PART D - SPECIFICATIONS

Contents

1. WORKS INFORMATION: APPENDIX A SPECIFICATIONS

List and attach all standard specifications and other documentation applicable to this contract. Publicly available standard documents should not be attached as they can be obtained directly from the respective publishers.

Employer specific variations to standard specifications are also listed and attached.

Specification No.	Rev.	Title and Publisher	Attached Y/N
SANS 135	1991	ISO metric bolts, screws and nuts (hexagon and square) (course thread free fit series) - SANS	N
SANS 763	1988	Hot-dip (galvanised) zinc coatings (other than on continuously zinc-coated sheet and wire) - SANS	N
SANS 1200	-	Standard specification for civil engineering construction - SANS	N
ESKASAAN0	1	Standard for labelling of high voltage equipment – Employer	N
DISASZAA2	0	Application standard for Distribution equipment labels – Overhead Lines	N
SCSASABK8	0	Distribution Standard for soil compaction for stay and pole foundations	N
SCSSCAAP5	2	Manufacturing Specifications for Distribution Equipment Labels	N
SCSPVACP7	0	Procedure for the dismantling of MV & Power Lines on Wood Pole Structures	N
SCSPVACP8	0	Safety Procedure for Planned Refurbishment/Dismantlement of Medium and Low Voltage Overhead Wood Pole Powerlines	N
DISPVAEH0	0	Procedure for The Manual Reference Replacement of a Rotten Wooden Pole Structure	N
DISASAAS3	3	Distribution Standard Part 8: Low-Voltage Services Section 1: Electrification	N
SCSASAAL9	2	Distribution Standard Part 2: Earthing Section 1: MV And LV Reticulation Earthing	N
SANS 0292:1998		Earthing of low-voltage distribution systems.	N
DST 34-1192	0	Distribution Standard: Part 4: Medium voltage reticulation Section 1: Light conductors' particular requirements for overhead lines up to 33kV with conductors up to Hare conductor	N
SRDOC002	0	Standard Procedure for Determining Prefixes and Numbers for MV Lines	N
SRGUID002	0	Southern Region Connection Manual	N
Unique Identifier (34-1985)		Distribution Earthing: MV & LV Distribution system earthing	N

2. WORKS INFORMATION: APPENDIX C LIST OF OTHER DOCUMENTS ATTACHED TO THIS CONTRACT FORM

List all other documents which are attached and part of this contract so that a complete record exists of what the Parties agreed as constituting the contract. Do NOT include tenderers letters or any other document relating to the enquiry phase as the contract itself must reflect only what has been agreed as a result of the tender and its final acceptance.

Document No.	Rev.	Title
		1. General National Standards and Acts
Act no. 73	1989	Environmental Conservation act.
Act no. 31	1963	Fencing Act.
Act no. 122	1984	Forest Act.
Act no. 85	1993	Occupational health and safety act.
		2. General Eskom Standards
ESKPVAAL7	2	Environmental impact assessment procedure for Eskom
ESKPBAAD6		Environmental management policy
OPR 6204		Eskom Operating Regulations
EVS 005	1	Quality requirements for quality related items and equipment
EVS 010		Quality requirements for quality related services
SCSPVABM9	0	Co-ordination of Safety on Capital Projects
SCSASABZ1	1	Handing over documentation: Major/Minor reticulation electrification
SCSPVABF3	1	Occupational Health and Safety Requirements to be met by Contractors and Sub-Contractors Employed by Eskom.

3. DETAILED PROJECT SPECIFICATION

Note: Unless otherwise specified the material shall be in accordance to the specifications listed in the Employers NEC Engineering and Construction Contract.

3.1 Preliminaries and General Cost and Site Establishment

Work Specification

- The *Contractor* shall allow for the following specific requirements of *Employer*:

  a) Office accommodation for meetings held on site.

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

  A Fixed-charge item such as:(SANS 1200A - 8.3)
  - Contractual requirements.
  - Establishment of facilities on site such as plant, sheds, water, electricity, lighting, etc.
  - Removal of facilities from site after completion of work.
  - Any other fixed-charge items.

  B Time related items such as: (SANS 1200A - 8.4)
  - Contractual requirements.
  - Operation & maintenance of facilities on site.
  - Supervision.
  - Company and head office overhead costs.
  - Other time related items.

Material Specification

- The specific contractor shall supply, transport and off-load his own facilities such as sheds, water, electricity, lighting, etc. on the site.
- The contractor shall also be responsible to remove all facilities established on site after his work is completed.

