

PART C3 – SCOPE OF WORK

C3.1 GENERAL PROJECT SPECIFICATION

1.0 GENERAL

The existing 66kV single circuit overhead line between Eskom's Melkhout Substation at Humansdorp and Kouga Municipality's Main Intake Substation in Jeffreys Bay is to be upgraded with a new 66kV double circuit overhead line, which to follow the same route as the existing line.

The planning of a new 66kV double circuit overhead line is a result of the existing line being aged and deteriorated, but also to create for more power carrying capacity to the town of Jeffreys Bay.

This contract includes only a first section, i.e. Phase 1A, of the new line as further detailed hereafter.

A description of the existing 66kV overhead line and the new 66kV overhead line to be constructed, is given hereafter.

2.0 DESCRIPTION OF EXISTING 66kV OVERHEAD LINE

The existing 66kV single circuit overhead line is of wooden H-pole construction with a horizontal cross-arm and vertical poles spaced $\pm 2,5$ metres apart. The vertical poles are ± 11 metres above ground level and ± 2 metres underground. The cross-arms each support three (3) Hare ACSR conductors with mostly porcelain long rod insulators at strain and suspension points. In certain cases the Municipality has already replaced some of the porcelain insulators with silicon long rod insulators.

3.0 DESIGN OF NEW 66kV OVERHEAD LINE

The Technical Specification contained herein only specifies the basic requirements and performance functions required for the new 66 kV overhead line.

Tenderers are required to submit a price for this item based on their own design in terms of pole structures, concrete foundations, pole spacing, etc., but following the design guidelines given in the Technical Specification.

This means that the Contractor will provide his own detailed specification and construction drawings for the line and take full responsibility therefore and ensure that it complies with all relevant statutory requirements.

4.0 EXTENT OF CONTRACT

This contract covers the following work:

- (i) Design and construction of ± 300 metres of a new single circuit 66 kV overhead line, using five (5) self-supporting steel poles and Chicadee ACSR overhead conductor.
- (ii) Supply and install a new 66kV outdoor isolator (visible open point), which to form part of one of the 66kV pole structures.
- (iii) Relocation of two (2) H-poles, forming part of the existing 66kV overhead line.

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

5.0 **SITE INFORMATION**

Refer to Parts C3.3 and C4.

It is extremely important that tenderers familiarise themselves with the local conditions and the line route itself. The new line will be constructed between existing and live Municipal as wells as Eskom overhead lines. All work to be undertaken shall fully comply with the relevant legislations of both Kouga Municipality and Eskom.

The Contractor shall notify Kouga Municipality's Electrical Department and the Engineer of the anticipated delivery of any equipment and/or material at least fourteen (14) days before the expected arrival time, to enable the necessary arrangements to be made.

6.0 **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.

7.0 **ENGINEER'S DRAWINGS**

The Engineer's Drawings applicable to this installation are listed under Annexures A and B of this document.

These drawings are sufficiently accurate for tendering purposes, but all dimensions must be verified after the successful Tenderer has provided his own detailed construction drawings and further verified on site prior to manufacture. No extras will be considered where work has been proceeded with, without such prior verification or approval.

8.0 **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 and power shutdowns required by Eskom and the Municipality.

The programme shall be submitted to the Engineer two (2) weeks after acceptance of the tender in order that such programme may be available for discussion at the first official site meeting.

Preference may be given to Tenderers with shorter completion periods.

9.0 **WORK BY OTHERS**

The following work will be carried-out by others:

- (i) The construction of an entire new and 2nd 66kV feeder bay for Jeffreys Bay at the Eskom Melkhout Substation at Humansdorp. This feeder bay is currently in the design and planning stage with Eskom.
- (ii) Written approvals for Phase 1a of the new 66kV double circuit overhead line from Eskom. This is currently being undertaken by the Engineer and the Municipality.

- (iii) An Environmental Control Officer (ECO) must be appointed for the construction phase of the project who will have the responsibility to ensure that the mitigation / rehabilitation measures and recommendations referred to in the environmental authorisation are implemented and also to ensure compliance with the provisions of the approved Environmental Management Programme (EMPr). Refer Clause 9, Page 15, of the EMPr.

A Provisional Sum for the appointment of an ECO has been allowed for in the Price Summary, forming part of Part C2.2, Bills of Quantities, hereof.

10.0 **PROJECT NOTICE BOARD**

A project notice board is required as part of the contract. The details of the board and support structure are depicted on Drawing No's 10425/E/09 and 10 as included under Annexure B hereof.

11.0 **ELECTRICAL SUPPLY**

The existing electrical supplies at Melkhout Substation are 132kV, 66kV and 22kV three phase, 50 Hz, as indicated on the drawings. Actual voltages may deviate by up to 10% 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.

The existing Eskom 66kV and 22kV overhead lines would have to be individually de-energised by Eskom for the time duration/s required to complete the proposed crossings between same and the new 66kV overhead line, while it is assumed that construction of the bulk of the concrete plinths and new 66kV pole structures can be safely accomplished while the existing overhead lines are energised.

