

PART C3 – SCOPE OF WORK

C3.1 GENERAL PROJECT SPECIFICATION

1.0 GENERAL

The work included in this tender includes, inter alia, construction of a new substation building, extension of an existing 22kV underground cable, one (1) indoor 22kV circuit breaker and the electrification of 237 sub-economic houses at Kruisfontein in Humansdorp. The location and access to the relevant areas are indicated on the enclosed Drawing No's 10325/E/01 to 04.

The Tenderer shall make allowance in the Bills of Quantities to appoint a Professional Land Surveyor to set out any erf boundaries required and confirm the correct and final positions of all cable routes, overhead line poles, etc. relevant to erf and road reserve boundaries, before construction commences.

2.0 PROJECT DESCRIPTION

This contract covers the manufacture, works testing, delivery to site, off-loading, erection, installation and on-site testing of the following items:

Bulk Infrastructure Work:

- One (1) 22kV indoor feeder circuit breaker.
- Approximately 1500m of 22kV underground cable.
- Brick built substation building of size $\pm 72\text{m}^2$.
- 22kV Pole mounted switchgear, including inter alia 2 x 22kV auto-reclosers and 5 x 22kV load break switches.

Electrification of Sub-Economic Houses:

- Approximately 400m of new 22kV overhead lines.
- Three (3) 315kVA, 22/0,4kV pole mounted transformer substations, each complete with a set of three (3) 22kV lightning arrestors and three (3) 22kV expulsion fuses forming part of the transformer.
- Three (3) separate main LV distribution boxes mounted below the transformer substations.
- Approximately 2800m of LV bundled conductor overhead line.
- Seventy eight (78) pole mounted consumer service connection boxes (CSCB's).
- Airdac house service connection cables to 237 houses.
- Material and equipment for 237 house installations.
- Testing and commissioning of the complete installation and issue of a Certificate of Compliance for each house installation.

The work is further depicted on the drawings and as further detailed hereinafter.

3.0 SITE INFORMATION

Refer to Parts C3.3 and C4.

The Contractor will not have exclusive possession of the site, and it is very important to note that the substation will remain "live" (in operation) during the entire duration of the contract. The Contractor will be required to carefully coordinate power shutdown periods, etc. with the Municipality as and when required.

The Tenderers must familiarise themselves with the local conditions.

The Contractor shall notify the Directorate: Infrastructure & Engineering and the Engineer of the anticipated delivery of the equipment at least fourteen (14) days before the expected arrival time, to enable the necessary arrangements to be made.

4.0 **NATURE OF CONTRACT**

The conditions of contract will be the General Conditions of Contract for Construction Works, Third Edition (2015), as amended and described in Part C of this document.

Tenderers must carefully study and understand the entire contents of this document and all annexures, and particularly the Contract Data, Part C1.2 which contains vital information peculiar to this contract.

5.0 **ENGINEER'S DRAWINGS**

The Engineer's Drawings applicable to this installation are listed in Annexure A to this document.

These drawings are sufficiently accurate for tendering purposes but all dimensions must be verified on site prior to manufacture. No extras will be considered where work has been proceeded with, without such prior verification or approval.

6.0 **PROGRAMME AND COMPLETION**

The Electrical Contractor will be responsible for drawing up his own programme in which he must take into account the delivery dates of the equipment/materials. The programme shall be submitted to the Engineer two (2) weeks after acceptance of the bid in order that such programme may be available for discussion at the first official site meeting.

It is imperative for all tenderers to indicate their completion periods for the work described in this contract. The anticipated completion period for the Works is twenty six (26) working weeks. This is taking into account that the electrification of houses, the 22kV underground cable and the construction of the new substation are completed concurrently. In view of this requirement, and the anticipated specified completion period, Tenderer's are required to make suitable allowance in their Preliminary and General Items under the Bills of Quantities, Part C2.2, hereof.

Provision shall be made in the Tenderer's programme for the annual Contractor's holiday as well as two (2) rain days per month. In order to meet the target dates, the Tenderer must seek ex-stock equipment/materials/plant where considered necessary.

7.0 **PROJECT NOTICE BOARD**

A project notice board, constructed in accordance with the details provided under Annexure B, is to be provided by the Contractor as part of the contract and erected in the position indicated by the engineer on site. The wording shall be approved prior to sign writing. The board shall remain in place until the end of the defects liability period at which time it shall be removed by the Contractor.

8.0 ELECTRICAL SUPPLY

The existing electrical supply is 22kV (MV) and 400V (LV) three phase, and 230V (LV) single phase, 50 Hz systems. Actual voltages may deviate by up to 8% from these values and all equipment, jointing materials, etc., shall be suitably rated for these conditions. The phase rotation is to be checked and maintained through-out the network.

9.0 SWITCHING OF SUPPLIES

All switching of the MV and LV supplies shall be arranged in advance with Kouga Municipality. The Electrical Contractor shall establish their requirements regarding advance notice, permits to work, etc., at the beginning of the contract and shall comply with these requirements.

The contact person at the Municipality's Humansdorp Electrical Department is Mr. Kenneth du Preez, contact Cell No. 082 894 9352.

10.0 SITE STAFF

The Contractor shall have a competent supervisor on site at all times that work is being carried out under this contract. Such supervisor shall be fully conversant with the equipment and materials being installed.

The Contractor shall further comply with Clause No's 4.10, 4.11 and 4.12 of GCC 2015 contractual conditions.

11.0 SITE FACILITIES

The Contractor shall be responsible for negotiating with the Employer to obtain a location for erection of his site office and storage yard. The Contractor shall also arrange for the supply of water, electricity and telephone services to this site at his own costs.

Latrine facilities will be required and must be in accordance with the local Health Department's regulations.

The Contractor shall further comply with all Environmental requirements.

12.0 CLEARANCES WITH OTHER SERVICES

It shall be the Electrical Contractor's responsibility to obtain all necessary drawings and information from the Municipality and Telkom regarding existing and new overhead power and telephone lines to ensure that no damage occurs to the existing services during the installation of electrical services, and also to ensure that all necessary clearances with existing and future plant are maintained.

The Contractor shall familiarise himself with all existing services and liaise with all relevant authorities for the location and detection of existing services. The Contractor shall also use all necessary means to locate and expose services without damage to such services.

13.0 **KOUGA SUPPLY CHAIN MANAGEMENT POLICY**

Tenders will be adjudicated in terms of Kouga Municipality's Supply Chain Management Policy of 30 May 2014. A copy of this document is available at the Municipality and on the Kouga website.

14.0 **LOCAL LABOUR AND SMME's**

Optimum use shall be made of local labour and Sub-Contractors, and the Electrical Contractor appointed for this project shall as far as practically possible and economically viable make use of labour intensive methods to do the work. Sourcing of local labour must be done as soon as the successful Tenderer has been appointed.

The Contractor shall source local labour from the specific area where work is to be undertaken.

Items of work included in this contract classified as labour intensive will include the following:

- Construction of a new substation building.
- Trenching, backfilling and compaction for underground MV cables and for holes for MV and LV poles and stays.

An advert will be placed for the post of a Community Liaison Officer (CLO) which will be employed by the Contractor. Local labour must be arranged through the CLO and interviewed by the contractor in conjunction with the client and the engineer.

Special Requirements

The Tenderer's attention is drawn to the following requirements which will form part of his responsibility and which he needs to take into consideration in his tender price regarding the use of SMME (Small, Medium and Micro-sized Enterprises) Contractors and the use of Local Labour:

- Worker Contracts and Materials Supplier Contracts need to be set up with each employee (full-time and casual) and supplier.
- The Contractor is required to register with the South African Revenue Services.
- Registration with the Unemployment Insurance Fund (UIF) as well as the Compensation of Occupational Injuries and Diseases Fund (Workmen's Compensation) is required.
- Fulfilment of the following employment targets are essential and need to be attained:
 1. At least 10% of the Contract value must be sub-let to SMME's (emerging sub contractor's in Humansdorp / Patensie / Hankey /Jeffreys Bay / St Francis Bay / Oyster Bay areas).
 2. Create a minimum of 30 job opportunities on site for the duration of the contract period.
- The ratio of local labour employed on the project must conform to the following:
 - * At least 20% women (Preference must be given to single heads of household)
 - * At least 40% youth (Persons above school going age of 18 to 35 years old)
 - * 40% men (Over the age of 35 years)

Labour Intensive Work

Guiding Principle:

The guiding principles upon which the labour intensive work to be provided is based, include:-

- creating sustainable job opportunities,
- poverty alleviation,
- local authority empowerment, and
- ensuring financial accountability

In line with the above, the following targets have been set in order to reach objectives and this Contract will be subject to these targets:

- Labour intensive methods of construction are to be used where possible.
- Women are to make up at least 20% of the Total Local Labour employed on this project with an emphasis on “Women who are the single head of households and have dependants”.
- Youth are required to make up at least 40% of the Total Local Labour employed.
- Men are required to make the balance of the Total Local Labour employed.

The Contractor shall therefore be required to plan his activities to maximise the use of local labour. A “local worker” is defined as a person whose domicilium citandi ex executandi is Kruisfontein in Humansdorp. The rates tendered shall cover the full cost of the all labour intensive work.

The following activities will be conducted by hand:

- Construction of a new substation building.
- Trenching, backfilling and compaction for underground MV cables and for holes for MV and LV poles and stays.

Furthermore, the Tenderer is required to complete the Statement of Intent relating to the use of local labour. This statement is required to indicate the methods which the Contractor intends employing to achieve the employment targets. The Contractor shall be expected to limit the use of non-local persons to his permanent core of key personnel only. The table attached should also be completed in full for tender purposes. The statement will be taken into consideration in the adjudication of the tender.

Minimum wages for local labour shall paid as per the statutory requirements for the specified industry.

Penalty Calculation

1. Use of SMME's:

Should the contractor fail to meet the minimum requirement of subletting at least 10% of the Contract value to SMME's (emerging sub-contractors), a penalty of 1,2 x the value of the amount to be sublet, minus the actual value sublet, will be implemented. This amount will be deducted from the Contractor's payment certificate.

The Contractor is to indicate to the Client via a report certified by their auditors indicating that at least 10% of the Contract value has been paid to SMME's.

2. Use of Local Labour:

Should the contractor fail to meet the minimum requirement of creating 10 employment opportunities on site for the duration of the contract, a penalty of 1,5 x the value of the amount of employment that was not created, calculated at R 140-00 per day per person, will be calculated and imposed. This amount will be deducted from the Contractor's payment certificate.

The Contractor is to indicate to the Client via a report certified by their auditors indicating the payments made to Local Labour and SMME's.

Monthly reports on labour to be supplied by the Contractor in the format provided by the Client.

15.0 **CONSTRUCTION AND "AS-BUILT" DRAWINGS AND MANUALS**

The Electrical Contractor shall submit to the Engineer, within 1 month after appointment, construction drawings of all work to be undertaken under this project.

Before the date of the issue of the Certificate of Completion, the Electrical Contractor shall hand-over to the Engineer three sets of electronic and hard copies of "As-Built" of the above-mentioned drawings. These drawings shall be complete in all respects, together with operational and maintenance manuals, test certificates, commissioning report, etc, where relevant. The manual shall include a description of the works, operating instructions, manufacturer's pamphlets and catalogues on all the equipment supplied and a spares list for the same equipment.

These drawings shall clearly show, with measurement relative to the various structures where applicable, all cable routes and positions of cable markers, final details of all circuits, and revised schedules of equipment etc. The Contract will not be considered complete until these drawings and manuals have been received.

16.0 **DAMAGE TO STRUCTURES**

The Electrical Contractor shall be responsible for the making good of damage caused by his / her staff to any part of the structures / equipment. In the event of the occurrence of damage he/she shall arrange the repair of such damage to be carried out at his / her own expense to the satisfaction of the Engineer and Employer.

C3.2 HEALTH AND SAFETY

1.0 GENERAL

The principal Contractor and Contractors are required to adhere to the provisions of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), as amended, and including the Construction Regulations 2014, as amended, forming part thereof. For the purposes of this part of the document, the terms principal Contractor and Contractor, and Client, shall have the meanings as defined in the abovementioned Regulations.

The principal Contractor, or Contractor, as the case may be, shall undertake all the duties and activities required of him in terms of the abovementioned regulations. These may include but not necessarily be limited to the following:

- Notification of construction work.
- Preparation, liaison with and submission to the Client, and implementation and maintenance of a suitable and sufficiently documented health and safety plan which must include and involve all Contractors under a principal Contractor's control.
- Liaison and cooperation with all other Contractors.
- Supervision of construction work, including appointment of a construction supervisor in terms of the Regulations.
- Risk assessment.
- Fall protection.
- Structures, formwork and support work, excavation work, demolition work, scaffolding and suspended platforms, hoists of any type, and explosive powered tools.
- Electrical installations and machinery on construction sites.
- Use and storage of flammable liquids, water hazards, general housekeeping and stacking and storage, as well as fire precautions.

2.0 HEALTH AND SAFETY INFORMATION

The design described in this document has taken into account the hazards to persons which may occur during construction, commissioning and subsequent use and maintenance. However, the nature of the work is such that certain hazards are unavoidable and will be prevalent during the above operations and these must be taken into account by the Contractor when preparing and implementing the health and safety plan.

In order to assist the Contractor, certain hazards and aspects of health and safety are identified in this document and on the drawings and a Hazard Identification List is provided below to inform the Contractor of any known or anticipated dangers or hazards relating to the design or construction work. The information is provided in order to assist the Contractor to analyse and evaluate the risks and does not, in any way, relieve the Contractor of his/her responsibilities in terms of health and safety.

3.0 HEALTH AND SAFETY PLAN

The Contractor shall be deemed to have read and fully understood the requirements of the above Act and Regulations and to have allowed for all costs in compliance therewith.

The Contractor shall prepare a Health and Safety Plan in respect of the Works in accordance with the Act and Regulations, which shall cover inter-alia the following details:

- Management Structure, Site Supervision and Responsible Persons including a succession plan.
- Contractor's induction training programme for employees, sub-contractors and visitors to the Site.
- Health and safety precautions and procedures to be adhered to in order to ensure compliance with the Act, Regulations and Safety Specifications.
- Regular monitoring procedures to be performed.
- Regular liaison, consultation and review meetings with all parties.
- Site security, welfare facilities and first aid.
- Site rules and fire and emergency procedures.

The Contractor is required to ensure that all sub-contractors or others engaged in the performance of the contract also comply with the above requirements.

4.0 **HEALTH AND SAFETY CONDITIONS**

The Chief Executive Officer of the Contractor shall assume the responsibility in terms of Section 16(1) of the Occupational Health and Safety Act (as amended). Should the Contractor assign any duty in terms of Section 16(2), a copy of such assignment shall immediately be provided to the representative of the Employer as defined in the Contract.

All work performed on the Employer's premises shall be performed under the supervision of the construction supervisor who understand the hazards associated with any work that the Contractor performs on the site in terms of Construction Regulations 2014.

The Contractor shall appoint a Competent Person who shall be trained on any occupational health and safety aspect pertaining to them or to the work that is to be performed.

The Contractor shall ensure that he familiarises himself with the requirements of the Occupational Health and Safety Act and that he, his employees, and any sub-contractors, comply with them.

Discipline in the interests of occupational health and safety shall be strictly enforced.

Personal protective equipment shall be issued by the Contractor as required and shall be worn at all times where necessary.

Written safe work procedures and appropriate precautionary measures shall be available and enforced, and all employees shall be made conversant with the contents of these practices.

No substandard equipment/machinery/articles or substances shall be used on the site.

All incidents referred to in terms of Section 24 of the Occupational Health and Safety Act shall be reported by the Contractor to the Department of Labour and the Employer.

The Employer hereby obtains an interest in the issue of any formal inquiry conducted in terms of Section 32 of the Occupational Health and Safety Act and into any incident involving a Contractor and/or his employees and/or his sub-contractor/s.

No use shall be made of any of the Employer's machinery / plant / equipment / substance / personal protective equipment or any other article without prior arrangement and written approval.

No alcohol or any other intoxicating substance shall be allowed on the site. Any person suspected of being under the influence of alcohol or any other intoxicating substance shall not be permitted access to, or allowed to remain on the site.

Prior to commencement of any work, verified copies of all documents mentioned in the agreement, must be presented to the Employer.

5.0 **HEALTH AND SAFETY HAZARD IDENTIFICATION LIST**

The following list highlights items identified as presenting a hazard or danger to persons during construction and commissioning:

Item	Hazard Description	Applicable to the Project Yes / No / N/A	Hazard Rating (Low, Medium, High) *	Comment / Recommendation
	Are there any specific client H&S requirements for the work?	Yes	High	The work will be undertaken in close vicinity of live 22kV overhead power lines. All regulatory requirements in this regard shall be adhered to.
	Have site archaeological issues been identified and evaluated (might be of historical importance)	N/A		
	Has a geotechnical survey been carried out, and if so do the results indicate hazards which require control measures?	N/A		
	Is the site adjacent to or over public transport (railways, taxi ranks, bus stops etc.)?	No		
	Is the site adjacent to or over water (eg. rivers, dams, sea, canals)?	No		
	Is the site adjacent to, over or under any services or drains etc.(eg. high voltage cables, municipal sewer lines)?	Yes	High	The work will be undertaken in close vicinity of live 22kV overhead power lines.
	Is the site adjacent to, over or under any public buildings such as schools and hospitals?	No		
	Are there any other local hazards such as overhead power cables?	Yes	High	The work will be in close vicinity of live 22kV overhead power lines.
	Will the ground contours present any construction problems?	Np		
	Is there any asbestos removal involved?	No		
	Will excavation be close to live electrical cables or pressure pipes?	No		
	Will any excavation works take place?	Yes		MV and LV pole and stay holes
	Will any work be carried out close to live electrical apparatus?	Yes	High	The work will be undertaken in close vicinity of live 22kV overhead power lines.
	Is there confined space or tank entry work involved?	No		
	Will any steel erection works be taking place?	No		
	Will tower cranes be used or heavy lifting operations taking place?	Yes		

C3.2.4

Item	Hazard Description	Applicable to the Project Yes / No / N/A	Hazard Rating (Low, Medium, High) *	Comment / Recommendation
	Will mobile work platforms, cradles or abseiling be necessary?	No		
	Is the access to the site adequate for vehicles and pedestrians? Are there any special arrangements and/or requirements?	Yes	Low	
	Will the public have access to the site?	Yes		
	Have arrangements been made or co-ordinated for temporary electric supplies?	N/A		
	Have site lighting needs been identified for all stages of the work?	N/A		
	Will any accommodation/ office units be located inside an existing structure?	No		
	Have arrangements been made or co-ordinated for temporary supplies such as water and sewage disposal?	N/A		
	What is the type of roof construction? Evaluate fall hazards	NA		
	Are there any 'Hot Works' to be undertaken?	No		
	Are electrical items to be installed?	Yes	Medium	New MV and LV overhead lines and pole mounted switchgear.
	Will there be any lift installation works?	No		
	Will there be any escalators to install?	No		
	Is the project a fire risk?	No		
	Have all environmental issues been evaluated and controlled?	N/A		
	Are there any specific fall protection hazards not already assessed?	N/A		
	Are there any additional hazards which have been identified as being site specific and which are not covered by the foregoing? If YES, note here:	No		

- * The hazard rating takes into account the likely level of consequence (injury/death) to which workers are exposed, the likely number of workers exposed to the hazard, and the probability of occurrence on the site.

C3.3 PROJECT TECHNICAL SPECIFICATION

1.0 GENERAL

This part of the specification deals with the main items of material and equipment which will be the Contractor's responsibility to supply and install in accordance with this document and the drawings.

Sufficient information is provided in this document and on the drawings to enable the tenderer to accurately price the work. Tenderers must allow for all items, whether specified in detail or not, required to complete the installation in a neat and workmanlike manner.

2.0 STANDARD TECHNICAL SPECIFICATION

This section of the Specification shall be read in conjunction with the Standard Technical Specification, Part C3.5, hereof, and the installation shall comply with the relevant clauses thereof.

All materials used under this Contract shall be of a quality and class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions that may arise without distortion, deterioration or the setting up of undue stresses in any part such as to affect the efficiency and reliability of the plant, and also without affecting the strength and suitability of the various parts for functions which they have to perform.

3.0 SUPPLY AUTHORITY

The Supply Authority for the area is Kouga Municipality and the installation shall fully comply with their requirements.

4.0 POLE MOUNTED TRANSFORMER SUBSTATIONS (PMT's)

The position and designation of the PMT's to be installed are depicted on Drawing No. 10325/E/04 and diagrammatically shown on Drawing No's 10325/E/05. The constructional details are depicted on Drawing No's 10325/E/06 to 08.

The PMT's shall further comply with the relevant clauses of the Standard Technical Specification and as further detailed hereafter:

ITEM	DESCRIPTION	REQUIREMENT
1.0	<u>Expulsion fuses:</u>	22kV Silicone cut-out suitable for 11/22kV operation. 560mm creepage. Fuse elements shall be rated at 15A.
2.0	<u>Lightning arrestors:</u>	Suitable for 22kV operation.

ITEM	DESCRIPTION	REQUIREMENT
3.0	<u>Jumper conductor at transformers:</u>	Jumpers from the overhead line to the expulsion fuses and to MV bushings of the transformer and to the lightning arrestors shall be 25mm ² Cu XLPE insulated conductors with UV stable outer sheath.
4.0	<u>Transformer Ratings:</u>	
4.1	All three (3) transformers	315kVA
4.2	Number of phases:	Three (3)
4.3	Windings:	Double wound
4.4	Material used for transformer windings:	<u>Copper</u> only
4.5	Primary service voltage:	22000 Volt
4.6	Secondary service voltage:	420/240 Volt
4.7	Vector group:	Dyn 11
4.8	Type:	Pole mounted transformer substation, hermetically sealed (welded cover) for outdoor use.
4.9	Primary side circuit arrangement:	Brown glazed porcelain bushings manufactured for severe coastal conditions.
4.10	LV Distribution Board:	Separate LV Distribution Board fitted below the transformer, and suitably sized to accommodate the equipment as indicated on the schematic diagrams, including padlocking facility.
4.11	External Finish:	Zinc metal sprayed and painted in accordance with the requirements for Coastal conditions as laid down in SABS 780. The finishing paint colour shall be avocado green.
4.12	Fittings:	Photo-cell mounted on the outside of the LV distribution box mentioned in Item 4.10 above. It shall be protected with a galvanised steel expanded metal enclosure with a wire mesh grill.

ITEM	DESCRIPTION	REQUIREMENT
4.13	Labels:	Labels shall be provided on the outside of the transformer and for all the equipment in the LV Distribution Box as indicated on the schematic diagrams and in accordance with the Standard Technical Specification.
5.0	<u>Wooden Poles:</u>	In compliance with the Standard Technical Specification and Clause 5.0 hereof.
6.0	<u>Steelwork:</u>	Steelwork to support transformer, etc. shall be as detailed on the relevant drawings. All steelwork shall be hot-dipped galvanised after manufacture.
7.0	<u>Earthing:</u>	The earthing shall be in accordance with the Standard Technical Specification and as further detailed on Drawing No's 10325/E/07 to 09.
8.0	<u>General Requirements:</u>	
8.1	All connections to the overhead line conductors shall be made with Aluminium "AMPACT" connectors, using an approved overhead line crimping tool.	
8.2	Padlocks (one for tap switch and two for LV Distribution Board double door per transformer) shall comply with the requirements of Kouga Municipality.	
8.3	All exposed phase conductor tails of the main LV supply cables between the PMT LV bushings and the LV distribution board to be covered with black coloured UV stable heat shrink material. The cable tail ends at the LV bushings to be colour coded on top of this with 10mm long colour coded heat shrink tags, as per the relevant phase colour.	

5.0 **MV OVERHEAD LINE**

The extent of the MV overhead lines required is depicted on Drawing No. 10325/E/04, with constructional details on Drawing No's 10325/E/09 to 12.

The line routes and pole positions are provisional and for tender purposes only. The Electrical Contractor shall mark-out the line routes as shown on the drawings, and thereafter assist the Engineer in determining whether they are suitable or not, and make any adjustments deemed necessary.

It is the Electrical Contractor's responsibility to ensure that no line is energised until such permission has been obtained, in writing, from the Engineer.

