# **general specification**

This specification comprises of all aspects regarding the electrical installation for execution of the VUT Electrical Master Plan Implementation. The Project Specification shall be read in conjunction with the General Specifications in this document, installation and quality specifications, schedule of quantities, drawings and Special Conditions of Contract included in this document. Where contradictions occur between the documents, the most stringent requirement shall rule, unless otherwise stated by the Engineer.

# **PRELIMINARIES**

### The contractor shall allow for the following specific requirements: Office accommodation for meetings held on site.

### In addition to the specific requirements, detailed above, the contractor shall allow for his own preliminaries and/or overhead costs as required for the execution of the contract. It shall be divided into the following two sections:

Fixed-charge items such as: (SABS 1200A - 8.3)

* + Contractual requirements.
	+ Establishment of facilities on site such as plant, sheds, water, Electricity, lighting, etc.
	+ Removal of facilities from site after completion of work.
	+ Any other fixed-charge items.

 Time related items:

* + Contractual requirements.
	+ Operation & maintenance of facilities on site.
	+ Supervision.
	+ Company and head office overhead costs.
	+ Other time related items.

# **SPECIFICATION FOR 11KV XLPE Cu CABLES**

## INTRODUCTION

The effect of a medium-voltage cable failure is generally severe in terms of customer outage as well as repair cost. It is therefore important to ensure that MV cables comply with the required specifications and are of acceptable quality.

## Scope

This specification covers the requirements for medium voltage cables in accordance with NRS 013 for 11kV and 22kV. The specific voltage required will be indicated in the project specification and the schedule A and B attached.

### **Normative References**

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

NRS 013: Medium-Voltage Cables

SANS 10198 (MULTIPLE PARTS): Installation of cables

### **Definitions and Abbreviations**

The definitions and abbreviations in NRS 013 shall apply to this specification.

### **Requirements**

The operating voltage of medium-voltage cables shall be;

1. 6,35/11 kV;
2. 12,7/22 kV; or
3. 600V/1000V

### **Cable types**

(a) All cables and jointing and termination accessories used for power distribution shall comply with the SANS 10198.

(b) Cables with copper conductors shall be used throughout unless otherwise specified or approved.

(c) All unarmoured cables shall be installed in metal trunking, sleeves or conduit unless clearly specified to the contrary.

(d) XLPE Cables shall be used.

## Competence of personnel

* It is a definite requirement that the Contractor shall only employ personnel fully conversant with cable manufacturer's recommendations for joining and terminating cables.

## Identification of cables

* Cables shall be identified at all terminations by means of punched metallic bands or marked with labels or tags. (Refer also to SABS 0142).
* The use of PVC tape with punched characters is not acceptable.
* The identification numbers of cables shall be shown on "as built" drawings of the Installation.

## Trenching

### **General**

* The Contractor shall be responsible for all trenching excavations unless specified to the contrary.
* The Contractor shall, before trenching commences, familiarize himself with the routes and site conditions and the procedure and order of doing the work shall be planned in conjunction with the general construction programme for other services and building requirements.
* The Contractor shall acquaint himself with the position of all the existing services such as storm water pipes, water mains, sewer mains, gas pipes, telephone cables, etc. before any excavations are commenced. For this purpose, he shall approach VUT's representative, the local municipal authority and any other authority which may be involved, in writing.
* The Contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and shall be responsible for the cost of repairs.
* The Contractor shall take all the necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and/or employees on site are not endangered.
* The Contractor shall ensure that the excavations will not endanger existing structures, roads, railways, other site constructions or other property.

## Mechanical excavators

* Power driven mechanical excavators may be used for trenching operations provided that they are not used in close proximity to other plant, services or other installations likely to be damaged by the use of such machinery.
* The use of power driven mechanical excavators shall be subject to the approval of the Engineer. Should the excavator produce trenches that exceed the required dimensions, payment based on volumetric excavation rates will be calculated on the required dimensions only.

## Blasting

* No guarantee is given or implied that blasting will not be required.
* Should blasting be necessary and approved by the Engineer, the Contractor shall obtain the necessary authority from the Engineer and Local Authorities.
* The Contractor shall take full responsibility and observe all conditions and regulations set forth by the above authorities.

## Routes

* Trenches shall connect the points shown on the drawings in a straight line. Any deviations due to obstructions or existing services shall be approved by the Engineer beforehand.
* The Engineer reserves the right to alter any cable route or portion thereof in advance of cable laying. Payment in respect of any additional or wasted work involved shall be at the documented rates.
* The removal of obstructions along the cable routes shall be subject to the approval of the Engineer.

## Shoring and Waterlogging

* The Contractor shall provide shoring for use in locations where there is a danger of the sides of the trench collapsing due to waterlogging or other ground conditions. Refer to the The Occupational Health and Safety Act.
* The strength of shoring must be adequate for site conditions prevailing and the shoring must be braced across the trench.
* The Contractor shall provide all pumps and equipment required to remove accumulated water from trenches. Water or any other liquid removed shall be disposed of without any nuisance or hazard.

## Trenching

* Trenching shall be programmed in advance and the approved programme shall not be departed from except with the consent of the Engineer.
* Trenches shall be as straight as possible and shall be excavated to the dimensions indicated in this specification.
* The bottom of the trench shall be of smooth contour, and shall have no sharp dips or rises which may cause tensile forces in the cable during backfilling.
* The excavated material shall be placed adjacent to each trench in such a manner as to prevent nuisance, interference or damage to adjacent drains, gateways, trenches, water furrows, other works, properties or traffic. Where this is not possible the excavated materials shall be removed from site and returned for backfilling on completion of cable laying.
* Surplus material shall be removed from site and disposed of at the cost of the Contractor.
* Trenches across roads, access ways or footpaths shall not be left open. If cables cannot be laid immediately the Contractor shall install tem­porary "bridges" or cover plates of sufficient strength to accommodate the traffic concerned.
* In the event of damage to other services or structures during trenching operations the Contractor shall immediately notify the Engineer and institute repairs.
* Prior to cable laying the trench shall be inspected thoroughly and all objects likely to cause damage to the cables either during or after laying shall be removed.
* Where ground conditions are likely to reduce maximum current carrying capacities of cables or where the cables are likely to be subjected to chemical or other damage or electrolytic action, the Engineer shall be notified before installing the cables. The Engineer will advise on the course of action to be taken.
* Extreme care shall be taken not to disturb surveyor's pegs. These pegs shall not be covered with excavated material. If the surveyor's pegs are disturbed, they shall be replaced by a person qualified to do so.

## Dimensions of trenches

* Cable trenches for one or two cables shall not be less than 300 mm wide and need not be more than 450 mm wide. This dimension shall be valid for the total trench depth.
* The width shall be increased where more cables are installed to allow for the spacings stipulated in par. 4.2.
* Where trenches change direction or where cable slack is to be accommodated, the Contractor shall ensure that the requirements of the relevant SABS Specification regarding the bending radii of cables are met when determining trench widths.
* Trench depths shall be determined in accordance with cable laying depths and bedding thickness.
* Payment will be made on a volumetric excavation rate calculated on the basis of the given maximum dimensions or the actual dimensions, whichever is the lesser.

### **Joint holes**

* Where cable joints are required to be made in the course of a cable run, a joint hole shall be excavated of sufficient size to enable the cable jointer to work efficiently and unimpeded.

### **Bedding**

* The bottom of the trench shall be filled across the full width with a 75mm layer of suitable soil sifted through a 6mm mesh and levelled off.
* Only sandy clay or loam soil with a satisfactory thermal resistivity (not exceeding 1,5°C m/W) may be used for this purpose. Sea or river sand, ash, chalk, peat, clinker or clayey soil shall not be used. The use of crusher sand is acceptable.
* Where no suitable soil is available on site, the Contractor shall import fill from elsewhere and make all the necessary arrangements to do so. The cost of importing soil for bedding purposes shall be included in the unit rates for excavations.
* After cable laying a further layer of bedding shall be provided to extend to 75 mm above the cables.
* The bedding under joints shall be fully consolidated to prevent subsequent settling.