All work carried out over, under or adjacent any of Eskom's existing overhead lines shall fully comply with all their applicable standard requirements, but in particular the following standards, which are included under Annexure C of this document:

Distribution Guide – Part 19:	Building Line Restrictions, Servitude Widths, Line Separations and Clearances from Power Lines
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Task Manual – Part 13:	Stringing Conductors over Energised Lines 11kV to 132kV using Live Work Methods
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Where shutdowns are required on any existing overhead line, it must be prior arranged with either the Municipality or Eskom, where applicable, at least fourteen (14) calendar days in advance. A shutdown shall be limited to eight (8) hours maximum, i.e. between 8h00 and 16h00.

All shutdowns required must be publically advertised at least fourteen (14) calendar in advance. It is therefore very important that the successful tenderer take cognisance hereof when preparing the construction programme.

Under no circumstances can work be carried-out on any existing of the overhead lines unless the lines are properly earthed after de-energisation and a permit to work has been issued by the Municipality and Eskom.

12.0 **SWITCHING OF SUPPLIES**

All switching of the HV and MV supplies shall be arranged in advance with Kouga Municipality and Eskom. The Electrical Contractor shall establish the Municipality's as well as Eskom's exact requirements regarding advance notice, permits to work, etc., at the beginning of the contract and shall comply with these requirements throughout the duration of the contract.

The contact person at Kouga Municipality's Electrical Department is as follows:

- Manager Electrical Services: Mr. Theo Madatt
Cell No. 067 108 2067 or Tel-042 200 2200 Ext 2183

The contact person at Eskom's Humansdorp office is as follows:

- Mr. Julius Marabe, Tel. No. 042 200 3959.

13.0 **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.

14.0 **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.

15.0 **CLEARANCES WITH OTHER SERVICES**

It shall be the Electrical Contractor's responsibility to obtain all necessary drawings and information from the Municipality, Eskom 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.

16.0 **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:

- Digging, backfilling and compaction of holes for 66kV pole structure foundations.

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 5 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 dependents”.
- 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 or Kwanomzamo in Humansdorp. The rates tendered shall cover the full cost of the all labour intensive work.

The following activities will be conducted by hand:

- Digging, backfilling and compaction of holes for 66kV pole structure foundations.

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 5 employment opportunities on site for the duration of the contact, a penalty of 1,5 x the value of the amount of employment that was not created, calculated at R 160-00 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.

17.0 CONSTRUCTION AND “AS-BUILT” DRAWINGS AND MANUALS

The Electrical Contractor shall submit to the Engineer, within fourteen (14) days after appointment, construction drawings of all the 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.

18.0 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 to 132kV 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 to 132kV 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 undertaken in close vicinity of live 22kV to 132kV 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 to 132kV 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	Yes		

C3.2.4

Item	Hazard Description	Applicable to the Project Yes / No / N/A	Hazard Rating (Low, Medium, High) *	Comment / Recommendation
	place?			
	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.
	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.

There are, however, four (4) existing Eskom overhead lines that would need to be crossed with the new municipal 66kV overhead line. In this instance, this installation shall further also fully comply with the requirements of Eskom.

As detailed under Clause 11.0 of the General Project Specification, Part C3.1 hereof, all work carried out over, under or adjacent any of Eskom's existing overhead lines shall fully comply with all their applicable standard requirements, but in particular the following standards, which are included under Annexure C of this document:

Distribution Guide – Part 19:	Building Line Restrictions, Servitude Widths, Line Separations and Clearances from Power Lines
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Task Manual – Part 13:	Stringing Conductors over Energised Lines 11kV to 132kV using Live Work Methods
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4.0 66kV OVERHEAD LINE WORK

4.1 General

The 66kV overhead line work shall be tendered on and be constructed on a "supply and design" basis, i.e. the Contractor shall take full responsibility for the construction as well as the design of the 66 kV overhead line and ancillary work to meet all statutory requirements and the design guidelines given hereafter.

4.2 **Design Guidelines**

- (i) The first section of the new line from Melkhout Substation is depicted on Drawing No. 10425/E/01. Phase 1a will include the following pole structures, incl. steel and/or concrete plinths, all insulators, etc.:
- Pole Structure S1
 - Pole Structure S2
 - Pole Structure S3
 - Pole Structure S4, together with 66kV isolator (visible open point)
 - Pole Structure S5

- (ii) The line route and pole structure positions is provided as a guide only. The Contractor shall select his own pole positions and types to optimise the design and meet the statutory requirements.

- (iii) The pole structures shall be of the typical “Self-Supporting” structure. No stays shall be used.

Drawing No’s 10425/E/02 to 06 indicates typical “Self-Supporting” structures that can be considered, but must not be seen as limiting the Contractor’s options.

