carrying full design load be fixed at 6%.

VOLT DROP CALCULATION METHOD

Forms are available for this purpose. A space exists for a diagram of the LV distributor. The headings the data which should be entered in the columns enabling step by step calculating to be made. On the reverse side there are two tables. Table 1 provides the % balanced volt drop per KW for each size of underground cable or overhead line. Table 2 provides the multiplying factor by which the balanced % volt drop should be increased. This factor depends upon the number of consumers whose load flows through the section under consideration.

For the sake of simplicity it is assumed that the volt drop produced by a group of consumers spread along a section is approximately the same as that produced by half the number in the group connected at the far end of the section.

Example: Calculations are attached.

INITIAL TRANSFORMER CAPACITY

Just enough transformer capacity to last for 5 years or so should be installed initially. Substations may be omitted until a later date using temporary LV interconnection between adjacent networks. This will help keep expenditure down.

INTERCONNECTION

No permanent LV link between adjacent should be designed as the cost can not be justified, and separate networks are simpler to operate.

LV RETICULATION TABLE 1

3 Phase balanced % volt drop per kw per km conductor. 225 volts

UG Cable Cu mm ²	6	10	16	25	35	50	70	120	150	105
% volt drop	2,28	1,37	0,84	0,57	0,38	0,308	0,217	0,129	0,110	0,091
OH HD Alum mm ²				25		50		100		
% volt drop				0,75		0,38		0,19		

Cond. temp 20°C 40°C

LV RETICULATION TABLE 2

Factor dependent on number of houses.

	0	1	2	3	4	5	6	7	8	9
		16,0	15,5	16,4	17,4	18,5	19,8	21,1	22,2	23,7
10	25,0	26,1	27,2	28,7	29,9	31,1	32,2	33,5	34,9	35,9
20	36,9	38,3	39,5	40,7	41,8	43,0	44,2	45,3	46,4	47,6
30	48,8	49,9	51,0	52,2	53,3	54,4	55,5	56,7	57,8	58,9
40	60,0	61,1	62,2	63,3	64,4	65,5	66,6	67,7	68,8	69,8
50	70,9	72,1	73,1	74,2	75,3	76,4	77,5	78,5	79,6	80,7
60	81,7	82,8	83,9	84,9	86,0	87,0	88,1	89,2	90,2	91,3
70	92,3	93,4	94,4	95,5	96,5	97,6	98,6	99,7	101	102
80	103	110,4	105	106	107	108	110	110	111	112
90	113	114	115	116	117	118	119	120	121	122

CURRENT CARRYING CAPACITY

DIRECT LAID CABLES				OVERHEAD CONDUCTORS			
mm ² Cu	amps	Balanced kw		mm ² A1	amps	Balanced kw	
70	180	125		25	100	69	
95	219	152		50	150	104	
120	257	178		100	200	139	
150	295	204					
185	333	231					

SHORT CIRCUIT RATING OS STANDARD HV
OVERHEAD LINES AND UNDERGROUND CABLES

1. GENERAL

The formulae given in Clauses 2 and 3 below enable short circuit rating of all HV overhead lines or underground cables to be calculated.

The attached tables are to be used as a guide to the short circuit rating of HV overhead lines or underground cables for the standard cables and lines now used. Figures are given for duration of short circuit of 0.5, 1.0, 1.5 and 2.0 seconds.

Note that the upper temperature limits quoted are for lines and cables constructed to the present day standards. For my existing lines, the limiting temperature used may be lower due to inferior connections, tension joints, bad workmanship, etc. The Planning Engineer must consider these items and fix a realistic upper temperature limit.

2. OVERHEAD LINE CONDUCTORS

The short ratings for overhead line conductors are based on formula:-

$$\text{Temperature rise in degrees C} = \frac{K \times I^2 \times T}{A^2}$$

Where I = current in amps
 T = duration of short circuit in seconds
 K = constant (see table below)
 A = cross sectional area (see table below)

Both copper and aluminium conductors begin to deteriorate at 200°C, thus assuming an average conductor temperature of 40°C at time of short circuit, the maximum permissible temperature use under short circuit would be 160°C.

CONDUCTOR TYPE	K	A CROSS SECTIONAL AREA IN
Aluminium - Metric sizes	1.4×10^{-2}	Square millimetres (mm ²)
Aluminium - Imperial sizes	3.4×10^{-8}	Square inches (in ²)
Copper - Metric sizes	5.5×10^{-3}	Square millimetres (mm ²)
Copper - Imperial sizes	1.3×10^{-8}	Square inches (in ²)

3. UNDERGROUND CABLES(a) Conductors

The short circuit ratings for the conductors of underground cables are based on formula:-

$$I T = A_c K_c$$

Where

I	=	Short circuit current in amps
T	=	Duration of short circuit in seconds
A_c	=	Cross sectional area of conductor in mm^2 or in^2
K_c	=	Constant see table below

An initial average temperature of 70°C at the time of short circuit should be taken for all types of cables. The values of K_c for this initial temperature at short circuit and a final permissible temperature of 160°C are:-

CONDUCTOR	CONDUCTOR CROSS SECTION	CONSTANT K_c
COPPER	mm^2	115.6
	in^2	74.5
ALUMINIUM	mm^2	74.4
	in^2	48.0

(b) LEAD SHEATH

The short circuit ratings for the lead sheaths of underground cables ignoring the carry capacity of the armouring and possible parallel earth paths are based on formula:-

$$I T = A_s K_s$$

Where

I	=	short circuit current in amps
T	=	duration of short circuit in seconds
A_s	=	area of lead sheath (mm^2 or in^2)
K_s	=	constant. see table below

The values of K are based on an initial lead sheath temperature of 60°C at time of short circuit and a final permissible temperature of 250°C .

Lead Sheath Cross Section	K_s
mm^2	29.6
in^2	19.1

(c) CURRENT LIMITING RESISTORS

Where current limiting resistors are installed in the neutrals of systems, I in (b) above is reduced and therefore the sheath should not form a limiting factor in the rating of cable.

Note: Where earthing resistances are not installed, the carrying capacity of the cable sheath in general forms the limiting factor for cables up to 11KV.

ELECTRIC MOTORS - STARTING CONDITIONS

The following is based on the Electricity Council Engineering Recommendation P13 dated October 1967.

1. The starting current taken by an electric motor depends upon the size and type of motor and the method of starting. When the starting current is drawn from the distribution system there is dip on voltage which must be kept within certain limits in order to avoid annoyance to consumers because of effect on tungsten filament lamps, electronic equipment etc. Whether or not there is annoyance depends on the amount of voltage variation and frequency of occurrence.
2. The methods recommended is to specify levels of voltage dip at the point of common coupling with other consumers' loads that should not be exceeded when the motor under consideration is started. Two levels of voltage dip are recommended according to likely frequency of starting the motor.
3. To avoid the need making calculations in every case Appendix A gives sizes of motors which can be accepted even when system conditions are onerous. Should it be considered necessary to perform the individual calculation necessary for a particular case, the information listed as Appendix B should be forwarded to Head Office.
4. The permissible voltage dip for the appropriate frequency of starting which electric motors (including associated starting equipment) may impress on the system is:-
 - (a) For motors which are subject to "infrequent starting", the initial starting current should not cause a voltage dip exceeding 3% in the phase/neutral voltage at the point of common coupling with other loads
 - (b) For motors subject to "frequent starting" the corresponding figure is 1%
 - (c) The term "infrequent starting" refers to motors which are not likely to start at intervals of less than two hours. The term "frequent starting" refers to motors which are likely to start at intervals of less than two hours.

ELECTRIC MOTORS - STARTING CONDITIONS

The starting current taken by an electric motor depends upon the size and type of motor and the method of starting. When the starting current is drawn from the distribution system there is a dip in voltage which must be kept within certain limits in order to avoid annoyance to consumers. Whether or not there is annoyance depends on the amount of voltage variation and frequency of occurrence.

Experience has shown that, although a few installations need detailed examination, in the majority of cases a simple assessment can be made of whether annoyance is likely to be caused.

The method recommended is to specify levels of voltage dip at the point of common coupling with other consumers' loads that should not be exceeded when the motor under consideration is started. Two levels of voltage dip are recommended according to the likely frequency of starting the motor.

To avoid the need for making calculations in every case Appendix A gives sizes of motors which can be accepted even when system conditions are onerous. To determine the acceptability or otherwise of larger sizes, individual calculations will be necessary, examples of which are given in Appendix B.

It is RECOMMENDED that electric motors (including associated starting equipment) be accepted for connection to distribution systems if the permissible voltage dip for the appropriate frequency of starting as defined below is not exceeded:-

PERMISSIBLE VOLTAGE DIP ON STARTING

For motors which are subject to "infrequent starting", the initial starting current should not cause a voltage dip exceeding 3% in the phase/neutral voltage at the point of common coupling with other loads. For motors subject to "frequent starting" the corresponding figure is 1%.

FREQUENCY OF STARTING

In this recommendation the term "infrequent starting" refers to motors which are not likely to start at intervals of less than two hours. The term "frequent starting" refers to motors which are likely to start at intervals of less than two hours.

Detailed information is given in the attached appendices:-

Appendix A - Motors for which individual consideration is not required.

Appendix B - Worked examples

Appendix C - System data (ohmic values to 415/240v base).

APPENDIX A

MOTORS FOR WHICH INDIVIDUAL CONSIDERATION IS NOT REQUIRES

It is convenient for both the supply authority and consumers if a range of motors can be accepted for direct starting without the need for special study.

Based on the general conditions of this recommendation and practical experience by Boards where similar figures have been used a number of years it is recommended that motors be accepted for direct starting, without further investigation, up to the sizes (horse-power) shown for each category below.

If these values are exceeded, detailed examination should be made. In many instances system conditions will permit the use of appreciably higher ratings.

(a) MOTORS NOT SUBJECT TO RESTRICTION

Motors up to the following sizes, but excluding lift and hoist motors may, subject to the availability of single phase or three phase supply, as appropriate, be accepted for connection at any point and a Board's distribution system without qualification as to the starting current or method of starting:-

Single phase 240 V 1 hp

Single phase 480 V 4 hp

Three phase 415 6 hp

(b) MOTORS FOR LISTS, HOISTS AND SIMILAR APPLICATION

Lift and hoist motors (and other subject to similar duty) up to the following sizes may, subject to the availability of single phase ore three phase supply, as appropriate, be accepted for connection at any point on a Board's distribution system without qualification as to the starting current or method of starting:-

Single phase 240 V 1/2 hp

Single phase 480 V 2 hp

Three phase 415 V 3 hp

(c) THREE PHASE MOTORS AT PREMISES WITH SUBSTATIONS

At premises with transformer substations, three phase motors up to the following ratings may, if the consumer wishes, be arranged for direct starting:-

Transformer Rating (kVA)	Motor Rating (horse power)	
	Infrequent Starting	Frequent Starting
100	Up to 15	Up to 5
200	" " 30	" " 10
300	" " 40	" " 13
500	" " 60	" " 20
750	" " 80	" " 25
1000	" " 100	" " 30

APPENDIX B

MOTOR FOR WHICH INDIVIDUAL CONSIDERATION IS REQUIRED

The following information will enable the maximum permissible starting current to be determined, from which it can be ascertained from the motor manufacturers' data whether a particular motor can be accepted, taking into account assisted starting methods.