3.2 Site Works

- Importing shall include:

a) Imported soil shall be used for the soil/cement mixture and shall not consist of any excavated Black Turf.
b) The layers shall be compacted to a minimum density of 90% MOD AASHTO before the next layer of soil/cement mixture is placed.

- Bush clearing shall include:

The requirements of ESKASABG3**, STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWERLINE SERVITUDES to adhered to at all times.**

Special reference from the above standard with respect to the Contractors responsibility is made below:

The *Contractor/Employer* shall:

a) remain on all existing roads and tracks and within the servitude area and not deviate therefrom;
b) Keep *Employers* gates locked and leave property owners' gates closed or as agreed to in writing between *Employers* and the land owner;
c) Not interfere with the property owners' activities;
d) Request permission for the use of water;
e) Provide appropriate toilet facilities;
f) Not make fires;
g) Not litter;
h) Not drop fences;
i) Not collect firewood without consent; and
j) Not disturb or remove stones/rock from the site (i.e. archaeological and heritage sites).

Warranty shall be obtained from the *Contractor* that:

a) He or she knows and understands the dangers involved in clearing bush in or around power lines and the dangers of the spread of fire.
b) He or she understands and will comply with the *Employers* procedures.
c) He or she understands that he/she must be authorized by the relevant *Employers* representative, in writing in terms of Contractor's ORHVS regulations. Employer must declare him or her competent.
d) He or she is a competent person and is a registered pest control operator or shall ensure that any chemical clearing shall be done under the supervision of a registered pest control operator.
e) He or she is able to and shall comply with, all legislation pertaining to the nature of the work to be done and all things incidental thereto.
f) He or she shall appoint a land owner liaison officer, who shall personally contact all affected land owners and users telephonically or in writing and obtain their permission before any trees or bushes are cut, regardless of any previous arrangements or agreements. This shall not be applicable in the case where the *Employer* has undertaken this requirement.
g) For all affected power lines a list of property owners shall be supplied, by Employer, to the contractor to enable him to obtain the owners' consent.

3.3 Installing of MV Equipment, which includes MV switchgear, sectionaliser, transformer etc.

Unless otherwise specified, *Contractor* to supply all nuts, washers, bolts needed for the works as per Bill of Materials, Part E.

- Equipment insulators installations shall include:
  - The vibration dampers shall be installed in the entire span greater than 180m length, and torque according to the manufacturer's specifications.

- Installation of MV transformer earthing shall include:
  - Where the MV and LV earth electrodes are separated at transformer installations, the transformer's LV windings shall be protected against insulation breakdown by install a neutral surge arrester between the LV neutral terminal and the tank earth.
  - For 22kV and 11kV MV systems, the maximum allowable resistance of the transformer earth electrode is 30Ω as per DST_34-1985.
  - A minimum separation distance of 5m shall be maintained between the MV and LV earth electrodes at transformer installations.

3.4 Support for overhead Distribution

3.4.1 Support of Overhead Distribution which includes installation of stays, poles, x-arms, etc.

Unless otherwise specified, *Contractor* to supply all nuts, washers, bolts needed for the works as per Bill of Materials, Part E.

- Installing stay rod assembly shall include:
  - Risk of collapse and keeping excavations free of water shall be included in the quoted rate.
  - Digging of holes of the installation of stays rod to D-DT-0350.
  - A rectangular stepped hole shall be dug so that the length of the hole is in line to the projected line the stay wire. The hole shall be large enough for the stay plate to fit in. Once the hole is dug, the front face of the lower step shall be undercut to accommodate the stay plate.
  - A 80 mm wide slot shall be cut in the steps at 45° to allow for the stay rod. This is absolutely essential as without this the stay rod will cut into the ground when tensioning or with a good rain and cause the pole to lean or possibly break.
  - All excavations shall be kept covered or barricaded in a manner accepted by Eskom to prevent injury to people or livestock when no casting is done.
  - The *Contractor* shall notify the *Clerk of Works* upon completion of the excavation for the stay rod. No concrete shall be placed until the Clerk of Works has inspected the excavations and acknowledge his approval.
  - The stay plate shall be placed up against undisturbed soil on the pole side of the hole.
  - After a stay has been planted to the required depth, the soil that is to be filled into the hole shall be at optimum moisture content; if the soil is held in the hand and squeezed, it shall stay compacted after opening the hand.
  - The hole shall be filled with 250 mm of soil at a time. Each layer of soil shall be compacted with a mechanical or hand compactor until no further settlement occurs. Once it is compacted a further 250 mm layer shall be added and compacted. This shall be done to each layer of soil until the stay hole is filled up to ground level with compacted soil.
  - If the soil removed is a very loose soil and does not stay squeezed together when slightly moist, then cement shall be added to the slightly moistened soil.
  - To every five wheelbarrows of excavated soil, add one pocket of cement: this makes a 1/10 mix. The cement shall be properly mixed with the soil then added to the hole in 250mm layers and compacted. The cement mix shall be allowed to set for two days before tension is put on the stay.
  - If the soil removed from the hole is clay, an import soil shall be used to backfill the hole as specified above. This import soil shall be a river concrete sand. To every five wheelbarrows of import soil add one pocket of cement. The cement shall be properly mixed with the soil then added to the hole in 250 mm layers and compacted. The cement mix shall be allowed to set for two days before tension is put on the stay.
  - If the hole is waterlogged, the water shall be removed before the soil is replaced, an import soil that is cement stabilized as specified above shall be used to backfill the hole.
  - For construction purposes the correct hole type shall be installed for the type of soil conditions and stay rod assembly to be installed.
  - Excavation nominations shall be done by the *Contractor* before construction of the line takes place.
  - The nominations shall be done in the vicinity of each supporting structure position where the stay rod is to be installed.
  - The nominated excavations shall be re-evaluated on site by the *Contractor*, in conjunction with the Clerk of Works, after the excavation of the stay rod hole has been done.