- (iv) The foundations for the poles or method of planting the poles are to be of the Contractor’s own design. The Contractor shall, however, take full responsibility to assess the soil conditions to ensure that the foundations meet the necessary requirements.

The design of the foundations must also take into account the position of the line relative to the existing overhead lines as indicated on Drawing No. 10425/E/01.

- (v) Most important is that the design and construction of the line must take into account that it has to be constructed very close to existing lines as explained before.

- (vi) The phase conductors shall be Aluminium Conductor Steel Reinforced, ACSR (code name Chicadee), stranding and wire diameter 18/1/3,77mm and greased for coastal conditions.

The earth or aerial lightning conductor is to be greased “Hare” ACSR, stranding and wire diameter 6/1/4,72mm, or as sized by the Contractor to meet the specific lightning and earth fault current requirements. The conductor dead end to consist of preformed dead end and aluminium thimble. The earth conductor shall be insulated in an approved manner on all poles. All conductors to be tension strung with tension equipment approved by the Engineer.

Compression dead ends to be used and all fittings of 120kN strength. Conductors shall comply in all respects with the requirements of BS 215 (Part 2), specification for aluminium conductors. In the case of local damage to the conductor during erection the use of repair sleeves of an approved type may be permitted at the discretion of the Engineer. Such repair sleeves shall be designed to be compressed onto the conductor.

Vibration dampers shall be provided where required and can be of the spiral, Stockbridge or dog bone type. All bolts shall be locked in an approved manner. Dampers shall be installed when clamping the conductors, but only after the conductor has been securely fastened in its support assembly.

C3.3.3

- (vii) The insulators shall be the composite silicon rubber type, suitable for coastal conditions, of the following types and minimum requirements:

- | | |
|-----------|--|
| Line post | <ul style="list-style-type: none">• Minimum 22 kN working load• Trunion clamp end fitting to take up to 36,75 mm diameter conductor.• Minimum creepage 31 mm/kV• BIL 325 kV |
| Long rods | <ul style="list-style-type: none">• Minimum 120 kN strength• Minimum creepage 31 mm/kV• BIL 325 kV• End fitting bolt/socket IEC 16 |

Fittings, bolts, nuts, etc. made of steel or malleable iron shall be galvanised. All bolts shall be locked by means of a locknut or approved means. All bolt threads shall be greased before erection.

Armour rods shall be provided where required.

Contractor to determine kN cantilever rating of insulators to suit line design and meet safety requirements.

Contractor to determine the best solution to select line post or other method to support the conductor jumper at strain poles. Cognisance must be taken of the impact hereof on the width of the line so that the conductors do not come too close to the existing lines.

- (viii) All poles shall be provided with a ground earth of ≤ 20 ohm earth resistance. The earth to consist of earth spikes (6 metres apart) / trench earth connected with 35 x 3 mm galvanised steel strap or equivalent to earth stud on each pole.
- (ix) All poles and foundations shall be designed by a registered professional structural engineer who shall provide a certificate to certify that these items comply with all the statutory requirements and take into account the specific soil conditions, wind loading, etc.

It is to be noted that the site location is notorious for very heavy wind conditions.

- (x) To assist the Contractor with the design of the line, the lowest ground clearance conductor heights of the proposed Eskom overhead line crossings are provided on Drawing No. 10425/E/01. These heights have been obtained from Eskom's Land Surveyor, but would need to be verified by the Contractor's own design engineer before shop drawings of the new pole structures are finalised.
- (xi) Particular attention must be given to the Eskom overhead line crossings to make sure it complies with the requirements of the relevant authorities, loading due to broken conductor, minimum clearances, etc.
- (xii) The line is to be constructed within approximately 15km from the coast and this needs to be taken into account in selecting the materials and protection for corrosion, etc.

In this regard the galvanising for the steel poles, etc. shall be heavy duty hot dipped galvanisers to min 110 microns in accordance with SABS – ISO 1461 edition. All bolts, washers and nuts and other steelwork used shall also be hot dip galvanised.

- (xiv) All poles shall be vertical within a tolerance at the top of the pole of 0,3% of the overall pole height, before the erection of the pole. Proper precautions shall be taken that poles are not strained or damaged in any way during erection.
- (xv) Unless otherwise approved conductors shall be erected by means of snatch blocks of approved material and dimension at every intermediate pole and by other approved means so as to reduce to a minimum any contact between the conductor and the ground or obstructions during erection.

The stringing method shall be submitted to the Engineer for approval prior to construction. Tension stringing shall be employed as directed by the Engineer.

The Contractor shall provide suitable dynamometers, thermometers, etc. for proper checking of the conductor tensioning.

- (xiii) It is the Contractor's responsibility to ensure that the line is not energised until such permission has been obtained in writing from the Engineer.
- (xiv) The Contractor shall also ensure that the line construction complies with the statutory requirements regarding Telkom communication lines and road crossings.

4.3 **Construction methodology**

The existing municipal 66kV single circuit overhead line will remain in operation whilst Phase 1a of the 2nd 66kV single circuit overhead line is being constructed. All other existing Eskom overhead lines will also remain in operation.