Network details required:-

1. Fault Level at primary substation, minimum expected level
2. Length and composition of main feed away from primary substation to distribution substation
3. Size of transformer at distribution substation
4. Length and composition of feed away distribution substation to the point of common coupling of the motor to the network.

Motor details required:-

- (a) Horsepower, voltage, phases, frequency of starting
- (b) Power factor running and efficiency
- (c) Starting current drawn and power factor starting
- (d) It may be necessary to consider the voltage drop to the motor on starting in certain instances when the information at (c) above would be required at various voltage levels (e.g., 75%, 85% etc.)

It will be appreciated that all the above information is not always readily available, and that the calculations involved are lengthy, and so it is strongly recommended that consumers are advised to limit their motors to sizes specified in Appendix A, even if this involves means of assisted starting.

Having determined the maximum permissible starting current as in these examples, it can be ascertained from the motor manufacturer's data whether a particular motor can be accepted, and whether it is necessary to stipulate a particular method of starting, e.g., star/delta, auto-transformer or rotor resistance, in order to keep the starting current within the desired limit.

EXAMPLE 1 - THREE PHASE 415 V. MOTOR

- (a) Fault level at primary substation - - - - - 150 MVA
- (b) From primary substation to distribution substation there are 1,000 yds. 0.5 sq. in. 6.6 kV cable (copper conductor)
- (c) At the distribution substation there is a 500 kVA transformer.
- (d) From the distribution substation to the point of common coupling is 1,000 yds. 0.2 sq. in. 415 V. cable (copper conductor).

Source to 6.6 kV busbar of Primary sub-station. (App. C - table 1	Equivalent Resistance (ohms)	Equivalent Reactance (ohms)
	-	0.00115
6.6 kV cable (App. C - table 2)	0.00064	0.00028
Transformer (App. C - table 4)	0.00466	0.01560
415 V. cable (App. C - table 5)	0.12950	0.06250
TOTAL	0.13480	0.07953

Assuming a starting power factor of 0.3, which is sufficiently accurate for practical purpose, the voltage drop per ampere as starting current will be:-

$$(0.3 \times 0.1348) + (0.95 \times 0.07953)$$

$$0.0405 + 0.0755 = 0.116 \text{ volts per amperes of starting current}$$

CASE 1: FREQUENT START

Permissible voltage dip os 1% of 240 V = 2.4 V. 2.4 : 0.116 = 20.7 A.

Therefore, maximum permissible starting current is 20.7 A.

CASE 2: INFREQUENT START

Permissible voltage dip is 3% of 240V. = 7.2 V. The maximum permissible starting current is 3 times the above. 3 x 20.7 = 62.1 A.

EXAMPLE 2 - SINGLE PHASE 240 V. MOTOR

- (a) Fault level at primary substation ----- 100 MVA
- (b) From primary substation to distribution substation, 1,000 yds. 0.1 sq. in. 11 kV. overhead line (copper conductor).
- (c) At the distribution substation, a single phase transformer ratio 11000/240 V.
- (d) From the distribution substation to the point of common coupling, 100 yds. q.1 sq. in. 240 V. overhead line (copper conductor).

	Basic Equivalent Resistance (ohms)	Basic Equivalent Reactance (ohms)	Adjustment Factor for Voltage $\frac{(240)^2}{(415)}$	Equivalent Resistance (ohms)	Equivalent Reactance (ohms)
Source to 11 kV. bus of prim Substation (App. C, Table 1)	-	0.00173	x 0.33	-	0.00058
	-	0.00173	x 0.33	-	0.00058
11 kV. Line (App. C Table 3)	0.00035	0.00049	x 0.33	0.00012	0.00016
	0.00035	0.00049	x 0.33	0.00012	0.00016
15 kVA Transformer (App. C. Table 6)	-	-	-	0.11900	0.14400
240 V. line (App. C. Table 6)	-	-	-	0.02490	0.02760
	-	-	-	0.02490	0.02760
TOTAL	-	-	-	0.16904	0.20068

Assuming a starting power factor of 0.3 which is sufficiently accurate for practical purposes, the voltage drop per ampere of starting current will be:-

$$(0.3 \times 0.16904) + (0.95 \times 0.20068)$$

$$= 0.05071 + 0.19065$$

$$= 0.24136 \text{ volts per ampere of starting current.}$$

CASE 1: FREQUENT START

Permissible voltage dip is 1% of 240 V. = 2.4 V.

$$2.4 : 0.24136 = 9.9$$

Therefore maximum permissible starting current is 9.9 A

CASE 2: INFREQUENT START

Permissible voltage dip is 3% of 240 V = 7.2 V.

$$7.2 : 0.24136 = 29.7$$

Therefore maximum permissible starting current is 29.7 A.

EXAMPLE 3 - SINGLE PHASE 280 V. MOTOR
 11,000/480 V. TRANSFORMER, RATING 25 KVA:
 OTHERWISE GENERALLY AS EXAMPLE 2:

	Basic Equivalent Resistance (ohms)	Basic Equivalent Reactance (ohms)	Adjustment Factor for voltage $\frac{(480)^2}{(415)}$	Equivalent Resistance (ohms)	Equivalent Reactance (ohms)
Source to 11 kV. bus of prim. substation (App. C Table 1)	-	0.00173	x 1.34	-	0.00232
	-	0.00173	x 1.34	-	0.00232
11 kV. line (App. C Table 3)	0.00035	0.00049	x 1.34	0.00047	0.00066
	0.00035	0.00049	x 1.34	0.00047	0.00066
25 kVA Transformer (App. C Table 4)	-	-	-	0.25600	0.37000
480 V. line (App. C Table 6)	-	-	-	0.02490 0.02490	0.02760 0.02760
TOTAL	-	-	-	0.30674	0.43126

Assuming a starting power factor of 0.3 which is sufficiently accurate for practical purposes, the voltage drop per ampere of starting current will be:-

$$\begin{aligned} & (0.3 \times 0.30674) + (0.95 \times 0.43126) \\ & = 0.09201 + 0.40975 \\ & = 0.50176 \text{ volts per ampere of starting current.} \end{aligned}$$

CASE 1: FREQUENT START

Permissible voltage dip is 1% of 480 V. = 4.8 V.

$$4.8 : 0.50176 = 9.57 \text{ A.}$$

Therefore maximum permissible starting current is 9.6 A.

CASE 2: INFREQUENT START

Permissible voltage dip is 3% of 480 V. = 14.4 V.

$$14.4 : 0.50176 = 28.7 \text{ A.}$$

Therefore maximum permissible starting current is 28.8 A.

EXAMPLE 4 - 7,000 HORSEPOWER COMPRESSOR MOTOR FOR CONNECTION AT 11 KV - INFREQUENT STARTING

DETAILS OF MOTOR: Horsepower 7,000: power factor 0.96; efficiency 96%

STARTING CURRENT: At power factor 0.2

At 75% voltage 3.5 x full load current
 " 80% " 3.6 x " " "
 " 100% " 5.0 x " " "

SYSTEM DETAILS:

33 kv. fault level at Grid substation ----- 660 MVA
 % impedance at 100 MVA; each of two parallel
 33 kv. overhead lines ----- 7.5 + j16.8
 % impedance at 100 MVA; each of two parallel
 15 MVA 33/11 kv. transformers ----- j102.7

(a) SUPPLY VIA BOTH 33 KV, OVERHEAD LINES AND BOTH TRANSFORMERS: MOTOR CONNECTED AT 11 KV.

(In this example and 4 (b) all equivalent impedances are to an 11 kv. base).

	Equivalent Resistance (ohms)	Equivalent Reactance (ohms)
Source impedance to 33 kv. busbars		
	-	0.18000
Two 33 kv. overhead lines in parallel	0.04540	0.10200
Two 33/11 kv. transformers in parallel	-	0.62500
TOTAL	0.04540	0.90700

Voltage drop per ampere of starting current at 0.2 power factor

$$(0.2 \times 0.04454) + (0.98 \times 0.9070)$$

$$= 0.0091 + 0.8890$$

$$= 0.8981 \text{ volts per ampere of starting current}$$

$$\text{Permissible voltage dip is } 3\% \text{ of } \frac{11000}{1.732} = 191 \text{ V.}$$

$$191 : 0.8981 = 212$$

Therefore maximum permissible starting current = 212 A.

$$\text{Corresponding full load current} = 212 : 5 = 42 \text{ A}$$

$$\text{Permissible horsepower} = \frac{1.732 \times 11000 \times 42 \times .96 \times .96}{746}$$

$$= 1,000 \text{ HP.}$$

Thus the proposed 7,000 HP motor cannot be accepted and 1,000 HP is the highest acceptable rating for the stated conditions.

(b) SUPPLY FROM THE 33 KV, BUSBARS AT THE 132/33 KV,
SUBSTATION, VIA A SINGLE LINE AND ONE 33/11 KV, TRANSFORMER

The ohmic values as 11 kV base are now:-

	Equivalent Resistance (ohms)	Equivalent Reactance (ohms)
Source impedance to 33 kV busbars		0.18
One 33 kV, overhead line	0.0908	0.204
One 33/11 kV transformer		1.25
TOTAL	0.0908	1.634

Voltage drop per ampere of starting current to 33 kV bar

$$= 0.8 \times 0.98 \text{ volts.}$$

The point of common coupling is now 33 kV

3% voltage drop at 33 kV bar referred to 11 kV.

$$= \frac{11000}{1.732} \times \frac{3}{100} = 191 \text{ Volts.}$$

Therefore Maximum permissible starting current = 191

$$\frac{0.18 \times 0.98}{0.0908}$$

$$= \underline{1083 \text{ A}}$$

Source + line + transformer impedance

$$= 0.0908 + j1.634 \text{ ohms (referred to 11 kV)}$$

Therefore voltage drop to terminals of motor when starting current flows

$$= (0.0908 \times 0.2 + 1.634 \times 0.98) \times 1083$$

$$= (0.01815 + 1.6) \times 1083$$

$$= (1.61815 \times 1083) = 1753 \text{ volts.}$$

Therefore % rated voltage appearing at motor terminals

$$= \frac{11000 - 1753}{11000} \times 100$$

$$= \frac{1.732}{11000} \times 100$$

$$= \frac{1.732}{11000} \times 100$$

$$= \frac{1.732}{11000} \times 100$$

$$= (1 - \frac{1753 \times 1.732}{11000}) \times 100 = (1 - 0.2765) \times 100$$

$$= 72.35\%$$

$$= 72.35\%$$

At this value the motor starting current is 3.5 x full load current.

Hence full load current is 1083 A = 310 A

$$\frac{1083}{3.5}$$

This is equivalent to -

$$\frac{1.732 \times 310 \times 11000}{746} \times 0.96 \times 0.96 \text{ h.p.}$$

$$= \frac{1.732 \times 310 \times 11000}{746} \times 0.96 \times 0.96$$

$$= 7200 \text{ h.p.}$$

This is a marginal case for acceptance of a 7.00 h.p. motor, not only from the aspect of possible annoyance to other consumers but also because of the low starting torque due to the poor regulation of the system.

In each case further investigation is desirable, preferably using a system analyser and taking account of such factors as the possibility of using transformer tapping to raise the voltage at the motor terminals, conditions with other switching arrangements and any proposals for system reinforcement.