##

### Cable Sleeves

* Where cables cross under roads, railway tracks, other service areas, etc. and where cables enter buildings, the cables shall be installed in Polyethylene (6mm thickness), asbestos cement pipes or earthenware pipes. Pitch fibre and PVC pipes are not acceptable because of the adhesion that occurs after a period of time between the pipe and the sheathing or outer serving of the cables.
* Pipes shall be joined in accordance with the manufacturer's instructions.
* Sleeves shall cross roads and railway tracks at right angles.
* Sleeves shall have a minimum diameter of 100mm. They shall extend at least 2m beyond the tracks of a railway line or of the outermost tracks where there is more than one line. In the case of roads, the sleeves shall extend at least 1m beyond the road edge or kerb on both sides of the road.
* All sleeves shall be graded 1:400 for water drainage.
* Cable sleeves shall be installed to the spacings and depths stated in paragraph 4 below.
* Galvanised metallic sleeves up to and including 76mm dia. shall be supplied and installed by the contractor.
* The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed.

### **Backfilling**

* The Contractor shall not commence with the backfilling of trenches without prior notification to the Engineer so that the cable in­stallation may be inspected. Should the Contractor fail to give a timeous notification, the trenches shall be re-opened at the Contractor's cost. Such an inspection will not be unreasonably delayed.
* For medium voltage cables (1 kV to 11 kV) a coloured plastic marking tape shall be installed 400 mm above the cable. The tape shall be yellow, marked with the words "ELECTRIC CABLE/ELEKTRIESE KABEL" in red. These markings shall not be more than 1m apart from centre to centre.
* Backfilling shall be undertaken with soil suitable to ensure settling without voids. The maximum allowable diameter of stones present in the backfill material, is 75mm.
* The Contractor shall have allowed in his tender for the importation of suitable backfill material if required.
* The backfill shall be compacted in layers of 150mm and sufficient allowance shall be made for final settlement. The Contractor shall maintain the refilled trench at his expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of.
* On completion, the surface shall be made good to match the surrounding area.
* In the case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.
* Cable Markers (for HV cables only, except where otherwise specified)
* Cable markers shall be provided along all HV cable routes but need only be provided along LV cable routes where specified.
* Cable markers shall consist of concrete blocks in the shape of truncated pyramids, approx. 300mm high, 150 x 150mm at the top and 250 x 250mm at the bottom.
* Brass plates shall be cast into the tops of the blocks in such a manner that they cannot be prised loose. The wording "ELECTRIC CABLE/ELEKTRIESE KABEL" shall be stamped on the brass plates as well as direction arrows and the cable voltage rating.
* Cable markers shall be installed on the surface along all the underground routes and shall project 35 mm above normal ground level unless the projected markers could be a hazard to pedestrian or other traffic in which case they shall be installed flush with the surface.
* Cable markers shall be installed at the beginning and end of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above all joints, above cable pipe entries and exits and at intervals not exceeding 50 m along the cable route
* The position of cable markers shall be indicated on the "as built" drawings.

### **Wayleave**

* The Engineer will arrange for the necessary wayleave and permission to cross TRANSNET property and railway tracks, or Provincial or National road reserves and TELKOM Authority approval of proposed cable routes.
* The Contractor shall carry out the crossing installation in strict accordance with the TRANSNET and Provincial Administration's requirements and stipulations. Where these requirements are in contradiction with this specification, the Engineer's ruling shall be sought.
* The Contractor shall ensure that he will comply with the various Administration's requirements regarding crossing of Provincial and National roads, especially with regard to the safeguarding of the public. The Contractor shall also provide proof of adequate in­surance cover against any claim from any accident as a result of work done by the Contractor during the crossing operation. The VUT shall also be indemnified from all liability in this regard.
* The Contractor shall liaise with the various Administrations well in advance regarding the intended dates, times and expected duration of the crossing operations and obtain their approval of the programme and method of operation before commencing with the work.

# **Installation of underground cables**

### **Installation Depths**

* Cables shall be installed at the following minimum depths below final ground level: Up to 11kV : 8OOmm
* All cable depth measurements shall be made to the top of the cable when laid directly in ground or to the top of the duct or sleeve where these are provided.
* The above depths shall apply to the top layer where cables are installed in layers.
* The Contractor may only deviate from the above depths provided prior authority in writing has been obtained from the Engineer. In this event the cables shall be protected with a suitable concrete covering.
* The depth of cable pipes or ducts beneath railway lines or roads shall be not less than 1,1 m below the formation level.

## Cable spacings

* Cables installed in the same trench shall be laid parallel to each other with the following spacings between cables (LV: up to 1 kV; HV: 1 kV to 11 kV):

LV/LV : 2 cable diameters

LV/HV : 150mm minimum

HV/HV : 150mm minimum

 LV/HV/PILOT : 1 cable diameter

* Where HV and LV cables have to be installed in the same trench, both shall be laid at a depth of 800 mm and then covered with 200mm of soil. The soil shall then be compacted, and then backfilled layer by layer and compacted until the trench is completely backfilled.
* Cables for telephones, communication systems and other low voltage systems (less than 50 V) shall be separated from power cables by at least 1m. All control or pilot cables without a lead sheath and steel armouring shall be laid at least 300mm from power cables.
* Cables shall not be buried on top of each other unless layers are specified. The minimum spacing between layers shall be 200mm.

## Cable laying

* Except where ducts, tunnels or pipes are provided, cables shall be laid directly in the ground.
* The cable shall be removed from the drum in such a manner that the cable is not subjected to twisting or tension exceeding that stipulated by the cable manufacturer.
* Cable rollers shall be used as far as possible to run out cables. Rollers shall be spaced so that the length of cable in the trench will be totally suspended during the laying operation and sufficiently close to prevent undue sagging and the cable from touching the ground. Rollers shall also be placed in the trench in such a manner that they will not readily capsize.
* Cable rollers shall have no sharp projecting parts liable to damage the cables.
* Where cables have to be drawn around corners, well-lubricated skid plates shall be used. The skid plates shall be securely fixed between rollers and shall constantly be examined during cable laying operations.
* Where cables have to be drawn through pipes or ducts, a suitable cable sock shall be used and particular care shall be exercised to avoid abra­sion, elongation or distortion of any kind. In the case of oil filled cables, a cable sock may never be used. Special eyes giving access to the interior of the cable, must be utilised.
* The maximum allowable tension when pulling a cable, is 70 N/mm2 of conductor area.
* It will be assumed that the price or rates contained in the tender includes for the installation of cables in pipes and ducts or below existing or newly installed services.
* The Engineer shall be informed timeously of the intention to carry out all cable laying operations to allow an inspection of the works if so required.

## Installation of cables in concrete trenches

### **General**

* This paragraph covers the installation of cables in building trenches, service ducts, etc. The trenches, ducts, etc. inside buildings will be constructed and installed by others.

### **Installation**

* Cables shall be installed in one of the following ways:

(a) On horizontal cable trays.

(b) On horizontal metal supports with suitable clamps.

(c) On vertical cable trays or metal. supports fixed to the side of the trench. The cables shall be clamped in position.

* Cables shall not be bunched and laid on the floor of the building trenches.

## Covers

* The covering of concrete trenches shall as a rule fall outside the scope of the electrical installation. The Contractor shall however be respon­sible for the cutting or drilling and smoothing of holes for cables through chequer plates, concrete or other coverings as required.
* Cables shall enter and exit the trench through sleeves protruding 300mm beyond the covering. The sleeves shall be permanently secured in position and the open space between the cable and sleeves shall be sealed with a non-hardening, watertight compound.