The lines shall further comply with the relevant clauses of the Standard Technical Specification and as further detailed hereafter:

ITEM	DESCRIPTION	REQUIREMENT
1.0	<u>Conductor:</u>	Aluminium Conductor Steel Reinforced (ACSR), code name HARE (6/1/4,72), <u>greased</u> .
2.0	<u>Insulators:</u> - Strain and Line Post.	In accordance with the Standard Technical Specification, insulators shall be suitable for coastal conditions: Strain – Pure silicone rubber Long Rod 22kV, 70kN, 31mm/kV Creepage. Line Post – Capless brown glazed porcelain 22kV, 12,5kN, 31mm/kV Creepage.
3.0	<u>Conductor Fixtures, etc:</u>	
3.1	Conductor dead-ending (at strain insulators)	Contrary to the Standard Technical Specification, install cast iron thimble clevis and “Preformed” dead end.
3.2	Conductor tying (at post top insulator)	Use “Preformed” twin-tie.
3.3	General	“Preformed” products shall be suitable for the “HARE” conductor specified.
4.0	<u>Steelwork:</u>	All steelwork for transformer substations shall be hot-dipped galvanised after manufacture.
5.0	<u>Earthing:</u>	Immediately after the new lines have been erected, it shall be effectively bonded to earth (to ensure safety of workers) near the supply points by way of temporary MV conductors. The temporary earths shall remain in situ until approval is obtained, in writing, from the Engineer to remove it. All hardware on poles shall be bonded with 16mm ² HD Bare Cu Earth conductor.
6.0	<u>Wooden Poles</u>	The new poles shall be <u>machine peeled and inspected by the Engineer at the Suppliers premises before delivery to site and no excessively bent or ragged looking poles will be accepted</u> . Poles must bear the SABS mark.

ITEM	DESCRIPTION	REQUIREMENT		
	Minimum top diam. and diam. at theoretical ground level and depth pole to be planted at (unless otherwise specified), for the following pole lengths:			
	Poles	Top diam.	Ground diam.	Plant depth.
6.1	10 metres	160mm	205mm	1800m
6.2	11 metres	160mm	210mm	1800m
6.3	12 metres	160mm	215mm	1800m
6.4	13 metres	180mm	245mm	2000m
6.5	14 metres	200mm	260mm	2200m
7.0	<u>General Requirements</u>			
7.1	Poles shall be selected on site in view of their ultimate duty so that heavier poles are used where stresses are highest, i.e. for angle-strain structures, and thereafter for in-line strain structures and suspension structures in that order.			
7.2	All connections to the overhead line conductors shall be covered with "Densal" paste and a double layer of "Denso" tape.			
7.3	No midspan through joints will be accepted in overhead conductors.			
7.4	Distance between centre of overhead line and erf boundaries shall be 1000mm.			
7.5	Poles and stays shall not obstruct entrances into erven.			
7.6	All MV stays shall be terminated at the top of the pole using a Single Wrap Guy-Grip.			
7.7	All MV and LV stay guards shall be of the solid PVC type, with black and reflective yellow marking tape evenly distributed over the length of the guard.			
7.8	Pole labels are to be fixed to poles at a minimum height of 3000mm above finished ground level, using electro-galvanised nails.			

6.0 LV OVERHEAD LINES

The extent of the LV overhead lines required is depicted on Drawing No. 10325/E/0 and diagrammatically shown on Drawing No. 10325/E/05, with constructional details depicted on Drawing No's 10325/E/13 to 20. The line routes and pole positions are provisional and for tender purposes only.

The Contractor shall assist the Engineer to finalise the line routes in the area, before commencing with the work.

The compliance with Telkom requirements shall also apply to LV lines. Since Telkom overhead lines will exist in conjunction with LV lines in the future, it is a requirement of this Specification that the Contractor liaise closely with Telkom regarding the position of poles and the construction of LV lines.

Double clamps or insulation piercing connectors shall be used on all neutral connections at bundled conductor overhead lines.

Pole labels with 50mm high black lettering are to be fixed to poles at a minimum height of 3000mm above finished ground level, using electro-galvanised nails. The LV lines shall generally comply with the relevant clauses of the Standard Technical Specification, Part C3.2.2 hereof and as further detailed in the table hereafter:

ITEM	DESCRIPTION	REQUIREMENT
1.0	<u>Conductor:</u>	
1.1	For main power distribution:	
1.1.1	Type	Aerial bundled conductor with supporting core system (French system).
1.1.2	No. cores and sizes	The following sizes are required: 3 x 50mm ² Al + 1 x 54,6mm ² Al + 1 x 25mm ² Al. 3 x 70mm ² Al + 1 x 54,6mm ² Al + 1 x 25mm ² Al.
1.2	For house service connections:	
1.2.1	Type	10mm ² Airdac.
1.2.3	<u>Phase Core</u>	
1.2.3.1	Conductor	Standard hard drawn copper
1.2.3.2	Insulation	Red XLPE and UV Stabilised.
1.2.4	<u>Neutral Core</u>	
1.2.4.1	Concentric conductor	Annealed copper wires
1.2.4.2	Insulation	Covering of Black PE
1.2.5	Earth Conductor	Concentric layer of bare copper wires
1.2.6	Conductor Cross-section	10mm ²
2.0	<u>Wooden Poles:</u>	Poles shall be <u>machine peeled and inspected by the Engineer at the Suppliers premises before delivery to site and no excessively bent or ragged looking poles will be accepted.</u> Poles must bear the SABS mark.
	Minimum top diameter and diameter at ground level and depth to be planted (unless otherwise specified), for the following pole lengths:	

ITEM	DESCRIPTION	REQUIREMENT		
	Poles	Top diameter	Ground diameter	Plant depth
2.1	8 metres	140mm	175mm	1500mm
2.2	9 metres	140mm	180mm	1500mm
2.3	10 metres	160mm	205mm	1800mm
3.0	Earthing	Combined Neutral Earth (CNE) System as further detailed in the Standard Technical Specification and on the drawings.		

7.0 **CONSUMER SERVICE CONNECTION BOXES (CSCB's)**

The extent of the overhead service cabling to the houses and pole mounted Consumer Service Connection Boxes (CSCB's) at LV overhead line poles is depicted on Drawing No's 10325/E/18 to 25. The mounting positions and equipment layout inside the CSCB's are shown on Drawing No. 10325/E/25.

The CSCB's shall be similar or equal approved to the Polybox Polyethylene, GreenBro IP54 pole mounted box fitted with neutral and earth bars, and interconnecting conductors as shown on Drawing No. 10325/E/25.

The box shall be complete with 4 (four) min. 2,5m long min. 16mm² copper UV stable, black insulated, conductor tails for connection to the bundled conductor overhead line, and stainless steel brackets for strapping the box to the wooden pole. The interconnecting conductors shall be colour coded (Red, White and Blue stripe and Black for neutral).

The CSCB's required for Phase 2B shall each be fitted with a minimum of three (3) 63A single phase, CBI type QF-1(26), orange handle (Curve 1) circuit breakers and also three (3) split pre-payment kWh meter Measurement and Control Units (MCU's). The total number required per CSCB for Phase 2B is quantified in the Bills of Quantities and is determined by the number of houses.

Three phases shall be connected to each CSCB. Details of which phase colours must be connected for each house are provided on Drawing No. 10325/E/04. The conductors/cables shall be installed as to create a "drip loop" to prevent water running down the conductors/cables into the connectors. Stainless steel straps, 19mm wide, shall be used to strap the box to the pole. The conductors/cables shall be neatly tied together with cable ties and the neutral conductor fixed to the pole with a suitably sized u-nail.

The protection rating of the box shall be IP54.

Stainless steel bolts and nuts to be used to lock doors of CSCB's.

All conductor/cable entries into the box shall be by means of suitably sized UV stable (grey) PVC compression glands.

8.0 **INSTALLATION INSIDE HOUSES**

This contract covers the supply and installation of a Pre-payment kWh Meter in each of the houses. The Pre-payment meters shall be served from the existing System Master Station (SMS) and Credit Dispensing Unit (CDU) of Kouga Municipality at their Humansdorp office.

Specifications for the Pre-payment Meter is included under Clause No. 9.0 hereafter.

The typical installation at each house, together with the termination and connection of the overhead service connection cable is depicted on Drawing No's 10325/E/21 to 24.

The split pre-payment meter's User Interface Unit (UIU) shall be mounted next to the semi-recessed distribution board, located in the kitchen area of the house (by others).

The following shall apply for the house installations:

- (i) The installation shall comply with the SANS 10142, Code of Practice for the Wiring of Premises.
- (ii) Fixing screws shall be plated steel, and "Fisher" or similar PVC plugs shall be used to secure screws to the walls.
- (iii) The cable supplied with the User Interface Unit (UIU) shall be terminated to the load terminal of a 20A circuit breaker forming part of the semi-recessed distribution board supplying internal 16A socket outlets.
- (iv) On completion of each house installation, a "Certificate of Compliance" shall be issued to the House Owner with a copy to the Municipality and the Engineer in compliance with the relevant Clauses of the Standard Technical Specification, Part C3.5, hereof.

9.0 **PREPAYMENT kWh METERS**

This contract covers the supply and installation of the meters. These meters are also known as "Single Phase Electricity Dispensers".

The meters shall be of the smart prepayment electricity meter type with a User Interface Unit (UIU) installed inside the house and shall comply with the following requirements:

- It shall have a smart configuration, which supports remote disconnect and reconnect of the supply control switch. The meter shall be able to form part of an end to end Advanced Metering Infrastructure (AMI) system when Data Concentrators (DC) are installed. The meter shall communicate to the DC by means of open standard G3-PLC communications.
- It must support account configuration of Standard Transfer Specification (STS) prepayment and post-payment (credit metering).
- It shall be industry and Eskom's standard STS compliant – Certificate of Compliance (COC) to be provided.
- It shall be industry standard Device Language Message Specification (DLMS) compliant – COC to be provided.
- For operating and maintenance purposes, the meter shall support visual indications of load switch status and G3-PLC communications status.
- It shall support an IEC optical interface for field and service read-out and parameterization.
- Ancillary meter support tools, licenses and training for key municipality personnel.
- Full compliance with SABS 1524-1: 1994 and NRS 009.
- Current limiting from 1A to 60A adjustable in 1A steps.
- Maximum initial current limit manufacturer preset at 20A.
- Voltage surge protection to comply with SABS 171.
- Fitted with tamperproof protection.
- Factory fitted with a 5A plug top.

C3.3.9

A remote audit and monitoring device (G3-PLC data concentrator) for the split prepayment kWh meters shall be supplied and installed under this contract. This device will make it possible to remotely audit and monitor the meters and also supports a range of direct reading and control tasks such as the disconnect and reconnect of the meter supply control switch.

The G3-PLC data concentrator shall comply with the following requirements:

- Support 2 Ethernet Local Area Network (LAN) ports for local configuration and for future fiber optic connection.
- Provide a modular modem which enables Access Point Name (APN) connection via the Wide Area cellular network.
- Provide a web based admin client, allowing the municipality engineers to remotely access the DC (via the cell phone APN network) with the purposes of G3-PLC network and communications analysis and fault finding.
- Be G3-PLC compliant – COC to be provided.

A 10A single pole, QF-1(13), circuit breaker shall be supplied and installed inside each house's Sub-Distribution Board (SDB), which to supply a dedicated surface mounted 5A unswitched socket outlet for the split prepayment meter UIU. The socket outlet shall be mounted adjacent to the SDB.

The meters and data concentrator shall be compatible to operate work together with the existing pre-payment meters in the remainder of Phase 2B, i.e. the Landis+Gyr E460 type smart meter.

10.0 **EARTHING**

The PMT's shall be earthed as depicted on Drawing No's 10325/E/06 to 08.

The LV bundled conductor neutral shall be earthed at the poles as indicated on Drawing No. 10325/E/04 by means of a 1,5m long earth spike and 70mm² Cu black PVC insulated down conductor.

All earth down conductors against poles shall be fixed with stainless steel straps and shall be protected with 32mm Ø hot dipped galvanised steel kicker pipe from 500mm below to 3500mm above ground level. The pipe ends shall be sealed with "Denso" tape. The straps shall be minimum width 19mm and spaced at 1 metre intervals. Care shall be taken to ensure that the cable conductor is not damaged due to over tightening the straps.

The combined MV and LV earth resistance at the PMT shall not exceed 1 ohm. Should this resistance not be achieved, two separate earth systems shall be installed for the MV and LV earths, of which the earth resistance shall each be below 10 ohm.

Earthing of the installation shall comply with the relevant clauses of the Standard Technical Specification, Part C3.5 hereof, and the AMEU Code of Practice for the Application of Neutral Earthing on Low Voltage Distribution Systems

11.0 **22kV INDOOR CIRCUIT BREAKER**

The detailed specification of the equipment required is given in the table hereafter. It must be noted that Schedule A gives information affecting and laying down requirements for the equipment, whilst Schedule B is to be completed by the Tenderer to provide technical and other particulars of the equipment offered and for acknowledgement of certain requirements. Failure to complete Schedule B could invalidate the tender. The detailed specification shall be read in conjunction with the Standard Technical Specification.

ITEM	DESCRIPTION	SCHEDULE "A"	SCHEDULE "B"
1.0	<u>General</u>		
1.1	Type	Extensible indoor, metal clad, withdrawable vacuum interrupter & air insulated	.....
1.2	Voltage rating	24kV	.....
1.3	Current rating	800A	.....
1.4	Rated impulse withstand voltage	125kV	.....
1.5	Rated short-circuit current	25kA for 3 seconds	.....
1.6	Arc Flash Detection:		
	a) Circuit breaker chamber	a) Point sensor	a)
	b) Cable termination chamber	b) Point sensor	b)
	c) Busbar chamber	c) Point sensor.	c)
1.7	Internal Arc Classification	To fully comply with IEC 62271-100 and -200. Test certificate to be provided.	.....
2.0	<u>22kV Feeder Circuit Breaker</u>		
2.1	Current rating	Min 800A	.....
2.2	<u>Current transformer core details:</u>		
2.2.1	<u>Protection (over current and earth fault):</u>		
2.2.1.1	Turns ratio	Core No. 1 1 / 400 turns	.....
2.2.1.2	Accuracy class	TPS	.....
2.2.1.3	Rated knee point voltage	Supplier to confirm	 volts
2.2.1.4	Magnetising current	Supplier to confirm	 mA
2.2.1.5	Maximum secondary winding resistance	Supplier to confirm	 ohm at 75°C
2.2.2	<u>Metering:</u>		
2.2.1.1	Ratio	Core No. 2 400 / 1 Ampere	.....
2.2.1.2	Accuracy class	0.2	.....
2.2.1.3	Rated burden	10 VA	 volts
2.3	Potential indicators	Three neon lamps energised from capacitor bushings to indicate cable live.	.....
2.4	Protection relay type	SEL-751	.....
2.4.1	Model Option Table Code (MOT Order Code)	751001DCD0X7081A230	.....

ITEM	DESCRIPTION	SCHEDULE "A"	SCHEDULE "B"
2.4.2	Configuration: a) Firmware b) Chassis and Mounting c) User Interface d) Power Supply e) Front Panel Options f) Secondary Input Current g) Control Input Voltage h) I/O Board	a) Standard b) Horizontal Panel mount c) English Language d) 30V DC e) Front Panel Options; 5" Colour Touchscreen Display with 8 x Pushbuttons f) 1 Amp Phase, 1 Amp Neutral g) 30V DC h) As per MOT Order Code in Item 2.4.1 above	a)..... b)..... c)..... d)..... e)..... f)..... g)..... h).....
2.5	Closing mechanism	30V DC Motor Charged spring closing mechanism.	.....
2.6	Tripping	110V AC	.....
2.7	Busbars	1250A rated normal current single busbars.	.....
2.8	Auxiliary switches	3NO + 3NC	.....
2.9	Heaters	One or more black element heaters controlled by thermostats.	..... ..... .....
2.10	Instrumentation	Voltages and currents to be indicated on the protection relay.	..... ..... .....
2.11	Telemetry system:	All inputs and outputs (I/O) for remote status indication and control to be wired and connected to relay inputs, where applicable. Should no relay inputs be available all I/O to be wired to terminal connectors at back of panel.	..... ..... ..... ..... ..... ..... ..... ..... ..... .....
2.11.1	Status inputs:	Circuit breaker (CB) closed CB open CB spring charged CB gas low CB in service position Bus fault trip CB fault trip CB supervisory CB in earth position CB in busbar earth position	..... ..... ..... ..... ..... ..... ..... ..... ..... .....
2.11.2	Analogue inputs: Analogue outputs from protection relay to be use - avoid the use of additional transducers.	White phase amps A phase voltage B phase voltage C phase voltage	..... ..... ..... ..... .....
2.11.3	Control outputs	CB open control CB close control	..... .....

ITEM	DESCRIPTION	SCHEDULE "A"	SCHEDULE "B"
3.0	Loose equipment	Operating handle, racking handle, test spears, integral earth handle, carriage ramp and tool rack.	..... ..... ..... .....
4.0	Incoming cables	Rear bottom cable entry. Gland plate with wooden cleat to accept heat shrink termination and 185mm ² x 3 core Al, Table 20, PILCA cable.	..... ..... ..... .....
5.0	Servicing	Method of obtaining access to service internal components unbolting / cutting.	..... ..... .....
6.0	Guarantee	1 Year	.....
7.0	Outer dimensions		..... ..... .....
8.0	Mass		 kg
9.0	Name and physical address of Manufacturer		..... ..... ..... .....
10.0	Delivery period		 weeks
11.0	Any departures from Specification		..... ..... ..... .....

12.0 **MV UNDERGROUND CABLE**

The extent of the cabling required is depicted on Drawing No. 10325/E/04.

The MV cable shall paper insulated, 12,7/22kV, 3 Core General Purpose Screened Cable, Table 20 with conductor size as depicted on the drawing.

All cable routes for new cables must be confirmed on site prior to trenching.

Cable joints shall be permitted in exceptional circumstances only and on the written permission of the Engineer. All MV cable joints must be marked with a cable marker.

All MV cable joints and terminations shall be done by an experienced cable jointer / terminator who shall be prior approved by the Engineer and the Municipality. Details of the Tenderer's proposed jointer / terminator shall be provided in the Schedule of Particulars forming part hereof. All MV cable joints and terminations shall be pressure tested to SABS 97. A test certificate shall be handed to the Engineer and Municipality before switch-on.

Concrete slabs and PVC marker tape shall be placed over all MV cables as depicted on the said drawing.

13.0 **TRI-SWITCH**

Where a new tri-switch is called for, it shall be similar or equal approved to the Linegear 2000 Type MK5 tri-switch, rated for 200Amp at 24kV.

Earthing of a tri-switch shall consist of a 25m length of 70mm² Cu black PVC insulated conductor, 32mm Ø, 6m long kicker pipe, two (2) off 1.2m long earth spikes and two (2) earth spike concrete markers with aluminium face plate. The cable markers shall be stencilled "EARTH SPIKE". The two (2) earth spikes shall be positioned 5m apart.

14.0 **POLE MOUNTED LOAD BREAK SWITCH**

Where a pole mounted load break switch is called for, it shall be similar or equal approved to the ABB type Sectos NXA24C630A1, 2-way, 3-position (On-Off-Earth), manually operated, SF6-insulated load break switch.

The switch shall be supplied with a custom made galvanised steel stand-off bracket which to be mounted on an existing 12m single wooden pole.

Two (2) sets of three (3) 24kV lightning arrestors each shall be supplied with the switch, each set mounted on either side of the switch, incl. mounting brackets. The lightning arrestors shall be suitable for 24kV operation.

Earthing of a pole mounted load break switch shall consist of a 25m length of 70mm² Cu black PVC insulated conductor, 32mm Ø, 6m long kicker pipe, two (2) off 1.2m long earth spikes and two (2) earth spike concrete markers with aluminium face plate. The cable markers shall be stencilled "EARTH SPIKE". The two (2) earth spikes shall be positioned 5m apart.

15.0 **SUBSTATION BUILDING**

The new 22kV substation building shall be erected at position as shown on Electrical Engineers' Drawing No. 10325/E/04, with constructional details depicted on the following drawings:

- Electrical Engineers' Drawing No. 10325/E/05.
- Structural Engineers' Drawing No's P161 – Plan P1 to P6
- Structural Engineers' Bending Schedule Roof Slab

Drawing No. 10325/E/04 and 05 are included under Annexure A and the Structural Engineers' drawings included under Annexure B hereof.

The Building Sub-Contractor to undertake this part of the work shall be prior approved by the Engineer / Municipality, and allowance must be made to meet all the requirements of the Municipality's Building Inspector.

The building work shall further comply with the clause "Substation Buildings" of the Standard Technical Specification, Part C3.5 hereof.

16.0 **FENCING**

A boundary fence shall be supplied and installed around the switch room building as depicted on Drawing No. 10325/E/01.

Note that Schedule A of the tables given hereafter lay down the detailed requirements of the Specification while Schedule B must be completed by the Tenderer providing quantities and technical particulars of the equipment/installation offered. Failure by the Tenderer to complete Schedule B could invalidate the tender.

ITEM	DESCRIPTION	SCHEDULE "A"	SCHEDULE "B"
1.0	Standard Specification	Similar or equal approved to the Betafence manufacture.	..... .....
2.0	Make and Type offered	Betaview 3, PVC coated	.....
3.0	Fence Height	2,4 metres	.....
4.0	Anti-climb device	Continuous serrated saw tooth spike along top edge of fence. To Manufacturer's detail.	..... ..... .....
5.0	Underdig	Continuous 450mm x 600mm flat mesh panel underground along bottom rail of fence. To Manufacturer's detail.	..... ..... ..... .....
6.0	Colour	Anthracite RAL 7021	..... .....
7.0	Guarantee	10 Year corrosion proof	.....
8.0	Name and physical address of Manufacturer		..... ..... .....
9.0	Delivery period		 weeks
10.0	Any departures from Specification		..... ..... .....

17.0 **FIRE EXTINGUISHERS**

Fire extinguishers shall be installed in the 22kV switch room in the position as indicated on Drawing No. 10325/E/04. The fire extinguishers shall further comply with Clause "Fire Extinguisher" of the Standard Technical Specification, Part C3.5 hereof.

18.0 **AUTO-RECLOSERS**

Where 22kV auto-reclosers are called for, it shall similar or equal approved to the Cooper Power Series NOVA 27i type.

Note that Schedule A of the tables given hereafter lay down the detailed requirements of the Specification while Schedule B must be completed by the Tenderer providing quantities and technical particulars of the equipment/installation offered. Failure by the Tenderer to complete Schedule B could invalidate the tender.

ITEM	DESCRIPTION	SCHEDULE "A"	SCHEDULE "B"
1.0	Standard Specification and Ratings	To comply with NRS 036-1/1994 and ANSI C37. 60/1981.	.....
2.0	Make and Type No. offered		.....
3.0	Maximum Voltage	38kV max.	.....
4.0	Rated Basic Impulse Level	150kV	.....
5.0	System connection	3-Phase, 4 wire	.....
6.0	Current input range	1A rating, 20A 4S	.....
7.0	Voltage input burden	0,2VA at 220V AC	.....
8.0	Rated continuous current	630 Amps	.....
9.0	Short circuit current, Symmetrical	12,5kA	.....
10.0	Making Current, Asymmetrical Peak	32kA	.....
11.0	Cabling Charging Current	25 Amps	.....
12.0	Interface and electronic control unit	Control-Powered Interface with FXD control unit (or similar approved), and 220V AC input voltage.	.....
13.0	Mounting	For single pole. Hot dip galvanised bracket shall be provided for mounting of auto-recloser on a single pole.	.....
14.0	Lightning Arrestor Mounting Brackets	The unit shall be equipped with removable lightning arrestor mounting brackets on <u>both the Primary and Secondary sides</u>.	.....
15.0	Operation	The unit shall not require a high voltage supply on its bushings for operation.	.....
16.0	Servicing	Method of obtaining access to service internal components unbolting / cutting.	.....
17.0	Enclosure	Stainless Steel, rated IP65. Manufactured for coastal conditions.	.....
18.0	Guarantee	1 Year	.....
19.0	External dimensions		.....

ITEM	DESCRIPTION	SCHEDULE "A"	SCHEDULE "B"
20.0	Mass		kg
21.0	Name and physical address of Manufacturer		..... ..... ..... ..... .....
22.0	Delivery period		 weeks
23.0	Any departures from Specification		..... ..... ..... ..... ..... .....

Earthing of an auto-recloser shall consist of a 25m length of 70mm² Cu black PVC insulated conductor, 32mm Ø, 6m long kicker pipe, two (2) off 1.2m long earth spikes and two (2) earth spike concrete markers with aluminium face plate. The cable markers shall be stencilled "EARTH SPIKE". The two (2) earth spikes shall be positioned 5m apart.

19.0 **TRENCHING, BACKFILLING AND COMPACTION**

Disturbance to existing vegetation must be kept to a minimum at all times during construction. Where small trees, plants and shrubs located on the cable route need to be removed, it shall be replanted in its same position after installation of the cable.

A 2% cement mixture shall be added to the backfilling for all poles and stays. Backfilling and compaction to further comply with the Standard Technical Specification, Part C3.5.

Disposal of surplus or unsuitable material including haulage shall be free of charge up to 5km from the site. A Rate Only (R/O) shall be allowed for in the Bills of Quantities for any distance exceeding 5km.

20.0 **PADLOCKS**

Padlocks shall be provided for all equipment and shall comply with the requirements of Kouga Municipality.

21.0 **LABELS AND NOTICES**

Designation labels shall be provided for the poles and pole mounted switchgear as indicated on the drawings and elsewhere in the specification.