APPENDIX C

SYSTEM DATA

EQUIVALENT IMPEDANCES PER PHASE IN 415/240V SYSTEM

TABLE (1) IMPEDANCE BETWEEN SUPPLY SOURCE AND LOWER-VOLTAGE BUSBARS OF PRIMARY SUBSTATION

Fault level at 6.6 kV or 11 kV. Busbars of primary substation.	Equivalent impedance per phase in 415 V. system corresponding to stated fault level at 6.6 kV or 11 kV busbars	
(MVA)	R (ohms)	X (ohms)
250	0	0.00069
200	0	0.00086
150	0	0.00115
100	0	0.00173
75	0	0.00230
50	0	0.00346
25	0	0.00691

TABLE (2) - IMPEDANCE OF 6.6 KV AND 11 KV CABLES

MATERIAL	Cable Section (Sq. in)	6.6 kV		11 kV	
		R (ohms)	X (ohms)	R (ohms)	X (ohms)
		Equivalent impedance per phase in 415 V system corresponding to 1,000 yds of 6.6 kV cable of stated section		Equivalent impedance per phase in 415 V system corresponding to 1,000 yds. of 11 kV cable of stated section	
		R (ohms)	X (ohms)	R (ohms)	X (ohms)
	0.00225	0.00446	0.00037	0.00161	0.00016
C	0.04	0.00252	0.00033	0.00090	0.00014
O	0.06	0.00165	0.00031	0.00059	0.00013
P	0.1	0.00098	0.00030	0.00035	0.00013
P	0.15	0.00064	0.00028	0.00024	0.00012
E	0.2	0.00050	0.00027	0.00018	0.00011
R	0.25	0.00040	0.00027	0.00014	0.00011
	0.3	0.00033	0.00026	0.00012	0.00011
A	.04	0.00422	0.00034	0.00153	0.00013
L	.06	0.00278	0.00032	0.00100	0.00013
U	.1	0.00166	0.00030	0.00060	0.00012
M	.15	0.00113	0.00029	0.00041	0.00011
I	.2	0.00085	0.00028	0.00031	0.00011
N	.25	0.00068	0.00027	0.00024	0.00010
I	.3	0.00055	0.00027	0.00020	0.00010
U	.4	0.00041	0.00026	0.00015	0.00010
M	.5	0.00034	0.00026	0.00012	0.00010

TABLE (3) - IMPEDANCE OF 6.6 KV AND 11 OVERHEAD LINES

MATERIAL	Line Section (Sq. in)	6.6 kV		11 kV	
		R (ohms)	X (ohms)	R (ohms)	X (ohms)
		Equivalent impedance per phase in 415 V. system corresponding to 1,000 yds. of 6.6 kV line of stated section		Equivalent impedance per phase in 415 V. system corresponding to 1,000 yds. of 11 kV. line of stated section	
		R (ohms)	X (ohms)	R (ohms)	X (ohms)
COPPER	0.025			00140	00055
	0.05	0.00143	0.00143	0.00070	0.00052
	0.10	0.00098	0.00136	0.00035	0.00049
	0.15	0.00063	0.00132	0.00024	0.00047
	0.06			.00055	.000505
ALUMINIUM	0.03			0.00130	0.00054
	0.05	0.00197	0.00143	0.000707	0.00052
	0.1	0.000978	0.00136	0.000352	0.00049
	0.15	0.00066	0.00132	0.000238	0.00047

TABLE (4) - IMPEDANCE PF DISTRIBUTION TRANSFORMERS:

Transformer		Equivalent impedance per phase in 415 V system corresponding to a distribution transformer of stated size	
Type	Rating kVA	R (ohms)	X (ohms)
Single phase 240 V	5	0.43800	0.35200
	10	0.19400	0.20000
	15	0.11900	0.14400
Single phase 480 V	25	0.25600	0.37000
	50	0.10700	0.198000
	75	0.06500	0.13600
	100	0.04500	0.10000
	400	0.00746	0.0269
3-phase 415 V	25	0.19000	0.25500
	50	0.08000	0.13200
	75	0.04800	0.10600
	100	0.03400	0.07440
	200	0.01500	0.03800
	315	0.00931	0.02720
	300	0.00887	0.02590
	500	0.00466	0.01560
	750	0.00288	0.01050
1000	0.00203	0.00790	
800	0.00265	0.00983	

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TABLE (5) - IMPEDANCE OF 415 V. CABLES:

MATERIAL	Cable Section (Sq. in)	Impedance per 1,000 yds. of single conductor	
		R (ohms)	X (ohms)
C O P P E R	0.0225	1.14900	0.7910
	0.04	0.64220	0.07260
	0.06	0.42380	0.06970
	0.10	0.25190	0.06700
	0.15	0.17210	0.06380
	0.2	0.12950	0.06250
A L U M I N I U M	0.25	0.10310	0.06180
	0.04	0.062	0.072
	0.06	0.7015	0.069
	0.1	0.4171	0.067
	0.15	0.2848	0.064
	0.20	0.2143	0.063
	0.25	0.1707	0.063
	0.30	0.1391	0.062
	0.4	0.1035	0.062
	0.5	0.0844	0.061

TABLE (6) - IMPEDANCE OF 415 V. OVERHEAD LINES

MATERIAL	Line Section (Sq. in)	Impedance per 1,000 yds. of single conductor	
		R (ohms)	X (ohms)
COPPER	0.025	0.99400	0.31300
	0.05	0.49700	0.29300
	0.1	0.24900	0.27600
	0.15	0.16700	0.26400
ALUMINIUM	0.025	0.9882	0.313
	0.05	0.4949	0.293
	0.1	0.2461	0.273
	0.15	0.1665	0.264

SYSTEM AND EQUIPMENT EARTHING

This circular generally covers system and equipment earthing on the Corporation HV and LV distribution system.

1. GENERAL PRINCIPLES

1.1 Earthing of LV Neutral and Steelwork

The LV neutral earthing connections of a transformer and LV Equipment connected thereto must be kept entirely separate from the electrode to which the HV steelwork is connected. Any earth mat must be kept separate from both HV and LV earthing system.

This is necessary to avoid:-

- (i) Dangerous voltage being impressed on the LV system.
- (ii) HV steelwork and stays becoming live due to faults on the LV system.
- (iii) Earth mat where install becoming live due to faults on either HV or LV systems.

The necessary separation can only be achieved by careful segregation of earthing leads on the transformer, correct placing of earth electrodes, earth mats, buried conductors and insulation of earth leads, both above ground and for some distance from the point where they enter the ground at the foot of the pole or substation. Where insulated earth leads are referred to in this Circular the insulation shall be PVC black of thickness 0.8mm.

1.2 Joints in Earthing Conductors

Under heavy fault conditions the temperature of the earthing conductor may exceed the melting point of solder and it is therefore important that solder should not be relied upon for joints. It is therefore necessary for mechanical connectors to be used for all joints and connections in earthing conductors.

2. GROUND MTD DISTRIBUTION SUBSTATION INDOOR AND OUTDOOR

2.1 Earth Electrode Resistance

- (a) Where a common earth resistance of 1 ohm cannot be achieved the HV steelwork earth and the LV neutral earth must be segregated (see Clause 2.2 below).
- (b) The neutral earth electrode resistances required are:-
If all consumers are connected to the Corporation's earthing conductor and this is suitable for earthing purposes 40 ohms
If some or all consumers have direct earthing to water pipes or other forms of earth electrode 1 ohm (when connected in parallel with cable sheaths).

2.2 Segregation of Earths

2.2.1 HV Steelwork

Steelwork associated with the high voltage system, including the transformer tank, shall be connected to a driven earth electrode or system of electrodes having a resistance value not exceeding 40 ohms.

2.2.2 Transformer Neutral

The neutral earth electrode or electrode system shall be installed at a distance of at least 3m. away from any other metal work or cable associated with the HV system and connected to the neutral link in the LV pillar or fuse board by means of an earthing conductor insulated with PVC black of thickness 0.8 mm.

2.2.3 LV Cables

The LV cable earth wire will be connected to the earth bar in the LV Feeder pillar or fuseboard which will be connected to the neutral.

Where the feeder pillar or fuseboard is separate from the transformer the earth wire of the LV cables between the transformer and the feeder pillar or fuseboard will be bonded and earthed at the transformer box and insulated at the feeder pillar or fuseboard.

It is important to keep the LV cable well separated from the HV cables. Where this distance is less than 3m. the HV cables shall be wrapped with 'Denso' or other suitable tape.

2.2.4 LV Feeder Pillar

Where the feeder pillar is mounted on the transformer the pillar shell will be connected to the HV steelwork earth and the neutral bar, earth bar and the earth wire of the LV cables will be insulated therefrom and connected to the neutral earth electrode.

2.3 Earth Electrodes

The earthing electrodes will, where practicable, be driven copperweld rods.

Earthing conductors to earth electrodes will be 32 sq. mm. stranded copper.

2.4 Earthing Conductor to Equipment

Earthing conductors at substations will be 70 sq.mm. stranded copper.

2.5 Installation of Earthing Conductors and Connection to Equipment

As for Clause 3.7

3. HV/HV SUBSTATIONS - OUTDOOR

3.1 Earth Electrode Resistance

Every effort should be made to achieve an earth electrode resistance (including any cable sheath connected to the substation) of 1 ohm maximum in this type of substation, but under bad soil conditions a higher figure may be accepted. The resistance value in any case must be such as to comply with the requirements for the limitation of the voltage rise under fault conditions (see substation Potential rise below).

In the case of earth electrode systems distributed over a considerable area it is difficult to measure the overall earth resistance. It is therefore recommended that this should be calculated from measured values of resistivity of the soil at various points over the site area taken prior to the installation of the earth electrode.

The following table gives values of earth resistance for various lengths of buried conductor or driven rods based on a soil resistivity of 10,000 ohm/cm.

For a combination of buried conductor and driven rods it will be sufficiently accurate to calculate the overall earth resistance from the table assuming the two resistances to be in parallel.

Buried Loop	Driven Rods	Resistance
Length of Buried Conductor (metres)	Summated length of Rods installed with spacing of twice rod length (metres)	The figures refer to 10,000 ohm/cm resistivity. (For other values note that resistance is directly proportioned to resistivity) (ohms)
1.036	579	0.3
762	427	0.4
579	351	0.5
487	290	0.6
396	244	0.7
305	183	0.9
259	167	1.0
213	146	1.2
152	122	1.5
137	91	1.8
122	79	2.0
91	61	2.5

* Resistance increases with lesser spacing e.g., plus 10% for spacing equal to rod length and plus 25% for spacing equal to half rod length. There is no appreciable reduction for greater spacing.
 It will be appreciated that values of overall earth resistance arrived at from the table will be very approximate and wherever possible the overall earth resistance should be measured after installation.

3.2 Substation Potential Rise

The substation potential rise above true earth potential must not exceed 300 volts. To ensure this the overall earth electrode resistance must not exceed $\frac{3000}{A}$ where A = the maximum value of earth fault current in amps

which may flow to earth through the earth electrode system, taking into account the influence of any neutral earthing resistance.

3.3 Rating

The earthing system at these substations should have a rating of 18 kA for two seconds (see Appendix 'B').

3.4 Main Earth Grid (Earth Electrode)

This will normally consist of 70 sq. mm., stranded copper conductor buried in the form of a loop direct in the ground in such a way as to enclose the majority of the site area subject to a separating distance of at least 2 m., from the perimeter fence and from any building except in the case of earthing equipment therein. The outer loop may be supplemented by buried cross connections where these are required to connect equipment to the earth grid. These cross connections will not, however, have much effect on the overall resistance of the earthing system which is mainly determined by the area enclosed by the main earth grid.