This section of the new line between Pole Structure No's S1 and S5 as depicted on Drawing No. 10425/E/01 will require careful planning in order to minimize the power shutdowns of the existing 66kV line and main power supply disruptions to Jeffreys Bay.

Phase 1a of the work as described under Clause 4.2 (i) above forms part of the said section around Melkhout Substation with the relevant pole structures to be erected.

The following sequence of construction is proposed at Melkhout Substation, and is further depicted on the said drawing:

A proposed sequence of construction and methodology is as follows:

- (i) Excavate for and construct all concrete foundations for all pole structures and complete earthing installations.
- (ii) Construct and erect Pole Structure No's S1 to S5.
- (iii) Construct 66kV isolator together with Pole Structure No. S4.
- (iv) Construct new Pole Structure No's H1 and H2.
- (v) Relocate existing 66kV strain points to new Pole Structure No's H1 and H2.
- (vi) String conductor between Pole Structure No's S1 to S5.

The work sequence provided above is a mere guideline and proposed method statement for the work to be done. The Electrical Contractor may propose their own construction methodology based on their own design and resources that can be made available.

Cognicance must be taken of the various Eskom and Municipal shutdowns that will be required and also the time intervals between same when preparing the construction programme.

5.0 **66kV OUTDOOR ISOLATOR**

A new 66kV outdoor isolator shall be supplied and installed as part of Pole Structure No. S4, as depicted on Drawing No's 10425/E/01, 05, 07 and 08.

The detailed specification of the equipment required is given in tabled form hereafter. It must be noted that Schedule A of each table gives information affecting and laying down the requirements for the equipment, whilst Schedule B is to be completed by the Tenderer in order to provide guarantees, 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 Specifications in Part C3.5 hereof.

ITEM	DESCRIPTION	SCHEDULE A	SCHEDULE B
1.0	Number required, complete with mechanism and auxiliary switches.	One as indicated on Drawing No. 10425/E/01.	.....
2.0	Type	Hand operated centre rotate double break <u>with</u> earthing switch.	.....
3.0	Creepage	31mm/kV	.....
4.0	Auxiliary switch arrangement	1 x F, 5 x M, 8 x G and 2 x N contacts	.....
5.0	Disconnecter rating:		
5.1	Nominal system rms voltage	66kV	.....
5.2	Normal continuous current rating	1600A	.....
5.3	Nominal short-time current withstand (thermal).	25kA	.....
5.4	Short time withstand current duration.	3 seconds	.....
5.5	Rated peak withstand current (dynamic)	50kA	.....
5.6	60 second power frequency withstand rms voltage.	140kV min	.....
5.7	Lightning impulse withstand peak voltage.	350kV min	.....
5.8	Phase spacing	1500mm	.....
5.9	Isolating distance		.....
6.0	Earthing switch rating:		
6.1	Nominal system rms voltage	66kV	.....
6.2	Nominal short-time current withstand (thermal).	31.5kA	.....
6.3	Maximum system rms voltage	72.5kV	.....
6.4	Short time withstand current duration.	3 seconds	.....
6.5	Rated peak withstand current (dynamic)	50kA	.....
7.0	Mounting	Line Isolator and Pole Structure to be mounted on one continuous concrete plinth.	.....
8.0	Standard Technical Specification	Line isolator / earthing switch to further comply with the relevant Clauses	.....

ITEM	DESCRIPTION	SCHEDULE A	SCHEDULE B
9.0	Supply and Delivery Details:	of Part C3.5 hereof and Eskom Specification ESP 32-536.	.....
9.1	Manufacturer		.....
9.2	Delivery Time	To site, from the date of tender acceptance.	 weeks

6.0 **EARTHING**

A ground earth shall be provided for each of the steel pole structures for the 66 kV overhead line, which includes bonding with the earth or aerial lightning conductor. A separate ground earth shall also be provided for the 66kV isolator.

An earth test certificate shall be provided listing the earth resistance value for each of the ground earths.

A concrete cable marker labelled "Earth Spike" shall be installed above each earth spike.

The Contractor shall issue an earth test certificate confirming the measured earth resistance values at each structure to be within acceptable limits.

The earthing shall further comply with clause "Earthing and Bonding" of the Standard Technical Specification, Part C3.5 hereof.

7.0 **DISMANTLING**

In order to create space for the section of new 66kV overhead line between Pole Structure No's S3 and S5, two (2) of the existing 66kV line's H-pole structures must be relocated with approx. 10m each to new pole positions H1 and H2, as depicted on Drawing No. 10425/E/01.

In both instances, the existing overhead line conductor must be disconnected, shortened and terminated to the new Pole Structure No's H1 and H2. Allowance has been made for new wooden structures and strain insulators in this regard.

The existing two (2) H-pole structures must then be dismantled and delivered to the municipal stores in Humansdorp.