## Filled trenches

* Where specified, floor trenches shall be filled with fine crusher sand (no river or see sand).
* If a sand filling is specified, the cables shall be fixed to non-corroding supports.
* Sand-filled trenches other than in substations shall be covered in one of the following ways:

(a) Reinforced concrete covers.

(b) Sand and cement screed.

(c) Removable chequer plates.

* Method (a) above shall be used where vehicular traffic may be encountered over trenches. Unless otherwise specified allowance for a mass of 2 tons shall be made.
* Cable trenches in substations, switch rooms and generator rooms shall be covered in accordance with the Engineer's standard specification.

## Fixing of cables to trays or structures

## Installation

* Cables may be installed in one of the following ways:

 (a) On horizontal cable trays.

 (b) Against vertical cable trays with suitable clamps.

 (c) Against horizontal or vertical metal supports or brackets with suitable clamps.

 (d) On clamps which are fixed to the structure.

### **Clamps**

* Suitable clamps (cleats) which will secure cables without damage shall be used. Metal clamps or drilled hard wood blocks shall be used. Clamps shall consist of adjustable metal wings which clamp to a metal support, or consist of two halves that are bolted together. The correct clamp size to fit the cable shall be used. Cables of different sizes nay only be fixed by a common clamp when the clamp is specially made to accommodate the various cables.

### **Spacing of Supports**

* Two methods of supporting cables are found in practice. The most generally known method is the restrained installation where the distance between supports is small enough to prevent any noticeable sag in the cable. The alternative method is the unrestrained installation where the distance between supports should be great enough to ensure that there will be obvious sag in each span between supports.
* Large single core cables shall always be installed according to this method. Generally, single core cables with conductors exceeding a cross sectional area of 185mm² should be supported at spacings in excess of 2m since the sag between supports will safely accommodate any thermal ex­pansion.
* Reducing the spacing between the supports to 1,5m or less shall be avoided at all costs, as expansion cannot be taken up by a change of sag and chances of sheath failure become considerable.

## Spacing of supports of restrained cables

* Additional cleats shall be installed at each bend or offset in the cable run. The maximum distance between supports or cleats for multi-core control cables shall be 20 times the outside diameter of the cable with a maximum spacing of 550mm for unarmoured cables and 30 times the outside diameter of the cable with a maximum spacing of 900mm for armoured cables. Spacing of supports for cables for medium voltage lighting shall be in accordance with Table 8 of SABS 0142. A minimum of 20mm ventilation clearance shall be maintained between cables and the wall to which they are cleated.

## Grouping and spacing of cables in buildings and structures

### **Spacing correction factors**

* + Cables shall as a rule be spaced two cable diameters apart, for which no grouping correction factor need be applied.

## Cables on different levels

* + Where parallel cable runs are installed at different levels (e.g. on parallel cable trays) and where the spacing of the layers is not specified, a minimum spacing of 300mm shall be maintained.

## Single core cables

* + Where single core cables are installed along a three-phase circuit, the cables shall be installed in trefoil formation and bound together at 300mm intervals.

## Medium voltage cables

* + Medium voltage cables shall be separated from other cables and services throughout the installation and shall as far as possible be installed in separate floor trenches, pipes or metal channels. Where this is not feasible a minimum spacing of 500 mm shall be maintained.

## Cables for other services

* + Cables for telephones, communication systems and other low voltage systems (less than 50 V) shall be separated from power cables. In building ducts a physical barrier shall be provided between power cables and cables for other services. Where armoured cables are used for such other services, they shall be installed on separate cable trays or shall otherwise be at least 1m away from power cables. Where unarmoured cables are used for these other services, they shall be installed in separate conduits or metal channels.

Table 1: Maximum spacing of support for restrained cables

|  |  |
| --- | --- |
| Cross-Sectional Area of Cable Conductors(mm²) | MAXIMUM SPACING OF SUPPORTS (CLEATS) (mm) FORRESTRAINED CABLES |
|  | Wire Armoured Cables | Other than WireArmoured Cables andUnarmoured Cables |
|  | Horizontal Cable Routes | Vertical Cable Routes | Horizontal Cable Routes | Vertical Cable Routes |
| 1,52,54,06,010,016,025,035,0Bigger than 35,0 | 450450600600750750900900900 | 7507507507509001000100010001000  | 300300300300400400450450450 | 400400400400450550550550550 |

For larger cables the spacing shall be 10 x outside diameter of the cable.

## TERMINATION AND JOINTING OF CABLES

### **General**

* + Cable ends shall be terminated with glands or in cable boxes with the associated accessories such as clamps, shrouds, etc. complying in all respects with the Engineer's quality specifications.
	+ Connection of cables to switchgear shall always be effected in such a way that the various phases, seen from the front of the switchgear will be in the following positions:

 No. 1 conductor : left (red) (A)

 No. 2 conductor : centre (white) (B)

 No. 3 conductor : right (blue) (C)

* + Exposed armouring shall be covered with bitumen-base paint.
	+ All cable ends shall be supplied with the necessary earth connection.
	+ A channel or other approved means of support shall be provided to remove mechanical stress from the glands.
	+ Cable cores shall be marked with heat-shrunk sleeves where necessary to identify the phases. Refer to SABS 0142.
	+ The current-carrying capacity and breakdown voltage of the cable end shall be the same as for the complete cable.
	+ Cables shall be terminated in accordance with the recommendations laid down by the manufacturers of the cables and glands employed.

## Termination of Paper‑Insulated Cables

* The ends shall be terminated in cable end boxes filled with bituminous, cold filling or resin oil semi-fluid compound or heat-shrinkable terminations in accordance with the Engineer's standard specification.
* Heat-shrinkable materials shall only be used in exceptional circumstances with the written permission of the Engineer.
* Before terminating or jointing paper-insulated cables, a test to establish the presence of moisture must be carried out.

The following procedure may be followed:

(a) Place an adequate quantity of cable impregnating oil in a suitable container and heat up to 130 C ± 5 C.

(b) Cut a small length (± 300mm) of the cable concerned and remove the armouring and sheath, taking care not to handle the dielectric in any way.

(c) Dip a section of the outer insulating impregnated paper (belt paper) in the heated oil, taking care not to contaminate the tapes with moisture from the hands. If frothing appears on the surface of the oil, this is a clear indication of the presence of moisture in the paper.

(d) The same procedure should then be repeated on the insulating impregnated paper around the conductors (especially those layers closest to the conductors). Frothing will also indicate the presence of moisture.

(e) Should only a small number of bubbles appear on the surface of the oil, this is an indication of air bubbles on the paper and not moisture since the presence of moisture will result in a series of bubbles rising to the surface of the oil for a number of seconds, until all moisture has been removed.

* The armouring shall be bonded to the main earth bar of the switchgear or transformer, but the bond shall be easily removable for testing purposes.
* The lead sheath shall be wiped against the conical wiping gland.
* All cut cable ends which will be exposed to the atmosphere for more than two hours shall be sealed and wiped to prevent penetration of moisture.

## Termination of XLPE cables

* These cables shall only be used in exceptional circumstances and only with the written permission of the Engineer.
* Cross-linked polyethylene cables (XLPE) shall be terminated in accordance with the Engineer's standard specification.
* The copper tapes of the earth screen on the cable shall be bonded to the main earth bar of the switchgear or transformer, but the bond shall be easily removable for testing purposes.
* The cable shall be firmly secured on the switchgear by means of a clamp to prevent mechanical stress on the cable and terminations.

## Termination of PVC‑insulated cables

* Cable ends shall be terminated by means of adjustable glands in accordance with the Engineer's standard specification.
* The glands shall be fitted in accordance with the cable and gland manufacturers instructions.
* The correct size and type of gland shall be used for the particular cable and application.