Where the site area is small and or the soil resistivity is high it will be necessary to supplement the buried conductor by driven rods installed at suitable points on the main grid. Where the main earth grid cannot be buried direct in the ground it may be run in cable ducts or trenches. In such cases the electrode system should consist entirely of driven rods installed at suitable points over the substation site area and interconnected by 70 sq. mm. stranded copper.

3.5 Installation of Earth Electrode

The main earth grid should be buried to a depth of 610 mm not including surface single and surrounded by non-corrosive damp soil of fine mixture, the soil being packed as tightly as possible by ramming. This surround must be at least 152 mm thick if the soil is hostile to copper. All crossings of conductors in the main earth grid shall be jointed.

Three methods of jointing are permitted:-

- (a) Brazing using zinc-free brazing material with a melting point of at least 600°C.
- (b) Compression joints
- (c) 'Cadweld' thermit or similar process.

3.6 Earthing Conductors to Equipment

3.6.1 General

Earthing conductors to equipment shall normally be 1256 sq.mm. stranded copper or 120.6 sq.mm. 38.1 x 3.175mm. copper strip.

3.7 Installation of Earthing Conductors and Connections to Equipment

All mounting steelwork, all tanks of OCB's, transformer, auxiliary transformers, casting and earthing of socket outlets,, cable sheath and other electrical apparatus are to be bonded to the earth grid. Earthing conductor connections to equipment shall as far as practicable be made on vertical surfaces only. In the case of painted metal the paint must be carefully removed where the connection is to be made. In fixing stranded conductor to structures or walls, cleats shall be used. Cleat fixing shall be 610 mm apart.

No connection point shall be less than 152 mm. above ground level. Connection to the metal cladding of building shall be inside the building. In any position subject to corrosion the finished joint shall be protected by bituminous paint.

Where the earthing conductor is in trip form this shall be drilled and bolted direct to the equipment. Where the earthing connection is stranded this shall be terminated by a compression lug which shall be bolted to the equipment. "Offsets" should be provided on the earthing conductor at each location where portable earth leads may require to be applied. These "offsets" are to take the form of a bulge 100mm from the face of the structure approx. 300mm above ground level. The earthing conductor should be clipped immediately above and below the bulge.

Joints between aluminium and copper shall be of the bolted type. The mating surface of the aluminium must be cleaned and the copper tinned 'Densal' grease must be applied to the mating surface of the aluminium; after bolt tightening any excess to be wiped off.

3.8 Switch Handless

Each switch operating rod must be provided with an insulated insert.

3.8.1 Substation with extensive buried earth grid

In the case of any manually operated switch, the earth conductor from the HV steelwork down the pole or structure shall be mounted on the opposite pole or structure of the 'H' member to which the mechanism box of fixing of the switch operating handle is mounted. A separate fully rated conductor should connect the mechanism box or switch handle fixing to the main earth grid as directly as possible with the proviso that it should also pass under the stance position of a person operating the switch.

3.8.2 Substations with no extensive buried earth grid

As for above with the exception that an earth mat is provided. The earth mat is to be bonded to the earth grid.

Insulating inserts shall be used in all operating rods of pole mounted switchgear.

4. HV/HV SUBSTATIONS - INDOOR

4.1 Earth Electrode Resistance

The overall resistance of the electrode and any underground cable sheath connected to the substation shall not normally exceed 1 ohm, but under bad soil conditions a higher figure may have to be accepted. It should be noted that PVC sheathed cable do not contribute to the substation earthing. The earth electrode installed at the substation shall be a 1.22m. copperweld earth rod.

4.2 Rating

The earthing system at these substations should have a rating of 18kA for 2 seconds (see Appendix 'B').

4.3 Earth Electrode

The earth electrode will, where practicable, be a driven copper-weld rod. The earthing conductors to the earth electrode will be 32 sq.mm. stranded copper.

4.4 Earthing conductors to Equipment

The main earth bar and earthing conductors to equipment should be 25 x 4.76mm HD HC copper strip.

4.5 Installation of Earthing Conductors and Connection to Equipment

As for outdoor HV/HV substations.

5. POLE TRANSFORMER SUBSTATIONS

5.1 Earthing Electrode Resistance

5.1.1 Pole Transformer

The will be dealt with as in the case of ground mounted substation, (see Clause 2.1), ensuring where a common earth resistance of 1 ohm cannot be achieved the HV steelwork earth and neutral earth must be segregated (see Clause 5.2 below).

5.1.2 Where a pole transformer supplies an isolated consumer and there appears to be no likelihood of additional consumers being connected in the future, the system known as Protective Neutral Bonding (PNB) should be adopted.
Under this system, which does not require PME approval, the neutral earth electrode should be installed remote from the transformer pole and adjacent to the consumers' premises to enable it to be used for the earthing of the consumer's installation. In such cases the resistance of the neutral earth electrode shall not exceed 20 ohms.

5.2 Segregation of Earths

5.2.1 HV Steelwork

The HV Steelwork earth conductor may be bare where the transformer pole carries no switchgear or LV cable box. This applies whether the neutral is earth at the transformer pole or at a LV pole at least one span away. (see Clause 5.2.7 below).

Where the transformer pole carries switchgear and no LV cable box, the earthing conductor must be insulated from the connection to the transformer tank down the pole and for distance in the ground of 3m from the foot of the pole.

5.2.2 Pole Transformer Tank

The transformer earthing terminal must be connected to the steelwork earthing conductor.

5.2.3 HV Cable Box
Where the transformer pole carries a HV cable box the cable box, cable sheath and armour shall be bonded to the HV steelwork earthing conductor. The size of earth bond shall be 32 sq. mm sstranded copper conductor.

5.2.4 LV Cable Box
Where the transformer pole carries a LV cable box, the metallic sheath of the underground cable must be bonded to the LV neutral. If, however, the LV overhead conductors have been erected in the first instance and the neutral electrode has been installed at a LV pole one span away from the transformer, this electrode may remain, but the earth wires of the underground cable must be connected to the transformer neutral. The steelwork is to be insulated throughout its length down the pole and for a distance of 3m from the foot of the pole.

5.2.5 Pole Transformer Neutral
Where the transformer neutral is earthed at the transformer pole the earthing conductor must be insulated in all cases throughout its length down the pole and for a distance in the ground of 3m from the foot of the pole.

5.2.6 Switch Operating Handles
An earth mat must be provided in the ground where a man would stand when operating the switch. This mat will consist of 32 sq.mm stranded copper conductor, both ends of which will be taken up the pole and connected to the operating handle. Insulating inserts shall be used in all operating rods of pole mounted switchgear.

5.2.7 Location of LV Neutral Earth
Where all LV circuits are overhead the neutral must be earthed at a LV pole near the transformer wherever practicable, preferably at the pole one span away. Where this is impracticable, or where one or more of the LV circuits consists of underground cable, the neutral must be earthed at the transformer pole with the earth lead insulated for the first 6ft away from the pole.

5.3 Earth Electrode Resistance

5.3.1 HV Steelwork
The steelwork associated with the high voltage system including the transformer tank shall be connect to a driven rod or a system of rods having a value as indicated in Clause.

5.4 Earth Electrodes

5.4.1 HV Steelwork
To be earthed to driven rods 1.83 m x 25.4 mm diameter. Buried 32 sq.mm stranded copper laid at a depth of 610 mm may be used where driving of rods is not possible. The size of earthing conductor to the earth electrode shall be 32 sq.mm stranded copper.

5.4.2 Transformer Neutral
The earthing electrode will be driven copperweld rods buried 32 sq.mm stranded copper laid at a depth of 610 mm may be used where driving of rods is not possible. The size of earthing conductor to earth electrodes shall be 32 sq.mm stranded copper.

5.5 Earthing Conductors to Equipment

Earthing conductors to equipment will be 32 sq.mm stranded copper.

6. Fencing

6.1 Sub-station having no exposed high voltage conductors

- (a) No special steps need to be taken to earth the fence
- (b) Earth electrodes, earthing connection, underground cables and other metalwork must be kept clear of the fence. The separating distance for buried conductors and cables should be at least 300mm.

6.2 Sub-stations having exposed high voltage conductors

- (a) When the separating distance between the plant within the sub-station and the fence, including any struts, etc., is at least 2m at all points, the fence should be separately earthed to its own electrode(s) and kept entirely separate from the sub-station earthing system.
- (b) When the separating distance between the plant within the sub-station and the fence, including any struts, etc., is less than 2m at any point the fence shall be bonded to the sub-station common earthing system.

6.3 Method of Earthing

When the sub-station fencing is required to be earthed in accordance with 6.2 (a) or (b) the following requirements shall be complied with:-

- (a) All earth connections shall be 32 sq.mm copper.
- (b) The earth connection shall be bonded to every horizontal reinforcing wire of the fence and to each horizontal barbed wire. Where the earthing is in accordance with (ii) (a) above a separate electrode and earth lead shall be provided for each separate section of the fencing and shall be connected to an earth electrode with an earth resistance not exceeding 60 ohms and consisting preferably of a galvanised steel rod 1.83m x 25.4mm diameters. Where the earthing is in accordance with (ii) (b) a separate earth lead shall be run from each section of the fencing to the sub-station common earthing system.
- (c) One of the above earth connections shall be installed adjacent to each gate post. If the gates are of metal the main frame of the gate shall be bonded by means of flexible copper braid of not less than 32 sq.mm cross-section to the earth connection at the gate post, and there shall be a buried copper bonding conductor of not less than 32 sq. mm cross-section across the gateway between the earth connections at the gate posts.

6.4 Where the fence is earthed separately in accordance with (ii)(a) above, buried cables or other metalwork shall be kept clear of the fence and its earth electrode and bonding wires, and a minimum clearance of 300mm maintained at all points.

7. Neutral Earth Electrode

The LV neutral earth electrode can be either of the following types, depending on the type and resistivity of ground concerned.

- (i) Buried copper conductor not less than 32 sq.mm (3/3.75) stranded copper conductor.
- (ii) Extensible 1.22m x 15.875 diameters driven copperweld rods.

Buried bare copper conductor forming the electrode itself or the connection to and between driven rods should be laid at a depth not less than that required by the use of the land and preferably at minimum depth of 2m. Advantage should be taken of ground likely to provide the best earthing. Every effort should be made to avoid running conductor along or across paths frequently used by the public or cattle. In order to reduce the risk of corrosion of the armour and sheathing of underground cables bare earth conductors are not to be laid in the same trench as metal sheathed underground cables.

8. LIGHTING ARRESTERS

8.1 The earth terminals of the lighting arresters shall be bonded together by 120.6 sq.mm 38.1 x3.175 mm copper strip. They shall normally have their own earth electrode which will consist of one or more copperweld driven rods and have a resistance of not more than 20 ohms. Where arresters are mounted on the same pole as a cable box, sealing end or transformer, the common steelwork earth and earth electrode must be used for earthing of the arresters, but earth electrode should be supplemented by an additional electrode if necessary to obtain a total earth electrode resistance not exceeding 20 ohms.

The connections between the lighting arresters and the underground cable or the transformer should be kept short. This applies to both live and earth connections.