8.0 **BUSH CLEARANCE / TREE FELLING**

The area where the new overhead line is to be constructed is relatively clear. This Contract, however, shall include for bush clearing and lopping of branches where it can possibly encroach the line.

Under no circumstances are protected indigenous trees to be removed or lopped without the written permission of the Engineer and Environmental Control Officer (ECO), who is to be advised immediately it is known that any such trees are affected.

All material is to be removed from the Site although the Contractor shall not be deemed to have ownership of any such material.

Any wattle trees are to be cut at 100mm above the ground level, and tree stumps are to be treated to prevent re-sprouting. Tree trunks and large branches are to be cut up in small enough sections and removed from the property to an authorised disposal site. No heaps of tree litter and small branches which may become a fire hazard are to be left under the overhead line route.

9.0 **LABELS AND NOTICES**

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

10.0 **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.

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.

C3.4.3

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 Clinkscapes 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 **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

5.1 General

- 5.1.1 This specification covers the supply, delivery and installation of indoor type MV switchgear, including associated voltage transformers, current transformers and auxiliary equipment.
- 5.1.2 Particular requirements are included in the Project Technical Specification elsewhere.
- 5.1.3 Earthing and bonding shall further shall further comply with Clause “Earthing and Bonding” elsewhere in this Part.

5.2 MV Switchgear:

- 5.2.1 See Eskom Specification above.

5.3 Current Transformers and Voltage Transformers:

- 5.3.1 See Eskom Specification above.

5.4 Auxiliary Equipment, i.e. Protection Relays and Meters:

- 5.4.1 Protection relays shall be supplied in accordance with Project Technical Specification.

5.5 Panel Wiring:

- 5.5.1 Panel wiring shall be neatly run in PVC channel fixed in an approved manner on inside of panel.
- 5.5.2 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.
- 5.5.3 Wiring from within panel onto components mounted on hinged facia plates or doors shall be neatly bunched and contained by flexible plastic spiral.
- 5.5.4 Clearly identifiable terminals of appropriate current rating shall be provided for connection of external cabling and buswiring.
- 5.5.5 Current transformer connection shall be brought to easily accessible and clearly labelled terminals, particularly c.t.s' with multiple ratios.

5.6 Battery Tripping Unit:

- 5.6.1 One tripping power supply unit shall be supplied and installed with each MV switchboard.
- 5.6.2 BTU shall be fully automatic maintenance free.
- 5.6.3 Particular requirements specified in Project Technical Specification.
- 5.6.4 110V/230V Connection to unit shall be brought out to an easily accessible terminal block for the external connection.
- 5.6.5 Battery shall be equipped with semi-sealed alkaline cells, (nickel-cadmium type) 10A/hr minimum capacity at 10 hour discharge rate.

- 5.6.6 Where a 110V DC output is specified or required, minimum capacity shall be 20A/hr at 10hr discharge rate.

6.0 **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
6.1	<u>General</u>

- 6.1.1 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.
- 6.1.2 Particular requirements are included in Project Technical Specification elsewhere.
- 6.1.3 Earthing and bonding shall further shall further comply with Clause "Earthing and Bonding" elsewhere in this Part.

7.0 **PLINTHS**

CMB Standards:

7.1 Construction:

- 7.1.1 Suitable cable entries shall be provided.
- 7.1.2 Outside edge of concrete plinths shall be bevelled to 50mm wide. No plastering will be allowed.

- 7.1.3 Where brick-built plinths are called for they shall comply with Project Technical Specification and drawings.
- 7.1.4 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.
- 7.1.5 Top of plinth 200mm above kerb, or 350mm above road level where no kerbs exist.
- 7.1.6 Holding down bolts, to fix the switchgear, must be installed if specified.
- 7.2 **Installation:**
- 7.2.1 Plinth to be located at the position shown on plans.
- 7.2.2 Ground material at plinth location must be well drained.
- 7.2.3 Top surface (200mm) to be removed. Ensure that no stumps and roots are visible.
- 7.2.4 Cleared surface to be moistened to optimum moisture content and thoroughly compacted.
- 7.2.5 Should clear surface needed to be raised, it must be done with approved material in horizontal layers not exceeding 150mm in depth.
- 7.2.6 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.
- 7.2.7 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.
- 7.2.8 Concrete shall only be poured after forms, reinforcing steel, and preparation for casting have been inspected by the Engineer or Clerk of Works.
- 7.2.9 Concrete shall be well compacted to ensure that all voids are eliminated.
- 7.2.10 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.
- 7.2.11 After forms have been stripped, surrounding ground shall be built up to top surface to ensure that water is led away from the plinth.

8.0 **TRENCHING, EXCAVATION AND COMPACTION**

CMB Standards:

- 8.1 **General:**
- 8.1.1 Contractor to allow for all excavation and backfilling of cable trenches and holes for planting of poles, unless specified otherwise in Project Technical Specification.
- 8.1.2 Contractor shall be responsible for ensuring that any trenches opened by him, or for him, do not constitute a hazard to the public.
- 8.1.3 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.
- 8.1.4 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.
- 8.1.5 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.
- 8.2 **Routing:**
- 8.2.1 Routes for underground cables are shown on the drawings.