## Connection of cable conductors

* Suitable lugs shall be used, preferably solidly sweated to the cable conductor ends. Lugs may be crimped, using mechanical or pneumatic tools designed for this purpose, on condition that evidence is submitted that the method used complies with the performance requirements of BS 4579, Part 1 : "COMPRESSION JOINTS IN COPPER".
* Contact surfaces shall be thoroughly cleaned and smoothed and fixing bolts shall match the hole size of the lug.
* Cables that are connected to clamp type terminals where the clamping screws are not in direct contact with the conductor, need not be lugged but the correct terminal size shall be used.
* Ferrules shall be used as far as possible where cable conductors are connected directly to equipment with screws against the conductor strands.
* When cutting away insulation from cable conductors to fit into lugs, care shall be taken that no strands are left exposed. Under no circumstances may any of the conductor strands be cut away to fit into lugs.

## Joints

* Joints in cable runs will not be allowed unless specified in the Detail Technical Specification or authorised by the Engineer.
* Jointing shall be carried out strictly in accordance with the manufacturer's instructions and by personnel competent in jointing the types of cables used.
* During outdoor jointing operations, the joint bays shall be adequately covered by tents of waterproof material suitably supported. Where necessary a trench shall be excavated around the bay to prevent the ingress of moisture. The sides of the hole shall be draped with small tarpaulin or plastic sheeting to prevent loose earth from falling in during jointing operations.
* The joint shall not impair the anti-electrolysis characteristics of the cable.
* The Contractor shall notify the Engineer timeously of the day on which jointing is to be carried out in order than an inspection may be arranged if so required. Any cable joint not inspected by the Engineer because of insufficient notice being given, shall be opened for inspection and redone at the discretion of the Engineer at the cost of the contractor.
* HV cable joints on paper insulated cables shall be of the compound cast type and the compound used shall comply with the Engineer's standard.
* HV cable joints on XLPE‑insulated cables shall be of the heat shrinkable type and shall comply with the Engineer's standard specification.
* LV cable joints shall be of the epoxy-resin type.
* Joints shall be fully water and air tight and shall be free of voids and air pockets.
* The crossing of cores in joints will not be permitted under any circumstances.

## Testing

* Each cable shall be tested after installation in accordance SABS 150 (up to 1 kV) and SABS 97 (up to 11 kV) as well as the requirements of the Local and Supply Authorities.
* LV Cables shall be tested by means of a suitable megger at 1 kV and the insulation resistance shall be tabulated and certified.

Table 2: Cable test voltage requirements

|  |  |
| --- | --- |
| Cable Rating(kV) | TEST VOLTAGE(Applied for 15 minutes)(kV) |
|  |  Paper-insulated cables | XLPE-insulated cables |
| 6,611 | Between conductors | Conductors to sheath | Conductors to screen |
|  | AC(r.m.s) | DC | AC(r.m.s) | DC | DC |
|  | 1220 | 1830 | 1220 | 1830 | 1118 |

\* Medium Voltage test with DC to 2kV for 1 minute only. Discharge cable slowly via discharge stick (1 minute). Clamp all conductors to earth for 24 hours.

* HV Cables shall be medium voltage tested and the exact leakage current shall be tabulated and certified.
* The Contractor shall make all arrangements, pay all fees and provide all equipment for these tests. The cost of testing shall have been included in the tender price.
* The Contractor shall notify the Engineer timeously so that a representative of the VUT may witness the tests.
* On completion of the tests on any cable, the Contractor shall without delay, submit three copies of the certified Test Reports to the Engineer.

## Measurements

* All measurements for payments shall be made jointly by the representatives of the VUT and the Contractor and the Contractor shall obtain the signature of the Engineer’s approval of such measurements.
* No allowance shall be made for the breaking away of the trench sides, other earth movements or for trenches excavated in excess of the stipu­lated dimensions.

 The classification shall be as follows:

Very hard rock shall mean rock that can only be excavated by means of explosives.

Hard rock shall mean granite, quartzitic sandstone, slate and rock of similar or greater hardness, solid shale and boulders in general requiring the use of jack hammers and other mechanical means of excavations.

Soft rock and earth shall mean rock and earth that can be loosened and removed by hand-pick and shovel.

* Where very hard rock and hard rock are encountered, the prior approval of the Engineer shall be obtained before proceeding with the excavation. This requirement is stipulated in order to afford the Engineer the opportunity to determine whether an alternative cable route is justified.
* All cable lengths indicated in the Detail Technical Specification and/or shown in the cable route drawings shall be regarded as estimates and are given for tendering purposes only. The successful tenderer shall measure actual cable lengths on site before ordering.
* The final price for the supply and installation of all cables will be adjusted, on the basis of the actual lengths of installed cables, in accordance with the unit rates quoted at the time of tendering. Cable lengths shall be measured on site to the nearest 500mm for this purpose and surplus cable will not be paid for.

## Completion

* The Engineer reserves the right to inspect the installation at any stage during the course of construction. Such inspections will however not deem the portions inspected as being complete or accepted and the Contractor shall remain responsible for completing the installation fully in accordance with the Contract Documents.
* The Contractor shall carry out a final "as built" survey of the cable routes and present to the Engineer "as built" route plans of the complete installation. The following information shall be reflected on the plans or submitted as separate schedules with the plans :

 (a) Overall length of each cable.

 (b) Locations of all joints (if any) in relation to permanent reference points. Dimensions shall be shown and the method of triangulation i.e. two dimensions to each joint, shall be used.

 (c) Identification of each cable.

* The works will be deemed to be incomplete until all tests have been conducted successfully and all "as built" drawings and schedules have been handed to the Engineer.

## Conductors

The standard conductor shall be stranded annealed copper with the cross-sectional areas specified below:

Table 3: Standard conductor requirements

|  |  |
| --- | --- |
| **Construction** | **Rated voltage (kV)** |
| **11** | **22** |
| **Area (mm²)** |
| **3-core + 70mm2 BCEW** | 70 |  |
| 95 |  |
| 185 |  |

## XLPE cables

Shall comply with the requirements of NRS 013 with the following requirements detailed below.

## Construction

Three-core cable shall be type A (armored with steel wire armor).

## Core identification

The cores of three-core cables shall be identified by the numbers 1, 2, 3, printed as numerals or words either directly on the extruded semi-conducting core screen or on the semi-conducting bedding tapes of each core, or by other acceptable means.

### Outer sheath

The outer sheath shall be black PE type PS2.

## Tests

Shall comply with the requirements of NRS 013.

## Marking, labelling and packaging

Shall comply with the requirements of NRS 013.

## Documentation

Documentation complying with the requirements of NRS 013 shall be submitted in a catalogue format.

# **SPECIFICATION FOR 11kv XLPE CABLES**

Table 4: Technical schedules A and B for 185mm2 Cu XLPE Cable

| **ITEM** | **DESCRIPTION** |  | **SCHEDULE A** | **SCHEDULE B** |
| --- | --- | --- | --- | --- |
| **Minimum Requirements** | **Equipment Details (To Be Completed By *Tenderer*)** |
| **1** | **185mm² 11kV XLPE 3-core Cu SWA (Type A)** |  |  |  |
| 1.1 | Manufacturer’s name |  | Tender to specify |  |
| 1.2 | Country of Origin |  | Tender to specify |  |
| 1.3 | System operating voltage | kV | 11 |  |
| 1.4 | Number of cores |  | 3 |  |
| 1.5 | Conductor size | mm² | 185 |  |
| 1.6 | Cable type |  | XLPE |  |
| 1.7 | Symmetrical fault level | kA | 25 |  |
| 1.8 | Earth fault level | kA | 8 |  |
| 1.9 | Marking requirements |  | Required |  |
| 1.10 | Technical Catalogue to be provided with tender documentation |  | Required |  |
| 1.11 | Certified copy of type test to be provided with tender documentation | SABS 1339 | Required |  |
| 1.12 | Drum length | m | 1500 |  |
|  |  |  |  |  |

Table 5: Deviation schedule for 185mm2 Cu XLPE Cable

| **Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified.** |
| --- |
| **ITEM**  | **PROPOSED DEVIATION** |
|  |  |