Notices required in terms of the Occupational Health and Safety Act shall be supplied and installed in- and outside the new 22kV substation "SS-KRUISFONTEIN".

The notices shall be similar or equal to the following Kontra Signs catalogue numbers:

Resuscitation Notice (internal): WC 661 – DANGER ELECTRICAL SUBSTATION NOTICE
 Danger Notices (external): WC 667 – DANGER NO ENTRY

WC 671 – DANGER UNAUTHORISED HANDLING OF
MACHINERY AND ELECTRICAL APPARATUS
PROHIBITED

Labels and notices shall further be provided in compliance with the relevant requirements of the Standard Technical Specification, Part C3.5, hereof.

22.0 INSPECTION, TESTING AND COMMISSIONING

The inspection, testing and commissioning procedure to be followed shall comply with the relevant clause of the Standard Technical Specification, Parts C3.5 hereof.

Provision shall be made for a Specialist Protection Settings & Commissioning Engineer to programme, test and commission the entire installation of the new 22kV switchgear, including verifying all other control functions. The programming and tests to be performed shall include, but not be limited to the following:

- (i) Primary injection of CT's to protection relays, including ratio, polarity and magnetization and insulation tests.
- (ii) Primary injection of VT's to protection relays, including ration, polarity and insulation tests.
- (iii) Testing all circuit breakers' contact resistance, insulation, speed and general functionality.
- (iv) Secondary injection testing of protection relays to the settings provided.
- (v) Functional Testing of the scheme including all primary and secondary equipment.
- (vi) Functional Testing of software logic in the scheme.

Three (3) sets of the Commissioning Engineer's test report, containing all test certificates and operating and maintenance manuals of all switchgear relays, etc shall be issued to the Engineer on handover.

C3.4 STANDARD PRELIMINARY AND GENERAL INFORMATION**1.0 PREAMBLE**

This Part of the Tender Document deals with general requirements to be met and standards for plant and workmanship which shall be observed in the execution of the contract covered by this Tender Document. "Plant" is defined as machinery, apparatus, materials, articles and things of all kinds to be provided under the contract other than Construction Equipment.

When the requirements of this Part are at variance with any detailed requirement of any other Part hereof, or the Drawings, such other detailed requirements shall take precedence. All items of plant which are specified in this Tender Document or by nature of the installation are required, shall comply with this Part, unless stated otherwise elsewhere in this Tender Document. In the event of ambiguity the Engineer shall be asked for his clarification prior to submission of the Tender.

Any reference herein to "elsewhere in this Tender Document" shall be deemed to mean in any of the other Parts of this Tender Document or on the Drawings.

This Tender Document covers major items required for this installation but shall not limit the contractor's responsibility to provide everything necessary to complete the contract. The works shall be carried out with best quality items of plant and to a high class of workmanship. All items of plant shall be the best of their respective kinds, and the contractor shall, upon request of the Engineer, furnish him with proof to his satisfaction that they so comply.

This Tender Document and accompanying Drawings are copyright and are the property of the Engineer and must be returned to him whether a bona-fide tender is submitted or not.

2.0 ALTERNATIVE OFFERS

No alternative tender offers will be considered.

3.0 SPARE PARTS

Tenderers shall state in the Schedule of Particulars / Information, Part T2.2.3, the names of the accredited South African Agents from whom spare parts for all items of plant offered are obtainable and the place nearest to the Works from which such spare parts are available. Submission of a tender will be construed as confirmation that spare parts for all equipment offered are readily available, and the contractor will be held responsible for any costs involved if this should prove to be otherwise.

4.0 DELIVERY TIMES OF MANUFACTURED ITEMS

The Tenderer shall, if required in the Schedule of Equipment Offered, state the times quoted by suppliers for both dispatch and delivery of major items of plant which may contribute to an extension of the time for completion.

The contractor shall, during the continuance of the contract, keep the Engineer well and sufficiently informed regarding the placing of all orders for materials and the progress of manufacture of any plant so as to ensure that no extension of the time for completion may be occasioned because of non-delivery of plant within the time specified for delivery of same. A delivery status report on each major item of plant shall be submitted by the 7th of every second month.

The contractor shall at all times remain fully and solely responsible for the timeous delivery to site of all plant, equipment and materials in terms of this contract.

5.0 **PACKING AND DELIVERY**

Plant shall be carefully packed and protected to avoid mechanical or other damage during transport and off-loading. The contractor will be held responsible for any damage occurring prior to its acceptance in writing by the Employer.

Every item of plant is to be clearly labelled with its description and with the contract number.

All consignments shall be addressed to the contractor on site and he/she shall make prior arrangements for receipt and storage upon arrival. The employer will not accept delivery of items of plant for the contractor unless the contractor has made prior arrangements to this effect with the employer. The contractor will be required to make all arrangements for off-loading since no equipment for this will be available on site unless specifically stated to the contrary elsewhere herein.

6.0 **LAYOUT OF INSTALLATION**

The layouts shown on the Engineer's Drawings shall be strictly adhered to in principle, only alterations to suit specific plant being provided being acceptable. The Engineer's Drawings show general arrangements of layout but the contractor is required to prepare detailed Drawings of pipework, fabricated plant, machine and plant rooms, ductwork, switchboards, transformers, sub-stations, etc. The position of services detailed by the Engineer shall not be altered.

All architectural and structural dimensions shown on the drawings are approximate and must be verified by the contractor on Site. All measurements specially marked on the drawings in connection with engineering services shall be strictly adhered to.

If Tenderers require alterations to structure these must be described at the time of tendering. Minor structural alterations which may facilitate the work can be arranged with the Engineer as the work progresses, but no claims will be entertained for alteration of any part of the contract works constructed before the necessary dimensions and details have been verified. Before work on any particular section is commenced, the position of all control equipment and plant shall be approved by the Engineer.

7.0 **DRAWINGS, CERTIFICATES AND OPERATING INSTRUCTIONS**

7.1 Tenderers shall submit with their tender, outline drawings and pamphlets showing principal dimensions of the plant offered together with a general description of its operation.

7.2 In instances where, for any reason, the contractor is required to prepare and/or submit detailed drawings of any portion of the contract works, the contractor shall, within one month of the date of acceptance of the contract tender, or on such other date as may be agreed with the Engineer to suit the contract programme, submit duplicate copies of such contractor's detailed drawings to the Engineer for approval. A further two copies of the finally approved drawings shall subsequently be supplied to the Engineer. The following drawings shall be submitted, as appropriate:

General arrangement details of all items of plant.

Schematic and wiring diagrams of all switchboards and control systems.

Detailed layout drawings of all pipework, ducting, cable racking etc.

Detailed layouts, sections and elevations of all plant rooms.

Rating plate details of all plant including inter alia- max. kW rating, speed, temperature limitations, no-load voltage, full load current, percentage impedance, etc.

Cable termination arrangements of all transformers, motors etc.:

Detailed drawings of all plinths, foundations or bases.

Failure to comply with this requirement may result in the Engineer instructing the contractor to place the order for the specific item of plant with another Manufacturer. Where failure of the Contractor to ensure that the proposed Manufacturer complies with this requirement necessitates the above action being taken, no increase in price will be considered.

- 7.3 The contractor shall, within one month of acceptance of the contract tender, or on such other date as may be agreed with the Engineer to suit the contract programme, submit triplicate copies of type test certificates issued by an authorised inspection authority or other approved testing agency in respect of all items of plant for which such certificates are required by the Engineer.
- 7.4 After completion of manufacture, all test certificates called for elsewhere in this Part shall be provided in duplicate.
- 7.5 Prior to the issue of the Practical Completion Certificate the following documents shall be provided, as appropriate, in duplicate, bound in a durable folder bearing the contract title and number:

Test certificates relating to tests done after completion of the installation as called for elsewhere in this Part.

Catalogue extracts of all major items of plant with performance curves marked to show operating duties.

List of spare part numbers and local Agents for these parts.

"As built" drawings, including layouts, sections, wiring and control diagrams and plant schematic diagrams. These are to show in detail the positions of poles, stays, cables, joints, sleeves, ducts, heating and cooling coils, dampers, pipes, control and regulating valves, air release valves, expansion joints, fixed equipment and all other pertinent items of plant. In the case of buried services, the route of such services and location of all cables, pipes, joints, valves, tees, access manholes, etc. are to be dimensioned relative to permanent and fixed objects, and the GPS coordinates must be provided. These drawings must depict the complete installation as finally commissioned.

Detailed instruction manuals covering the operation, maintenance and servicing of each item of major plant provided under this subcontract and, where the complete plant has been supplied under this subcontract, the operation of the plant as a whole.

In addition, one complete set of Engineer's Drawings clearly marked up to indicate all alterations made to the original drawings must be provided.

The contractor shall note that the Practical Completion Certificate may be withheld until the above has been complied with.

8.0 **STANDARDS AND CODES OF PRACTICE**

The installation shall comply with the following, and all amendments thereto, as appropriate:-

The Occupational Health and Safety Act and Regulations

SABS 0142 Code of Practice for the Wiring of Premises, as appropriate (referred to herein as the Wiring Regulations).

The Post Office Act.

The SAIEE Code of Practice for Overhead Power Lines.

The Local Authorities: Standard Electricity Supply By-Law and appropriate Additional By-Law or Regulations.

Any further Specification, Regulation or Code of Practice stated elsewhere in this Specification.

All items of plant supplied and/or installed, whether expressly specified herein or not, shall conform in respect of quality, manufacture, tests and performance with the requirements of the appropriate South African National Standards (SANS) Specifications and addenda thereto, or, if no such Specification exists covering any one or more of these requirements, with the relevant requirements of the appropriate British Standard Specifications and addenda thereto, except where elsewhere required by this Specification or approved by the Engineer. Where the South African Bureau of Standards has issued a licence for the use of its Mark on products complying with any of its Specifications, only such products which carry the Mark shall be supplied.

Preference will be given to plant manufactured in South Africa.

9.0 **WORKMANSHIP**

All work shall be carried out by qualified artisans or registered apprentices or, only where appropriate, labourers, under the constant supervision of a qualified artisan. At no stage during the construction programme shall any work be carried out without adequately qualified and experienced installation personnel being on site. If the contractor fails to comply with this requirement, the Engineer has the right to instruct the contractor to suspend the contract work. All costs incurred in so doing shall be for the account of the contractor.

10.0 **CO-ORDINATION OF SERVICES ON SITE**

The contractor will be required to work in close co-operation with other specialist direct contractors and subcontractors to ensure that no conflict arises between the various services, and to plan the progress of the various aspects of his work. It is imperative that such close liaison continues throughout the duration of the contract.

11.0 **INTERRUPTION OF EXISTING SERVICES**

No interruption of existing services will be permitted without the express permission of the Engineer and/or the Employer or his representative, given as a result of written notification by the contractor of the date, time and duration of such interruption. Any costs arising from the interruption of any service without such permission shall be for the contractor's account.

12.0 **BUILDER'S WORK**

All builders' work will be carried out as described in Part C3.1 of this Tender Document. The onus shall be on the contractor to ensure that all work carried out by others in this respect, is to the contractor's satisfaction.

Where builders work is to be carried out by others, the contractor shall notify the Engineer timeously of the positions where holes, cuts and recesses will be required and shall ensure that each is correctly located and that heavy-gauge draw-wires are supplied and installed in all sleeves.

13.0 **APPROVAL OF DRAWINGS**

All Drawings, circuit or schematic diagrams prepared by or on behalf of the contractor for submission to the Engineer in terms of the requirements of this Tender Document shall have been thoroughly checked, corrected where necessary and signed as approved by the subcontractor, prior to such submission.

14.0 **OPERATING, MAINTENANCE AND SERVICING PROCEDURES**

The contractor shall, by agreement with the Engineer, instruct the Employer's appointed Representative in routine operating, maintenance and servicing procedures of all items of plant supplied under this subcontract, and shall ensure that the Employer or his/her Representative, fully understands the documents provided in terms of Clause 7.5 hereof.

15.0 **MAINTENANCE**

During the defects liability period, up until issue of the Final Approval Certificate, the contractor shall, in addition to attending to any lists of work to be completed which may be issued by the Engineer, carry out full maintenance and servicing operations specifically recommended by the suppliers of any item of plant used in the contract works to maintain it in full and correct operation. Such maintenance shall include all attention necessary to comply with the suppliers' recommendations and shall include the provision of all necessary consumable items. The contractor will also be required to make any adjustments necessary during this period to ensure the satisfactory operation of the plant.

On completion of each such maintenance visit the contractor shall submit to the Engineer a schedule detailing the work done, which schedule shall have been countersigned by the Employer's representative, whereupon a certificate will be issued for moneys due, in respect of the particular maintenance service, as included in the original tender price.

Notwithstanding any maintenance and servicing which may be carried out during the defects liability period, the contractor shall carry out a full maintenance and servicing operation at the end of the defects liability period and before the Final Approval Certificate will be issued.

Allowance for all costs in relation to the above must be made in the tender price. It shall be noted that the Engineer reserves the right to omit partly or wholly the prices submitted for the maintenance of the contract works, should the installation not be adequately maintained within the stipulated maintenance period.

The Employer may request the contractor to enter into a Service/Maintenance Agreement for the contractor to continue to maintain and service the contract works, or a portion thereof, beyond the date of issue of the Final Approval Certificate. The terms and duration of such an Agreement shall be subject to mutual agreement between the Employer and Contractor, and shall be concluded before the issue of the Final Approval Certificate.

Mutually agreeable conditions will be negotiated by the Engineer with the Contractor should the contract works not be put into operation immediately on issue of the Practical Completion Certificate.

C3.5 STANDARD ELECTRICAL SPECIFICATION**SECTION 1 – REGULATIONS**

The following Regulations shall apply as applicable:

Electricity Act, 1987 (as amended)

Occupational Health & Safety Act, 1993 (as amended)

Post Office, Act 1958 (as amended)

SECTION 2 – STANDARDS

With the exception of Clause 1.0, all clauses hereafter will first contain a list of the SANS, NRS, BS, CKS, etc. Standards, and thereafter the Clinkscales Maughan-Brown Standards, whilst the latter Standards shall take precedence over the afore-mentioned Standards.

The Project Technical Specification contained elsewhere in this document shall, however, take precedence over all Standards contained in this Section.

1.0 DEFINITION

In this Part, the term "Contractor" means the person, firm or company whose tender has been accepted for the work specified in the document of which it forms a part.

High Voltage (HV):	Voltage in excess of 33 000 Volt
Medium Voltage (MV):	Voltage of 6 600 to 33 000 Volt
Low Voltage (LV):	Voltage up to 1 000 Volt

2.0 ELECTRICAL SUPPLY AND PHASE ROTATION

SANS 1019	Standard voltages, currents and insulation levels for electricity supply
SANS 1816	Electricity supply - Quality of supply: Power quality instruments
NRS 048	Quality of supply

CMB Standards

- 2.1 Electrical power supply details relative to fault levels, voltage and phase rotation are given elsewhere in this Document.
- 2.2 Phase rotation specified shall be maintained on all overhead lines, cables, transformers, switchgear and distribution equipment.
- 2.3 Where existing connections are to be reconnected to a new system, phase rotation is to be checked before disconnection and reconnection made to maintain the same phase rotation.

3.0 **SWITCHING OF HV, MV AND LV POWER SUPPLIES**

- 3.1 Switching of existing power supplies shall be pre-arranged with the appropriate Authority.
- 3.2 All possible preparation shall be made in advance, to minimize the time required for re-energising the system.
- 3.3 All such switching shall be carried out by the "responsible person" unless such authority is given to the Contractor by that person in writing.

4.0 **EARTHING AND BONDING**

SANS 10142	The wiring of premises (Part 1) Low voltage installations
SANS 10200	Neutral earthing in medium voltage industrial power systems
SANS 10292	Earthing of low-voltage (LV) distribution systems
NRS 076	Earthing of distribution substations with nominal voltages up to and including 132 kV.

CMB Standards

4.1 **Resistance Values:**

- 4.1.1 Every effort should be made to obtain an earth resistance value of 1,0 ohm or less.
- 4.1.2 Maximum acceptable values of earth electrode resistance:
 - Miniature substation = 10 Ohms
 - Indoor, outdoor switchboard or gang links = 15 Ohms
 - Cradle, lightning arrestors or other pole mounted equipment = 20 Ohm
 - Combined resistance to earth of LV feeder and overhead line neutrals = 10 Ohms

4.2 **Main Indoor Substation Earth System:**

- 4.2.1 Main earth bar shall consist of an adequate length of minimum 50mm x 6,3mm tinned copper bar.
- 4.2.2 Main earth bar shall be supported by means of insulators in a suitable position on a wall or plinth.
- 4.2.3 Conductors connecting equipment to main earth bar shall be 80mm² copper terminated in compression type lugs.
- 4.2.4 Size of earth bar and number of earth conductors shall be specified elsewhere.
- 4.2.5 All connections shall be suitably labelled.

4.3 **Main Outdoor Substation Earth System:**

- 4.3.1 Shall comply with the above Standards.

4.4 **General Earth Systems:**

- 4.4.1 Earth systems for distribution transformers, minisubs shall comprise two earth electrodes with 1,5m long earth spikes located 6,0m apart, linked with 80mm² bare conductor. Spikes are to be located adjacent to pole structures or ends of plinths in case of minisubs and shall be located at least 1,0m therefrom.
- 4.4.2 In case of transformer earthing, if neutral earth system resistance is not 1,0 ohm or less, two systems as above are to be installed, one for the LV neutral and the other for the tank and associated equipment, in which case they are to be kept at least 6,0m apart and at opposite sides of the transformer position.

- 4.4.3 Earth system is to be connected with 80mm² insulated earth conductor to the earth bar or transformer tank earth stud as appropriate.
- 4.4.4 Common leg of secondaries of CT's, other than secondaries of summation transformers, shall be effectively earthed to main earth system.
- 4.5 Transformer Earthing:
- 4.5.1 Transformers, pole mounted, ground mounted or in minisubs, shall be provided with earth systems as described in the Sub-Clause "General Earth Systems" above. If earth system resistance is $\leq 1,0$ ohm minisub neutral and earth bars, or transformer neutral and tank earth stud, shall be bonded with an insulated earth conductor.
- 4.5.2 Where earth system resistance is in excess of 1,0 ohm, a second separate earth system shall be installed in accordance with the foregoing Sub-Clause and neutral and tank connections shall be taken to each of the independent earth systems with separate insulated earth conductors. In this case a neutral surge arrestor, complying with the Clause "Lightning Protection" elsewhere in this Part, is to be installed and connected between the transformer neutral and the tank earth point. For tendering purposes it shall be assumed that the second earth system and neutral arrestor will not be required.
- 4.5.3 Earthing shall further comply with the AMEU/SAIEE Code of Practice for the use of Combined Neutral and Earth (CNE) on Low Voltage Distribution Systems and Separate Neutral Earth (SNE) System for the service connections.
- 4.6 Reticulation Feeder Neutral Earthing:
- 4.6.1 At kiosks and fused feeder pillars a 30m length of bare earth conductor of half the size of the phase conductors but not greater than 80mm² shall be laid from each kiosk earth bar towards the source of supply. Neutral bar shall be connected to the earth bar with green insulated conductor of equivalent size.
- 4.6.2 At various points not exceeding 150m apart along length of overhead lines and at tee connections and ends thereof as indicated on the drawings, neutral conductor shall be bonded to an earthing point which shall comprise a 1,5m long earth spike. Insulated earth conductor shall be carried in a galvanised sleeve from 500mm below ground to 3,5m above, unless otherwise advised. Connection of earth conductor to line conductor shall be made with a connector suitable for the particular line conductor material.
- 4.7 Earthing of Pole-Mounted Equipment:
- 4.7.1 At cradle earthing points, reclosers, or sets of lightning arrestors, one 1,5m long earth spike shall be provided, insulated earth connection being enclosed in galvanised conduit as described above.
- 4.8 Earth Spikes:
- 4.8.1 Top of earth spikes and interconnecting conductors are to be 1,0m below finished ground level.
- 4.8.2 Connections to earth spikes shall be by means of at least two suitable mechanical clamps of an approved type for this duty. Clamps shall not be attached to the rod but must be installed so that the bolt face is in contact with the rod. Brazing will not be accepted. Connection must be wrapped with two layers of "Denzo" tape.
- 4.8.3 Cable marker as described elsewhere in this Part shall be installed above each spike and shall be labelled "Earth Spike".
- 4.9 Earth Continuity Conductors:
- 4.9.1 Earth conductors shall be hard drawn bare copper wire or bi-coloured green/yellow or black PVC covered as specified elsewhere in the Specification, the PVC being UV stabilised. Sizes of earth wire are depicted on the drawings.

- 4.9.2 Bare earth continuity conductors shall be run with all cables constituting a low voltage distribution system except in case of township reticulation where an earth system as described in the sub-Clause "Reticulation Feeder Neutral Earthing" above shall be installed at kiosks, etc.
- 4.9.3 Uninsulated earth conductors shall not be less than 500mm below ground level. Above this level all earth conductors shall be green insulated carried in a PVC conduit sleeve.
- 4.9.4 Terminal lug shall be crimped onto the end of the main earth conductor for bolting to the main earth bar of a substation or minisub or other outdoor equipment. Two mechanical clamps shall be used for connection onto cradles or other equipment, as appropriate.
- 4.9.5 Earth connections must not be carried through metal conduits or sleeves.
- 4.9.6 Earth connections shall be so made that in event of any connections being removed the earth connection to the rest of the equipment will not be affected.
- 4.10 Bonding Generally:
- 4.10.1 All metallic parts of an installation are to be bonded to the earth system as required by the appropriate Standards.
- 4.11 Bonding of Equipment:
- 4.11.1 All earth bars shall be run in one continuous length as far as possible, and shall not be bent or formed in any way that requires hammering or severe distortion.
- 4.11.2 Any joints shall be lapped with at least two bolts with nuts and washers of suitable size. Lapped ends shall be pre-tinned.
- 4.11.3 If multiple straps are used, they shall be bolted and fixed together at not more than 750mm intervals.
- 4.11.4 All connections shall be made using brass or stainless steel bolts, nuts and washers, together with a star lock washer, on all kiosks, fused feeder panels, miniature substations and outdoor equipment. Connections to indoor equipment may be made with cadmium plated steel bolts, nuts and washers, with a steel spring washer.
- 4.11.5 All steelwork on a pole is to be bonded using 20mm² solid copper conductor. Requirement applies to cross-arms, all insulator supports and any other hardware.
- 4.11.6 Where equipment is also mounted on the pole, bonded metal is to be earthed to an earth spike as elsewhere specified herein, using a 40mm² bare copper conductor.
- 4.12 Bonding of Steel Lighting Poles
- 4.12.1 For three phase systems, steel streetlight and site lighting poles shall be bonded with a continuous earth continuity conductor of the size as specified elsewhere. For single phase systems three core cables, of the size specified, shall be installed where the third conductor will be utilised for the continues earth.
- 4.12.2 Continuous earth continuity conductor shall be connected to the pole earth stud.
- 4.12.3 At last pole in a run the neutral conductor shall be bonded to earth.
- 4.13 Supplementary Requirements for Building Services:
- 4.13.1 Main earth system is to comply with the Supply Authority's requirements.
- 4.13.2 Earth spikes, mats and conductors shall be installed as early as possible in building programme, and onus is on Contractor to arrange this with Building Contractor so as to avoid later disturbance of completed construction.
- 4.13.3 Ends of earth conductors shall be terminated in lugs securely bolted to switchboard frames or trays.
- 4.13.4 Earth conductors run outside flexible tubing, where this has been permitted, shall be run neatly along tubing and shall be held in place by approved cable ties. Such conductors shall not be wound around the tubing.

5.0 **FENCING**

NRS 060:2001

Code of practice for clearances for electrical systems with rated voltages up to and including 145kV, for the safety of persons.

D-DT-5237 (Eskom Specification)

Security Fences as per Eskom Specification and Drawings

CMB Standards:

5.1 General:

5.1.1 Security fences shall be of type as specified elsewhere in Project Technical Specification, based on Eskom's Standards and drawings.

5.1.2 Earthing and bonding shall further shall further comply with Clause "Earthing and Bonding" elsewhere in this Part.

6.0 **HV & MV SUBSTATION BUILDINGS**

SANS 10142

Wiring Code

CMB Standards

6.1 Regulations and Approval:

6.1.1 Building work shall be to the approval of the Employer and appropriate Building Inspector and shall comply with local building regulations.

6.1.2 Dimensions of cable trenches, ceiling height, width of door opening, ventilation requirements, etc. must be verified with the switchgear supplier before construction commences.

6.1.3 Any cost resulting from Contractor failing to verify this information and advise the Builder of any changes shall be for his own account.

6.2 Foundations:

6.2.1 Upper surface of foundations are to be $\pm 1000\text{mm}$ below ground level, depending on ground conditions. Actual depth is to be decided on site.