- 8.2.2 Variation of these routes shall be approved by Engineer or Clerk of Works before trenching is done.
- 8.2.3 Contractor's responsibility to ensure that the routes of the cables are correct.
- 8.3 Pegs:
- 8.3.1 Contractor will be responsible for the replacement of any pegs disturbed or removed by him.
- 8.4 Trenching and Excavation by Others:
- 8.4.1 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.
- 8.5 Type of Material:
- 8.5.1 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.
- 8.5.2 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.
- 8.6 Verification of Excavation Claims:
- 8.6.1 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.
- 8.6.2 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.
- 8.6.3 Amounts and type of rock encountered shall be measured by the Contractor in the presence of the Engineer or Clerk of Works.
- 8.7 Precaution with regard to other Services:
- 8.7.1 Contractor shall exercise extreme caution in his work to avoid damage to existing underground services.
- 8.7.2 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.
- 8.7.3 All excavation in the vicinity of other services must be undertaken by hand.
- 8.8 Compaction:

- 8.8.1 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.
- 8.8.2 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.
- 8.8.3 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.
- 8.8.4 Where material is too wet for proper compaction, it should be dried out and if too dry, shall be dampened.
- 8.8.5 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.
- 8.8.6 Degree of compaction required shall be field densities of 95% in respect of poles and road crossings and 90% in respect of sidewalks.
- 8.8.7 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.

9.0 **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 Gaps.

CMB Standards:

9.1 **General:**

- 9.1.1 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.
- 9.1.2 Particular requirements are included in 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 Circuit Breakers:
- 9.2.1 See Eskom Specification above.
- 9.3 Disconnectors and Earthing Switches:
- 9.3.1 See Eskom Specification above.
- 9.4 Voltage Transformers:
- 9.4.1 See Eskom Specification above.
- 9.5 Current Transformers:
- 9.5.1 See Eskom Specification above.
- 9.6 Busbars:
- 9.6.1 HV busbars shall be of tubular coastal grade aluminium alloy, and of current rating given in Project Technical Specification.
- 9.6.2 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.
- 9.6.3 Post insulators and busbar spacing shall be appropriate to system voltage and site conditions.
- 9.6.4 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.
- 9.6.5 Design of connectors and connections to other equipment shall be such as to permit easy dismantling for maintenance purposes.
- 9.6.6 Where dissimilar metals are connected, approved means shall be provided to prevent electro-chemical action and corrosion.
- 9.6.7 Support structures shall be of galvanised steel work suitable for bolting onto concrete foundations.
- 9.6.8 All open ends of busbars shall be suitably capped with UV resistant PVC caps.
- 9.7 Surge Diverters:
- 9.7.1 See Eskom Specification above.
- 10.0 **MV SWITCHGEAR AT SUBSTATIONS**
- | | |
|--|---|
| SANS 1652 | Battery Chargers – Industrial Type |
| DSP 34-1157 (Eskom Specification) | 11kV and 22kV Withdraw able Pattern Air-Insulated Indoor Primary Switchgear |
- 10.1 General
- 10.1.1 This specification covers the supply, delivery and installation of indoor type MV switchgear, including associated voltage transformers, current transformers and auxiliary equipment.
- 10.1.2 Particular requirements are included in the Project Technical Specification elsewhere.
- 10.1.3 Earthing and bonding shall further shall further comply with Clause “Earthing and Bonding” elsewhere in this Part.

- 10.2 MV Switchgear:
- 10.2.1 See Eskom Specification above.
- 10.3 Current Transformers and Voltage Transformers:
- 10.3.1 See Eskom Specification above.
- 10.4 Auxiliary Equipment, i.e. Protection Relays and Meters:
- 10.4.1 Protection relays shall be supplied in accordance with Project Technical Specification.
- 10.5 Panel Wiring:
- 10.5.1 Panel wiring shall be neatly run in PVC channel fixed in an approved manner on inside of panel.
- 10.5.2 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.
- 10.5.3 Wiring from within panel onto components mounted on hinged facia plates or doors shall be neatly bunched and contained by flexible plastic spiral.
- 10.5.4 Clearly identifiable terminals of appropriate current rating shall be provided for connection of external cabling and buswiring.
- 10.5.5 Current transformer connection shall be brought to easily accessible and clearly labelled terminals, particularly c.t.s' with multiple ratios.
- 10.6 Battery Tripping Unit:
- 10.6.1 One tripping power supply unit shall be supplied and installed with each MV switchboard.
- 10.6.2 BTU shall be fully automatic maintenance free.
- 10.6.3 Particular requirements specified in Project Technical Specification.
- 10.6.4 110V/230V Connection to unit shall be brought out to an easily accessible terminal block for the external connection.
- 10.6.5 Battery shall be equipped with semi-sealed alkaline cells, (nickel-cadmium type) 10A/hr minimum capacity at 10 hour discharge rate.
- 10.6.6 Where a 110V DC output is specified or required, minimum capacity shall be 20A/hr at 10hr discharge rate.