Table 6: Technical schedules A and B for 95mm2 Cu XLPE Cable

| **ITEM** | **DESCRIPTION** |  | **SCHEDULE A** | **SCHEDULE B** |
| --- | --- | --- | --- | --- |
| **Minimum Requirements** | **Equipment Details (To Be Completed By *Tenderer*)** |
| **1** | **95mm² 11kV XLPE 3-core Cu SWA (Type A)** |  |  |  |
| 1.1 | Manufacturer’s name |  | Tender to specify |  |
| 1.2 | Country of Origin |  | Tender to specify |  |
| 1.3 | System operating voltage | kV | 11 |  |
| 1.4 | Number of cores |  | 3 |  |
| 1.5 | Conductor size | mm² | 95 |  |
| 1.6 | Cable type |  | XLPE |  |
| 1.7 | Symmetrical fault level | kA | 25 |  |
| 1.8 | Earth fault level | kA | 8 |  |
| 1.9 | Marking requirements |  | Required |  |
| 1.10 | Technical Catalogue to be provided with tender documentation |  | Required |  |
| 1.11 | Certified copy of type test to be provided with tender documentation | SABS 1339 | Required |  |
| 1.12 | Drum length | m | 1500 |  |
|  |  |  |  |  |

Table 7: Deviation schedule for 95mm2 Cu XLPE Cable

| **Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified.** |
| --- |
| **ITEM**  | **PROPOSED DEVIATION** |
|  |  |

Table 8: Technical schedules A and B for 70mm2 Cu XLPE Cable

| **ITEM** | **DESCRIPTION** |  | **SCHEDULE A** | **SCHEDULE B** |
| --- | --- | --- | --- | --- |
| **Minimum Requirements** | **Equipment Details (To Be Completed By *Tenderer*)** |
| **1** | **70mm² 11kV XLPE 3-core Cu SWA (Type A)** |  |  |  |
| 1.1 | Manufacturer’s name |  | Tender to specify |  |
| 1.2 | Country of Origin |  | Tender to specify |  |
| 1.3 | System operating voltage | kV | 11 |  |
| 1.4 | Number of cores |  | 3 |  |
| 1.5 | Conductor size | mm² | 70 |  |
| 1.6 | Cable type |  | XLPE |  |
| 1.7 | Symmetrical fault level | kA | 25 |  |
| 1.8 | Earth fault level | kA | 8 |  |
| 1.9 | Marking requirements |  | Required |  |
| 1.10 | Technical Catalogue to be provided with tender documentation |  | Required |  |
| 1.11 | Certified copy of type test to be provided with tender documentation | SABS 1339 | Required |  |
| 1.12 | Drum length | m | 1500 |  |
|  |  |  |  |  |

Table 9: Deviation schedule for 70mm2 Cu XLPE Cable

| **Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified.** |
| --- |
| **ITEM**  | **PROPOSED DEVIATION** |
|  |  |

# **SPECIFICATION FOR DIRECT BURIAL PROTECTIVE SLEEVE FOR FIBRE OPTIC CABLES**

## Introduction

The protective sleeve will be used to provide a ready means of drawing fibre optic cables under streets and pavements, and to afford protection to the fibre optic cables that will be subject to loads due to heavy transport passing on the road above.

## Scope

This specification covers the requirements for flexible protective HDPE sleeve for fibre optic cables.

## Normative references

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

SANS 1222: *Classification of degrees of protection provided by enclosures.*

*NRS 088-2: Duct and direct-buried underground fibre-optic cable, Part 2: Installation guidelines*

## Requirements

### **Type**

The protective sleeve shall:

1. Be constructed from high density polyethylene (HDPE);
2. Be yellow in colour;
3. Be supplied with pre-installed pilot rope, except if fibre optic cable can be blown through the sleeve by means of a compressor;
4. Be in a coil of 300m in length;
5. Have a nominal outside diameter of 40 mm, with a tolerance of -0 / +0.3 mm;
6. Have an internal diameter of 33 mm;
7. Be supplied with a knock on end caps at either end of the sleeve; and
8. Be suitable for normal duty use (direct burial).

### **Construction**

The protective sleeve shall:

1. Contain the highest quality virgin polymer;
2. Have a bore that is true and smooth;
3. Contain no recycled or poor-quality polymer material;
4. Have an ultra-slippery silicon co-extruded bore; and
5. The length shall be continuous with no welds or joints.

### **Flexibility**

The protective sleeve shall be flexible to facilitate the installation of the sleeve around immovable objects.

### **Friction**

The protective sleeve shall have a low co-efficient of friction of less than 0,1 to accommodate the easy draw (or blow) of fibre optic cables through the sleeve.

### **Jointing**

Jointing of the protective sleeve shall be done by means of standard compression couplings which shall have an IP 66 rating as per SANS 1222 and shall have a pressure rating of 10 bar.

### **Bending Radius**

The minimum bending radius shall be 10 times the outside diameter of the sleeve.

## Physical properties

### **Impact**

The protective sleeve shall exhibit no signs of splits and cracks when conditioned at -5 ºC for 2 hours and subject to an impact of 5 kg falling from 1 m drop height.

### Pressure rating

The direct buried sleeves shall have a pressure rating of 10 bar.

### Ultra violet

The protective sleeve, although intended to be buried underground, shall be UV resistant for up to one year for storage purposes.

## End caps

End caps for sealing the open ends of sleeves already laid in the ground, but not yet installed with fibre optic cable, shall be provided for both ends of the sleeve. The end caps shall fit securely into the sleeve ends and hold the pilot rope captive.

## Pilot rope

The polypropylene pilot rope shall be pre-installed in the sleeve.

The pilot rope shall have a breaking strain of 100 kg.

## Marking

### **Information**

All protective sleeves shall be clearly printed at 1 metre intervals with the following:

1. The manufacturer’s trademark or name,
2. Outer and inner diameter, and
3. The name “Greater Tzaneen Municipality”.

### Print

The protective sleeve shall be marked with black lettering.

The numbers and characters shall be 4 mm in height.

### Packaging

All flexible protective sleeves shall be securely supplied in coils of 300m.

The ends of the protective sleeve shall be sealed to prevent ingress of water.

Each coil shall have a waterproof label attached with the following information:

1. product code;
2. length of the sleeve in meters;
3. total mass

## Documentation

Documentation shall be submitted in a technical catalogue format. The catalogue shall specify the protective sleeve sizes, dimensions, reference number, and other products and accessories.

Table 10: Technical schedules A and B of 40mm sleeve for fibre optic cables

| **ITEM** | **DESCRIPTION** |  | **SCHEDULE A** | **SCHEDULE B** |
| --- | --- | --- | --- | --- |
| **Minimum Requirements** | **Equipment Details (To Be Completed By *Tenderer*)** |
| **1** | **40mm sleeve for fibre optic cables** |  |  |  |
| 1.1 | Manufacturer |  | Tender to specify |  |
| 1.2 | Material of flexible sleeve |  | HDPE |  |
| 1.3 | Colour |  | Yellow |  |
| 1.4 | Pilot string or draw-wire supplied | Yes/No | Yes |  |
| 1.5 | Outside diameter | mm | 40 mm |  |
| 1.6 | End caps on both ends | Yes/No | Yes |  |
| 1.7 | Constructed of high quality polymer | Yes/No | Yes |  |
| 1.8 | Does the sleeve contain an ultra slippery silicon bore | Yes/No | Yes |  |
| 1.9 | Minimum bending radius of sleeve |  | 10d |  |
| 1.10 | Is the sleeve impact resistant? | Yes/No | Yes |  |
| 1.11 | Pressure rating of the sleeve | bar | 10 bar |  |
| 1.12 | Is the sleeve UV protected? | Yes/No | Yes |  |
| 1.13 | Are end caps supplied? | Yes/No | Yes |  |
| 1.14 | Breaking strain of the pilot rope | kg | 100 kg |  |
| 1.15 | Do the markings on the sleeve comply? | Yes/No | Yes |  |
| 1.16 | Does the packaging comply? | Yes/No | Yes |  |
| 1.17 | Are the ends sealed? | Yes/No | Yes |  |
| **2** | **40mm coupling compression for fibre optic** |  |  |  |
| 2.1 | Manufacturer |  | Tender to specify |  |
| 2.2 | Material of compression coupling |  | Tender to specify |  |
| 2.3 | IP rating of compression coupling | IP | 66 |  |
| 2.4 | Pressure rating | bar | 10 bar |  |

Table 11: Deviation schedule of 40mm sleeve for fibre optic cables

| **Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified.** |
| --- |
| **ITEM**  | **PROPOSED DEVIATION** |
|  |  |

# **SPECIFICATION FOR SINGLE MODE DUCT FIBRE OPTIC CABLE**

## General

New cable differential protection relays will be installed between the following substations:

* Existing Emfuleni’s Vesco 88/11kV substation and New VUT Switching substation
(6 diff relays)

Fibre optic cable will be used for communication purposes between two differential relays. Fibre optic ducting will be installed, with manholes for splicing purposes.