6.2.2 Concrete mix: 5 parts 19mm stone; 3 parts sand; 1 part cement.

6.3 Brickwork:

6.3.1 Bricks are to be laid stretcher bond with "Brickforce" every fifth course.

6.3.2 All walls are to be 230mm thick.

6.3.3 Outer skin is to be of approved facebrick, samples of which must be submitted for approval before ordering.

6.3.4 Horizontal and vertical joints of outer skin are to be raked out 12mm. Inner skin jointing is to be flush.

6.3.5 External walls are to have a 12mm overlap at damp course level.

6.3.6 Vermin proof air bricks shall be provided to the extent shown.

6.4 Floor:

6.4.1 Sub-floor is to be a 100mm thick concrete slab reinforced with 152 x 152 gauge mild steel mesh.

6.4.2 Base, and fill if any, is to be well compacted before casting floor slab. Concrete mix shall be 4 parts 19mm stone; 2 parts sand; 1 part cement.

- 6.4.3 Floor is to be finished with 25mm cement screed, steel trowelled and level to within 3mm, screed being coloured with an oxide of a selected colour.
- 6.4.4 Brass weather strip shall be set in floor immediately inside the doors.
- 6.4.5 Cable ducts are to have 100mm thick concrete mat and are to be lined with 144mm brickwork, unless otherwise specified. Concrete mix shall be as for foundations.
- 6.5 Roof:
- 6.5.1 Roof shall be tile on timber construction as shown with PVC weathersheet beneath tiles.
- 6.5.2 Tile colour will be as specified by Architect / Engineer. Samples shall be submitted for approval before ordering. All ridge tiles are to be cement grouted.
- 6.5.3 Roofing timber shall be seasoned and suitably treated against termites. Gang-nailing of rafters, trusses and posts is acceptable. Roofing timber is to be rough sawn.
- 6.5.4 Tie straps of 8 gauge galvanised wire or 32mm x min. 18 gauge galvanised hoop iron for fixing of wall plates shall be provided between tile battens and rafters. Tiles shall be nailed to these battens.
- 6.5.5 Fascia and barge boards shall be of selected hardwood. "Flexit" board is to be installed below eaves. All other timber shall be of SA Pine or similar.
- 6.5.6 Gutters and downpipes shall be uPVC or aluminium, gutters being half-round. Downpipes shall discharge onto a concrete rainwater trap.
- 6.6 Ceiling:
- 6.6.1 Ceiling shall be Rhinoboard on SA Pine bracker with standard cornices.
- 6.7 Doors:
- 6.7.1 Doors shall be fabricated of selected hardwood as detailed, vermin proof louvres being fitted as shown.
- 6.7.2 Doors shall be hung with brass or bronze "parliament" type hinges, unless otherwise specified. Brass tower bolts shall be fitted to the normally closed door with brass barrel keeps set in floor and frame. 230mm Brass or bronze swivel type locking bar shall be provided on external face of doors. Padlocks will be provided by Contractor. 230mm Brass or bronze cabin hooks and eyes shall be provided to retain each door in the fully open position. Eyes shall be fixed to outside of door and the hook screwed into the facebrick at 1,0m above floor level. All screws for fabrication of doors and louvres and for fixing of all accessories shall be brass.
- 6.8 Chequer Plate:
- 6.8.1 All cable trenches within building shall be provided with galvanised chequer plates or an alternative material with equivalent strength.
- 6.8.2 Angle iron supports shall be fixed to trench walls to support chequer / equivalent plates flush with floor.
- 6.8.3 Plates shall comprise lengths which can be conveniently handled and where pieces are odd shaped to cover trenches diverting and changing direction, odd shapes pieces may be neatly welded together to form a single section.
- 6.8.4 Chequer / equivalent plates shall butt square against each other along the full run of the trenches and shall neither overlap nor have gaps between them.
- 6.9 Finishes:
- 6.9.1 Internal walls and duct walls shall be smooth plastered. Internal walls and ceiling are to be painted with two coats of white Acrylic PVA.
- 6.9.2 Timber fascias and barge boards are to be treated with one coat of wood primer, one coat of undercoating, and finished with two coats of best quality white oil based hard gloss enamel.

- 6.9.3 Doors and louvres are to be given two coats internally and three coats externally of clear wood sealer.

7.0 **ELECTRICAL INSTALLATION IN HV & MV SUBSTATIONS**

SANS 10142 Wiring Code

CMB Standards:

7.1 Sub-Distribution Boards:

- 7.1.1 Shall comprise proprietary galvanised trays with all components mounted therein, a fascia plate, but no doors being required.

- 7.1.2 Boards shall further comply with Clause "LV Main Distribution Switch Boards" elsewhere in this Part.

7.2 Wiring in Conduit:

- 7.2.1 Wiring shall comply with Clause "LV Wiring in Conduit" elsewhere in this Part. Installation shall be as per drawings forming part of Specification.

7.3 Switches, Socket Outlets, Plugs and Boxes:

- 7.3.1 Allowance shall be made for switches, socket outlets, plugs and boxes to comply with Clause "LV Switches, Socket Outlets, Plugs and Boxes" elsewhere in this Part.

- 7.3.2 Fittings shall be installed in positions shown on drawings forming part of Specification.

7.4 Light Fittings:

- 7.4.1 Allowance shall be made for light fittings to comply with Clause "Light Fittings" elsewhere in this Part.

- 7.4.2 Fittings shall be installed in positions shown on drawings forming part of Specification.

8.0 **HV SWITCHGEAR AT SUBSTATIONS**

SANS 1195 Busbars

BS 3297 Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V.

**ESP 32-1166
(Eskom Specification)** Outdoor Circuit Breakers for Systems with Nominal Voltages from 6,6 kV up to and including 765 kV.

**ESP 32-536
(Eskom Specification)** Outdoor Disconnectors and Earthing Switches

34-1688 (Eskom Specification) Inductive Voltage Transformers

**34-1689
(Eskom Specification)** Current Transformers: Eskom- Specific Requirements for Voltages up to 132kV in accordance with NRS 29.

**DSP 34-419
(Eskom Specification)** Station Class Metal Oxide Surge Arrestors without Spark Gabs.

CMB Standards:

8.1 General:

- 8.1.1 This specification covers the supply, delivery and installation of outdoor HV circuit breakers, disconnectors & earthing switches, voltage transformers, current transformers, surge diverters, busbars and auxiliary equipment.

- 8.1.2 Particular requirements are included in Project Technical Specification elsewhere.
- 8.1.3 Earthing and bonding shall further shall further comply with Clause “Earthing and Bonding” elsewhere in this Part.
- 8.2 Circuit Breakers:
- 8.2.1 See Eskom Specification above.
- 8.3 Disconnectors and Earthing Switches:
- 8.3.1 See Eskom Specification above.
- 8.4 Voltage Transformers:
- 8.4.1 See Eskom Specification above.
- 8.5 Current Transformers:
- 8.5.1 See Eskom Specification above.
- 8.6 Busbars:
- 8.6.1 HV busbars shall be of tubular coastal grade aluminium alloy, and of current rating given in Project Technical Specification.
- 8.6.2 Busbars shall be supported on brackets clamped to post type insulators mounted on support structures and/or on equipment bushing connectors as may be specified and/or shown on drawings.
- 8.6.3 Post insulators and busbar spacing shall be appropriate to system voltage and site conditions.
- 8.6.4 General construction of busbars, connections and associated supports shall be mechanically robust and shall withstand all forces that may be imposed upon them in normal operation due to vibration, fluctuations in temperature, short circuit condition, or other causes. Provision shall be made for expansion and contraction of busbars and connections thereon.
- 8.6.5 Design of connectors and connections to other equipment shall be such as to permit easy dismantling for maintenance purposes.
- 8.6.6 Where dissimilar metals are connected, approved means shall be provided to prevent electro-chemical action and corrosion.
- 8.6.7 Support structures shall be of galvanised steel work suitable for bolting onto concrete foundations.
- 8.6.8 All open ends of busbars shall be suitably capped with UV resistant PVC caps.
- 8.7 Surge Diverters:
- 8.7.1 See Eskom Specification above.
- 9.0 **MV SWITCHGEAR AT SUBSTATIONS**
- | | |
|------------------------------|---|
| SANS 1652 | Battery Chargers – Industrial Type |
| DSP 34-1157 | 11kV and 22kV Withdraw able Pattern Air-Insulated |
| (Eskom Specification) | Indoor Primary Switchgear |
- 9.1 General
- 9.1.1 This specification covers the supply, delivery and installation of indoor type MV switchgear, including associated voltage transformers, current transformers and auxiliary equipment.
- 9.1.2 Particular requirements are included in the Project Technical Specification elsewhere.

- 9.1.3 Earthing and bonding shall further shall further comply with Clause "Earthing and Bonding" elsewhere in this Part.
- 9.2 MV Switchgear:
- 9.2.1 See Eskom Specification above.
- 9.3 Current Transformers and Voltage Transformers:
- 9.3.1 See Eskom Specification above.
- 9.4 Auxiliary Equipment, i.e. Protection Relays and Meters:
- 9.4.1 Protection relays shall be supplied in accordance with Project Technical Specification.
- 9.5 Panel Wiring:
- 9.5.1 Panel wiring shall be neatly run in PVC channel fixed in an approved manner on inside of panel.
- 9.5.2 All wiring shall be PVC insulated high conductivity stranded copper conductor of appropriate cross-sectional area, and terminated with numbered ferrules corresponding to wiring and schematic diagrams.
- 9.5.3 Wiring from within panel onto components mounted on hinged facia plates or doors shall be neatly bunched and contained by flexible plastic spiral.
- 9.5.4 Clearly identifiable terminals of appropriate current rating shall be provided for connection of external cabling and buswiring.
- 9.5.5 Current transformer connection shall be brought to easily accessible and clearly labelled terminals, particularly c.t.s' with multiple ratios.
- 9.6 Battery Tripping Unit:
- 9.6.1 One tripping power supply unit shall be supplied and installed with each MV switchboard.
- 9.6.2 BTU shall be fully automatic maintenance free.
- 9.6.3 Particular requirements specified in Project Technical Specification.
- 9.6.4 110V/230V Connection to unit shall be brought out to an easily accessible terminal block for the external connection.
- 9.6.5 Battery shall be equipped with semi-sealed alkaline cells, (nickel-cadmium type) 10A/hr minimum capacity at 10 hour discharge rate.
- 9.6.6 Where a 110V DC output is specified or required, minimum capacity shall be 20A/hr at 10hr discharge rate.

10.0 **MV SWITCHGEAR AT DISTRIBUTION NETWORKS**

SANS 1874	Metal-enclosed ring main units for rated A.C. voltages above 1 kV and up to and including 24 kV
SANS 1885	Metal-clad switchgear for rated A.C. voltages above 1 kV and up to and including 36 kV
SANS 60694/IEC 60694	Common specifications for high-voltage switchgear and control gear standards
SANS 60265	High-voltage switches
SANS 61958/IEC 61958	High-voltage prefabricated switchgear and control gear assemblies - Voltage presence indicating systems

NRS 31	Alternating current disconnectors and earthing switches (up to 145 kV)
NRS 35	Outdoor distribution cut-outs.
NRS 036	Auto-reclosers with local and remote control capabilities for nominal A.C. voltages up to 33kV.
NRS 046	Electricity distribution - load-break switch-disconnectors - pole-mounted type for rated A.C. voltages above 1 kV and up to and including 36 kV
BS EN 5463, BS EN 60265-2 DSP 34-888 (Eskom Specification)	Specification for A.C. switches of rated voltage above 1 kV
DSP 34-889 (Eskom Specification)	Specification for pole-mounted auto-reclosers: General and Protection Requirements.
DSP 34-889 (Eskom Specification)	Specification for pole-mounted auto-reclosers: Telecontrol Requirements

10.1 General

- 10.1.1 This specification covers the supply, delivery and installation of outdoor type MV metal enclosed ring main units, disconnectors and earthing switches, outdoor distribution fuses and auto-reclosers.
- 10.1.2 Particular requirements are included in Project Technical Specification elsewhere.
- 10.1.3 Earthing and bonding shall further shall further comply with Clause "Earthing and Bonding" elsewhere in this Part.

11.0 **MV MINIATURE SUBSTATIONS**

SANS 1029 Miniature substations

CMB Standards:

11.1 General

- 11.1.1 Colour of unit shall be as specified elsewhere in Project Technical Specification.
- 11.1.2 Unit shall be of steel construction with plate thickness not less than 2,5mm.
- 11.1.3 If a fully galvanised unit is offered, plate thickness shall not be less than 3,0mm.
- 11.1.4 Top canopy shall have vertical sides and shall be removable.
- 11.1.5 Unit shall be mounted on a 6,0mm hot dip galvanised steel channel underbase for bolting down onto a concrete plinth.
- 11.1.6 MV compartment enclosure shall be easily removable without having to disturb the equipment.
- 11.1.7 Transformer shall be readily removable and replaceable by a similar transformer of any standard rating up to 630 kVA.
- 11.1.8 MV compartment shall be provided with hinged front access doors and hinged side access panel measuring 600mm x 600mm with levered latching on inside.
- 11.1.9 LV compartment shall have front and end fully opening access doors.
- 11.1.10 Doors shall be provided with three point latching suitable for padlocking and shall be fitted with a 3CR12 or stainless steel restraining device to prevent whipping when opened.
- 11.1.11 Units shall be so designed that no back access is necessary.

- 11.1.12 Each unit shall be bonded to the other with a copper strap and to an earth bar run the full length of the LV unit. Earth bar shall be not less than 25mm x 6mm to which all items are to be bonded. Earth bar is to be earthed as further detailed in the Clause "Earthing and Bonding" elsewhere in this Part.
- 11.2 Finish:
- 11.2.1 Entire miniature substation, except transformer tank, shall be either hot dip galvanised in accordance with Clause "Hot Dip Galvanising" elsewhere in this Part or otherwise cooling tubes shall be galvanised and the rest shall be zinc metal sprayed to a thickness equivalent to that called for in the latter clause.
- 11.2.2 Paint finish is to comply with requirements set out in Clause "MV Distribution Transformers" elsewhere in this Part.
- 11.3 Installation:
- 11.3.1 Miniature substation shall be installed on a concrete or brick built plinth constructed as specified in Clause "Plinths" elsewhere in this Part. It shall rest on two layers of 5 ply malthoid, or similar product, which shall be trimmed flush.
- 11.4 MV Compartment:
- 11.4.1 One 3-way non-extensible ring main switch unit complete, comprising two switches and one HRC fused switch / circuit breaker tee-off, as specified in Project Technical Specification, for connection to transformer MV terminals, shall be provided.
- 11.4.2 Ring main unit shall comply generally with the Clause "MV Switchgear at Distribution Networks" elsewhere in this Part. Spare fuses shall be located inside a holder, fixed to enclosure, within compartment.
- 11.4.3 Connection between live side of tee-off switch and transformer MV bushings shall be made using single core XLPE trailing cable tails which shall be so installed that a separation of 50mm is maintained between phases and earth. No separators shall be used on the MV tails.
- 11.4.4 All connections to bushings shall be puttied and taped, unless not achievable as a result of the type of connection.
- 11.4.5 In case of cable terminations, wooden cleats shall be provided for support of cables. Such terminations shall comply with the Clause "MV and LV cable joints and terminations" elsewhere in this Part.
- 11.4.6 When no ring main unit is provided, a sheet of perspex shall be installed between MV compartment door and MV cable terminations covering whole door opening, to avoid accidental contact with MV cable terminals. Minimum distance between perspex sheet and cable terminals shall be 250mm. Wording "DANGER EXPOSED MV TERMINALS", minimum 75mm high and in red, shall appear in centre of perspex sheet.
- 11.5 Extended MV compartment:
- 11.5.1 Where configuration of MV circuits requires a switching station in a position near to a miniature substation, a non-standard miniature substation with extended MV compartment shall be used and switching station and miniature substation combined to form a single unit.
- 11.5.2 Switches shall be enclosed in a steel cubicle of same cross-section as the miniature substation to which it forms an extension.
- 11.5.3 Cubicle shall be so arranged that each switch has a door in front of it and removable rear doors measuring 600mm x 600mm for terminating cables.
- 11.5.4 Rear doors shall be removable by means of catches levered from inside.
- 11.5.5 Arrangement of switchgear and enclosing cubicle shall be such that cable terminations can readily be made.
- 11.6 Transformer Compartment:

- 11.6.1 Transformers shall be of hermetically sealed type complying generally with Clause "MV Distribution Transformers" elsewhere in this Part.
- 11.6.2 Transformer accessories, i.e.: rating plate, tap-change switch, dial type thermometer, etc., shall be located such that they are safely accessible from LV compartment.
- 11.7 LV Compartment:
- 11.7.1 All equipment contained in LV compartment shall be accessible from front and shall be arranged such that any items of equipment may be easily removed or installed on Site.
- 11.7.2 At bottom of LV compartment, but high enough above base of miniature substation, to allow adequate working space, minimum 3,0mm thick galvanised steel gland plates shall be mounted on suitable brackets.
- 11.7.3 Neutral busbar of minimum 50mm x 6,3mm hard drawn copper shall be mounted above gland plate and shall be connected to neutral terminal of transformer using minimum 80mm² insulated copper conductor.
- 11.7.4 Neutral and earth bars shall be kept electrically separate until connected in accordance with the requirements of Sub-Clause "Earthing and Bonding" elsewhere in this Part.
- 11.7.5 A chassis shall be provided above neutral bar suitable for mounting six 15kA 200A TP MCB's at a minimum height of 400mm above gland plate.
- 11.7.6 Actual number and type of MCB's to be provided shall be as stated elsewhere in Project Technical Specification or on drawings.
- 11.7.7 Circuit breakers will be from the same Manufacturer.
- 11.7.8 Where MCB's are required to be connected to cables larger than 70mm², terminals shall be of stub busbar or rear connecting stud types, fitted with suitable phase barriers. For all other cables, box type terminals shall be provided.
- 11.7.9 At connection points busbars shall be plated and connection made with brass bolts, nuts and washers. Flat washers shall be provided on both sides of connection and star washers beneath nuts.
- 11.7.10 Busbars shall be pre-drilled and plated for connection to the maximum number of circuit breakers.
- 11.7.11 A hinged steel panel shall be provided with three CT operated maximum demand reading ammeters and a voltmeter and selector switch installed thereon. These instruments shall be as specified under Clause "Instruments, Meters and Protection Relays" elsewhere in this Part.
- 11.7.12 Current transformers for ammeters and other equipment shall be readily accessible.
- 11.8 Compartment Labelling:
- 11.8.1 Doors of all compartments are to be provided with labels and notices as required by Occupational Health and Safety Act, and as specified in Clause "Labels and Notices" elsewhere in this Part.

12.0 LV METER AND DISTRIBUTION KIOSKS

SANS 141	Glass-reinforced polyester (GRP) laminates
SANS 1195	Busbars
NRS 056	Service Distribution Boxes – Meter Kiosks and Distribution Kiosks

CMB Standards:

- 12.1 **Construction:**
- 12.1.1 Type, construction, material and colour specified elsewhere in Project Technical Specification.
- 12.1.2 Suitable to accommodate all equipment specified elsewhere in Project Technical Specification.
- 12.1.3 Kiosks to be from same manufacturer.
- 12.1.4 Restraining device on door – 3 point latching for larger and 2 point for 6 way and smaller.
- 12.1.5 Padlocking facilities.
- 12.1.6 Stainless steel, brass or chrome on brass hinges.
- 12.1.7 Hot dipped galvanised mild steel locking rods, guides, striker plates, etc.
- 12.1.8 Gland plate pre-drilled for feeder cables specified and total number of service cables for which kiosk is designed.
- 12.1.9 Neutral bar to be connected to the 12mm stud with 70mm² PVC insulated earth conductor.
- 12.1.10 Minimum plate thickness for 3CR12 and hot dipped galvanised kiosks shall be 2 and 3 mm respectively.
- 12.1.11 Welding on 3CR12 shall be M1G. All welded areas to be pickled and passivated after welding.
- 12.1.12 Hot dipped galvanising shall comply with Clause “Hot Dip Galvanising” elsewhere in this Part.
- 12.2 **Contents and Equipment:**
- 12.2.1 9,5mm “Masonite Weatherboard” mounting board.
- 12.2.2 HD Copper busbars min. 25mm x 6mm mounted vertically on colour coded stand-off insulators on back face of mounting board.
- 12.2.3 Busbars equipped with 12mm and 8mm brass bolts & nuts for termination of feeder and service cables respectively.
- 12.2.4 Busbars to extend downward below the bottom insulator to enable connection of incoming and outgoing feeder cables vertically above one another.
- 12.2.5 Galvanised steel gland plate to extend full length and width of kiosk.
- 12.2.6 Gland plate to be provided with two 75mm long brass or stainless steel bolts facing upwards. 12mm Dia for feeder cable earth connection and 8mm dia. for service connection earth connection. Bolts to be held by nuts and washers to gland plate. Each lug to be individually bolted to the stud.
- 12.2.7 Steel kiosks shall be equipped with a 50 x 50 x 6mm hot dip galvanised under base for bolting down to a concrete plinth.
- 12.2.8 Labelling shall comply with Clause “Labels and Notices” elsewhere in this Part.
- 12.2.9 Main circuit breakers shall comply with Clause “LV Circuit Breakers” elsewhere in this Part.
- 12.3 **Installation:**
- 12.3.1 Top of root 100/150mm above top of kerb or 250/300mm above road level.
- 12.3.2 Sandy soils require a deeper root with wider flange than normal.

13.0 **PLINTHS****CMB Standards:**

13.1 Construction:

- 13.1.1 Suitable cable entries shall be provided.
- 13.1.2 Outside edge of concrete plinths shall be bevelled to 50mm wide. No plastering will be allowed.
- 13.1.3 Where brick-built plinths are called for they shall comply with Project Technical Specification and drawings.
- 13.1.4 Plinths shall be 300mm thick and of sufficient dimension to allow 150mm clearance around edge of equipment with a steel reinforcing mesh extending it's full length and width.
- 13.1.5 Top of plinth 200mm above kerb, or 350mm above road level where no kerbs exist.
- 13.1.6 Holding down bolts, to fix the switchgear, must be installed if specified.

13.2 Installation:

- 13.2.1 Plinth to be located at the position shown on plans.
- 13.2.2 Ground material at plinth location must be well drained.
- 13.2.3 Top surface (200mm) to be removed. Ensure that no stumps and roots are visible.
- 13.2.4 Cleared surface to be moistened to optimum moisture content and thoroughly compacted.
- 13.2.5 Should clear surface needed to be raised, it must be done with approved material in horizontal layers not exceeding 150mm in depth.
- 13.2.6 Layers of material to be moistened to an optimum moisture content and compacted to a density of not less than 93% of Modified AASHO density.
- 13.2.7 An approved impermeable sheet, similar in size of plinth area, shall be placed on completed founding surface before placing reinforcement, shuttering and concrete for plinth. No sheet required when founding surface is rock. Rock surface shall be moistened before concreting commences.
- 13.2.8 Concrete shall only be poured after forms, reinforcing steel, and preparation for casting have been inspected by the Engineer or Clerk of Works.
- 13.2.9 Concrete shall be well compacted to ensure that all voids are eliminated.
- 13.2.10 During first stages of hardening concrete shall be protected from harmful effects of sunshine, drying winds and cold, and also from running or surface water.
- 13.2.11 After forms have been stripped, surrounding ground shall be built up to top surface to ensure that water is led away from the plinth.

14.0 LV MAIN DISTRIBUTION SWITCH BOARDS

These are defined as boards controlling main supplies, either incoming and/or outgoing, by air break or moulded case circuit breakers, or outgoing supplies with fused-switch units.

SANS 10142	The wiring of premises (Part 1) Low voltage installations
SANS 1195	Busbars
SANS 1274	Coatings applied by the powder-coating process
SANS 60529/IEC 60529	Degrees of protection provided by enclosures (IP Code)

CMB Standards:

14.1 Construction:

- 14.1.1 Construction, material and colour as specified elsewhere in Project Technical Specification.
- 14.1.2 Type, i.e. flush mounted, wall mounted, extension or floor standing, as specified elsewhere in Project Technical Specification.
- 14.1.3 Suitable to accommodate all equipment specified elsewhere in Project Technical Specification.
- 14.1.4 Panels shall be either hinged or removable as specified elsewhere in Project Technical Specification.
- 14.1.5 Comprise of a welded or bolted framework of steel sections with a minimum 1,6mm thick steel panel cladding.
- 14.1.6 Securing of fixed panels shall be by means of square key latches with bottom locating pins.
- 14.1.7 Edges of all doors and removable panels shall be so constructed that they can readily accept a rubber gasket, should dust and damp proofing be required.
- 14.1.8 All equipment shall be mounted behind removable fascia plates, only switch toggles, etc., protruding.
- 14.1.9 Padlock able doors over toggles shall be provided. Switch toggles not covered by a padlock able door, shall be provided with means for padlocking in the "OFF" position.
- 14.1.10 Doors of fuse-switched unit shall be hinged and interlocked with mechanism so that case cannot be opened with switch closed, or switch closed with case open. With case open, no live parts shall be exposed.
- 14.1.11 Metal surfaces of the boards shall be epoxy powder coated.
- 14.1.12 Cabling arrangements shall be such that outgoing feeder ends can be made off with board live at all times.
- 14.1.13 Gland plates shall be bonded to earth bar by means of a 70mm² bare copper conductor fixed with min. 10mm cadmium plated bolts and nuts.
- 14.1.14 Space shall be left to allow access to the rear of board.
- 14.1.15 Board must be designed to fit into space available and be of suitable dimensions to enter through door-ways provided.
- 14.2 Contents and Equipment:
- 14.2.1 Busbars shall be mounted at top of board, enclosed by removable full height panels at back, removable top panels and removable front panels covering busbar section only. Droppers from enclosed busbar chamber shall pass through insulating barriers located as necessary.