11.0 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

SANS 60372/IEC 60372	of insulator units of the cap and pin type
SANS 60383-1/IEC 60383-1	Locking devices for ball and socket couplings of string insulator units - Dimensions and tests
SANS 61089/IEC 61089	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 61109/IEC 61109	Round wire concentric lay overhead electrical stranded conductors
SANS 61211/IEC 61211	Composite insulators for A.C.. overhead lines with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria
SANS 61284/IEC 61284	Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1 000 V - Impulse puncture testing in air
SANS 61467/IEC 61467:1997	Overhead lines - Requirements and tests for fittings
SANS 61643-1/IEC 61643-1	Insulators for overhead lines with a nominal voltage above 1 000 V - AC power arc tests on insulator sets
SANS 61952/IEC 61952	Low-voltage surge protective devices Part 1: Surge protective devices connected to low-voltage power distribution systems - Requirements and tests
NRS 022	Insulators for overhead lines - Composite line post insulators for alternative current with a nominal voltage > 1 000 V
NRS 028	Electricity distribution - stays and associated components
NRS 031	Cable lugs and ferrules - for copper and aluminium conductors
NRS 035	Alternating current disconnectors and earthing switches (up to 145 kV)
NRS 038	Outdoor distribution cut-outs
NRS 039	Concrete poles
NRS 043	Surge arresters for use in distribution systems
NRS 044	Code of practice for the joint use of structures for power and telecommunication lines
NRS 060	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 066	Code of practice for clearances for electrical systems with rated voltages up to and including 145 kV, for the safety of persons
NRS 073	Medium voltage insulators
NRS 075	Wood poles, cross-arms and spacer blocks
	Mechanical torque shear connectors

CMB Standards:

11.1 General:

- 11.1.1 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.

11.2 Surveying and Pegging:

- 11.2.1 Routes of overhead power lines are shown on drawings.
- 11.2.2 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.
- 11.2.3 Contractor may not enter private property without owner's written consent.

11.3 Bush Clearance:

- 11.3.1 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.
- 11.3.2 Under no circumstances are protected indigenous trees to be removed or lopped without written permission of Engineer.
- 11.3.3 All material is to be removed from Site although Contractor shall not be deemed to have ownership of any such material.

11.4 Supports:

- 11.4.1 Wood poles shall be used unless otherwise specified, various constructional arrangements being indicated on drawings.
- 11.4.2 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.
- 11.4.3 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'.
- 11.4.4 All poles shall carry SABS mark.
- 11.4.5 Lengths, top diameter, etc., of poles required are given in Project Technical Specification.
- 11.4.6 Extreme care shall be taken to ensure that correct size of pole is used at strain and intermediate positions.
- 11.4.7 All wood poles and crossarms are to be banded by nailing and stapling.
- 11.4.8 Poles up to 10m shall be planted 1,5m in ground, longer poles 1,8m in ground, unless detailed elsewhere in Project Technical Specification.
- 11.4.9 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.
- 11.4.10 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.
- 11.4.11 "Shell" of treated poles shall not be damaged by cutting, shaving or drilling unnecessary holes.

11.5 Pole Holes:

- 11.5.1 It is preferred that pole holes be auger drilled.
- 11.5.2 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.

11.6 Wood Crossarms:

- 11.6.1 Shall be of suitable lengths and diameter as detailed in Project Technical Specification.

11.7 Steel Crossarms

- 11.7.1 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.
- 11.8 Insulators:
- 11.8.1 Type and material of MV and LV insulators shall be as specified elsewhere in Project Technical Specification.
- 11.8.2 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.
- 11.8.3 All spindles mounted on wooden poles or cross-arms are to be bonded with 16mm² HD bare copper.
- 11.8.4 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.
- 11.9 Cross-arm Fixing:
- 11.9.1 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.
- 11.9.2 Cross-arms supporting strain insulators or cradles shall be mounted so that they pull towards pole, no tension being taken by the attachment bolts.
- 11.10 Pole Washers:
- 11.10.1 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.
- 11.11 Conductor:
- 11.11.1 Full details of conductors required are given in Project Technical Specification.
- 11.11.2 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.
- 11.11.3 At strain points "Preformed" dead-ends shall be used.
- 11.11.4 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.
- 11.11.5 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.
- 11.11.6 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.
- 11.12 Mid-span Joints:
- 11.12.1 Approved type proprietary mid-span joints shall be used for copper to copper or for aluminium to aluminium conductors.
- 11.12.2 Such joints shall be made strictly in accordance with the Manufacturer's instructions.
- 11.12.3 Mid-span joints of dis-similar conductors will not be permitted.
- 11.13 Connections and Joints:
- 11.13.1 Connectors shall be suitable for the particular conductors, and shall comply with conductor Manufacturer's recommendations.