## Normative references

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below:

NRS 088-1: 2007, *Duct and direct buried underground fibre optic cable. Part 1: Product specification.*

NRS 088-2: 2007, *Duct and direct buried underground fibre optic cable. Part 2: Installation guidelines.*

EIA/TIA 598-C, *Optical fibre cable color coding.*

ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps.*

NRS 081, *Single-mode non-dispersion shifted optical fibres.*

SANS 1411-6:2001, *Materials of insulated electric cables and flexible cords – Part 6: Armour.*

SANS 1411-7:2003, *Materials of insulated electric cables and flexible cords – Part 7: Polyethylene (PE).*

SANS 60793-2-50/IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres.*

SANS 60794-1-2:2003/IEC 60794-1-2:2003, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*.

SANS 10198-8, *The selection, handling and installation of electric power cables of rating not exceeding 33 kV* − *Part 8: Cable laying and installation.*

SANS 10340-2*, Installation of telecommunication cables* − *Part 2: Outdoor fibre optic cables.*

SANS 60793-1-40/IEC 60793-1-40: 2001, *Optical fibres – Part 1-40*: *Measurement methods and test procedures – Attenuation.*

## Testing of fibre optic cables

Testing will be done as per NRS 088, and will include the following:

* Optical test
* Longitudinal water penetration
* Sheath UV withstand test
* Tensile strength
* Crush resistance
* Cable bending
* Cable twist (torsion)
* Impact resistance
* Temperature cycling
* Compound flow (drip)

It should be noted that it is deemed mandatory for the Contractor to test the fibre optic cable after delivery, before installation. This is required should the cable be faulty after installation.

All tests above should be incorporated into the tendered rate.

## Marking, labelling and packaging

As per NRS 088-1.

## Installation of fibre optic cable

As per NRS 088-2. Note paragraph 4.3.5 (Trench floor) and 4.3.6 (Backfilling of trenches). The particle size of the soil is not allowed to be more than 12mm.

Table 12: Technical schedules A and B specification for single mode duct fibre optic cable

| **ITEM** | **DESCRIPTION** |  | **SCHEDULE A** | **SCHEDULE B** |
| --- | --- | --- | --- | --- |
| **Minimum Requirements** | **Equipment Details (To Be Completed By *Tenderer*)** |
|  | Number of fibres |  | 4 |  |
|  | Type of fibre (e.g. type B 1.1 single mode fibre as in NRS 081) |  | Single mode |  |
|  | Armouring required |  | No |  |
|  | Type of armouring (CST or SWA) |  | N/A |  |
|  | Details of fibre colour coding |  | As in EIA/TIA 598-C |  |
|  | Measures taken to prevent water ingress |  | XXXXXXXXX |  |
|  | Toxicity and dermatological safety |  | Yes |  |
|  | Cable tension for 0,2 % fibre strain | N | XXXXXXXXX |  |
|  | Availability of type test reports. If not available, specify date when available |  | XXXXXXXXX |  |
|  | Wound length of cable on drum | m | XXXXXXXXX |  |
|  | Treated wooden drum required |  | Yes |  |
|  | Cable construction drawing number |  | XXXXXXXXX |  |
|  | Cable mass per unit length | kg / km | XXXXXXXXX |  |
|  | Effective group index of refraction at1 310 nm/1 550 nm |  | XXXXXXXXX | 1310 nm = 1550 nm =  |

Table 13: Deviation schedule specification for single mode duct fibre optic cable

| **Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified.** |
| --- |
| **ITEM**  | **PROPOSED DEVIATION** |
|  |  |

# **SPECIFICATION FOR MINIATURE SUBSTATIONS**

## Miniature substation

The following miniature substation sizes shall comply with the following specification:

* 315kVA 11/400V
* 500kVA 11/400V
* 600kVA 11/400V

## General

The mini sub shall be suitable for outdoor purposes and comply with the requirement for coastal condition.

## Descriptions

The mini sub shall consist of three compartments ie:

* Medium voltage switchgear compartment
* Transformer compartment
* Low Voltage switchgear compartment

All live terminals shall be tamper proof.

The LV compartment shall consist of 2 sections ie:

* The front section containing meter, busbars, circuit breakers and cable gland plate.
* The side section making provision for streetlight equipment and cables.
* Access to the HV and LV compartments shall only be possible by unlocking the doors.
* The miniature substation shall be constructed of 3 CR 12 sheet metal.
* The final colour finish shall be in SABS C12 “Advocado”.
* An earth bar of nominal cross section area of 70mm minimum shall be fitted inside the mini sub extending across the length of each of the medium voltage transformer and low voltage compartments.

The following notices shall be riveted onto the outside of the miniature substation:

* Danger sign in accordance with figure 3 of SABS1029 with in addition the word “Ingozi” below the word “Gevaar” to be fitted in front of the transformer compartment.
* The letters HV/S on the door of the medium voltage compartment.
* The letters LV/S on the door of the low voltage compartment.
* The word street lighting on the door of the street lighting panel.
* Lifting lugs suitable for hoisting the complete Mini sub shall be provided concerted under the removable roof.
* All ventilation openings shall have a deflecting plate and shall be suitable “vermin proof”.

## Medium Voltage Compartment

* The ring switches shall have a continuous rating of 630 Amp. A fault making of 250 MVA of 11 kV and withstand a fault current of 25 kA for 3 seconds.
* The fuse unit must have the characteristics to protect the transformer under all conditions.
* Each unit shall be supplied with appropriate labels to indicate the circuits.
* Switchgear shall be supplied with cable end boxes suitable for XLPE cables. Cable boxes to be earthed to main earth bar.

## Transformer in transformer compartment.

* Three phase double wound transformer with laminated core to SABS 780.
* The load will consist of resistive and inductive circuits.
* The no-load voltage is 11000/420 volt.
* DYN 11 Vector group.
* 50 Hz Frequency
* Supplied with and external operated off-load tap change to alter the secondary voltage in 5 steps from 95% - 105%. The tap changer shall be insulated for line voltage between tappings and provision shall be made to eliminate unintentional operation of the tap changer. The tap change switch shall be housed in the low voltage compartment in an accessible position.
* Hermetically sealed.
* The neutral shall be coupled to the earth bar directly.
* The three primary bushes shall be suitable for the use in a mini sub.
* The four secondary isolating bushes shall be suitable for the use in a mini sub.
* Type ONAN COOLING.