Where busbars are exposed in cubicles requiring access for operation or maintenance, they shall be shrouded with a suitable insulating material.
- 14.2.2 Busbars shall be of adequate section for current and short circuit rating. Current density shall not be more than 185A per square centimetre at current rating specified. Bars shall have a minimum spacing of 32mm between bars and 25mm to earth.
- 14.2.3 Where multiple bars are used, the air gap between bars shall be same as bar thickness.
- 14.2.4 Busbars shall be securely supported by insulators of a size and so spaced that they will prevent busbar distortion under maximum short circuit conditions.
- 14.2.5 Equipment shall be arranged to connect to busbars with solid copper connections of adequate section to resist short circuit stresses imposed by faults up to maximum breaking capacity of associated switchgear.
- 14.2.6 Joints between busbars and equipment shall be tinned and connected using phosphor bronze or stainless steel nuts and washers above a fault level of 20kA or cadmium plated

steel below this rating. Flat washers shall be provided on both sides of connection and spring lock-washers beneath the nuts.

- 14.2.7 Busbars shall be pre-drilled and tinned at both ends for future extensions and removable plates shall be fitted at either end of busbar chamber to enable such extensions to be made.
- 14.2.8 Suitably drilled and tinned fishplates for later coupling of the bars shall be provided.
- 14.2.9 Air-break fuses shall be provided with best quality dust and damp-proof ironclad cases, arranged for flush mounting.
- 14.2.10 Tiered construction insulating barriers are to be installed between all fused-switch units.
- 14.2.11 Equipment inside board shall be of type and manufacture as specified elsewhere in Project Technical Specification.
- 14.2.12 Six (6) spare HRC fuses for each switch shall be supplied, except that a maximum of 6 spare fuses of any one size are required per board. All such spares shall be mounted in stainless clips, or fuse holder, in a special compartment attached to board, marked "Spare Fuses".
- 14.2.13 Metal clad covers of fused switches shall be clearly labelled, where retractable type units are used, both carriage and the panel are to be labelled.
- 14.2.14 Cabling arrangements shall be such that outgoing feeder ends can be made off with board live at all times.
- 14.2.15 Continuous earth bar sized to match the specified fault rating of the board but of not less than 25mm x 6,3mm cross section shall be run along the entire length of board and shall be provided with a minimum 10mm cadmium plated bolt for connection of earth conductor.
- 14.2.16 Wiring of boards shall comply generally with Clause "Control Equipment and Wiring" elsewhere in this Part.
- 14.2.17 Main circuit breakers shall comply with Clause "LV Circuit Breakers" elsewhere in this Part.
- 14.2.18 Hot dipped galvanising shall comply with Clause "Hot Dip Galvanising" elsewhere in this Part.
- 14.2.19 Labelling shall comply with Clause "Labels and Notices" elsewhere in this Part.
- 14.2.20 Three maximum demand reading ammeters and a voltmeter and selector switch are to be provided for each incoming supply circuit breaker.
- 14.3 Installation:
- 14.3.1 No board shall exceed 2,4m in height nor shall any operating handle, button or switch be mounted higher than 1,8m or lower than 0,6m.
- 14.3.2 No part of any equipment shall be mounted closer than 300mm to the floor.

15.0 **LV MCB MAIN AND SUB-DISTRIBUTION BOARDS AND CONTROL PANELS**

These are defined as boards controlling the main supplies, normally coming from a LV Main Distribution Switch Board, and outgoing supplies with moulded case circuit breakers.

SANS 10142	The wiring of premises
SANS 1195	Busbars
SANS 1274	Coatings applied by the powder-coating process

CMB Standards:

- 15.1 Construction:
- 15.1.1 Construction material and colour specified elsewhere in Project Technical Specification.
 - 15.1.2 Larger MCB panel distribution boards and motor control panels shall be floor standing.
 - 15.1.3 Suitable to accommodate all equipment specified elsewhere in Project Technical Specification.
 - 15.1.4 Where single phase breakers are used in three phase boards, these must be arranged in three vertical rows, one for breakers in each phase.
 - 15.1.5 All structural elements of main and sub-distribution boards and complete construction of motor control panels shall be of minimum 2,0mm thick material.
 - 15.1.6 Non-structural elements shall be of 1,6mm material. Minor bonding trays shall be of 1,2mm material and all bonding trays shall be galvanised.
 - 15.1.7 All boards to be mounted outside or specified as being weatherproof shall be constructed of 2,0mm 3CR12 sheet, epoxy powder coated to a thickness of 70 microns.
 - 15.1.8 Cognisance must be taken of the heat dissipated by equipment and adequate ventilation be provided.
 - 15.1.9 Panels shall be either hinged or removable as specified elsewhere in Project Technical Specification.
 - 15.1.10 Securing of fixed panels shall be by means of square key latches with vertical locating pins.
 - 15.1.11 Boards shall be at least 115mm in depth unless otherwise approved.
 - 15.1.12 A maximum of two rows of conduit shall enter horizontal edges of boards and width of board must be sufficient to accommodate all conduits entering.
 - 15.1.13 All control panel doors shall be fitted with dust and damp proof seals
 - 15.1.14 Flush boards in walls shall be provided with a separately attached metal frame and door which is adjustable so that it may be set plumb.
 - 15.1.15 Boards with a width of 600mm or greater shall be fitted with double doors. Surface and flush boards shall be provided with doors.
 - 15.1.16 Hinges shall be as specified elsewhere in Project Technical Specification.
 - 15.1.17 Hot dipped galvanising shall comply with Clause "Hot Dip Galvanising" elsewhere in this Part.
 - 15.1.18 All metal surfaces of boards shall be epoxy powder coated.
 - 15.1.19 Cabling arrangements shall be such that outgoing feeder ends can be made off with board live at all times.
 - 15.1.20 Gland plates shall be bonded to earth bar by means of a 70mm² bare copper conductor fixed with min. 10mm cadmium plated bolts and nuts.
 - 15.1.21 Where single phase breakers are used in three phase boards, these must be arranged in three vertical rows, one for breakers in each phase.
 - 15.1.22 Interior of boards shall be arranged for easy access to all wiring and components.
 - 15.1.23 Where boards are installed in 115mm walls, they shall be provided with expanded metal fixed to entire back of board.
 - 15.1.24 Underside of board shall be rendered vermin proof by means of similar plates to gland plates above.

15.2 Contents and Equipment:

- 15.2.1 Unless made specifically to clip in from front, blanking plates shall be fixed with short cadmium plated bolts and nuts
- 15.2.2 All openings for future equipment shall be covered with blanking plates fixed on inside of opening.
- 15.2.3 Copper busbars are to be provided for each phase and are to be mounted on suitable insulators or fixed to terminals of miniature circuit breakers, and be of sufficient length to accommodate future breakers as specified elsewhere in Project Technical Specification.
- 15.2.4 Busbar and other connections shall be made using cadmium plated steel (or brass in coastal areas) bolts, nuts, flat and spring washers.
- 15.2.5 Main neutral feed to busbar shall be connected by a lug bolted to bar, as described above.
- 15.2.6 Neutral busbars shall be solid brass with two per-way pinching screws and sufficient ways for feed and all circuits connected, including spare ways to same number as spare circuits.
- 15.2.7 All equipment shall be mounted behind removable fascia plates, only switch toggles, etc., protruding.
- 15.2.8 Isolating device for all motors situated remote from control panel shall be lockable in the "OFF" position.
- 15.2.9 Fascia panels shall have moulded knobs for ease of removal of the panel.
- 15.2.10 Transformers for low voltage supplies and all low voltage wiring shall be separated by metal barriers from medium voltage circuits.
- 15.2.11 Positions of transformers are to be indicated by labels attached to face of board.
- 15.2.12 All equipment on boards shall be back-connected and no wire or cable shall be visible from front.
- 15.2.13 PVC insulated wiring shall be used throughout, current rating being not less than rating of circuit breaker or aggregate rating of bank of circuit breakers which it connects.
- 15.2.14 In case of MCB Main Boards cabling arrangements shall be such that outgoing feeder ends can be made off with board live at all times.
- 15.2.15 In case of MCM Main Boards all gland plates shall be bonded to earth bar by means of a 70mm² bare copper conductor fixed with min. 10mm cadmium plated bolts and nuts.
- 15.2.16 Wiring of boards shall comply generally with Clause "Control Equipment and Wiring" elsewhere in this Part.
- 15.2.17 Main circuit breakers shall comply with Clause "LV Circuit Breakers" elsewhere in this Part.
- 15.2.18 Labelling shall comply with Clause "Labels and Notices" elsewhere in this Part.
- 15.2.19 A spare set of HRC fuses for each switch-fuse unit or set of fuse holders installed shall be supplied and value included in tender price, except that a maximum of 6 spare fuses of any one size is required.
- 15.2.20 All spares shall be handed to Employer's representative at time of handover inspection.
- 15.2.21 All instruments, meters, pilot lights, etc., and main isolator must be operable with the doors closed unless otherwise specified.
- 15.2.22 Heat anti-condensation heaters are to be so constructed and fitted that they cannot be inadvertently touched.
- 15.2.23 Transformers for low voltage supplies and all low voltage wiring shall be separated by metal barriers from medium voltage circuits.
- 15.2.24 Positions of transformers are to be indicated by labels attached to face of board.

- 15.2.25 Equipment on boards shall be back-connected and no wire or cable shall be visible from front.
- 15.2.26 PVC insulated wiring shall be used throughout, current rating being not less than rating of circuit breaker or aggregate rating of bank of circuit breakers which it connects.
- 15.3 **Installation:**
- 15.3.1 Floor standing boards shall be bolted in position.
- 15.3.2 No board shall exceed 2,4m in height nor shall any operating handle, button or switch be mounted higher than 1,8m or lower than 0,6m.
- 15.3.3 No part of any equipment shall be mounted closer than 300mm to floor.
- 15.3.4 Minor types of main and sub-distribution boards and control panels shall consist of sheet metal trays, suitably built in or secured on surface.
- 15.3.5 Where boards are installed in 115mm walls, they shall be provided with expanded metal fixed to entire back of board.
- 15.3.6 Trays of flush boards shall be built in or suitably secured to brickwork in specified places. Each shall be mounted with upper edge at a height of 2,0m above floor level, unless otherwise specified.
- 15.3.7 Unless otherwise specified elsewhere in this Specification, boards contained in cupboards shall be surface mounted and all conduit shall drop into them neatly, vertically and evenly spaced, in a single row, if possible.

16.0 **LV CONSUMER SERVICE CONNECTION BOXES (CSCB)**

These are defined as electrical distribution boxes, mounted on poles, controlling main supplies to normally residential units, by circuit breakers.

SANS 1195

Busbars

SANS 60529/IEC 60529

Degrees of protection provided by enclosures (IP Code)

CMB Standards

- 16.1 **Construction:**
- 16.1.1 Construction material and colour specified elsewhere in Project Technical Specification.
- 16.1.2 Suitable to accommodate all equipment specified elsewhere in Project Technical Specification.
- 16.1.3 The protection rating of CSCB shall be at least IP54.
- 16.1.4 All conductor/cable entries into the box shall be by means of suitably sized UV stable PVC compression glands.
- 16.1.5 Electro-galvanised padlock able lever locks shall be used to lock doors.
- 16.2 **Contents and Equipment:**
- 16.2.1 Equipped with number of and size of UV stable colour coded conductor tails for connection to overhead line specified elsewhere in Project Technical Specification.
- 16.2.2 Wiring of boards shall comply generally with Clause "Control Equipment and Wiring" elsewhere in this Part.
- 16.2.3 Main circuit breakers shall comply with Clause "LV Circuit Breakers" elsewhere in this Part.

- 16.2.4 Each main circuit breaker is to be labelled with erf number it will serve. Such labelling is to comply with appropriate requirements of Clause "Labels and Notices" elsewhere in this Part.

16.3 Installation:

- 16.3.1 Stainless steel straps, 19mm wide, shall be used to strap box to pole.
- 16.3.2 Conductors shall be installed at box as to create a "drip loop" to prevent water running down conductors into connectors.
- 16.3.3 Exact mounting height on poles specified elsewhere in Project Technical Specification.

17.0 **READY BOARDS**

These are defined as electrical "Small Power Distribution Units", normally used inside low cost houses.

SANS 1619

Small power distribution units (ready-boards) for single-phase 230 V service connections

CMB Standards

17.1 Construction:

- 17.1.1 Shall be suitable for a 230 volt single phase supply.
- 17.1.2 Suitable to accommodate all equipment specified elsewhere in Project Technical Specification.

17.2 Contents and Equipment:

- 17.2.1 Wiring of the boards shall comply generally with Clause "Control Equipment and Wiring" elsewhere in this Part.
- 17.2.2 Main circuit breakers shall comply with Clause "LV Circuit Breakers" elsewhere in this Part.
- 17.2.3 Labelling shall comply with Clause "Labels and Notices" elsewhere in this Part.
- 17.2.4 Equipment specified elsewhere in Project Technical Specification.

17.3 Installation:

- 17.3.1 Not be mounted within a radius of 1000mm from any water tap.
- 17.3.2 Mounted so that the top of the board is 1800mm above floor.

18.0 **LV CIRCUIT BREAKERS**

SANS 156

Moulded-case circuit-breakers

SANS 767

Earth leakage protection units

SANS 1473

Low-voltage switchgear and control gear assemblies

SANS 1765

Low-voltage switchgear and control gear assemblies (distribution boards) with a rated short-circuit withstand strength up to and including 10 kA

SANS 60439

Low-voltage switchgear and control gear assemblies

SANS 60934

Circuit-breakers for equipment (CBE)

SANS 61008

Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)

BS EN 60947

Specification for switchgear and control gear for voltages up to and including 1000 V A.C. and 1200 V d.c. Circuit-breakers

CMB Standards18.1 General:

- 18.1.1 Supply voltage, normal current, fault capacity and type, as well as any special characteristics required for circuit breakers, shall be as stated elsewhere in Project Technical Specification.
- 18.1.2 Main circuit breakers are to be of one make throughout installation.
- 18.1.3 Main circuit breakers inside LV main distribution switchboards shall be equipped with adjustable instantaneous magnetic and inverse time delay thermal overload releases on each phase and shall be arranged for flush mounting. Shall be connected to busbars with solid copper connections of adequate section to resist short circuit stresses that may be imposed by faults up to maximum rupturing capacity of breaker.
- 18.1.4 Where circuit breakers are used to control supply taken directly from Supply Authority, they shall be of a make approved by that Authority, and shall be set to trip within specified limits laid down by that Authority.
- 18.1.5 Rack-out type air circuit breakers shall have interlocking to ensure that racking in or out can take place only with circuit breaker open.
- 18.1.6 Moulded case circuit breakers shall have a time delay tripping on low overloads and high speed tripping on short circuit.
- 18.1.7 Three phase MCB's shall be fitted with suitable phase barriers.
- 18.1.8 Where MCB's are required to be connected to cables larger than 70mm², terminals shall be of stub busbar or rear connecting stud types. For all other cables, box type terminals shall be provided.

18.2 Installation

- 18.2.1 Connecting device between incoming cable and air circuit breaker, and between said breaker and outgoing bars shall be fitted with shutters which are automatically closed and locked by the action of racking out.
- 18.2.2 MCB's shall be fitted with purpose made terminal shrouds where no fascia plate is provided.

19.0 **SUPPLY AUTHORITY METERS****BS 5685**

Electricity meters. Specification for Class 3 var-hour meters

CMB Standards19.1 General:

- 19.1.1 Meters shall be of type as stated elsewhere in the Project Technical Specification.

19.2 Installation and Commissioning:

- 19.2.1 Meters shall be installed in kiosks / miniature substations as specified elsewhere in the Project Technical Specification.

- 19.2.2 Allowance must be made in tender price for Metval testing and programming of these meters to meet municipal requirements.

20.0 **INSTRUMENTS, METERS AND PROTECTION RELAYS**

SANS 473 / NRS 071	Automated meter reading for large power users
SANS 474 / NRS 057:2005	Code of practice for electricity metering
SANS 1524	Electricity payment systems
SANS 1799	Watt-hour meters - AC electronic meters for active energy
SANS 1966 / IEC 60211	Maximum demand indicators, Class I.0
SANS 60044 / IEC 60044	Instrument transformers
SANS 62052 / IEC 62052	Electricity metering equipment (A.C.) - General requirements, tests and test conditions
SANS 62053:2003 / IEC 62053	Electricity metering equipment (A.C.) - Particular requirements
NRS 057 / SANS 474	Code of practice for electricity metering
NRS 068	Electricity distribution - cable earth fault indicator
NRS 071 / SANS 473	Automated meter reading for large power users
NRS 072	Overhead line fault path indicators
BS EN 60044, BS EN 60044	Specification for voltage transformers

CMB Standards:

- 20.1 **General:**
- 20.1.1 Indicating instruments and meters shall have HRC fuse protection on all voltage connections as specified elsewhere on the drawings.
- 20.1.2 Meters and instruments shall have labels fitted below, stating in which circuit they are installed.
- 20.1.3 Cases of all meters shall afford complete protection from dust and damp and shall be suitable for attachment of seals.
- 20.1.4 Selector switches shall be rated at 16A shall be provided with an "OFF" position.
- 20.1.5 Tenderer shall submit full details of meters, instruments and control switches offered in the tender, including connection diagrams for all equipment.
- 20.2 **Potential Indicators:**
- 20.2.1 Potential indicators shall comprise three neon indicating lamps each energised from a capacitor bushing connected to indicate that incoming cable or busbars are alive, unless specified elsewhere in the Project Technical Specification.
- 20.3 **Protection Relays:**

- 20.3.1 Protection relays are specified elsewhere in the specification.
- 20.4 Current Transformers:
- 20.4.1 Current transformers are specified elsewhere in Project Technical Specification.
- 20.5 Voltage Transformers:
- 20.5.1 Voltage transformers shall be three phase and of the type specified in the Project Technical Specification.
- 20.5.2 Output shall be 50VA per phase at 110V phase to phase.
- 20.5.3 Fuse protection shall be provided on both primary and secondary.
- 20.5.4 Transformers shall not be affected by single-phasing on the MV side.
- 20.6 Indicating instruments:
- 20.6.1 All instruments shall be as specified elsewhere in the Project Technical Specification.
- 20.7 Ammeters:
- 20.7.1 Ammeters, including whole current ammeters, unless specified otherwise in the Project Technical Specification, shall be calibrated to 120% of rated current. Overload capability shall be 10 x rated current for 1,0 second. Those reading in excess of 100A shall be CT operated with 5A full scale deflection.
- 20.7.2 One instantaneous reading ammeter, unless specified otherwise in the Project Technical Specification, shall be provided and connected via a phase selector switch with "OFF" position.
- 20.7.3 Maximum demand reading ammeters, unless specified otherwise in the Project Technical Specification, shall be of combined maximum demand and instantaneous type, one meter being supplied per phase.
- 20.7.4 Shall comprise a thermal maximum demand ammeter with drag pointer combined with a moving iron instantaneous pointer. The drag pointer reset knob shall be sealable.
- 20.7.5 Where dual ratio CT's are specified, ammeter scale plates are to be engraved on both sides to suit these ratios, the plate for the lower ratio being outermost.
- 20.8 Voltmeters:
- 20.8.1 One instrument shall be provided in each instance connected via a selector switch to read line to line voltages and also line to neutral voltages.
- 20.8.2 Voltmeters for MV use shall be suitable for operation on the 110V side of the voltage transformer, while LV voltmeters shall operate off a nominal line to line voltage of 400V. Scales between 90% and 110% of nominal voltage shall be graduated in 1,25% divisions.
- 20.9 PF Indicators:
- 20.9.1 Power factor indicators shall be of the type specified in the Project Technical Specification.
- 20.10 Consumption Meters:
- 20.10.1 KWh meters shall be of the type specified in the Project Technical Specification.
- 20.10.2 Full details of programme facilities and operating instructions shall be supplied with these meters.
- 20.10.3 Allowance must be made in the tender price for Metval testing and the programming of the bulk meters.
- 20.11 Supply Monitors / Power Analysers
- 20.11.1 Power analyser module shall display the voltage and currents of all three phases as well as the record the peak, i.e. maximum values of same. The instantaneous power consumed, power factor and total harmonic distortion (THD) of all three phases shall also be accesses via a scrollable menu interface.

20.12 Medium Voltage Metering Units:

- 20.12.1 Shall comprise of a free standing panel mounted on a concrete plinth.
- 20.12.2 When used in conjunction with extensible switchgear, metering unit shall form an integral part of the switchboard. In such cases it shall be specifically designed to match the associated switchgear and to be connected to the busbars of the extensible switches from which the complete switchboard is assembled.
- 20.12.3 When mounted adjacent to non-extensible switchgear or within an extensible switchboard it shall share a common plinth with switchgear.
- 20.12.4 Voltage transformer, current transformers, and consumption metering equipment shall comply with the relevant requirements detailed elsewhere in this part and in the Project Technical Specification.
- 20.12.5 Operating voltages, CT and VT ratios, and metering requirements are detailed in the Project Technical Specification.
- 20.12.6 Voltage transformer shall not be affected by single phasing on the medium voltage side.
- 20.12.7 Cable boxes shall be suitable for the cable sizes and types specified in the particular specification or on the drawings.
- 20.12.8 Exposed metal work shall be hot dip galvanized or zinc metal sprayed and painted to match adjacent or associated MV switchgear. Where such switchgear is remote from the metering unit, the unit shall be painted as specified in Project Technical Specification.
- 20.12.9 Exposed bolts, nuts and hinges shall be galvanized or fabricated from a suitable grade of stainless steel designed to resist corrosion or discolouration in service.

21.0 CONTROL EQUIPMENT AND WIRING

SANS 767

Earth leakage protection units

SANS 1091

National colour standard

BS EN 60947

Specification for motor starters for voltages up to and including 1000 V A.C. and 1200 V D.C. Direct-on-line (full voltage) A.C. starters

CMB Standards:

21.1 Time Switches:

- 21.1.1 Time switches shall be mounted in an accessible position for ease of adjustment.
- 21.1.2 Shall be provided with re-chargeable batteries to provide up to 48 hours of operation should a power failure occur.
- 21.1.3 Shall be fully programmable as specified in the Project Technical Specification.
- 21.1.4 Shortest switching interval shall be 1,0 minute for motor control and 30 minutes for general purposes.
- 21.1.5 Units shall include a manual override facility and be suitable for wall or DIN-rail mounting.
- 21.1.6 Protection shall be at least to IP42 and the units shall operate satisfactorily in the temperature range - 5°C to + 55°C.

21.2 Low Voltage Transformers:

- 21.2.1 Bell and other low voltage transformers shall be of the double wound type.
- 21.2.2 Shall have an adequate capacity for the duty required but not less than 50VA on short-time rating.
- 21.2.3 Transformers shall have one end or the centre point of the low voltage winding earthed.