8.2 A separate earth rod for arrestors may be omitted in substations having a buried earth electrode system, provided that a driven rod is installed and connected to the main earth grid adjacent to the pole on which the arresters are mounted. In addition, a short and direct bond must be made from the earth terminals of the arresters to the plumbing gland(s) on the cable dividing box or sealing ends or to the frame or tank of apparatus to be protected.

If, in the case of transformer, a direct bond connection from earth terminals of the arresters to the tank is not possible above ground, this should be run below ground by the shortest route.

8.3 The size of earthing conductors to the earth electrode and equipment shall be as follows:-

Overhead Lines 11KV and 33KV

32 sq.mm stranded copper

HV/HV Substations

125 sq.mm stranded copper from earthing terminals to earth electrode.

125 sq.mm stranded copper from earthing terminals of lighting arrestors to apparatus to be protected

9. PROVISION FOR TESTING EARTH ELECTRODES

No provision for testing individual driven rod electrodes need be made where these are used to supplement a main earth grid.

If, however, the main earth grid cannot be buried direct in the ground and the electrode system consists entirely of driven rods then provision should be made by means of bolted links to test each group of driven rod electrodes.

10. DRIVEN ROD EARTH ELECTRODES

Driven rod earth electrodes shall consist of 15.875mm diameter copper weld rod is 1.22m lengths.

Where multiple lengths are used they shall be joined by screwed couples. The stranded earth conductor connection to the upper end of the rod shall be by means of compression lug. Strip earthing conductor shall be connected by means of screwed and bolted clamp.

11. AUXILIARY SUPPLIES TO SUBSTATION

Auxiliary supplies should, as far as practicable, be provided from transformers installed specifically for this purpose at the substation. This avoids the hazard which may be introduced by bringing in an auxiliary supply from a medium voltage network earthed at a remote substation. This objection does not apply to underground networks in urban areas where a medium voltage neutral at the distribution substation is connected to a 'common' earthing system extending throughout the network.

If, however, an auxiliary supply is provided from a medium voltage overhead line supplied from a remote substation transformer must be provided at the main substation with adequate insulation between windings to withstand the voltage rise which may occur under fault conditions.

LABELLING OF SWITCHGEAR

1. All BPC switchgear installed on the network shall have the BPC insignia which clearly shows the 24 hours telephone number and if applicable the power station plot number.
2. If there is more than one isolator switches in a row and are referred to using one number for operational purposes, then one should bear the BPC insignia. If there is only one item e.g., Ring-main unit standing on its own and having a number on it for operational purposes then it should also have the BPC insignia.
3. For brick-built substation the BPC insignia shall be marked on the door of such a substation. On wire mesh fenced ground-mounted transformers or mini-substations the label shall be on the equipment. On grid substations the label will be on a white background and be written in red - similar to danger notices posted haere to warn people to warn people against the dangers of unauthorised entry into such places.
4. The size of the BPC insignia shall be such that it is clearly visible from 10 meters away.
5. HV circuit labels (150 x 150mm) on every equipment on the network on which there is an outgoing or incoming circuit there shall be a name of that particular circuit. The name of the circuit will be an indication of to which substation the cable emanating from the ring-main unit, switch or circuit breaker is going.
6. From the foregoing it must be clear to all that HV circuit labels identify the substation or switch-stations to which the other substation is solidly attached or linked.
7. Depending on the type of switchgear concerned, the circuit labels will vary in size but they will all be on a white background stencil board with engraved letters in black.
8. On all ground-mounted or pole-mounted transformers there shall be bolt 75mm size stencil figures showing the number of those substations.
9. Brick-built substations will have their substation identity number on the fence gate as well as it being stencilled on the clearly visible of the transformer or any switchgear being part of the substation.
10. Ring-main units, switch stations will also bear their identity numbers on the clearly visible side.
11. Whereas circuit labels on ring-main units and switch stations are bounded to be external to the switchgear in the case of mini-substations they should be internal to the door as close as possible to the circuit they are referring to.
12. LV circuit labels: (60 x 30 mm) all fuse ways must bear the name of the circuit they identifying.
13. In case of overhead line circuit these must where possible be given geographic names.
14. In case of direct cable feeders to consumers as would be the case in mall areas and high rise buildings, the circuits must be strictly identifying by name of the consumer.
15. The foregoing labels on LV circuits or feeder ways must never be in dymo tape as this with age peels off. Only white background stencils with black letters are to be used. These labels must be screwed on rather than be glued onto the feed ways carrier. With age glue looses its adhesive property and the label drops off.
16. On mini-substations, both high voltage and low voltage doors must be clearly labelled to show the two sides.
17. Auxiliary and other equipment: Except where self-evident, every fixed item and auxiliary cable to be clearly and concisely labelled or stencil to make it purpose clear to any visiting competent person. All medium low voltage and auxiliary terminals or fuse ways are to be identified. Among the items to be included are distribution boxes, fire apparatus room, every auxiliary cable at each terminating gland, three phase socket outlets and battery installations. Each protection item, including relays, must be clearly labelled as to its purpose.
18. Where a feeder (HV) circuit is controlled by an aerial switch, the switch shall be given a full name such as ganged link (abbreviated GLK), Drop-out link (abbreviated (D)L) or Drop-out fuse (abbreviated DOF) followed by a number which further identifies it. These numbers are chosen in sequential order for each of the type of switched GLK, DOL or DOF, and a record kept.

19. On the main HV schematic the symbol chosen for the ganged links indicate whether that particular switch has interrupter heads for load breaking or not by being shown as two as two rings. A single ring for the ganged links show the absence of interrupter heads on that particular switch.
20. All labels for aerial switches are to be placed 1.8 m above the ground on the pole carrying the switch. Labels for auto-reclosers, sectionalizers are to be placed 1.8 m above the ground on the pole carrying same.

CONSUMERS' PRIVATE GENERATING PLANT

1. This document refers only to LV installation which are not intended to run in parallel with the Botswana Power Corporation's mains. For HV installations and LV installations intended to run in parallel see separate circular.
2. This document applies to generating plant including battery/inverter installations, and outlines the requirements regarding the connection of this plant.
3. The safety of the Botswana Power Corporation's staff carrying out their proper duties shall not be put at risk as a result of the operation of private generation. The Botswana Power Corporation Safety Rules (Electrical) must be strictly adhered to.
4. The Botswana Power Corporation will not require the consumer to break any earthing connections (whatever means) when local generation is in operation. This is because it is felt that the hazards introduced are greater than the advantages of such a procedure.
5. If there is only one neutral-earth connection of the generator, it must not be remote from the consumer's premises. This is to reduce the possibility of a significant voltage to earth occurring on the consumer's neutral which could be a result of a break in the neutral/earth connection or could be due to the passage of neutral current through a long neutral connection.
6.
 - (a) In general the consumer must provide a changeover switch which completely isolates the Botswana Power Corporation's supply, and in addition his own earth electrode for earthing the generator neutral. However, exceptions as in (b) and (c) below could be applied, and are to be recommended to the consumer where they are applicable.
 - (b) With the Botswana Power Corporation's approval, and if supply is from 11kV/LV substation situated on the consumer's premises and the generator is near the point of supply, the consumer must supply a changeover switch, but this need only control the phase connections (e.g., 3 poles for a 3 phase supply). The generator neutral must then be bonded solidly to the Botswana Power Corporation's neutral earthing system. See (5) above, and note the need to ensure transformer neutral earthing values below 1 ohm. The transformer/neutral earthing arrangement must carry a clear label of the generators earthing through it to ensure inadvertent disconnection does not occur.
 - (c) With the Botswana Power Corporation's approval and if the supply is direct from a network to which PME has been applied, the consumer must supply a changeover switch but this need only control the phase connections (e.g., 3 poles for a 3 phase supply), in which case, the generator neutral must be bonded solidly to the Botswana Power Corporation's neutral. Note requirements of (5) above.
7. In general, and in connection with 6 (a) above, the consumer must provide a changeover switch to control all phase and neutral connection (e.g., 4 poles for a 3 phase supply) and thereby completely isolate the Botswana Power Corporation Supply. The neutral of the generator must be separately earthed.
8. In all cases the consumer must provide a changeover switch which breaks before making.
9. Where the Botswana Power Corporation provides an earth terminal for the consumer's use, it may remain connection. Any incidental bonding to a generator neutral earth electrode installed in accordance with (7) above will be accepted.

APPENDIX 4

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LOW COST WIRING OF HOUSES

SPECIFICATION

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2. Standards and Drawings
3. Installation Requirements
4. Inspection and Testing
5. Detailed Material Specifications

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1.0 SCOPE OF WORK

1.1 Description

The Botswana Power Corporation wishes to offer consumers a means of affordable wiring to encourage a wider use of electricity. It is intended that any small premises could be wired in urban and rural areas which have access to power supplies.

To this end a scheme is proposed whereby BPC Registered Contractors will be used to install standardised wiring systems into consumer's premises. In order to register as an approved Contractor, private electrical contractors are invited to submit tenders with priced offers of rates, together with supporting information. BPC may register certain contractors with a limit on the value of work they are authorised to undertake.

In order to allow participation by smaller contractors, a number of work areas have been defined to cover the electrified parts of the country. The Botswana Power Corporation will register at least one Contractor for each work area. A schedule of work areas and principal villages is given below.

The wiring system to be used under this contract has been developed in Southern Africa for Low Cost Wiring applications. It comprises a supply point and a pre-payment meter to be installed by BPC, connected to a Ready Board and other wiring as selected by the consumer. The Ready Board and final wiring are to be installed by registered Contractors under this Contract.

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1.2 Schedule of Area Groups

<u>Group</u>	<u>Town/Village</u>	<u>Group</u>	<u>Town/Village</u>	<u>Group</u>	<u>Town/Village</u>
1	Tsabong Bray Werda Makopong	8	Mogoditsane Mmopane Gabane Metsimotlhaba Kumakwane Kopong	13	Selibe Phikwe Serule Bobonong Sefophe Tsetsebjwe
2	Lobatse Pitsane/GdHope Tihareseleele Metlojane Magoriapitse Ramatlabama Digawana Gathwane Mmathethe Magojwagojwe Molapowabojang	9	Molepolole Letlhakeng	14	Francistown
3	Kanye Jwaneng	10	Mochudi Morwa Lensweletau Rasesa Sikwane Mabalane Malolwane Ramonaka Mmathubudukwan e	15	Tonota Mathangwane Tati Sebina Makaleng
4	Moshupa Thamaga Manyana Mmankgodi	11	Mahalapye Shoshong Kalamare Mookane Machaneng	16	Tutume Masunga
5	Ramotswa Otse Mogobane	12	Palapye Radisele Ratholo Gootau Maunatlala Lerala Mogapinyana Kgagodi Serowe	17	Nata Sua
6	Gaborone			18	Kasane Kazungula
7	Tlokweng Oodi Modipane Matebeleng Mokatse			19	Maun
				20	Ghanzi
				21	Shakawe
				22	Letlakane Mopipi

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1.3 Consumer Wiring Options

Depending on the style of construction of a dwelling, the Employer and Consumer may agree on a particular choice of wiring. This may comprise a Ready Board plus additional wiring for other rooms. To simplify pricing and work control, a series of options for types of wiring are given below.