## Low Voltage compartment

* The busbars shall be sized for 500 kVA and marked in the three phase colours ei: Red, Yellow and Blue.
* The neutral busbar shall have the same cross-sectional area as the phase busbars.
* The fault capacity of the busbars, circuit breakers and other equipment are determined by the impedance of the transformer ie: 25 KA.
* The front section of the LV compartment shall house the following equipment:

a. 400V, 5A Ennermax Electronic meter with maximum mass memory, manufactured by Strike Technologies with test certificate - Programming will be done by Council.

b. One 25 kA MCB rated at full load current of miniature substation.

c. Mounting space must be provided for at least five LY603 25 kA HY-MAG circuit breakers to be fitted next to each other with sufficient working space in between. These breakers must be supplied from busbars mounted above them.

d. It shall be fitted with a cable-clamping rail over the whole length of terminations of the outgoing cables complete with clamps for minimum 95mm x 4 core cable.

e. The distance from the rail to the top of the plinth shall be at least 75mm and not less than 350mm between the rail and the nearest terminals of the outgoing LV circuits.

f. An earth busbar of bare hard-drawn copper shall be provided to facilitate earthing of cable amour and at least a cross - sectional are of 70mm and minimum width of 25mm. Centrally located holes to clear M12 bolts shall be provided at intervals of 75mm along the whole length.

g. Low Voltage terminations shall be suitable for Aluminium out-going circuits.

* The side section of the LV compartment for street-lighting shall provide for the following equipment:

 a. 1 x 100 Amp 25 KA breaker (MCCB)

 b. 1 x 5 Amp MCCB for protection of the contactor coil.

 c. 1 x 10 Amp isolator as a “bypass” for the photo cell.

 d. 3 x Single phase kWh meters.

 e. 1 x 60 Amp triple pole contactor with 220V coil.

 f. Cable gland plate to terminate the outgoing cables.

 g. 1 x 20 Amp photo cell mounted inside the compartment behind a suitable Perspex window.

# **11kV METAL-CLAD SWITCHGEAR specification**

Table 14: Technical Schedule A and B for 11kV metal-clad switchgear specification

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** |  |  | **Requirements** |
| **1** | **MV SWITCHGEAR** |  |
| 1.1 | Ambient air temperature range | °C | -5 to +40 |
| 1.2 | Average humidity | % | up to 95 |
| 1.3 | Altitude (amsl) | m | up to 1800 |
| 1.4 | Degree of pollution (SANS IEC 60815)  |   | Medium |
|  |  |  |  |
| **2** |  |   |
| 2.1 | Number of phases |   | 3 |
| 2.2 | Normal power frequency | Hz | 50 |
| 2.3 | Operating Voltage | kV | 11 |
| 2.4 | Normal Load Current | A | 630 |
| 2.5 | Normal Busbar Rating | A | 1250 |
| 2.6 | System voltage range | pu | 0,95 to 1,05 |
| 2.7 | System earthing (effective/non effective) |   | Non-effective |
|   |   |   |   |
| **3** |  |   |
| 3.1 | **Rated Insulation Level** |   |
| 3.2 | Lightning impulse withstand voltage | kV peak | 95 |
| 3.3 | Short duration P.F withstand voltage | kV r.m.s | 25 |
|   |   |   |   |
| 4 | **Rated Withstand Currents** |   |
| 4.1 | Short duration withstand current (3 Sec) | kA r.m.s | 25 |
|   |   |   |   |
| 4.2 | Heater Size | Watt | 40 |
| 4.3 |  - Installed in Busbar compartment |   | Yes |
| 4.4 |  - Installed in Breaker compartment |   | Yes |
| 4.5 |  - Installed in Cable compartment |   | Yes |
|   |   |   |   |
| **5** | **Switchboard assembly** |   |
| 5.1 | Loss of service continuity category (LSC) |   | LSC2B |
| 5.2 | Enclosure material type |   | Metal-Clad |
| 5.3 | Switchboard application |   | Incomer/Feeder |
| 5.4 | Interchangeable with different current rating breakers | NO |
| 5.5 | Integral shutters in accordance with IEC 62271-200 | Class PM |
| 5.6 | Withdrawable, padlockable parts |   | YES |
| 5.7 | Padlocking facility-shank diameter | mm | >6 |
| 5.8 | Separate compartments needed for: |   |   |
| 5.9 |  - Main switch |   | Yes |
| 5.1 |  - Primary busbar |   | Yes |
| 5.11 |  - Power cable/Current transformers |   | Yes |
| 5.12 | Degree of protection by enclosures with racked in/out. | IP3X |
| **6** | **Internal Arc Classification** |   |
| 6.1 | Types of accessibility to switchgear |   | AFLR/BFL-AR |
| 6.2 | Classification test values: |   |   |
| 6.3 |  - Fault current | kA r.m.s | 25 |
| 6.4 |  - Duration (AFLR / BFL-AR) | ms | 1000 / 200 |
|   |   |   |   |
| **7** | **Busbars** |   |
| 7.1 | 3-phase busbars |   | Single |
| 7.2 | Bus-section/coupler device |   | Circuit Breaker |
| 7.3 | In-service withstand parameters |   |   |
| 7.4 |  - Lightning impulse withstand voltage | kV peak | 95 |
| 7.5 |  - Short duration P.F withstand voltage | kV r.m.s | 25 |
| 7.6 |  - Short duration withstand current (3 Sec) | kA r.m.s | 25 |
| 7.7 |  - Peak withstand current | kA peak | 25 |
| 7.8 | Permissible partial discharge quantity | pC | < 100 |
|   |   |   |   |
| **8** | **Power Cabling** |   |
| 8.1 | Supply of power cabling |   |   |
| 8.2 | Cabling |   |   |
| 8.3 | Installation and termination of power cable |   |   |
| 8.4 | Cable Size  | mm2 | 185 |
| 8.5 | Cable Type |   | XLPE |
| 8.6 | Cable entry and access |   | Rear & Below |
| 8.7 | Height of cable termination from gland plate | mm | >600 |
| 8.8 | Termination medium |   | Air |
| 8.9 | Termination method |   | Shrink-end |
| 9 | Termination clearances (air and bare lugs) |   | NRS 012 |
| 9.1 | Earthing via insulated glands for: |   |   |
| 9.2 |  - 1 Core |   | YES |
| 9.3 |  - 3 Core |   | NO |
|   |   |   |   |
| **9** | **Surge Arrestor Requirements (Feeder Panel ONLY)** |   |
| 9.1 | Position |   | Cable termination |
| 9.2 | Surge arrester earthing |   | To be bonded to panel with 150mm2 copper (minimum) |
|   |   |   |   |
| **10** | **Earthing Requirements** |   |
| 10.1 | To be rated for fault making |   | YES |
| 10.2 | Earth circuit rated at full short circuit withstand capacity |   | YES |
| 10.3 | Rated short-time withstand r.m.s. current | kA r.m.s | 25 |
| 10.4 | Position of bar primary |   | Cable Side |
|   |   |   |   |
| **11** | **Marking and labelling** |   |
| 11.1 | Labelling as per Eskom standard DISASAAN0 |   | YES |
| 11.2 | Label visibility |   | During in-service conditions |
| 11.3 | Main circuit label dimensions on front and rear of panels: |   |
| 11.4 |  - Width (min.) | mm | > 150 |
| 11.5 |  - Height (min.) | mm | > 35 |
| 11.6 | Main circuit label positions |   | Front and rear of panels (not on removable doors) |
| 11.7 | Function label dimensions (min height) | mm | > 5 |
| 11.8 | On, Off, Earth labels as per NRS 003 |   | YES |
| 11.9 | Shutter labels as per NRS 003 |   | YES |
| 11.1 | Danger Zone labelling on sides and back of panel | YES |
| 11.11 | Busbar blanking plates |   | "Busbar DoNot Remove" |
|   |   |   |   |
| **12** |  |   |
| **12.1** | **General** |   |
| 12.2 | Rating name plate position |   | Front of BKR |
| **12.3** | In service withstand parameters |   |   |
| 12.4 |  - Lightning impulse withstand voltage | kV peak | 95 |
| **12.5** |  - Short duration P.F withstand voltage | kV r.m.s | 25 |
| 12.6 |  - Short duration withstand current (3 Sec) | kA r.m.s | 25 |
| **12.7** |  - Peak withstand current | kA peak | 25 |
| 12.8 |   |   |   |
| **12.9** | **Classification (Refer to IEC 62271-100)** |   |
| 12.1 | Electrical Endurance |   | E2 |
| **12.11** | Re-strike Performance |   | C1 |
| 12.12 |   |   |   |
| **12.13** | **Operation and function** |   |
| 12.14 | Type of arc control method |   | SF6 / Vacuum |
| **12.15** | Number of poles |   | 3 |
| 12.16 | Withdrawable with self-alignment device |   | YES |
|   |   |   |   |
|   |  |   |   |
|   | Spring-charge motor ratings: |   |   |
| 12.17 |  - A.C. supply voltage | Vac | 230 |
| 12.18 |  - D.C. supply voltage | Vdc | 110 |
| 12.19 | Isolation of trip circuit, if circuit-breaker is earthed | YES |
| 12.2 | Trip-free circuit-breaker operation |   | YES |
|   |   |   |   |
| **13** | **Coil devices** |   |
| 13.1 | Range of operation (as applicable) |   |   |
| 13.2 |  - A.C. supply voltage | % | 85 to 110 |
| 13.3 |  - D.C. supply voltage | % | 70 to 110 |
| 13.4 | Ratings for continuous operation |   |   |
| 13.5 |  - D.C. supply voltage | Vdc | 110 |
| 13.6 |  - D.C. real power (peak) | W |  1500 |
| 13.7 | Number of trip coils required |   | 2 |
| 13.8 | Number of close coils required |   | 1 |
|   |   |   |   |
| **14** | **Auxiliary contacts facilities (spare for Eskom use)** |   |
| 14.1 | Duty rating |   |   |
| 14.2 |  - A.C. and D.C. supply current | A | 10 |
| 14.3 |  - A.C. supply voltage | Vac | 230 |
| 14.4 |  - D.C. supply voltage | Vdc | 110 |