21.3 Contactors:

- 21.3.1 Contactors shall, unless otherwise specified, comply with the standards for current making and breaking Category AC1 for non-inductive loads and Category AC3 for inductive loads.
- 21.4 Earth Leakage Protection Units:
- 21.4.1 Earth leakage protection units shall have a sensitivity of 30mA, unless stated to the contrary elsewhere in this Specification, or on the drawings.
- 21.4.2 Unit shall actuate a shunt trip isolator or MCB as specified.
- 21.4.3 Units shall carry the SABS Mark.
- 21.5 Motor Starters:
- 21.5.1 All Starters are to be of the same make.
- 21.5.2 Star-Delta starters are to be provided with both electrical and mechanical interlocks.
- 21.5.3 Starters are to be protected by moulded case circuit breakers as specified in Sub-Clause "Moulded Case Circuit Breakers" elsewhere in this Part.
- 21.5.4 Starters are to be so selected that they are not subjected to a higher fault current than that for which they are designed.
- 21.5.5 MCB's and isolators are to be lockable in "OFF" position where motors are situated remote from control panel.
- 21.5.6 Starters for all motors shall comprise magnetically operated contactors, shall be of robust design, operate without undue noise and vibration.
- 21.5.7 Unless otherwise stated, they shall be of continuous rating, current making and breaking Category AC3.
- 21.5.8 Contactors shall be of the hold-in type capable of operating satisfactorily without overheating for a period of 10 minutes if the supply voltage falls to two thirds nominal.
- 21.5.9 Contactors shall not chatter when opened at two thirds voltage, or at a frequency 10% below nominal.
- 21.5.10 Low voltage release is to be inherent in the operating coil.
- 21.5.11 Starters are to be equipped with a voltage free auxiliary change-over contact to provide a "RUN" signal during operating.
- 21.5.12 No motor control gear shall have a continuous rating of less than 10A at Category of duty AC3.
- 21.5.13 Contactors shall be capable of making and breaking the starting current of the motor and of carrying this current without damage for a period of one minute.
- 21.5.14 Contactors shall also be capable of withstanding, without damage, the passage of the maximum fault MVA of the circuit until such time as the fault can be cleared by the operation of the back-up protection.
- 21.5.15 Where anti-condensation heaters are fitted, these must be disconnected by the starter main switch.
- 21.5.16 Overloads of the thermal type shall be matched to the motor ratings and are to be manually reset.
- 21.5.17 Overloads are to be so set that the motor will trip within 30 seconds of a single phase condition arising when the motor is hot and operating at 80% of full load current. If the starter is not capable of this, then single phase protection devices are to be fitted for all motors of 10kW and over.
- 21.5.18 All overload devices must be fitted with a voltage free auxiliary changeover contact to provide a "tripped" signal. If this facility is not available on the overload offered, an interposing relay is to be provided to perform the same function. Such a relay must be energised upon an overload trip occurring.
- 21.5.19 The following shall be included as standard features :

Overload protection; Phase imbalance and single phase protection; Locked rotor and excessive re-starts protection; Thermal memory; Auxiliary supply dip-proofing; Fail-safe operation on main trip relay; Analogue or LED indication of percentage motor load and thermal memory.

- 21.5.20 Optional features which may be specified elsewhere in this Specification are:
Earth fault protection; Short circuit protection, etc.
- 21.5.21 In the case of dual-speed motors, protection shall be provided by a dual-operation relay separately configured to provide full protection at each speed.
- 21.6 Pilot Lights:
- 21.6.1 Pilot lights are to be either cluster LED, neon, transformer or resistor reduced wattage type.
- 21.6.2 Lights shall be easily seen when operating in normal daylight.
- 21.6.3 Where pilot lights are connected to remote equipment by multi-core control cables neon lamps shall not be used because of the inductive effect of the control cores.
- 21.6.4 100% spare lamps are to be provided for all pilot lights.
- 21.6.5 Lamp test facilities via a lamp test push button wired to all indicator lights must be provided.
- 21.6.6 Pilot lights are to be of the colours indicated below, unless elsewhere specified.
- | | |
|------------|-------|
| Power on - | Amber |
| Fault - | Red |
| Run - | Green |
- 21.6.7 Pilot lights indicating "STARTER CLOSED" and "OVERLOAD TRIP" shall be fitted to all motor circuits.
- 21.7 Hour Meters:
- 21.7.1 Hour meters shall be of the digital type reading up to 99999 hours, unless otherwise specified.
- 21.7.2 Meters shall be suitable for 230V, 50Hz. AC operation.
- 21.8 Duty Selector Switches:
- 21.8.1 Control of all items of equipment which can act as standby to each other must include a duty selector switch to enable the lead duty to be selected as well as second and third preference, i.e. 1,2,3; 2,3,1; 3,1,2 for a three motor system.
- 21.9 Hand/Off/Auto Switches:
- 21.9.1 The hand/off/auto switch shall be fitted to each starter subject to automatic control.
- 21.9.2 The hand control circuit, which shall comprise stop-start push button, shall be fed from a fuse other than that for the automatic control system.
- 21.10 Phase Failure Relays:
- 21.10.1 Phase failure relays are to provide reverse phase rotation protection.
- 21.10.2 The relay is to be so arranged with a timer that it will only initiate a trip upon a single phase condition occurring and not upon restoration of power.
- 21.10.3 Provision is to be made to ensure that a trip occurs irrespective of which phase is lost.
- 21.11 Relays:
- 21.11.1 Type of relay specified elsewhere in the Project Technical Specification.
- 21.11.2 Each relay is to be numbered and this number must appear on both relay and adjacent to its respective base in the case of the plug-in type.

- 21.11.3 Adjustable timing relays must be labelled with their function.
- 21.12 Photo-electric Controls:
- 21.12.1 Photo-electric switches shall be of the type comprising a photo-sensitive resistor, thermal actuator with an inherent operating delay to make it insensitive to short duration changes in light levels and a change-over switch mechanism, all housed within a tough, translucent, weather and ultra-violet resistant cover.
- 21.12.2 Operating level shall be factory preset to switch on at approximately 50 lux and off at approximately 100 lux.
- 21.12.3 Response time after sudden changes in light level shall be not less than 15 seconds.
- 21.12.4 Integral protection against voltage surges shall be provided.
- 21.13 Main and Control Circuits:
- 21.13.1 Control equipment shall be mounted in a separate hinged panel fitted with square key latches to permit ease of access to terminals, etc., at the rear of the panel.
- 21.13.2 Where busbars are located directly behind such panels, a separate removable insulated panel shall screen them.
- 21.13.3 Wiring shall be carried out using suitably rated, colour coded insulated wire.
- 21.13.4 Main terminals are to be connected in strict phase rotation.
- 21.13.5 Wires shall not be joined between terminal points and no terminal shall have more than two wires connected to it unless they are lugged connections.
- 21.13.6 Spare terminals are to be provided to accommodate all spare control cable cores.
- 21.13.7 Terminals for wires smaller than 16mm² shall have pressure plates.
- 21.13.8 Terminals for the connection of external control wiring shall be of the "disconnect" type.
- 21.13.9 Terminations shall be fitted with numbered ferrules, the numbers corresponding to those on the appropriate wiring diagrams to be prepared by the board Manufacturer. All terminal strips are to be similarly numbered.
- 21.13.10 Generally, wiring shall be enclosed in strategically placed plastic wireways. Small numbers of wires to remote positions may be neatly strapped, using plastic buckle clips or hard plastic "loom formers". Where wiring is run to equipment mounted on hinged doors, wiring shall be carried in a plastic "loom former" which is so installed that the wiring is not strained with the door fully open.
- 21.13.11 Colour of all panel wiring shall comply with the following:-
- | <u>Colour of Wire</u> | <u>Circuit Particulars</u> |
|------------------------|--|
| Red, White and Blue | Phase connections in current and voltage transformer circuits and in all three phase circuits. |
| Green/Yellow bi-colour | Insulated earth wires. |
| Black | Neutral connections. |
| Grey | Control connections. |
| White | Connections in DC alarm circuits. |
- All control circuits shall have 5A HRC fuse protection.
- 21.14 Labelling:
- 21.14.1 Control equipment both within the panel as well as all projecting items, are to be labelled in accordance with Clause "Labels and Notices" elsewhere in this Part.
- 21.14.2 Any device which can be unplugged is to be labelled at the base and on the device.

22.0 **TRENCHING, EXCAVATION AND COMPACTION**

CMB Standards:

22.1 **General:**

- 22.1.1 Contractor to allow for all excavation and backfilling of cable trenches and holes for planting of poles, unless specified otherwise in Project Technical Specification.
- 22.1.2 Contractor shall be responsible for ensuring that any trenches opened by him, or for him, do not constitute a hazard to the public.
- 22.1.3 Barriers and warning lights at night, or any other protection of trenches or excavations, to be provided as required by Engineer or any Statutory or Local Authority.
- 22.1.4 Contractor shall be responsible for leaving all areas affected by cable trenches, holes in the ground, and any other work done by him or on his behalf, in a clean and tidy state, and for making good all tarmacadam, concrete, paved or grassed surfaces.
- 22.1.5 Contractor's responsibility to make good any subsidence that may occur within six months of back-filling trenches, and, in case of tarred surfaces, to remove and re-tar with new material.

22.2 **Routing:**

- 22.2.1 Routes for underground cables are shown on the drawings.
- 22.2.2 Variation of these routes shall be approved by Engineer or Clerk of Works before trenching is done.
- 22.2.3 Contractor's responsibility to ensure that the routes of the cables are correct.

22.3 **Pegs:**

- 22.3.1 Contractor will be responsible for the replacement of any pegs disturbed or removed by him.

22.4 **Trenching and Excavation by Others:**

- 22.4.1 Contractor to co-operate closely with the Trenching Contractor at all times and is required to be in attendance during backfilling of all trenches, etc., to ensure that cables are not damaged in any way and that poles are correctly aligned.

22.5 **Type of Material:**

- 22.5.1 Unless otherwise specified elsewhere in this Specification or Bill of Quantities, Tenderers shall allow for excavating cable trenches and holes in earth. In addition, unit rates shall be provided for excavating in soft rock and hard rock.
- 22.5.2 Following definitions shall apply to the three categories: Where the conditions experienced are a combination of two or more of the conditions listed below, the Contractor shall be paid on rates in proportion to the contents of earth, soft rock or hard rock experienced in the excavations.

"Earth" shall mean ground that can be removed by hand and includes loose gravel, clay, made-up ground, loose or soft shale, loose oukclip, and boulders less than 75mm in diameter.

"Hard Earth" shall mean all hard ground such as oukclip, hard shale, decomposed rock, loose boulders and large stones, etc., which require the use of pneumatic tools, mechanical rippers and / or excessive hard labour to excavate and remove economically.

"Rock" shall mean granite, quartzite, dolomite, or other rock of similar hardness, which can only be excavated and removed economically by blasting, wedging or breaking.

22.6 **Verification of Excavation Claims:**

- 22.6.1 Notwithstanding any Provisional Amounts for excavation in rock included in the Schedule of Quantities, payment will only be authorised for excavation in ground other than "earth"

and "hard earth" upon submission of documentary proof of such excavation made and signed as correct at the time trenches or holes were excavated.

22.6.2 In all cases where rock has to be excavated, or where poles, etc., have to be stabilised with concrete or by other means, in loose sand or in soft or waterlogged ground or where substitution of excavated material is necessary for backfilling, that the Engineer or Clerk of Works be notified before such excavation work is back-filled.

22.6.3 Amounts and type of rock encountered shall be measured by the Contractor in the presence of the Engineer or Clerk of Works.

22.7 Precaution with regard to other Services:

22.7.1 Contractor shall exercise extreme caution in his work to avoid damage to existing underground services.

22.7.2 Certain services may be indicated on the drawings but it is not to be assumed that these are the only services, nor that their indicated position is entirely accurate. Such information is given as a guide only and does not negate the above responsibility.

22.7.3 All excavation in the vicinity of other services must be undertaken by hand.

22.8 Compaction:

22.8.1 Care shall be taken in compacting pole holes, trenches crossing roads and those crossing or running under or within 1,0m of paved or tarred sidewalks.

22.8.2 In trenches, the backfill shall be replaced in 150mm layers and four to six passes with a vibrating pan compactor shall be made per layer. Around poles, a jumping jack shall be used on each 150mm layer.

22.8.3 When clay is encountered, Engineer should be advised and may instruct the Contractor to remove all such excavated material and replace it with more suitable material, which shall then be compacted as above.

22.8.4 Where material is too wet for proper compaction, it should be dried out and if too dry, shall be dampened.

22.8.5 In the case of road crossings, the excavated base and sub-base material shall be mixed and replaced up to the top level of the original sub-base. New material equal in composition to the original base course shall be supplied, this material being used for the full depth of the base course layer.

22.8.6 Degree of compaction required shall be field densities of 95% in respect of poles and road crossings and 90% in respect of sidewalks.

22.8.7 All trenches crossing roads and side walks shall be approved by the Civil Engineer, who will be responsible for the roads and pavements after hand-over. Engineer will, if the compaction is in doubt, arrange to have it independently tested and should the compaction prove to be below standard, the cost of the test will be debited to the Contractor, who will be required, at his own expense, to open and re-fill the trench or pole hole to obtain the specified compaction value.

23.0 **SLEEVES**

SANS 791

Unplasticized poly(vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings

CMB Standards:

23.1 Type, material, colour and size specified elsewhere in Project Technical Specification.

23.2 Sleeves shall extend at least 1,0 m beyond each side of road crossing and shall be effectively sealed at ends.

23.3 Each sleeve shall be provided with a draw-wire.

- 23.4 Both ends of all sleeved crossings shall be marked by means of cable markers as elsewhere specified, labeled "cable sleeve".
- 23.5 Where MV or main LV cables cross over or pass under other services such as water or drain pipes, they shall be run in sleeves.
- 23.6 All sleeves shall be laid at a depth of 900mm.
- 23.7 Radius of bends used in sleeves shall not be less than six times diameter of sleeve, and sleeve not less than twice cable diameter.
- 23.8 Sleeves shall be laid on a 100mm compacted layer of selected bedding material or, if this is not available, on a 100mm sand bedding. Cover layer shall be hand compacted completely around sleeves and to a cover of 150mm above top of them. Sleeves shall be supported along their entire length by bedding. A further 100mm layer of selected bedding material shall be added and this shall be compacted using four to six passes of a vibration pan compactor. Thereafter, trench shall be back-filled and compacted as specified in Sub-Clause "Trenching, Excavation and Compaction" elsewhere in this Part.
- 23.9 Contractor shall make all necessary arrangements with the appropriate Authorities for closing sidewalks and/or half the roadway at a time, and he shall comply fully with any statutory requirement applicable and any requirements the Authorities deem necessary. Surfaces shall be made good to satisfaction of Authorities and Engineer.

24.0 **MV AND LV CABLES**

SANS 97	Electric cables - Impregnated paper-insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV (excluding pressure assisted cables)
SANS 1339	Electric cables - Cross-linked polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
SANS 10198	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 1
SANS 60227	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
SANS 60502	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV)
NRS 011	Pilot Cables
NRS 013	Medium -Voltage Cables
NRS 074	Low-voltage (600/1000 V) cable systems for underground electrical distribution
NRS 077	XLPE -insulated cables and accessories for system with nominal voltages of 44 kV, 66 kV, 88 kV and 132 kV
NRS 078	Long-span all-dielectric self-supporting fibre optic cable

CMB Standards:

- 24.1 **General:**
- 24.1.1 Type and insulation requirements for paper insulated, or cross-linked polyethylene MV cables specified elsewhere in Project Technical Specification.
- 24.1.2 PVC insulated cables for LV shall consist of PVC insulated conductors, PVC bedding, galvanised steel wire armouring and PVC sheath. The abbreviation for this type of cable is PVCAS.
- 24.1.3 Type and insulation requirements for service connection cables specified elsewhere in the Project Technical Specification.
- 24.1.4 All cables are to be installed in compliance with Manufacturer's recommendations.

- 24.1.5 Sizes and conductor material, i.e. copper or aluminium, are specified elsewhere in Project Technical Specification and drawings.
- 24.2 Cable Lengths:
- 24.2.1 All scheduled cable lengths are for tendering purposes only and Contractor shall measure actual lengths required before ordering.
- 24.2.2 Length of all cables will be re-measured after installation and lengths indicated in bill will be adjusted accordingly.
- 24.2.3 Contractor will be paid for actual lengths measured on site and any allowance for snaking, joints or ends must be incorporated in unit price.
- 24.3 Handling of Cables:
- 24.3.1 No cable shall be bent to a radius less than 12 times overall diameter of cable.
- 24.3.2 Bending or straightening shall be done slowly.
- 24.3.3 Engineer shall be notified immediately should there be any suspicion of moisture having entered a cable.
- 24.4 Cables fixed to Surface:
- 24.4.1 Where cables enter flush boards from cable sleeves, sleeve shall turn up to floor level and a duct shall be formed in wall to accommodate cable.
- 24.4.2 Care shall be taken to ensure that bending tolerance of cable is not exceeded in drawing cable into sleeve.
- 24.4.3 Edges of duct are to be lined with timber battens to which a bevel edged metal cover is to be screwed, using countersunk headed screws and cup washers.
- 24.4.4 Wherever cable saddles or any other items are to be fixed to structural components, use of dry plugs of wood will not be permitted. 'Rawl plugs' or other plugs to approval only shall be used.
- 24.4.5 Surface mounted cable protection pipes shall be galvanised and shall be fixed with saddles of 32mm x 3mm galvanised strap bolted to wall using bolts grouted in, 'Rawlbolts' or similar.
- 24.4.6 All cables rising on outside of buildings or on poles shall be protected by such pipes to a height of 3,0m above ground level.
- 24.4.7 Where a cable is installed fixed to a pole, it shall be attached to pole using stainless steel "Bandit" strap or equal.
- 24.4.8 Care shall be taken to ensure that straps are tightened correctly and that they do not distort or indent cable sheath.
- 24.5 Cables in Sleeves:
- 24.5.1 Cables shall pass in and out of buildings and under roadways and pavements in sleeves.
- 24.5.2 In addition, where cables cross or run along a boundary between two plots, these cables shall, where called for, be installed in sleeves.
- 24.5.3 All sleeves shall be installed in accordance with Clause "Sleeves" elsewhere in this Part.
- 24.6 Cables laid in Trenches:
- 24.6.1 Cables shall be laid at a depth as specified elsewhere in Project Technical Specification and drawings. Should no dimensions be indicated, installations shall comply with applicable standard.
- 24.6.2 Where two MV cables are run in same trench, they shall be laid a minimum of 300mm apart with separate cable slabs over each cable.
- 24.6.3 Where MV and LV cables are laid in same trench, MV cable shall be located on road side and LV cables on plot side of trench.

- 24.6.4 A horizontal distance of not less than 400mm shall be maintained between cables of different voltage groups.
- 24.6.5 Where a number of LV cables are run in same trench, they shall be laid with a minimum separation of 100mm. This applies to feeder cables only and not streetlighting and service cables which shall be only 25mm apart. Cables shall not cross each other.
- 24.6.6 Where cables run across even parallel to lateral boundaries, they shall be located 1,0m from the boundary at a depth of 1,0m. If so specified they shall be run in sleeves, otherwise both MV and LV cables shall be protected by cable slabs and a PVC sheet marker laid 300mm above them.
- 24.6.7 Trench bottom shall be cleared of all sharp or protruding stones. Trench is then to be refilled with 150mm of soft material and compacted. A further layer of soft material shall be installed after cables are laid to provide 200mm cover for cable when compacted. Protective cable slabs a minimum of 50mm thick x 230mm wide shall then be laid in case of MV cables, as specified in Project Technical Specification, and PVC sheet cable marker strip 300mm wide with indelibly printed warnings every 150mm along its length, in case of LV cables. In cases where MV and LV cables run in same trench, 100mm of soft bedding for LV cables shall be situated above protective cable slabs. Where LV service cables or streetlighting cables only are installed, a clean trench bottom and soft material back-fill only is required,
- 24.6.8 Soft material described above may be either sand or backfill material sifted through a 3,0mm mesh grid.
- 24.6.9 Balance of trench is to be back-filled with excavated material from which all stones, etc. greater than 100mm in size have been extracted. All such material is to be removed from site.
- 24.6.10 Cable route markers shall be provided for all MV and main LV feeder cables at road, culvert and Telkom cable crossings, at all changes of direction, at joints and at intervals not exceeding 60 metres along the straight.
- 24.6.11 Cable route markers shall comprise concrete blocks in shape of truncated pyramids 300mm high, 150mm x 150mm at top and 225mm x 225mm at base. An aluminium plate 3,0mm thick minimum, with four rods 75mm minimum, welded to it on underside, shall be cast into top of concrete block, and plate shall have stamped on it cable data and direction arrows, and at a crossing, crossing shall be indicated.
- 24.6.12 Cable route markers shall be placed over cable, in trench way, and shall protrude 25mm above finished ground level but not where they are likely to cause an obstruction or be in way of moving traffic. Joint markers shall indicate as such. Contractor shall ensure that ground under and around cable marker is properly compacted.
- 24.7 Laying of Cables with other Services:
- 24.7.1 Where cables are laid in trenches containing water and other pipes, etc., electrical cables shall be laid along one edge of trench with other services occupying the other edge.
- 24.7.2 Cables shall be laid not less than 600mm from such service unless otherwise approved by the Engineer.
- 24.7.3 At road and services crossings, sleeves as described elsewhere herein shall be provided, one for each MV cable and a separate sleeve for other cables, unless otherwise indicated on drawings.
- 24.7.4 At Telkom cable crossings, power cables shall cross 300mm below and at right angles to all such cables or sleeves for future cables. Power cables shall be enclosed in uPVC sleeves with cable slabs over, both of which shall extend 1,0m either side of the crossing. No power cable running parallel with a Telkom cable shall be laid within a distance of 1,0m measured horizontally from the Telkom cable. Wherever existing buried Telkom cables are encountered, strict precautions and care shall be taken and close supervision given. Any damage to, or disturbance of Telkom cables whatsoever shall be immediately reported and confirmed in writing to the Engineer.

24.8 Labeling of Cables:

- 24.8.1 All cables shall be clearly labelled with an everlasting type of label.
- 24.8.2 Label shall state cable size and number of cores.
- 24.8.3 All main feeder cables shall be labelled to state from whence they are supplied.
- 24.8.4 Labels shall be so installed that they are easily readable.

25.0 **CABLE TRAYS**

CMB Standards:

- 25.1 Type, i.e. perforated and folded or wire mesh comprising Light, Medium and Heavy Duty, shall be specified in Project Technical Specification.
- 25.2 Tray, incl. hardware, support brackets, etc. shall be hot dip galvanised after manufacture.
- 25.3 Maximum spacing between supports shall be as per Manufacturer's recommendations.
- 25.4 Splicing pieces, bends and tee pieces shall be provided to suit cable tray system. These shall be of an approved make conforming to width and quality specification of the particular cable tray being used.
- 25.5 Trays are to be installed in accordance with Manufacturer's recommendations, supported in such a way that they are carried on cross members cantilevered from a vertical support so that cables do not have to be threaded between the supports.
- 25.6 Trays on walls are either to be carried horizontally on right-angled brackets or fixed vertically to wall.
- 25.7 Support brackets shall be spaced so that a sag of 1/200 is not exceeded with tray fully loaded.
- 25.8 Where trays are likely to be damaged because of their proximity to a working area and could therefore be stepped on or similarly abused, they are, if at all possible, to be installed out of way of such abuse. Where this is not possible, only heavy duty tray is to be used and additional longitudinal support in way of angle iron of suitable size is to be installed.
- 25.9 Where width of cable trays is unspecified elsewhere in this Specification, they shall be sized to accommodate 20% more cables than number presently to be installed on basis that future cables will be of the same average size.
- 25.10 All cables over 16mm² are to be spaced at least 12mm apart. Where cables are laid flat on trays, fixing is required for all cables larger than 16mm² using heavy duty nylon cable ties. Where fixed in vertical plane, all cables are to be strapped to trays using stainless steel strapping applied with an approved tool. This also applies to single cables fixed to trusses or other parts of structure and to all cables fixed to cable trays in a physically vulnerable situation.

26.0 **MV AND LV CABLE JOINTS AND TERMINATIONS**

SANS 808

SANS 10198-9

SANS 1213

SANS 1803

NRS 053

Cable glands for use on flameproof enclosures (Ex d)

The selection, handling and installation of electric power cables of rating not exceeding 33 kV.

Mechanical cable glands

Lugs and ferrules for insulated electric cables

Accessories for medium-voltage power cables (3,8/6,6 kV to 19/33 kV)

CMB Standards:

26.1 General:

- 26.1.1 Cable jointing and termination shall be carried out by a qualified cable joiner using only approved standard methods for particular type of cable. Proof of his training may be required.
- 26.1.2 Joints in all cables shall only be made at full drum length intervals, but where necessary and when approved by Engineer cable through joints may be used in other approved positions.
- 26.1.3 Where a cable has steel wire armouring all strands of armouring shall be through jointed.
- 26.2 Connections:
- 26.2.1 Cable connections shall be made by means of crimped or sweated lugs, firmly bolted, one plain and one lock washer being placed under nut, so that plain washer is against lug and there shall be no washer between lug and terminal. A plain washer is also required under the bolt head. Alternatively, sweated systems fitting into clamp connections will be acceptable.
- 26.2.2 Crimped lugs shall be fitted using manual tools up to 70mm² and hydraulic tools from this size upwards. Approved tools are to be used in both cases. An hydraulic tool is to be used on all sizes of aluminium cable. Where a single point hydraulic crimping tool is used, lug shall be crimped in three places. Where a hexagonal die is used, this shall extend full length of lug.
- 26.2.3 Where aluminium cored cables are to be connected to circuit breakers, aluminium cable lug shall be bolted to a copper tag or tail, which is to be connected to circuit breaker. Ensure that sufficient Densal paste is installed on faces of lugs.
- 26.2.4 Where an aluminium cable is to connect to copper, lug shall be a bi-metal type lug with a copper spade and an aluminium ferrule friction welded to the spade.
- 26.2.5 Cable connections shall be made using brass bolts, nuts and washers, together with a star lock washer, on all kiosks, fused feeder panels and minisubs and with cadmium plated steel bolts and nuts on all indoor equipment.
- 26.2.6 All bolted joints shall be taped with self-vulcanising (not adhesive) tape, unless otherwise specified elsewhere in Specification.
- 26.2.7 Where cable connections are required to the MV and LV terminals of transformers, these shall be made off as follows:-
- 26.2.8 Red Phase to Terminal A
- 26.2.9 White Phase to Terminal B
- 26.2.10 Blue Phase to Terminal C
- 26.2.11 All transformer connections shall be kept in strict phase rotation and where two or more units are to operate in parallel, respective connections are to be checked for phase rotation and polarity. In case of cable terminations to transformer bushings cable itself shall be clamped substantially to a post adjacent to transformer, connections to bushings being puttied and taped.
- 26.2.12 All connections are to be colour coded.
- 26.3 MV Cable Terminations:
- 26.3.1 PILCA Cables:
- 26.3.1.1 PILCA cable terminations are to be made in full compliance with recommendations of Supplier of termination system.
- 26.3.1.2 Where a PILCA cable is terminated onto an item of equipment with a cable box as in case of switchgear, whether indoor or outdoor, an outdoor type taped termination shall be used, unless otherwise specified in the Project Technical Specification.
- 26.3.1.3 Cable box must be effectively sealed against moisture but shall not be compound filled.