In all cases the Contractor will be required to install a Prepayment Meter base in the consumer's dwelling. The meter bases are available to the Contractor from the BPC Stores as a free issue item on production of a Works Instruction. The Contractor will be required to pay for losses or damage to the meter base.

All other materials including the Ready Board, cabling, switch plates and accessories are to be purchased and supplied by the Contractor, in accordance with the Specifications.

The incoming supply cable to the roof entry box (or pole box), and the final installation of the meter will be the responsibility of BPC. The wiring from the roof entry box (or pole box) to the meter base and the Ready Board, together with the installation of the Ready Board and any further wiring will be the responsibility of the Contractor.

Type 1 : Replace existing kWh meter with a Prepayment meter.

Type 2 : Prepayment Meter only, wiring by consumer

Type 3 : Meter and Ready Board

Type 4 : Meter, Ready Board plus one room.

Type 5 : Meter, Ready Board plus three rooms

Type 6 : Meter and Ready Board (Type 3) plus wiring as per Miscellaneous Rates

Each room mentioned in Types 4 and 5 above shall be provided with two double socket outlets, one light switch and one Type A light fitting.

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2.0 STANDARDS AND DRAWINGS

All designs, materials and work shall be in compliance with the following regulations, standards and specifications. All relevant regulations and standards may be viewed at the BPC Offices, and Contractors must be familiar with them.

2.1.1 Regulations

Electricity Supply Regulations, 1988
IEE Wiring Regulations 16th Edition
BPC Safety Regulations
Any local bye-laws.
Factories (Electricity) Regulations

2.1.2 Specifications

The Botswana Power Corporation Standard Requirements for Distribution Systems (SRDS) shall apply unless superseded by this specification.

2.1.3 Standards

The relevant British or South African Standards and Codes of Practice will apply.

2.2 Drawings

Drawings contained in the BPC SRDS.
Detailed drawings in this document.

The tender drawings show the general layout of all equipment, which together with the specification gives sufficient information to enable the Contractor to estimate the cost and to determine how the system must be installed, commissioned, tested, inspected, operated, serviced and maintained.

These drawings are not dimensioned installation drawings, and cannot be used as construction/shop drawings. Location dimensions shown are only indicative of the routes and zones in which this equipment must be installed.

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2.3 Supply of Electricity

Supply Voltage (LV)	230 Volts single phase $\pm 10\%$
Frequency	50 Hertz
Fault Level (LV)	2.5 kA
Max Ambient Temp	45°C
Min Ambient Temp	-5°C
Humidity	Over 80%
Lightning	Severe
Dust	Dust storms likely
Altitude	900 - 1200 m above sea level

Premises are supplied directly by BPC through their reticulation. BPC will terminate their overhead service cable in one of two points depending on the mode of construction of the premises:

a) For premises with conventional roof trusses, the Contractor is to provide a shackle point and a roof entry box. The shackle point must be a D Iron with shackle insulator, bolted solidly onto the roof truss. The Contractor will provide a 16 mmsq airdac cable from the roof entry box down to the Prepayment Meter Base. BPC will connect their service cable to the shackle point and to the airdac cable in the roof entry box.

b) For premises without conventional roof trusses, the Contractor is to provide a 4 metre creosoted wood pole for termination, mounted within 1 metre of the building. The pole shall be buried to a depth of 1 metre, having 3 metres above ground. The contractor shall provide a shackle point and a Pratley termination box on the pole. The shackle point must be a D Iron with shackle insulator, bolted solidly onto the pole. The Contractor will provide a 16 mmsq airdac cable from the pole box across to the building and down to the Prepayment Meter Base. BPC will connect their service cable to the shackle point and to the airdac cable in the pole box.

All rates for new installations shall include for provision of the wood pole, service cable, shackle point and box.

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3. INSTALLATION REQUIREMENTS

3.1 General

This section covers the supply, installation, and wiring of all electrical equipment which has been specified and shown on the drawings.

3.2 Surface Wiring Cables

Buildings shall be wired with Surfex surface wiring cables cabling. Surfex cables shall be fixed to walls with non compressive staples at spacings not exceeding 300 mm. Staples shall be used on either side of a bend. Staples are to have plastic cable clips such that the cable is not in contact with the metallic pins. The cable is to be bent on a radius of 3 times the cable diameter.

Joint boxes are not to be used and cables are to run directly between items of equipment.

The push-out entries of switch boxes shall only be removed where cables are installed; boxes having surplus open holes will be rejected.

Surfix cables shall be terminated in Ready Boards, Meter Bases or switch outlets using captive compression glands, correctly sized for the cable. Cables shall have adequate tails provided to allow termination without straining the cable.

3.3 Wiring

Wiring shall be done with surfex cables. The minimum cable sizes for certain applications are given below. In all cases the Contractor must ensure that cables are adequately rated for their function and the level of protection available.

3.3.1 Wiring to Light Points

For general light and switch points no size of cable smaller than 1.5 mm² PVC insulated Surfex cable shall be used. Lighting circuits shall be protected by 10 amp mcbs.

3.3.2 Wiring to Socket Outlets

For general small power points no size of cable smaller than 2.5 mm² PVC insulated Surfex cable shall be used. Radial circuits shall be protected with 20 Amp mcbs.

3.3.3 Wiring to Equipment Outlets

For general equipment points no size of cable smaller than 2.5 mm² PVC insulated Surfex cable shall be used. Circuits shall be protected with 20 Amp mcbs.

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3.3 Ready Boards and Meter Boxes

Supply, install and connect surface ready board complete with architrave, sub frames, hinged doors, all accessories, equipment and labels as specified.

The Ready Board shall be mounted on a common base adjacent to the Prepayment Meter. If there is any reason why a board will not fit into the space allowed, the attention of the Employer shall be drawn in good time to enable alternative arrangements to be made. It shall be the responsibility of the Contractor to verify the suitability of the space provided before the work commences.

The mounting height of the boards shall be 1350mm to the base of the board from the floor. Boards should not be within 200 mm of a door or window.

3.3.1 Testing of Boards

The boards shall be checked for correct operation and construction prior to dispatch from the manufacturer. A test certificate shall be provided with each board. After erection, the boards shall be tested for insulation resistance. Phase to phase and phase to earth resistance values of under 20 megohms shall be suspect and should be investigated.

3.3.2 Prepayment Meter Box Base

Supply, install and connect a surface mounted Prepayment Meter Base. Meter Bases shall be supplied by BPC and shall be collected and installed by the Contractor. Any loss or damage to the bases shall be to the Contractor's account.

Supply, install and connect 16 mmsq cable between the Meter Base and the Ready Board. Cabling may utilise a length of Airdac cable, or single conductors in conduit.

3.3.3 Replace a kWh Meter with a Prepayment Meter

Stage 1

In an existing installation, supply and install a Prepayment Meter Base inside the house, with a new airdac cable from the roof entry box to the Meter Base. Supply and connect a second length of airdac cable from the Prepayment Meter Base to the existing external Meter Board. During this stage, no interruptions to the consumer's power will be needed.

Stage 2

When the basic installation is complete, arrange with BPC Metering Department to visit site. During a shutdown of supply, connect the new airdac cable in the roof entry box, remove the kWh meter, and connect the other airdac cable to the MCB in the old meter box. BPC will install the Prepayment Meter, and shall retain the old kWh meter.

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3.4 Small Power

The Contractor shall supply and install all small power outlets in positions indicated on the drawings. The mounting height from the bottom line of the outlet to :-

the finished floor level against clear walls shall be 250 mm
a fixed bench or worktop shall be 250 mm.

The edge of any outlet shall be more than 200 mm away from the edge of a door, wall corner or other fixed item.

No item of electrical equipment shall be within 1500 mm of a sink or tap. No socket outlets are permitted in bathrooms. Bathroom light switches shall be mounted outside the bathroom.

3.4.1 Socket outlet point

Supply and install 16 Amp switched socket outlets complete with accessories and wired in a radial circuit with 4 mmsq 3 core Surfex PVC insulated copper cable. A point includes accessories, wiring, boxes and the switch socket outlet.

3.4.2 Equipment Connection Point

Supply and install 20 amp Double Pole isolators complete with backing box and accessories. Circuits to be wired with 2.5 mmsq 3 core Surfex PVC insulated copper cable. A point includes accessories, wiring, boxes and the switch plate.

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3.5 Lighting

3.5.1 General

This section covers the supply, installation, connection, adjusting of all light fittings.

3.5.2 Light Switches

Supply and install switch points complete with accessories, switches, cover plates, fixing screws and wired with 1.5 mmsq 3 core Surfex cable, PVC insulated, copper conductors.

The mounting heights of the bottom of the switch to the finished floor level shall be 1350 mm. Switches should be mounted between 50 to 300 mm from the edge of a door frame.

3.5.3 Light Points

Supply and install light points complete with accessories and wired with 1.5mmsq 3 core Surfex cable, PVC insulated, copper conductors.

3.5.5 Lighting luminaires

Supply and install lighting luminaires complete with lamps, mounting brackets, and fixing accessories. Wall mounted bulkhead fittings shall be at a height of 2000 mm from the floor to the base.

Bulkhead luminaires intended for outdoor use shall be weather proof and insect proof. They shall be suitable for continuous exposure to the sun.

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3.7 Earthing

The installation shall form part of a T.N.C.S. earth system. The neutral shall be bonded to an earth of less than 20 ohms on the BPC system at the point of supply, but thereafter the neutral shall be run separately from the earth.

3.7.1 Earth Points

Supply and install a 2400 mm long copper earth electrode complete with clamps, labels, inspection pit and inter-connecting green 16 mm² PVC insulated copper earth wire to the distribution board earth bar. The earth conductor shall be secured to the earth bar with a suitable sized tinned copper lug with bolts, washers and nuts.

3.7.2 Earthing of Buildings

Supply and install all material required for the installation to be effectively earthed in accordance with the IEE wiring regulations and to the requirements of the supply authority.

Surfix cables have an earth wire which shall be connected to the earth studs provided in the panels and boxes.

All hot and cold water pipes and gas pipes shall be bonded to the earthing system with copper tape clamped by means of a brass bolt, washer and nut. Metal roofs, gutters and down pipes shall be bonded together and earthed. Steel benches and tables shall be bonded to the earthing system.

Buildings constructed of metal frames and sheeting shall be provided with a bonding strap in each room between the frames, walls and roof. During testing for earth continuity, particular attention should be paid to identifying and rectifying any parts of the metal structure which do not have adequate continuity.

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3.8 Builders Work

The Contractor shall be responsible for any builders work involved when installing the equipment, irrespective of the nature of such works, and the making good any damage howsoever caused in the execution of those works. The Contractor will not be required to plaster or paint any surfaces other than those which have been damaged by his works.

Consumers premises may include several types of construction materials such as brick, precast, plaster board, sagex, sheeting, timber or traditional.

3.8.1 Fixing of Outlets and Boards

Equipment shall be fixed to structures such as brick and concrete by drilling the wall with a masonry bit and using wood screws with filler plugs.

Equipment mounted on panels, timber or plaster board shall be fixed with woodscrews screwed into predrilled undersized holes. Mounting onto metal work shall be by means of self tapping screws.

Screws shall be at least 40 mm long for supporting Ready Boards, and 25 mm long for outlets.

3.8.2 Fixing of Cables

Surfix cables shall be fixed to walls with non compressive staples as described in Section 3.2. When fixing to timber, brick, plaster or concrete, normal cable staples shall be used of the appropriate size to ensure a firm grip without compressing the cable. When fixing cable to metal structures, the staple shall be fixed with self tapping screws.