Table 15: Deviation schedule specification for single mode duct fibre optic cable

| **Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified.** |
| --- |
| **ITEM**  | **PROPOSED DEVIATION** |
|  |  |

# **WIRING**

* All internal wiring shall generally comprise of PVC insulated stranded copper conductors and bare stranded copper earth continuity conductors. The Electrical Contractor to note that protective earth conductors for all computer outlets shall be green PVC insulated stranded copper conductors.
* Only new wiring shall be used under this contract.
* Wiring shall not be drawn into conduit until the conduit installation has been completed, fitted with bushes and all moisture and debris has been removed.
* No joints of any kind shall be permitted in wiring.
* No more than one (1) single - or one (1) three-phase circuit may be drawn into any conduit.
* No “surfix” and/or “twin & earth” wiring will be accepted.

The following minimum conductor sizes shall be used:

Table 16: Minimum conductor sizes

|  |  |
| --- | --- |
| Circuit | Minimum conductor (size) |
| Phase (mm²) | Earth (mm²) |
| Lighting | 1.5 |  1.5 |
| Socket outlet | 4 |  4 |
| Geyser | 4 | 4 |
| Hydro boil | 4 | 4 |
| Air conditioning unit | 4 | 4 |
| Extraction fan | 4 | 4 |

* Wiring for information and communication services i.e. data and telephone, shall be supplied, installed and terminated by others. The Electrical Contractor shall only be responsible for provision of all wireways for such installations. Steel draw wires shall also be provided by the Electrical Contractor in all conduit and other wireways provided for all electronic services as indicated on the relevant drawings.

# **Telephone and data installation**

* The Electrical Contractor shall also be responsible for provision of all wireways for data and telephone systems
* Galvanised draw wire (2,5mm diameter) shall be installed in all telephone and data conduits. All information and communication outlet points shall be interlinked by means of 32mm and 25mm diameter conduit which via the roof space

# **Earthing and bonding**

* The Electrical contractor is to ensure that the installations covered in this document are effectively earthed and bonded in accordance with the requirements of SABS 0142.
* All hot and cold water and waste metal pipes are to be effectively bonded by means of 12,5 mm x 1,6 mm solid or perforated copper tape (not wire), clamped by means of brass bolts and nuts. The tape is to be fixed to walls by means of rounded brass screws at intervals not exceeding 150 mm.
* Metal cable supports and others structures e.g. aerials shall be bonded by means of green insulated copper earth conductor of 16mm2 minimum size.

# **LIGHTNING PROTECTION**

* A provisional sum has been allowed in the bills of quantities for supply and installation of an earthing and lightning protection system by a Specialist Sub-Contractor. The design and installation shall be based on results of the soil resistivity tests to be conducted by the specialist to be appointed as part of this sub-contract.
* Lightning protection shall be carried out in accordance to SANS 10313 – “Protection against lightning - Physical damage to structures and life hazard”
* The system shall comprise of air terminations, down conductors, testing joints and earth electrodes. All metallic projections on or above the main surface of the roof structure shall be bonded to the protective system and shall form part of the air termination network.

# **SECURITY LIGHTING**

* Security lighting shall be provided as part of this contract around the building.
* Light fittings shall be supplied and installed complete with lamps, ballasts, control gear, diffusers, mounting facilities, etc., as applicable. All fittings shall be new and unused and shall be delivered to site as packed by the supplier.
* The permanent luminaires intended for installation shall not be used for temporary lighting during construction. The certificate of completion for the installation will not be finalised unless all light fittings and lamps are in working order.
* All fixing screws, nuts, bolts and washers shall be of stainless steel manufacture. Luminaires shall be installed so as to ensure manufacturer’s IP classification is still valid.

# **Luminaire Specification**

* All luminaires shall bear the SABS mark. Luminaires shall be provided complete with lamps and drivers
* Security and area lighting shall be provided by means of LED and/or CFL luminaires and installed at positions shown on the relevant drawings.
* The post-top light poles shall be 6m high (mounting height) with 76mm in diameter at the top, manufactured from hot deep galvanised steel. Mounting brackets shall also be hot dipped galvanised.
* All external luminaires shall have protection rating of IP 65 or better.

Distribution board equipment shall be connected in such an order that the load is balanced across all three phases.

# **Site tests and commissioning**

* It shall be the responsibility of the Electrical Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary for all the tests required under this contract.
* Prior to beginning any aspect of commissioning, the contractor shall present for the Engineer’s review/approval, two copies of a complete commissioning procedures manual including checklists. The relevant checklists shall be utilised and formally signed off as part of the commissioning phase.
* Preparation of commissioning report shall include, but not necessarily limited to:
* Manufacturer’s operating, servicing and maintenance manuals for each and every individual item of plant installed.
* Inventory for the items of mechanical/electrical plant(s) and or equipment that shall be for installation in the project.
* The following minimum site tests shall be carried out by the electrical contractor and the results presented to the Engineer:
* Insulation resistance between all conductors and earth
* Insulation resistance between all conductors and neutral
* Insulation resistance between all 3 phase conductors
* Resistance of earth path between the main earth bar, all exposed conductive parts of the installation and distribution boards
* Polarity of light switches and socket outlets
* Earth leakage protection
* Phase rotation of three phase circuits
* After submission of the test results, the Electrical contractor shall notify the Engineer that the installation is complete, tested and in working order. The Client and/or the Engineer will witness the re-testing of the installation.

# **Maintenance period**

* The equipment and installation supplied under this contract shall be guaranteed for a period of twelve months from date of completion of the whole project of the Contract Works. The tender price shall include for the above.
* The maintenance period will be for a period of twelve months, calculated from the date the complete installation has been taken over by the Client. Payment of the full amount of the retention money will be effected after the lapse of the maintenance period, provided the installation has been in satisfactory working order during this period. The Electrical contractor shall be responsible for the replacement of all faulty electrical equipment supplied and installed as part of this Sub-Contract, including blown or faulty lamps during the maintenance period.