- 26.3.1.4 Standard compression type gland shall be used where cable enters cable box. Gland plate shall be effectively earthed to equipment earth bar.
- 26.3.1.5 For through joints a seamless non-porous type of straight through plumbed joint with cast iron protection box fitted with armour tape clamps and finally filled with compound or, heat shrink through-joint, shall be provided as specified in Project Technical Specification.
- 26.3.2 XLPE Cables:
 - 26.3.2.1 XLPE cable terminations are to be made in full compliance with recommendations of Supplier of termination system.
 - 26.3.2.2 Where an XLPE cable is terminated onto an item of equipment with a cable box as in case of switchgear, whether indoor or outdoor, an outdoor type taped termination complete with silicone tape shall be used.
 - 26.3.2.3 Cable box must be effectively sealed against moisture but shall not be compound filled.
 - 26.3.2.4 Standard compression type gland shall be used where cable enters cable box. Gland plate shall be effectively earthed to equipment earth bar.
 - 26.3.2.5 Through joints in XLPE cables shall be provided with steel protective sleeves covering the joint.
- 26.3.3 Outdoor Terminations:
 - 26.3.3.1 Outdoor cable ends to transformer or similar bushings, overhead line equipment or cable ends within minisubs shall be made with heat-shrinkable high voltage termination systems suitable for 5 - 69kV.
 - 26.3.3.2 At all outdoor terminations a minimum of 3,0m of cable slack shall be provided adjacent to termination point.
 - 26.3.3.3 Where a cold tail is joined to cable tail, this shall be done by means of a barrier ferrule. heat-shrink shall cover barrier ferrule.
 - 26.3.3.4 Where cable tail itself is connected to lug or stud of an item of equipment, a sealed-end lug shall be crimped onto tail and lug connected to equipment. Heat-shrink shall cover all but spade of lug to prevent ingress of moisture.
 - 26.3.3.5 Where a cable tail connects onto an overhead line, a solid centre sleeve shall be crimped onto cable tail and sleeve clamped to line. Heat-shrink is to overlap the sleeve to prevent the ingress of moisture.
- 26.3.4 LV Cable Terminations:
 - 26.3.4.1 PVCAS cables shall be made off using adjustable mechanical glands.
 - 26.3.4.2 Care shall be taken to ensure that armour wires are correctly seated in gland and that all parts are properly tightened.
 - 26.3.4.3 Outdoors, in damp situations and in all minisubs and kiosks, neoprene waterproofing shrouds are to be fitted over all glands.
 - 26.3.4.4 Wherever PVCAS cables are terminated to overhead lines a suitable moulded heat shrinkable glove to effect a watertight seal at crotch shall be used, in accordance with Manufacturer's instructions. Alternatively, a PVC cable cap may be used.
- 26.3.5 Service Cable Ends:
 - 26.3.5.1 Service cable ends are to be located in positions indicated on drawings.
 - 26.3.5.2 In general case, ends are to be located 1,0m from each of the front and lateral boundaries. Where they cross road in sleeves they are to be located 1,0m into erf directly opposite the sleeve.
 - 26.3.5.3 No service cables are to be laid to erven directly behind kiosks or at pole positions.
 - 26.3.5.4 Cables are to be left sealed with a heat shrink cap at a depth of 500mm, unless specified elsewhere in the Specification and drawings.

- 26.3.5.5 Before sealing, each cable is to be checked by Contractor, in Engineer's presence if he so decides, to ensure that it is correctly located and labelled at respective kiosk or pole.
- 26.3.5.6 After checking and sealing and while end of connection is still exposed, marker posts shall be installed at end of connection and vertically above it as detailed on drawings.

27.0 **MV AND LV CABLE TESTING**

- SANS 97** Electric cables - Impregnated paper-insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV (excluding pressure assisted cables)
- SANS 10198-13** The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 13: Testing, commissioning and fault location.

CMB Standards:

- 27.1 On completed sections of laid, jointed and terminated MV cables, a high voltage DC test of 15 minutes duration shall be carried out by persons qualified to make such tests.
- 27.2 Contractors must note that where such tests will include sections of cable which have already been in service, test voltages and duration are to be reduced in accordance with Engineer's instructions.
- 27.3 After cables have been laid, jointed and terminated, they may, if required, be subjected to appropriate test voltage as follows:

CABLES FOR EARTHED SYSTEMS							
TYPE	PVCAS ¹	BELTED		SCREENED		XLPE ²	
Rated Voltage	600/1000	11000	22000	11000	22000	11000	22000
Between conductors - DC	3kV	31kV	60kV	-		18kV	36kV
Conductor to screen - DC	-	-	-	19kV	36kV	18kV	36kV
Conductor to earth - DC	3kV	19kV	35kV	19kV	36kV	18kV	36kV

¹ Test only when specifically called for

² Obtain instructions from the Engineer before testing.

28.0 **MV AND LV OVERHEAD POWER LINES**

- SANS 182** Conductors for overhead electrical transmission lines
- SANS 470** Concrete poles for telephone, power and lighting purposes
- SANS 616** High-temperature wood-preserving creosote
- SANS 673** Mixtures of copper-chromium-arsenic compounds for timber preservation
- SANS 753** Pine poles, cross-arms and spacers for power distribution, telephone systems and street lighting
- SANS 935** Hot-dip (galvanized) zinc coatings on steel wire
- SANS 10280** Overhead power lines for conditions prevailing in South Africa
- SANS 60282-1/IEC 60282-1** High-voltage fuses Part 1: Current-limiting fuses
- SANS 60305/IEC 60305** Insulators for overhead lines with a nominal voltage above 1 000 V - Ceramic or glass insulator units for A.C. systems - Characteristics of insulator units of the cap and pin type
- SANS 60372/IEC 60372** Locking devices for ball and socket couplings of

SANS 60383-1/IEC 60383-1	string insulator units - Dimensions and tests Insulators for overhead lines with a nominal voltage above 1 000 V Part 1: Ceramic or glass insulator units for A.C. systems - Definitions, test methods and acceptance criteria
SANS 61089/IEC 61089	Round wire concentric lay overhead electrical stranded conductors
SANS 61109/IEC 61109	Composite insulators for A.C.. overhead lines with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria
SANS 61211/IEC 61211	Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1 000 V - Impulse puncture testing in air
SANS 61284/IEC 61284	Overhead lines - Requirements and tests for fittings
SANS 61467/IEC 61467:1997	Insulators for overhead lines with a nominal voltage above 1 000 V - AC power arc tests on insulator sets
SANS 61643-1/IEC 61643-1	Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems - Requirements and tests
SANS 61952/IEC 61952	Insulators for overhead lines - Composite line post insulators for alternative current with a nominal voltage > 1 000 V
NRS 022	Electricity distribution - stays and associated components
NRS 028	Cable lugs and ferrules - for copper and aluminium conductors
NRS 031	Alternating current disconnectors and earthing switches (up to 145 kV)
NRS 035	Outdoor distribution cut-outs
NRS 038	Concrete poles
NRS 039	Surge arresters for use in distribution systems
NRS 043	Code of practice for the joint use of structures for power and telecommunication lines
NRS 044	Working procedures and standards in respect of the installation of new electrical works and telecommunication facilities, or the extension or modification of such existing works and facilities
NRS 060	Code of practice for clearances for electrical systems with rated voltages up to and including 145 kV, for the safety of persons
NRS 066	Medium voltage insulators
NRS 073	Wood poles, cross-arms and spacer blocks
NRS 075	Mechanical torque shear connectors

CMB Standards:

- 28.1 General:
- 28.1.1 Overhead power lines shall be erected to ensure their compliance with requirements of Occupational Health and Safety Act, especially so far as clearances and factors of safety are concerned, as well as with requirements of Telkom's Regulations governing crossing, parallel running, etc. with Telkom lines and any other relevant Acts.
- 28.2 Surveying and Pegging:
- 28.2.1 Routes of overhead power lines are shown on drawings.

- 28.2.2 Contractor will be responsible for ensuring that route is accurately followed and that best locations are selected for poles, taking into account topographical conditions, road crossings, telephone crossings, buildings, gates, etc.
- 28.2.3 Contractor may not enter private property without owner's written consent.
- 28.3 Bush Clearance:
- 28.3.1 Bush clearing includes removal of all trees and bush within 5,0m of centreline of line and for lopping of branches encroaching within this area. Extend of bush clearing will be itemised in Bill of Quantities.
- 28.3.2 Under no circumstances are protected indigenous trees to be removed or lopped without written permission of Engineer.
- 28.3.3 All material is to be removed from Site although Contractor shall not be deemed to have ownership of any such material.
- 28.4 Supports:
- 28.4.1 Wood poles shall be used unless otherwise specified, various constructional arrangements being indicated on drawings.
- 28.4.2 All poles, crossarms, props and structures made from wood poles shall be Pinus-Radiata. No bent, bowed or split poles will be accepted. All rejected poles shall be removed and replaced at Supplier's / Contractor's expense.
- 28.4.3 All poles shall be preserved with creosote and all crossarms with a mixture of creosote and waxy oil or, if so specified, with a copper-chromium-arsenic mixture otherwise referred to as 'Tanolith'.
- 28.4.4 All poles shall carry SABS mark.
- 28.4.5 Lengths, top diameter, etc., of poles required are given in Project Technical Specification.
- 28.4.6 Extreme care shall be taken to ensure that correct size of pole is used at strain and intermediate positions.
- 28.4.7 All wood poles and crossarms are to be banded by nailing and stapling.
- 28.4.8 Poles up to 10m shall be planted 1,5m in ground, longer poles 1,8m in ground, unless detailed elsewhere in Project Technical Specification.
- 28.4.9 Care shall be taken to ensure poles are planted plumb and in line and are properly compacted in accordance with the Clause "Trenching, Excavation and Compaction" elsewhere in this Part.
- 28.4.10 All drilling of wood poles and wood structures shall be done prior to erection and all drilled holes, cut surfaces, and pole tops, etc., shall be coated with a creosote/tar mixture.
- 28.4.11 "Shell" of treated poles shall not be damaged by cutting, shaving or drilling unnecessary holes.
- 28.5 Pole Holes:
- 28.5.1 It is preferred that pole holes be auger drilled.
- 28.5.2 Where pole holes are hand-excavated, material is to be set aside in layers to ensure that during back-filling material is replaced in its original strata.
- 28.6 Wood Crossarms:
- 28.6.1 Shall be of suitable lengths and diameter as detailed in Project Technical Specification.
- 28.7 Steel Crossarms
- 28.7.1 Shall be hot dipped galvanised rolled steel channel section not less than 100mm x 50mm x 6mm unless otherwise specified and of suitable length for the particular purpose.
- 28.8 Insulators:

- 28.8.1 Type and material of MV and LV insulators shall be as specified elsewhere in Project Technical Specification.
- 28.8.2 MV Strain insulators are clevis/tongue and shall be "in-line" for tension and "twisted" for suspension applications. A thimble clevis, aluminium for aluminium conductor and cast iron for copper conductor, shall be used.
- 28.8.3 All spindles mounted on wooden poles or cross-arms are to be bonded with 16mm² HD bare copper.
- 28.8.4 Type of construction, method of insulator support, details of brackets, spacing, etc., together with details of insulators for other duties or voltages are specified in Project Technical Specification.
- 28.9 Cross-arm Fixing:
- 28.9.1 Contact between cross-arm and pole surfaces shall be such as to ensure no possible movement of cross-arm, either longitudinal or rotational. Where necessary, suitable hot dipped galvanised braces shall stabilize cross-arms.
- 28.9.2 Cross-arms supporting strain insulators or cradles shall be mounted so that they pull towards pole, no tension being taken by the attachment bolts.
- 28.10 Pole Washers:
- 28.10.1 All bolts used in wood pole construction, all "D" bracket fixing bolts, "A" frame fixing bolts, crossarm bolts, etc. are to be fitted with suitable heavy duty galvanised pole washers below nut.
- 28.11 Conductor:
- 28.11.1 Full details of conductors required are given in Project Technical Specification.
- 28.11.2 Stringing of conductors shall be carried out in accordance with sag curves given in SAIEE "Code of Practice for Overhead Power Lines". Before making off at appropriate tension, conductors shall be over strained to 45% of their breaking strain for 20 minutes.
- 28.11.3 At strain points "Preformed" dead-ends shall be used.
- 28.11.4 Binding-in at intermediate MV insulators shall be carried out using "Preformed" twin-ties. Care shall be taken to ensure that ties are correctly sized for both insulator and conductor.
- 28.11.5 For binding-in of aluminium conductor, armour rods shall always be used except where armouring is automatically provided by use of the proprietary tie installed. In this case extreme care should be taken to ensure that all recommended conductor protection pads are properly in place.
- 28.11.6 Where slack spans are employed, care is to be taken to ensure that conductors are free of kinks, bends, etc., and that span has a neat and tidy appearance.
- 28.12 Mid-span Joints:
- 28.12.1 Approved type proprietary mid-span joints shall be used for copper to copper or for aluminium to aluminium conductors.
- 28.12.2 Such joints shall be made strictly in accordance with the Manufacturer's instructions.
- 28.12.3 Mid-span joints of dis-similar conductors will not be permitted.
- 28.13 Connections and Joints:
- 28.13.1 Connectors shall be suitable for the particular conductors, and shall comply with conductor Manufacturer's recommendations.
- 28.13.2 For aluminium to aluminium or copper to copper non-tension joints, these shall be parallel groove clamp, double line tap or compression sleeve joints made with an hydraulic tool.
- Extreme care shall be taken to ensure that only compatible materials are used for jointing aluminium conductors. Terminating lugs shall be of cold compression type.

- 28.13.3 Where aluminium to copper connections are to be made, either from line to line or line to cable tail, these shall be made using sacrificial tails. These tails, which shall be of same material as line, shall be joined by means of bi-metal connectors to prevent electrolytic corrosion occurring, and installed in accordance with Manufacturer's recommendations.
- 28.13.4 Where copper cables not larger than 25mm² are to be connected to aluminium lines, grease tubes and aluminium line taps must be used. In all cases where joints are made between different metals, copper conductor must be below aluminium to reduce risk of electrolytic corrosion.
- 28.13.5 All aluminium to aluminium joints are to be coated with "Densal" paste, regardless of method of jointing, and are to be wrapped in "Denso" tape, unless detailed elsewhere in Project Technical Specification.
- 28.14 Fittings:
- 28.14.1 All fittings shall be selected to ensure that their factor of safety is in compliance with Code of Practice at maximum design tension.
- 28.14.2 Pigtail hooks will not be accepted.
- 28.14.3 All fittings such as clamps, tower hooks, spindle brackets, eye nuts, rods, nuts, washers, stay rods, turnbuckles, etc., shall be hot dip galvanised mild steel, and shall comply with any other requirements elsewhere in this Specification.
- 28.15 Stays:
- 28.15.1 Stays shall be provided as indicated on drawings, and in any other places necessary for proper stability.
- 28.15.2 Stay wires shall be galvanised steel of 700MPa UTS and shall be 12mm diameter 1/7/4,00mm.
- 28.15.3 Stays shall, in all cases, be looped twice around pole at a point mid-way between two bolts in case of an 'A' frame construction or at level of middle conductor in case of a vertical construction. Where two stays are called for, these shall be between vertical conductors, or at top and bottom bolts of an 'A' frame.
- 28.15.4 Stay rods shall be galvanised steel of 400/500MPa UTS of circular section, inc. turnbuckle. Shall have at least 30% take up remaining after line has been tensioned. Stay rods shall be 20mm dia and 2,5m long and base plates shall be 450mm square.
- 28.15.5 In case of LV ABC lines, rod shall terminate in an eye and no turnbuckle shall be used, guy grip being made off into eye with a GMS 'U' bolt at end of grip.
- 28.15.6 All stays shall, except in case of LV ABC lines, be fitted with stay insulators. Shall be located not less than 5,0m above ground. In case of ABC lines stay wire is to be bonded to neutral conductor.
- 28.15.7 Angle between stay wire and pole shall be as near to 45° as possible, but shall not be less than 35°.
- 28.15.8 Stay wire shall be attached to poles and stay rods using "Preformed" pole and guy grips as required.
- 28.15.9 Wooden, or approved uPVC, stay guards, shall be fitted to all stays readily accessible to pedestrian or vehicular traffic. Guards shall be painted in alternate yellow and black cross stripes along their complete length.
- 28.15.10 Flying stays shall be installed as indicated on drawings.
- 28.16 Props (Struts):
- 28.16.1 Wood props shall be provided as indicated on drawings.
- 28.16.2 A concrete block shall be installed at pole butt to decrease ground pressure.
- 28.17 Cradles and Cradle Supports:

- 28.17.1 Cradles shall be in the form of two stringer wires of 16mm² hard drawn solid copper, with cross-rungs of same wire at 600mm intervals.
- 28.17.2 Cradle wire stringers shall be securely fixed to each cross-arm and at shackle points. Two clamps per stringer wire shall be used for fixing.
- 28.17.3 Cradle supports shall be similar in construction to cross-arms or as detailed elsewhere in this Specification.
- 28.17.4 Earth continuity of each cradle to its earthing point must be ensured.
- 28.18 **Bonding of Steelwork:**
- 28.18.1 All equipment, steelwork, cross-arms, insulator supports and any other hardware on a pole is to be bonded in accordance with Clause "Earthing and Bonding" elsewhere in this Part.
- 28.19 **Expulsion (D) Fuses:**
- 28.19.1 Expulsion fuses, three units to a set, suitable for voltage specified, shall be provided as shown on drawings.
- 28.20 **Links:**
- 28.20.1 Type of links (set of three) specified in Project Technical Specification.
- 28.20.2 All steelwork shall be hot dip galvanised.
- 28.21 **Lightning Arrestors:**
- 28.21.1 Arrestors shall, be rated as follows for 11kV and 22kV operation. Peak values shall apply with a 1,2/50 wave form and peak discharge voltages with 8/20 micro-second current wave of 10kA.

Nominal Voltage	kV	11	22
Rated Voltage	kV	11	24
Rated Current	kA	10	10
Minimum Flash-Over Voltage	kV rms	17.5	38
Peak Flash-Over Voltage	kV rms	44	80

- 28.21.2 A set shall comprise three units, complete with suitable steel cross arm mounting bracket.
- 28.21.3 Earthing shall be by means of a 40mm² bare copper conductor to an earth spike, as specified in the Clause "Earthing and Bonding" elsewhere in this Part.
- 28.21.4 Where arrestors have a connection of a metal not compatible with earth conductor, a sacrificial tail shall be used, generally as specified in Sub-Clause "MV and LV Cable Joints and Terminations" elsewhere in this Part.

29.0 **MV AND LV AERIAL BUNDLED CONDUCTOR**

SANS 1418

Aerial bundled conductor systems

SANS 1713

Electric cables - Medium-voltage aerial bundled conductors for voltages from 3,8/6,6 kV to 19/33 kV

CMB Standards:

29.1 **General**

- 29.1.1 Aerial bundled conductor shall be erected on wood poles whose supply and erection shall comply with Clause "MV and LV Overhead Power Lines" elsewhere in this Part.

- 29.1.2 Where mid-block distribution is called for construction must comply with Telkom's "Guidelines for Sharing of Structures Supporting Aerial Power Conductors and Telecommunication Lines".
- 29.2 Description:
- 29.2.1 Size of all conductors, together with details of any auxiliary (ie. streetlighting) cores or earth cores, shall be as specified in Project Technical Specification.
- 29.2.2 Supporting system shall be Trench type, i.e. supporting core system.
- 29.3 Suspension System:
- Only three or four items of hardware shall be used for suspension of bundle irrespective of size of phase, neutral, streetlighting and earth cores. These items shall be:
- 1) Dead end or strain clamp assembly
 - 2) Suspension clamp assembly
 - 3) Suspension bracket
 - 4) Eye bolts
- 29.3.1 Dead end or strain clamp assembly:
- 29.3.1.1 Shall comprise a heavy duty reinforced plastic body into which fits a glass fibre reinforced plastic or similar moulding designed to hold bundle in tension without damaging its insulation.
- 29.3.1.2 Clamp shall be attached to pole by means of an aluminium alloy bracket bolted to pole, a suitable pole washer being used on 16mm diameter bolt. Fixing with stainless steel strapping will not be accepted.
- 29.3.2 Suspension clamp assembly:
- 29.3.2.1 Shall comprise a support bracket of aluminium alloy with a suitable weather and wear resistant insert, the whole designed to hold the bundle rigidly into the clamp, while the clamp shall be unable to come loose from the suspension bracket.
- 29.3.2.2 Clamp shall be so designed that it can accommodate an angular line deviation of up to 35° when turning away from pole.
- 29.3.2.3 Clamp shall be attached to pole by means of an aluminium alloy bracket bolted to pole, a suitable pole washer being used on 16mm diameter bolt. Fixing with stainless steel strapping will not be accepted.
- 29.3.2.4 Suspension brackets shall be so designed that should line be subjected to excessive downward force due to a fallen tree etc, bracket will shear to prevent breakage of line.
- 29.3.3 Service conductor strain clamp assembly:
- 29.3.3.1 Shall generally comply with above, as appropriate, but strain clamp shall be fixed to pole by means of a threaded eye bolt, fitted complete with pole washer.
- 29.4 Joints and Terminations:
- 29.4.1 Bundled conductor jointing and termination shall be carried out by a qualified cable jointer using only standard methods approved by Manufacturer for particular type of bundle.
- 29.4.2 While mid-span joints will be accepted in LV conductor installations, they will not in case of MV installations.
- 29.4.3 All unconnected ends of line cores shall be sealed with an approved heat-shrink end cap.
- 29.4.4 MV connections shall be made using an approved heat-shrink termination for cable, as specified in Clause "MV and LV cable Joints and Terminations" elsewhere in this Part, and a termination system approved by the MV bundle Manufacturer for the line conductors.
- 29.5 Tap-off Connections:

- 29.5.1 Only tap-off connectors approved by bundle Manufacturer shall be used for connecting to bundled conductor.
- 29.5.2 Connectors (irrespective of conductor size) shall be of watertight, piercing type, to permit connection to a live cable without stripping of any insulation.
- 29.5.3 Contact faces of connectors shall have a sealant having a very high resistance to tracking, shall be watertight and have a minimum dielectric strength of 6kV.
- 29.5.4 Connectors shall have a main body manufactured of glass fibre reinforced plastic or similar material.
- 29.5.5 Contact faces of clamps shall have inserted copper alloy contact plates with teeth, which shall penetrate conductor insulation and establish sound electrical contact when bolt(s) that hold connector together are tightened. Bolts shall be hot dip galvanised.
- 29.5.6 Connector shall be suitable for insulated aluminium and copper conductors and shall be designed so that electrolytic corrosion does not occur. Entire construction shall be such that no part may be dislodged or lost during storage or installation.
- 29.6 Installation:
- 29.6.1 Installation shall be carried out in accordance with Manufacturer's recommendations. , the Contractor is to ensure that his employees erecting the system are familiar with all aspects of aerial bundled conductor, and shall be suitably equipped to install it.
- 29.6.2 Ground clearance of bundled conductor shall comply with latest requirements of Occupational Health and Safety Act.
- 29.6.3 Conductor shall be bound with heavy duty cable ties either side of all suspension points, at strain points and either side of all take-off points.
- 29.7 Earthing:
- 29.7.1 Earthing of neutral and/or earth conductor is to comply with appropriate requirements of Clause "Earthing and Bonding" elsewhere in this Part.
- 30.0 **LIGHTNING PROTECTION**
- | | |
|-----------------------------|--|
| SANS 10313 | The protection of structures against lightning |
| SANS 62305/IEC 62305 | Protection against lightning |
- 31.0 **LV WIRING AND CONDUIT FOR LV WIRING**
- | | |
|---------------------|--|
| SANS 950 | Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations |
| SANS 1507 | Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) |
| SANS 1574 | Electric flexible cores, cords and cables with solid extruded dielectric insulation |
| SANS 10142-1 | The wiring of premises Part 1: Low-voltage installations |
| SANS 60614 | Conduits for electrical installations |
| SANS 61035 | Specification for conduit fittings for electrical installations |
- CMB Standards:**
- 31.1 Size of conductor as per Project Technical Specification.
- 31.2 Loop-in system is to be adopted throughout any conduit installation.