Airdac service cables shall be fixed to the structure at the point of entry to the building and adjacent to the Meter Board with conduit saddles. The airdac shall also be fixed at intermediate positions every 500 mm, or at bends.

Earthwire shall be fixed with saddles to external walls, and shall be strapped to the airdac cable where the two cables run together into the Meter.

3.8.3 Cable Entries

Cable entry holes shall be drilled with masonry or steel drill bits as appropriate. After cables are installed, the holes shall be sealed with a silicon sealant to prevent water ingress. Holes shall be sited at a high level under the shelter of the roof eaves where possible.

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3.8.4 Traditional Construction

Where premises are constructed of materials such as pole and thatch with irregular surfaces and uncertain structural strength, then the contractor shall take particular care to ensure that electrical equipment is mounted on a secure base. In such types of premises, the contractor shall install a 2 metre long creosoted eucalyptus stub pole inside the building, buried 500 mm deep, set against an outside wall. The Meter, Ready Board, switches and outlets shall be mounted on this pole.

3.8.5 Making Good of Damage

The contractor shall make good any damage caused by his work. Failure to do so will result in a deduction of monies due, as assessed by the Employer. The contractor should record any existing damage prior to commencement which may be incorrectly attributed to him later. The contractor shall also report any damage which he causes directly to the Employer.

The contractor shall keep on site a stock of building repair materials. These shall include (but not limited to) plaster, white pvc paint, silicone sealant, epoxy adhesive, wood fill etc.

The contractor shall take care to remove or cover any furnishings in the area where he is working. He shall also clean marks from surfaces and remove debris from the site which are from his workings.

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4.0 INSPECTION AND TESTING

4.1.1 Testing Procedure

During the course of and on completion of the work, the whole of the installation shall be tested in accordance with IEE Regulations. The Contractor will be required to carry out preliminary tests of his own, and to be present when the installation is tested by BPC. He shall give all reasonable assistance required to the BPC Inspector and provide such tools, materials, implements and instruments as are necessary for the tests.

BPC must not be called on to carry out inspections until the work is complete and initial tests have been carried out by the contractor. The contractor is to follow normal BPC procedures when making applications for temporary supplies for testing.

The Contractor will be required to replace, re-wire and/or renew at no extra cost any portion of the installation which fails to pass the prescribed tests. In addition the Contractor will be liable for costs incurred by the Employer for repeated tests should the installation not pass the first inspection.

Test equipment necessary for the complete testing includes :-

500 V Insulation Tester	Resistance Range Continuity Tester
Voltmeter	3 terminal earth tester
RCD tester	Earth Fault Loop Impedance Tester

4.1.2 Inspection

The Contractor shall, at the request of the Employer uncover or expose any portion of the contract works to permit random sample inspection to be made of workmanship, etc. Workmanship which in the opinion of the Employer falls below acceptable standards shall be rejected and shall be made good by the Contractor.

4.1.3 Test and Commission

The Contractor shall include in his rates for commissioning of the works to the complete satisfaction of the Employer. This item shall include the submission of completed Test Certificates and attendance at Inspections. It shall also include for the arranging and attendance of any tests or provision of documentation as may be required by the Botswana Power Corporation.

The Contractor shall arrange for Temporary Supplies for testing from the Supply Authority. The rate shall fully include all costs incurred in arranging for the tests and provision of preliminary test certificates.

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5.0 DETAILED MATERIAL SPECIFICATIONS

Where fittings have been specified by name, this is to be a guide to tenderers. Similar fittings of comparable quality and function are acceptable but written approval from the Employer shall be obtained.

A sample fitting of the alternative fittings offered will be required to be submitted to the Employer at the time of quoting.

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5.1 Ready Boards

1. SCOPE

The following items shall comply with the specification:

Ready Board, consumer equipment

2. STANDARD SPECIFICATIONS

Ready Boards (Small Power Distribution Units - SPDUs) shall be purchased in accordance with the attached Purchase Form given in the Annex to NRS 019:1992, Electricity Distribution - Small Power Distribution Units for Single Phase 230 V Service Connections, amendment No 1 June 1993, published by SABS.

3. MANUFACTURERS

Approved manufacturers are: York Enclosures
Voltex

4. DETAILED SCHEDULES

References are made to Clauses in NRS 019:1992.

4.1.1 Dimensions

In accordance with attached drawing.

4.1.2 Cable entries

Top: 35 mm from left edge, a knockout for number 1 or 2 gland to take 10 mmsq 3 core airdac or surface cable;
4 knockouts for 20 mm conduit;
4 knockouts for 6 mmsq surfix cable.

Left: 35 mm from the top of the box, a knockout for number 1 or 2 gland to take 10 mmsq 3 core airdac or surface cable;

Bottom: 4 knockouts for 20 mm conduit;
4 knockouts for 6 mmsq surfix cable.

4.1.4 Mounting Points

The SPDU shall be provided with three mounting points attached to the back panel, with 4 mm mounting slots. The mounting brackets shall be 1.5 mm thick metal. The mounting points shall be arranged such that the board can be mounted without disassembly. The board shall also have 4 internal mounting points.

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6.4 Circuit labels

Circuits shall be labelled as Main, Plugs, Lights etc as applicable.
Refer also to 4.6.1.2 b).

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Schedule A: Purchaser's specific requirements
 Schedule B: Guarantees and particulars of equipment to be supplied

xxxxxxxxxxxxx = No information to be provided in this section.

1	2	3	4	5
Item	Subclause	Description	Schedule A	Schedule B
B.1		Number of SPDUs required a) non-extendable type	N/A	xxxxxxxxxxxxx
		b) extendable type		xxxxxxxxxxxxx
	4.1.1.1	Method of Wiring	Airdac supply, surfix feeders	xxxxxxxxxxxxx
B.2	4.1.1.1	Cable Entry Points	See attached details	xxxxxxxxxxxxx
B.3	4.1.1.3	Mounting Details	See attached details	xxxxxxxxxxxxx
B.4	4.1.1.9	Colour of SPDU	Ivory	xxxxxxxxxxxxx
B.5	4.1.1.9	Material of SPDU cover	Polycarbonate	
B.6	4.1.1.13	Applicable dimensions	See attached details	xxxxxxxxxxxxx
B.7	4.5.1	Overcurrent protection device	NO	xxxxxxxxxxxxx
B.8	4.5.2	Overcurrent protection device rating (if other than 60 A)	N/A	xxxxxxxxxxxxx
B.9	4.5.3	Earth leakage circuit breaker rating	60 Amp isoaltor, 30 mA rcd	xxxxxxxxxxxxx xxxxxx
B.10	4.6.1	Arrangement of socket outlets and circuit breakers to subclause:	4.6.1.2 b)	xxxxxxxxxxxxx xxxxxx
B.11	4.6.3	Manufacturer of MCBs	xxxxxxxxxxxxx	
B.12	4.6.3	Type of MCBs	xxxxxxxxxxxxx	
B.13	4.7	Is a main earthing terminal or an earth bar required?	Earth Bar	xxxxxxxxxxxxx xxxxxx

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1	2	3	4	5
Item	Subclause	Description	Schedule A	Schedule B
B.14	4.8.1	Is a luminaire required?	NO	XXXXXXXXXXXXXX
B.15	4.8.3	Type of luminaire	N/A	XXXXXXXXXXXXXX
B.16	4.9.3	Method of corrosion protection for painted cover/board	XXXXXXXXXXXXXXXXXX XXXXXXX	
B.17	4.9.3	Type of paint	XXXXXXXXXXXXXXXXXX	
B.18	5.1	Are type test results to be provided with tender?	YES	XXXXXXXXXXXXXX XXXXXX
B.19	6.1	Material of label	XXXXXXXXXXXXXXXXXX	
B.20	6.1	Method of fixing	XXXXXXXXXXXXXXXXXX	
B.21	6.1(a)	SPDU manufacturer's name	XXXXXXXXXXXXXXXXXX	
B.22	6.1(b)	SPDU manufacturer's type or code	XXXXXXXXXXXXXXXXXX	
B.23	6.1(d)	Is the wording "If this board is faulty..." required?	YES	XXXXXXXXXXXXXX XXXXXX
B.24	6.1(d)	If YES, details of contact person/organisation	"Contact a qualified lectrician"	XXXXXXXXXXXXXX XXXXXX
B.25	6.1(d)	What languages other than English are required on the labels?	Setswana	XXXXXXXXXXXXXX XXXXXX
B.26	6.4	Are circuit labels required?	See attached list	XXXXXXXXXXXXXX
B.27	6.5	Is any other marking or labelling required?	No	XXXXXXXXXXXXXX XXXXXX
B.28	6.6	Method of packing required	Plastic wrapped, in cardboard cartons.	XXXXXXXXXXXXXX XXXXXX
B.29	6.7	Are routine test results required with each SPDU?	NO, only at time of approval.	XXXXXXXXXXXXXX XXXXXX
B.30	6.8	Is a circuit diagram required with each SPDU?	NO, only at time of approval.	XXXXXXXXXXXXXX XXXXXX
B.31	6.9	Is a certificate of compliance with this specification required?	NO, only at time of approval.	XXXXXXXXXXXXXX XXXXXX

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5.2 Surface Wiring Cable (Surfix)

1. SCOPE

The following items shall comply with the specification:

Cable surfix 1.5mm² 3 core
Cable surfix 2.5mm² 3 core
Cable surfix 4 mm² 3 core
Cable surfix 6 mm² 3 core

2. STANDARD SPECIFICATIONS

The cables shall comply with the requirements of:

SABS 1507 : electric cables with extruded solid dielectric insulation for fixed fixed installations, or
BS 6346 : PVC cables for electricity supply.

3. GENERAL

Surface wiring cables shall have solid plain copper conductors, PVC insulated, laid up with a tinned earth wire in contact with longitudinal aluminium foil tape, PVC sheathed overall, rated 300/500V.

Cables shall have red and black internal coding, and white outer sheath.

4. TESTS

Records of routine tests shall be provided by the manufacturer.

5. MANUFACTURERS

Approved manufacturers are:

SA PVC Cables
Aberdare

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5.3 Switches and Accessories for Surfex Wiring Systems

1. SCOPE

The following items shall comply with this specification:

- 1 lever 1 way 5 Amp light switch, Surfex type
- 2 lever 1 way 5 Amp light switch, Surfex type
- 16 Amp single switch socket outlet, Surfex type
- 16 Amp double switch socket outlet, Surfex type
- 20 Amp double pole isolator, Surfex type

2. STANDARD SPECIFICATIONS

The equipment shall comply with the requirements of the following specifications:

- SABS 163:1978: Wall and appliance switches (amendment No 2 March 1988)
(revised now applicable SABS IEC 61058-1)
- SABS 164 : 1980 Two pole and earthing pin plugs and socket outlets.
- SABS 950 : Unplasticised pvc rigid conduit & fittings for use in electrical installations.
- SABS 1084 : Cover plates for wall outlet boxes
- SABS 1085 : Wall outlet boxes for the enclosure of electrical accessories.

3. GENERAL

The wiring boxes used for Surfex systems shall be surface, low profile (32 mm), white pvc, size 100 x 50, with "push out" entries sized to suit Surfex wiring. Cord grips of the appropriate size shall be used as supplied by the switch box manufacturer.