- 11.13.2 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.
- 11.13.3 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.
- 11.13.4 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.
- 11.13.5 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.
- 11.14 Fittings:
- 11.14.1 All fittings shall be selected to ensure that their factor of safety is in compliance with Code of Practice at maximum design tension.
- 11.14.2 Pigtail hooks will not be accepted.
- 11.14.3 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.
- 11.15 Stays:
- 11.15.1 Stays shall be provided as indicated on drawings, and in any other places necessary for proper stability.
- 11.15.2 Stay wires shall be galvanised steel of 700MPa UTS and shall be 12mm diameter 1/7/4,00mm.
- 11.15.3 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.
- 11.15.4 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.
- 11.15.5 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.
- 11.15.6 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.
- 11.15.7 Angle between stay wire and pole shall be as near to 45° as possible, but shall not be less than 35°.
- 11.15.8 Stay wire shall be attached to poles and stay rods using "Preformed" pole and guy grips as required.
- 11.15.9 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.
- 11.15.10 Flying stays shall be installed as indicated on drawings.

11.16 Props (Struts):

- 11.16.1 Wood props shall be provided as indicated on drawings.
- 11.16.2 A concrete block shall be installed at pole butt to decrease ground pressure.

11.17 Cradles and Cradle Supports:

- 11.17.1 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.
- 11.17.2 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.
- 11.17.3 Cradle supports shall be similar in construction to cross-arms or as detailed elsewhere in this Specification.
- 11.17.4 Earth continuity of each cradle to its earthing point must be ensured.

11.18 Bonding of Steelwork:

- 11.18.1 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.

11.19 Expulsion (D) Fuses:

- 11.19.1 Expulsion fuses, three units to a set, suitable for voltage specified, shall be provided as shown on drawings.

11.20 Links:

- 11.20.1 Type of links (set of three) specified in Project Technical Specification.
- 11.20.2 All steelwork shall be hot dip galvanised.

11.21 Lightning Arrestors:

- 11.21.1 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

- 11.21.2 A set shall comprise three units, complete with suitable steel cross arm mounting bracket.
- 11.21.3 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.
- 11.21.4 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.

12.0 LIGHTNING PROTECTION

SANS 10313
SANS 62305/IEC 62305

The protection of structures against lightning
 Protection against lightning

13.0 **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
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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:

- 13.1 Before galvanising, all cutting, drilling, welding, etc., shall be complete.
- 13.2 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.

14.0 **LABELS AND NOTICES**

SANS 1186	Symbolic safety signs
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CMB Standards:

- 14.1 Contractor shall arrange for labeling of all equipment, instruments, meters, relays, cables, etc.
- 14.2 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.
- 14.3 All labels shall be ivory or other back engraved white on black labels of sizes indicated.
- 14.4 Labels are to be located in purpose made holders or otherwise are to be screwed or riveted into position.
- 14.5 "Dymo" tape or similar labels will not be accepted nor will labels which are glued in position only.
- 14.6 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.

- 14.7 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.
- 14.8 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.
- 14.8.1 50mm high lettering:-
 Substation and minisub designation.
 Outdoor switchgear designation. Transformer designation.
 Distribution kiosk and fused feeder panel designation.
- 14.8.2 20mm high lettering:-
 Main or sub-main board designation. Control panel designation.
 Indoor switchgear designation.
- 14.8.3 10mm high lettering:-
 Individual switches on switchgear.
 Cubicles.
 Sub-distribution board designation.
 Poles for OH lines.
- 14.8.4 5mm high lettering:-
 Minisub feeder breakers and isolators.
 Distribution kiosk feeder breakers and isolators.
 General distribution switchgear.
 Meters, instruments and relays.
 Multiplying factors.
- 14.8.5 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.
- 14.9 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.
- 14.10 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.
- 15.0 **DISMANTLING**
CMB Standards:
- 15.1 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.

- 15.2 Under no circumstances is any material or equipment to be taken over by Contractor.
- 15.3 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.
- 15.4 All such material is to be neatly coiled, packed, etc., as appropriate.
- 15.5 Extreme care is to be taken in dismantling all such equipment, since it will be re-used by Employer.
- 15.6 If, in opinion of Engineer, unnecessary damage is done, cost of replacing such equipment will be debited to Contractor's account.
- 15.7 Receipt detailing all equipment and materials delivered in accordance with above must be obtained and a copy submitted to Engineer.

16.0 **INSPECTION, TESTING AND COMMISSIONING**

CMB Standards:

- 16.1 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.
- 16.2 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.
- 16.3 Contractor shall supply all equipment necessary for testing and commissioning procedures.
- 16.4 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.

17.0 **COMPLETION OF WORKS**

CMB Standards:

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

18.0 **CERTIFICATE OF COMPLIANCE**

CMB Standards:

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