- 31.3 Circuit wiring for different services, e.g. lighting and power, shall be run in separate conduits.
- 31.4 Where switches fed from different phases are mounted adjacent, they must be mounted in separate boxes or a single box with a fixed metal barrier between each switch.
- 31.5 Metal conduit shall be heavy gauge solid lap welded steel, screwed or plain-end galvanised, both as specified in Project Technical Specification.
- 31.6 All metallic conduit shall be manufactured from mild-steel with a minimum thickness of 1,6mm in respect of screwed and 0,9mm for plain-end conduit except that when used in concrete slabs, plain-end conduit shall have a minimum wall thickness of 1,2mm and when laid in screed on top of concrete slabs, 1,6mm.
- 31.7 Only plastic saddles and compatible fittings shall be used with non-metallic conduit.
- 31.8 Earth wires shall be installed with all non-metallic conduits.
- 31.9 All conduit fittings for steel conduit shall be malleable iron or pressed steel except for brass bushes.
- 31.10 Use of inspection tees or elbow pieces and internally screwed solid bends will not be permitted.
- 31.11 All conduit shall, wherever possible, be concealed by being cast in concrete slabs, chased in, built in or run in roof spaces.
- 31.12 When run in surface beds conduit is to be galvanised and is to be laid in concrete on surface bed so that it is completely covered.
- 31.13 Conduit cast in concrete shall be fixed at intervals to ormwark.
- 31.14 Where hollow tile slabs are being used in structure back entry conduit boxes shall be used.
- 31.15 All outlet boxes for lighting points shall be of long spout, deep type.
- 31.16 Where structural expansion joints occur, conduits shall, as far as possible, be laid to avoid crossing joint.
- 31.17 When crossings are unavoidable, the following arrangement shall be made. From a drawbox, or the nearest outlet within 4,0m of the joint, conduit of one size larger than necessary for the wire sizes, shall be run straight, and at right angles to the joint, finishing at the joint. Conduit of the required size shall then be passed into this from the other side of the joint, bushed inside the draw-box, but not mechanically connected otherwise. Care shall be taken to prevent concrete from entering the end of the larger conduit. The Conduits approaching from both sides of the expansion joint shall be wrapped with two layers of corrugated cardboard from a point 1,0m from the joint. A bare earth wire of the same size as the wiring in the conduit shall be run from the drawbox to the next outlet, connecting firmly and solidly to each box. Care shall be taken to exclude the ingress of dirt or moisture to partially completed runs, and all open ends shall be plugged temporarily while work is not actually in progress. Plug may consist of a conduit socket with brass ET plug or conduit fishtail, or purpose made tightly fitting plastic sealing caps. Wooden or paper plugs will not be acceptable.
- 31.18 Conduit in false ceiling spaces shall be run surface.
- 31.19 In roof spaces all conduit runs shall be parallel or at right angles to trusses and joists.
- 31.20 Where conduits run along trusses and joists they shall not be run or fixed on top but on side.
- 31.21 Conduit shall lead into and out of back entry conduit boxes at all fitting positions. All such boxes shall be finished flush with the underside of ceiling and lighting fittings shall be screwed directly onto box.
- 31.22 At ceiling positions where conduit runs do not have to continue to next truss (e.g. last point in a row), conduit shall be extended beyond box to next truss. This conduit extension shall be plugged.

- 31.23 Where conduit is run on surface, it shall be fixed with stand-off saddles, multiple spacer saddles being used for conduits run together.
- 31.24 Maximum distance between saddles shall not exceed 1,5m.
- 31.25 Conduit box lighting fitting shall be fixed within 100mm on either side of box.
- 31.26 Where conduits have to run adjacent to gas or cold water pipes, communication or data circuits, they shall be prevented by spacing or other means from coming into contact with these other services under any condition.
- 31.27 Under canopies, outlets for future signs, etc., which have been terminated in round conduit boxes, are to be blanked off with 75mm dia galvanised cover plates finished with a zinc plumbate primer. These are to be fitted prior to painting and are to be fixed using cheese headed brass machine screws.
- 31.28 Where conduit enters boards, trays, etc., locknuts shall be used inside and outside, with female bushes inside. Same arrangement shall be used wherever possible for entry into switch boxes, control gear, etc., provided with clearance holes. Where this arrangement does not allow sufficient wiring space, however, couplings and hexagonal male bushes may be used, but must be very tightly screwed up. In case of multiple back entries into a conduit box, male bushes and couplings are to be used.
- 31.29 Care must be exercised when laying conduit in vicinity of distribution boards of any type to ensure that conduits radiate from these points in order. Under no circumstances are more than two conduits to cross at any point where cast in concrete and a space of at least 20mm must be left between all conduits both vertically and horizontally after emerging from distribution point.
- 31.30 Drops to switch and other high level outlets shall be from ceiling while conduit to low level outlets shall be run in floor. In basements and ground floor areas which are below natural ground level, all conduits to any type of outlet shall drop from ceiling level.
- 31.31 No draw boxes which are not, in themselves, outlets shall be permitted. Notwithstanding Wiring Code, if it proves necessary to draw conductors round more than two 90° bends, or equivalent, or on very long straight runs, draw boxes are required. Maximum length of straight runs between draw boxes shall not exceed 20m. Such draw boxes shall be provided with oversize flat covers fitted flush with ceiling, fixed with cheese-headed screws.
- 31.32 Contractor is responsible for checking with Building Contractor by reference to drawings on site, of positions where paneling, tiling, tile edging or dados, etc., may affect exact positioning of outlets.
- 31.33 All setting of conduit shall be done with approved tools. No kinks will be accepted. Where necessary, boxes with special configurations shall be used to avoid necessity for too many sets in conduitwork.
- 31.34 Conduit shall be run or erected in straight or symmetrical lines, with easy sets or bends. Care shall be taken when installing conduit that cut ends are completely free from burrs and sharp edges which might damage conductors. All open ends shall be fitted with brass bushes. Composition bushes will not be accepted. All bushes are to be fitted prior to wiring. All running joints shall be fitted with lock-nuts, and lock-nuts shall be provided wherever necessary to ensure that all conduit joints in installation are tight.
- 31.35 Where conduit only is required, draw-wires shall be left in each such conduit, irrespective of service for which it is required. Draw-wires shall be minimum 1,6mm dia hot dipped galvanised steel.
- 31.36 Conduit run on surface within ducts shall be painted an approved colour under this Contract. Conduit in false ceilings and roof spaces is not to be painted.
- 31.37 Contractor must ensure that, prior to final completion, all openings left at conduit exit from switchrooms or between floors in rising ducts, are made good.

32.0 LV WIRING TRUNKING**SANS 60570**

Electrical supply track systems for luminaires

CMB Standards:

Trunking shall be used where indicated in the Project Technical Specification and shall be of type specified.

- 32.1 Where trunking is to be fabricated of sheet metal, this shall be of 1,0mm minimum thickness. Each length shall be so constructed that it matches identically with the other lengths and the lengths shall be joined by splicing sections inside the trunking.
- 32.2 Trunking shall be finished by degreasing, suitably primed and painted with two coats of high quality enamel, unless otherwise specified. Where galvanising is specified, this shall mean fabrication from pre-galvanised plate unless hot-dip galvanising is specifically called for. Electrogalvanising will not be accepted.
- 32.3 Trunking shall be installed straight and level and shall incorporate all recommended fixings when of proprietary makes. Plastic clips shall be installed at not more than 1200mm centres to hold wiring in place when covers are removed.
- 32.4 Earth wires shall be run in all wiring trunking and these shall be bonded to all equipment fed by wiring carried in the trunking and to the trunking lengths themselves.
- 32.5 When trunking is cast into structures it shall be taped to prevent the ingress of slurry and it will be the Contractor's responsibility to ensure that the trunking runs true. Where trunking is fitted to pre-formed slots in the structure or built into brickwork, the trunking shall be adequately braced to prevent deformation of the sides during plastering, resulting in the bowing of the cover when finally fitted.
- 32.6 Where light fittings cross ceiling trunking, the cover strip shall be cut square to abutt the fittings, and the raw edges, if of metal, shall be painted to match the applied finish.
- 32.7 Skirting trunking shall be as specified elsewhere in this Specification, the general remarks above being deemed to apply.

33.0 LV BUSBAR TRUNKING**SANS 784**

Design for access and mobility – Tactile indicators

SANS 10142-1

The wiring of premises Part 1: Low-voltage installations

CMB Standards:

- 33.1 Busbar trunking for LV systems shall consist of metal-enclosed copper or aluminium busbars intended for use indoors at voltages not greater than 1000V.
- 33.2 Busbars shall be spaced apart and held in position by robust insulating material and shall be sufficiently strong to withstand the rated fault level without failure.
- 33.3 Metal enclosure around the busbars shall be sheet metal of sufficient thickness so as to provide adequate rigidity and strength under fault conditions. Metal enclosure shall be treated adequately against corrosion by means of hot dip galvanizing or enamel coatings. Ventilation openings shall comply with IP 30 and with the vermin proofing requirements set out in the Project Technical Specification.
- 33.4 Busbar trunking systems shall be installed strictly in accordance with the Manufacturer's instructions.
- 33.5 No protective devices shall be provided within the busbar trunking system (except as described in the standards) and outgoing circuits or tee-offs shall be adequately protected from overcurrent by fuses or circuit breakers.
- 33.6 Expansion joints shall be purpose made and shall be installed at such intervals as recommended by the Manufacturer.

- 33.7 Fire-resistant units shall be purpose made and shall be installed where busbar trunking passes through walls and floors and shall be installed strictly in accordance with the Manufacturer's instructions. The opening through the wall/floor around the fire resistant unit shall be fire stopped with non-combustible/fire-retardant foam in compliance with the National Building Regulations.

34.0 **LV FLAT TWIN AND EARTH AND SURFIX**

SANS 1507 Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)

CMB Standards:

- 34.1 Where flat twin and earth (ABB T & E) or surfix is called for, Electrical Contractor will be required to supply all cable and cable glands required.
- 34.2 Cable sizes shall be as specified or shown on drawings.
- 34.3 Cables shall consist of copper conductors, PVC insulated and laid with a bare copper earth-continuity-conductor between them, PVC sheathed 300/250V. (T & E) or copper conductors, PVC insulated laid up with a bare copper earth wire in contact with aluminium foil tape, and overall PVC sheathed 300/500V or 600/1000V.
- 34.4 All cables shall be free from kinks and dents and shall be run straight and true, all cable shall be properly handled to prevent damage.
- 34.5 Cables shall be fixed with single, purpose made clips or multiple saddles attached with screws at following spacings. When run vertically the distance between saddles may be one and one half distance specified.

Cable Size	
2 Core and Earth	Spacing
1,5mm ²	500mm
2,5mm ²	500mm
4mm ²	600mm
6mm ²	600mm
10mm ²	700mm
16mm ²	700mm

- 34.6 Conductors larger than 4mm² are usually stranded.
- 34.7 Where cables are run on cable trays they shall be strapped to cable tray at above spacings.
- 34.8 Plaster depth installations will not be permitted.
- 34.9 In general all installations shall be re-wirable, and all cabling to flush mounted outlets such as switches, switch socket outlets and outlet boxes etc., shall be drawn through conduits or wireways concealed within structure.
- 34.10 Where ceilings are provided as part of structure, conduits or wireways need only be provided between actual outlet and ceiling void.
- 34.11 Where cables are to be installed underground these shall be drawn through sleeves sizes of which shall be as specified or shown on drawings.
- 34.12 Sleeves shall be at a depth of not less than 600mm.

- 34.13 Where Project Technical Specification expressly permits plaster depth installations, cables shall be fixed to wall in same manner as described above.
- 34.14 Cable from switches, socket outlets, etc., shall run vertically to ceiling for ease of future location.
- 34.15 Ceiling outlets shall be in the form of plaster depth ceiling outlet boxes.
- 34.16 Cable ends shall be made off using suitably sized purpose made adjustable glands with lock nuts which shall be effectively fitted and tightened.
- 34.17 All tails shall be phase coloured with neoprene or similar sleeving. Use of insulation tape will not be accepted.
- 34.18 When terminating at motors mounted on slide rails cable shall be saddled at specified distances up to a point adjacent to motor. At this point cable is to be terminated into a standard round conduit box adequately supported. Final connections between conduit box and motor shall be carried out using single core conductors in approved similar flexible tubing or alternatively with PVC SWA cable and glands. Where motors are not provided with means of altering their positions, they may be connected directly with cable. However, prior to entering motor cable must be formed into an unsupported loop to minimise effect of vibration.
- 34.19 Where cables are installed in vulnerable positions they are to be protected by either the use of channel iron sections or kick pipes fixed to structure.

35.0 **LV SWITCHES, SOCKET OUTLETS, PLUGS AND BOXES**

SANS 164	Plug and socket-outlet systems for household and similar purposes for use in South Africa
SANS 1085	Wall outlet boxes for the enclosure of electrical accessories
SANS 1239	Plugs, socket-outlets and couplers for industrial purposes
SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
SANS 60309	Plugs, socket-outlets and couplers for industrial purposes
SANS 60669	Switches for household and similar fixed-electrical installations
SANS 60670	Boxes and enclosures for electrical accessories for household and similar fixed electrical installations
SANS 60884	Plugs and socket-outlets for household and similar purposes
SANS 60906	IEC system of plugs and socket-outlets for household and similar

CMB Standards:

- 35.1 Type, size, finishing and IP rating (in case of weatherproof) plugs and switches will be specified in Project Technical Specification.
- 35.2 Samples of all switches and socket outlets shall be approved by Engineer before installation.
- 35.3 Weatherproof and watertight switches and socket outlets are to be semi-recessed in a manner to be discussed with Engineer to ensure their acceptable mounting, especially in case of facebrick walls.
- 35.4 Contractor is to ensure that the Plasterer covers right to edge of various boxes since gaps between plates and plaster will not be accepted, and it is deemed the Contractor's responsibility to ensure that no such gaps are visible.

- 35.5 Switches and socket outlets shall be mounted at dimensions as indicated in the Project Technical Specification or depicted on drawings.

36.0 **LIGHT FITTINGS**

SANS 56	Incandescent lamps.
SANS 475	Luminaires for interior lighting, street lighting and floodlighting - Performance requirements
SANS 890	Ballasts for fluorescent lamps
SANS 1012	Electric light dimmers (Metric units)
SANS 1777	Photoelectric control units for lighting (PECUs)
SANS 101141	Interior lighting
SANS 60238	Edison Screw Lamp holders
SANS 60598	Luminaires
SANS 60921	Ballasts for tubular fluorescent lamps - Performance requirements
SANS 61184	Bayonet Lamp holders
SANS 61347	Lamp control gear
VC 8043	Incandescent Lamps

CMB Standards:

- 36.1 Allowance shall be made for light fittings as specified in Project Technical Specification.
- 36.2 Fittings to be installed at each point are detailed on drawings according to code types set out in in Project Technical Specification.
- Fittings shall be directly fixed to ceiling or structure in addition to being fixed to the conduit box.

37.0 **TELEPHONES**

CMB Standards:

- 37.1 Telephone outlets and distribution boards, etc., shall be located as shown on drawings.
- 37.2 Telephones will be supplied and installed by others, unless advise otherwise.
- 37.3 Distribution boards shall comprise galvanised metal bonding trays of sizes indicated, mounted flush, unless otherwise specified, in position shown. Doors shall be carried on a separately mounted and adjustable architrave and construction shall comply generally with Clause "LV MCB Main and Sub-Distribution Boards and Control Panels" elsewhere in this Part. All such boards shall be provided with a 16mm thick timber backing board.
- 37.4 Internal arrangement, size, and specific requirements of Main Telkom Board shall comply with the Project Technical Specification and drawings detailed elsewhere.
- 37.5 Contractor responsible to supply and install conduit and boxes of sizes shown, and in positions indicated on drawings, from point of entry to building to distribution points and individual outlets and skirting ducts. Where no outlet sizes are shown, 100mm x 100mm x 50mm flush boxes shall be provided. When mounted adjacent to socket outlets, plates shall be in line and 25mm apart, unless advised otherwise.
- 37.6 Conduit shall conform to particulars laid down elsewhere in this Part, all bends being large radius. No draw-in boxes on telephone circuits will be permitted in roof spaces. 1,6mm min. diameter galvanised draw-wires are to be left in all conduit. All draw boxes are to be labeled.
- 37.7 Contractor shall be responsible for supply and installation of blank cover plates to all boxes. Plates shall be of exactly matching finish to cover plates specified for switches and socket outlets.
- 37.8 Distribution boards shall be appropriately labeled in accordance with Clause "Labels and Notices" elsewhere in this Part.

- 37.9 Sleeves shall be laid 500mm, unless detailed elsewhere, below ground. Galvanised 1,6mm draw wires are to be left in all such sleeves. Joints are to be made using exterior couplings.

38.0 **PADLOCKS**

CMB Standards:

- 38.1 All padlocks shall be provided by Contractor.
- 38.2 In case of extensions to existing installations, all padlocks shall match existing with same combinations.
- 38.3 Padlocks with stainless steel shackles shall be provided.
- 38.4 Padlocks shall operate with a master key in addition to individual key. Where special combinations are required these will be stated elsewhere in Project Technical Specification. Padlocks and keys shall be stamped with combination number. Three (3) sets of keys for each combination shall be provided. Keys shall be handed to Employer's authorised Representative and a receipt obtained.

Following equipment shall be fitted with padlocks:

Combination No. 1.

Outdoor substation gates.

Transformer tap-change switches.

MV switches and isolators.

Minisub MV compartment doors.

Combination No. 2.

Minisub LV compartment doors.

Distribution kiosk doors.

Combination No. 3.

Doors of compartments containing consumer meters.

39.0 **FIRE EXTINGUISHERS**

CMB Standards:

- 39.1 Fire extinguishers shall, unless otherwise specified, be of CO₂ type.
- 39.2 Fire extinguishers shall be of wall mounted type and installed in positions indicated on drawings.
- 39.3 Where specifically required due to nature of fire hazard, chemical all purpose dry powder extinguishers may be called for. Unless specifically stated to contrary these shall each be 4,5kg units.
- 39.4 All extinguishers shall bear SABS mark.

40.0 **HOT DIP GALVANISING**

General Hot Dip Galvanizing Standards:

SANS 32	Hot-dip (galvanized) zinc coatings (other than on continuously zinc-coated and sheet wire)
SANS 121	Hot-dip (galvanized) coatings on fabricated iron and steel articles
SANS 10094	The use of high strength friction grip bolts

SANS 14713 General principles of design and corrosion resistance

Mechanical Cleaning and Zinc Thermal Spraying Standards:

SANS 2063 Metallic and other inorganic coatings

Continuously Hot Dip Galvanized Sheeting Standards:

SANS 4998 Continues hot dip zinc coated carbon steel sheet of structural quality

SANS 3575 Continues hot dip zinc coated carbon steel sheet of commercial, lock forming and drawing qualities

SANS 9364 Continues hot dip aluminium / zinc coated steel sheet of commercial, drawing and structural qualities

SANS 14788 Continues hot dip zinc / 5% aluminium alloy coated sheets

Continuously Hot Dip Galvanized Wire Standards:

SANS 675 Zinc coated fencing wire

SANS 935 Hot dip galvanized zinc coatings on steel wire

SANS 10244 Steel wire and wire products

CMB Standards:

40.1 Before galvanising, all cutting, drilling, welding, etc., shall be complete.

40.2 Galvanised parts shall be stored under cover and in stacks such that no part is resting on another and there is sufficient ventilation to prevent condensation occurring. No galvanised parts shall be stored directly on ground but on pallets or similar protection.

41.0 **PAINTING**

SANS 1274 Coatings applied by the powder-coating process

CMB Standards:

41.1 Equipment that is delivered to site painted shall, after installation, and as near as possible to handover be inspected for damaged paintwork and be touched up, if necessary, according to manufacturer's recommendation.

41.2 Where any galvanised or zinc coated surface has been damaged or cut, this shall be touched up using an organic zinc rich epoxy primer (containing min. 90% zinc).

42.0 **LABELS AND NOTICES**

SANS 1186 Symbolic safety signs

CMB Standards:

42.1 Contractor shall arrange for labeling of all equipment, instruments, meters, relays, cables, etc.

42.2 Where identical items of equipment can be removed from their housings, e.g. circuit breaker carriages, plug-in relays etc., both fixed and withdrawable portions are to be labeled identically.

42.3 All labels shall be ivory or other back engraved white on black labels of sizes indicated.

42.4 Labels are to be located in purpose made holders or otherwise are to be screwed or riveted into position.

42.5 "Dymo" tape or similar labels will not be accepted nor will labels which are glued in position only.

- 42.6 Labels on poles shall be manufactured from a material as specified in Project Technical Specification with the designated number. Labels shall be nailed to pole 3,5m above ground level, unless otherwise specified in the Project Technical Specification. Nails shall be electro-galvanised clout nails.
- 42.7 Prior to any equipment being labeled, Contractor shall request Engineer to provide a complete labeling schedule for all items of equipment. Under no circumstances is equipment to be labeled in accordance with tender drawings since any description thereon is for identification purposes during construction only and is unlikely to apply to the completed Works.
- 42.8 Following list indicates general labeling requirements but does not limit extent of labeling required, which shall encompass full extent of equipment supplied, or in case of existing equipment, any such which is affected by this Contract.
- 42.8.1 50mm high lettering:-
 Substation and minisub designation.
 Outdoor switchgear designation. Transformer designation.
 Distribution kiosk and fused feeder panel designation.
- 42.8.2 20mm high lettering:-
 Main or sub-main board designation. Control panel designation.
 Indoor switchgear designation.
- 42.8.3 10mm high lettering:-
 Individual switches on switchgear.
 Cubicles.
 Sub-distribution board designation.
 Poles for OH lines.
- 42.8.4 5mm high lettering:-
 Minisub feeder breakers and isolators.
 Distribution kiosk feeder breakers and isolators.
 General distribution switchgear.
 Meters, instruments and relays.
 Multiplying factors.
- 42.8.5 3mm high lettering:-
 This size shall be used to designate conductor size and number of cores of each cable. In addition, all feeder cables shall be labelled to state from whence they are fed.
- 42.9 All substations, minisubs, kiosks, transformer rooms and switchrooms shall be provided with notices as required by Occupational Health and Safety Act. All doors to such locations shall be fitted with appropriate notices.
- 42.10 Where more than one similar item of equipment is fed from same board or control panel, item itself shall be labeled, this being fixed in a permanent position, i.e. not attached to motors, pumps, etc., but to bases or adjacent thereto. The lettering shall be 50mm high.
- 43.0 **DISMANTLING**
CMB Standards:
- 43.1 Where dismantling of existing parts of installation is called for, all components including wire, insulators, poles, cable, switchgear, transformers, etc., are to be removed and handed to appropriate Authority.

- 43.2 Under no circumstances is any material or equipment to be taken over by Contractor.
- 43.3 In case of reclamation of conductor, this is to be done after removing binding wires on intermediate insulators so that full strain lengths are recovered.
- 43.4 All such material is to be neatly coiled, packed, etc., as appropriate.
- 43.5 Extreme care is to be taken in dismantling all such equipment, since it will be re-used by Employer.
- 43.6 If, in opinion of Engineer, unnecessary damage is done, cost of replacing such equipment will be debited to Contractor's account.
- 43.7 Receipt detailing all equipment and materials delivered in accordance with above must be obtained and a copy submitted to Engineer.

44.0 **INSPECTION, TESTING AND COMMISSIONING**

CMB Standards:

- 44.1 Engineer shall have access at all reasonable times to such parts of the Works or Contractor's premises or premises of Manufacturer of component parts, as may be necessary for purpose of inspecting, examining and testing materials, workmanship and performance of any plant or equipment specified for Works.
- 44.2 Contractor shall ensure that complete project and inspection, testing and commissioning of any equipment shall be done as per the applicable SANS or BS Specification.
- 44.3 Contractor shall supply all equipment necessary for testing and commissioning procedures.
- 44.4 Contractor shall provide duplicate test certificates relating to cable tests, current injection tests of all instruments, meters and relays and results of earth mat tests.

45.0 **COMPLETION OF WORKS**

CMB Standards:

- 45.1 Completion of works will be executed as per relevant contract conditions.

46.0 **CERTIFICATE OF COMPLIANCE**

CMB Standards:

- 46.1 Contractor to complete and submit certificate of compliance as per the relevant contract conditions.