The socket outlets shall comprise 16 ampere 3 pin shuttered socket outlets with adjacent 16 ampere single pole control switches, mounted together as units enclosed with white plastic or metal cover plates. Terminals shall be of suitable size to accept 2 x 4 mmsq stranded single core conductors.

Lighting switches shall be 5 amp rated, and shall comprise a rocker switch with terminals suitable for accepting 2 x 1.5 mmsq conductors.

Boxes shall be made from a white, rigid, non brittle PVC. The cover plates shall be fixed by means of non-ferrous coated screws. Cover plates shall be located on the back box by means of small lips or locating pins.

All boxes shall have a terminal for connecting the earth wire of the Surfex cable.

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4. MANUFACTURERS

Approved ranges of boxes are:

1 lever 1 way 5 Amp light switch
2 lever 1 way 5 Amp light switch
16 Amp single switch socket outlet
16 Amp double switch socket outlet
20 Amp double pole isolator

Surfmaster 1201W
Surfmaster 1202W
Surfmaster 1285W
Surfmaster 1286W
Surfmaster 1230W

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5.4 Prepayment Meter Bases

1. SCOPE

The following BPC stock items comply with this specification:

DM5025	Budget Energy Controller	BEC 11M - Conlog
DM5027	BEC11M Wall Unit	Conlog
DM5028	BEC11M Adaptor Plate for BEC1	Conlog

2. SPECIFICATION

DM5025 - Model BEC11M V5.07H
Part No. 70 0011 900 102 V01
230 Volt 20A(60A) 50 Hz IP41
Constant: 2560 I/kWh Class 2 ERR

DM5027- E-K BEC 11M wall Unit with S-A
Part No: 70 0011 901 000 V00

DM5028 - Adapter for matching BEC 11M with BEC1 Wall Unit

3. GENERAL

Prepayment Meter Bases comprise an assembly and housing for the fitting of a removable meter. The base includes terminals for the connection of the incoming service cable, and for the cable leading to the Ready Board. It also includes an Earth Stud which is to be used as the Main Earth Point.

4. ISSUE TO CONTRACTORS

Bases may be collected as free - issue items from the BPC Stores on production of a Works Instruction. Contractors are responsible for loss or damage to the equipment.

4. MANUFACTURER

Conlog

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5.5 Light Fittings

1. SCOPE

The following items comply with this specification:

A	Internal Round Wall Bulkhead	Voltex W1LUSA 100WBC RND WHI
B	External Box Wall Bulkhead	Voltex W1LUCT SPEC WHI/CLR 100W
C	Pendant Luminaire	Voltex W1VOLTEX SPDU/01C
D	1200 mm single fluorescent	Lascon R1 1/40 SS

All fittings shall be supplied and installed complete with tubes or lamps.

2. STANDARD SPECIFICATIONS

SABS 165 : 1959 Lampholders (revised now applicable SABS IEC 61184)
SABS 890 : 1988 Ballasts for fluorescent lamps
SABS 1119 : Interior luminaires for fluorescent lamps

3. PENDANT LUMINAIRES

Pendant (hanging) luminaires shall include the luminaire, flexible cable and ceiling rose. The luminaire shall be non-metallic, made with a toughened polypropylene diffuser to minimise breakage. It shall contain a 100 W rated bayonet cap lamp holder. The flex cable shall comprise 500 mm of 2 core 1.0 mm² pvc insulated cable to SABS 168. It shall be made off onto a terminal block in the ceiling rose. The ceiling rose shall include a cable clamp to support the pendant cable.

4. MANUFACTURERS

Approved manufacturers are: Lascon
Voltex

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SECTION 1TOOLS AND EQUIPMENT FOR SAFETYSTOCK ITEMS (TOOLS)

STORES CODE	ITEM NAME	REF	MANUFACTURE R	SUPPLIER
DC2127	SUPER TESTER VOLTAGE DETECTOR	H1990-ST	PFISTERER	HARDWARE ASSEMBLIES
DC2128	NOISY SUPER TESTER ADAPTOR	M4455-98	PFISTERER	HARDWARE ASSEMBLIES
GT6001	HEAVY DUTY LINK STICK SECTION TELESCOPIC 7.6M WITH M4455-9 UNIVERSAL HEAD, SILICON WIPING CLOTH &BAG	C403-1601	PFISTERER	HARDWARE ASSEMBLIES
GT6003	UNIVERSAL TREE TRIMMER	H2106-4	PFISTERER	HARDWARE ASSEMBLIES
GT6004	UNIVERSAL STICK	H1761	PFISTERER	HARDWARE ASSEMBLIES
GT6006	POSITIVE GRIP CLAMP STICK	HG3030-2	PFISTERER	HARDWARE ASSEMBLIES
GT6007	EARTHING KIT COMPLETE WITH 3x9m LG-60mm ALUFLEX CABLES, 1x3m LG-60mm ALUFLEX CABLES ALL CABLES WITH LUGS AND HEATSHRINK SLEEVES PER END 1xHA61 INTERCONNECTOR 3xS9D PHASING CLAMPS 1x360414414 EARTH CLAMP 1xBAG	EK633	PFISTERER	HARDWARE ASSEMBLIES
GT6005	OPERATING HEAD FOR S9D PHASE	363179204	PFISTERER	HARDWARE ASSEMBLIES
GT6002	LINK STICK BUTTONS & SPRING	T403-1249	PFISTERER	HARDWARE ASSEMBLIES

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SECTION 2

TOOLS AND EQUIPMENTS FOR SAFETY

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SOCKET SPANNERS (GEDORE 25 PIECE)		1	1	1	1	-	-	-
SPIRIT LEVEL (1m LONG)		1	1	-	1	-	-	-
4 LBS HAMMER		1	1	1	1	1	-	1
2 LBS HAMMER		1	1	1	1	1	-	1
14 LBS HAMMER		-	-	-	-	-	-	-
19 mm AUGER (GREEN LEE)		1	1	1	1	1	-	1
25 mm AUGER (GREEN LEE)		1	1	1	1	1	-	1
2 TON COME ALONG		1	1	1	1	1	-	1
3/4 TON COME ALONG		1	1	1	1	1	-	1
1.5 TON COFFIN HOIST (KITO) WITH 1.5 m LONG CHAIN		1	1	1	1	1	-	1
3/4 TON COFFIN HOIST (KITO)		1	1	1	1	1	-	1
COLD CHISEL 25 x 300 mm		1	1	1	1	1	-	1
COLD CHISEL 19 x 200 mm		1	1	1	1	1	-	1
D SHACKLE 2 TON		1	1	1	1	1	-	1

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D SHACKLE 3.5 TON		1	1	1	1	1	-	1
CHAIN SLING 2 TON		1	1	1	1	1	-	1
CHAIN SLING 3 TON		1	1	1	1	-	-	-
CRIMPING TOOL (HAND CRIMPING UP TO 20 sq mm)		1	1	1	1	1	-	-
ABC CRIMPING TOOL		1	1	1	1	1	-	1
RED DEVIL STAY CLAMPS		1	1	1	1	1	-	1
WIRE BRUSH ALUMINIUM		1	1	1	1	1	-	1
BINDING TOOL (BANDIT)		1	1	1	1	1	-	1
COMBINATION SPANNER No. 13 GEDORE		1	1	1	1	1	-	1
COMBINATION SPANNER No. 17 GEDORE		1	1	1	1	1	-	1
COMBINATION SPANNER No.19 GEDORE		1	1	1	1	1	-	1
COMBINATION SPANNER No. 24 GEDORE		1	1	1	1	1	-	1
COMBINATION SPANNER No. 28 GEDORE		1	1	1	1	1	-	1
COMBINATION SPANNER No. 30 GEDORE		1	1	1	1	1	-	1
300 mm ADJUSTABLE TABLE SPANNER (GEDORE OR BACHO)		1	1	1	1	1	-	1

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380 mm ADJUSTABLE SPANNER TABLE (GEDORE OR BACHO)		1	1	1	1	1	-	1
450 mm ADJUSTABLE WRENCH (RIGID)		1	1	1	1	1	-	1
200 sq mm COMBINATION PLIERS (WILL)		1	1	1	1	1	-	1
200 sq mm LONG NOSE PLIERS (WILL)		1	1	1	1	1	-	1
200 mm VICE GRIP (GEDORE)		1	1	1	1	1	-	1
SCREW DRIVER SET (BLACK-POINT WERA)		1	1	1	1	1	-	1
TRIMMING KNIFE		1	1	1	1	1	-	1
HACKSAW - FRAME LARGE (ECLIPSE)		1	1	1	1	1	-	1
JUNIOR HACKSAW (ECLIPSE)		1	1	1	1	1	-	1
750 mm BOW-SAW		1	-	-	-	1	-	1
530 mm BOW-SAW		-	-	-	-	1	-	-
30 m MEASURING TAPE (LINEN)		-	-	-	-	1	-	-
3 m MEASURING TAPE		1	1	1	1	1	-	-
450 mm CUTTER (RECORD 936H)		1	1	-	-	1	-	-

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CUTTER FALCO		1	1	-	-	1	-	-
TOOL BOX (STEEL)		1	1	1	1	1	-	1
ALLEN KEYS METRIC (8 PIECE SET)		1	1	1	1	1	-	1
WIRE STRIPPERS		1	1	1	1	1	-	1
VOLTAGE TESTER (RAPP)		1	1	1	1	-	-	1
DIGITAL MULTIMETER		1	1	1	1	-	-	1
PHASE ROTATION METER		1	1	1	1	-	-	-
DIGITAL INSULATION TESTER		-	1	1	1	-	-	-
EARTH RESISTANCE TESTER		-	1	1	-	-	-	-
DIGITAL CLIP-ON METER		-	1	1	-	-	-	-
CRIMPING TOOL (16 mm - 240 mm HYDRAULIC)		1	1	1	1	-	-	-
PHASING SET 11 kV - 66 kV		-	1	1	-	-	-	-
PORTABLE DRILLING MACHINE		1	1	1	1	1	-	-
TREE TRIMMER		-	-	1	1	-	-	-

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PORTABLE EARTH		1	1	1	1	1	-	-
HOLE SAW PUNCH 20 mm		-	-	-	1	-	-	-
HOLE SAW PUNCH 25 mm		-	-	-	1	-	-	-
HOLE SAW PUNCH 32 mm		-	-	-	1	-	-	-
HOLE SAW PUNCH 40 mm		-	-	-	-	-	-	-
HOLE SAW 50 mm		-	-	-	1	-	-	-
COMPRESSOR JACK HAMMER		-	-	-	-	-	1	-
COMPRESSOR JACK HAMMER HOSE		-	-	-	-	-	1	-
SAFETY BELT		1	1	1	1	1	-	1
ROUND FILE 250 mm		1	1	1	1	1	-	1
FLAT FILE 300 mm		1	1	1	1	1	-	1
MEASURING WHEEL (THE MAGIC WHEEL)		1	1	1	1	-	-	-
DYNAMOMETER		1	-	1	-	1	-	-
SMASHER BLOCK OR ROLLER		1	-	1	-	1	-	-
ABC CUTTING TOOL		1	-	1	-	1	-	-
CENTRE PUNCH		1	1	1	1	1	-	1
CRIMPING TOOL 1.5 - 6 sq mm INSULATED LUGS		1	1	1	1	1	-	1