- Installing of stays shall include:
  - Wind stays shall follow the requirements of D-DT-0341, D-DT-3124.
  - The stay wires shall be handled with care to prevent damage to the individual strands.
  - Ensure that the stay rod is firm to the ground before re-attaching it to the stay.

- The stay shall be tensioned in accordance with the applicable design drawing as above using an approved load locker until no further upward movement occurs. The post installation load, as shown in table 1 column 2 below, shall be applied to the stay and held for two minutes. No upward movement of the stay shall be allowed during the two minute pre-tensioning.
- If the stay is unable to sustain the required post installation load, then an alternative stay size shall be installed and the process repeated.
- After the stay is pre tensioned the stay rod shall be marked with red spray paint just above the ground line. This is to indicate that the *Contractor* installing the stays has installed the stay in accordance with this document and load locked the stay in accordance with table 1 below.
- No stays shall be planted without the relevant stay plates fitted on the stay rod.

1 Stay	2 Post installation load	3 Ultimate load	4 Pre tensioning required	5 Stay rod/ tendon length	6 D DT Dwg. No.
34 kN	25 kN	34 kN	All stays	1,5 m	DDT 3011
95 kN	60 kN	95 kN	All stays	2,0 m	DDT 3012

Table 1: Percussion stay technical data

3.4.2 Overhead Support which includes the completion of all civil works for the excavation of pole and stay foundations

Planting depth of poles shall be as in D-DT-0332. The foundation arrangements shall be as in D-DT-0330. Note: Construction teams should take steps to improve the foundation of the individual soil as and when such conditions are met on site. This may involve the use of kicking blocks or soil cement. For foundation deeper than 1.5m shoring should be used. The Employer *Clerk of Works* or the Employer representative shall approve all pole foundations and/or hole before the contractor backfills. NB: If the *Contractor* is planning to use a batching plant not located in the construction camp, the cost due to transporting the concrete from the batching plant to the construction camp shall be at the expense of the contractor.

- Excavation shall include:
  - Excavations shall include digging and drilling holes of between 0.8m – 2m for normal applications and >2m for special applications as in D-DT-0332.
  - All excavations shall be kept covered or barricaded, if not attended to, in a manner accepted by Employer to prevent injury to people or livestock.
  - The *Contractor* shall notify the *Clerk of Works* upon completion of the excavation for the pole foundation. No shuttering, reinforcing steel or concrete shall be placed until the *Clerk of Works* has inspected the excavations and acknowledge his approval.
  - Removal of excavated Black Turf or any other soil unsuitable for backfilling and transporting it to borrow pits.
  - The excavated material shall be disposed of in borrow pits or a suitable place, indicated by the Employer site representative or the Employer environmental representative.
  - The *Contractor* shall make his own arrangements for the provision to dispose of the excavated material on such a disposal place.
  - Free haul shall be the distance within a radius of 1.5km from the pole position.
  - Limited haul shall be the first 1km beyond the end of the free haul distance by the shortest practicable route.
  - Long haul shall be the remainder of the distance beyond the limited haul by the shortest practicable route.
- Backfilling shall include:

- Compacting the excavated pole hole where for normal application backfill material will be used.
- For special applications where the pole planting depth exceeds 2m, backfilling shall include the use of soil cement to reinforce the pole foundation.

❖ Importing soil shall include:

- The *Contractor* shall be responsible for supplying imported soil. If not otherwise specified, the imported soil shall be in accordance to SANS 1200.
- The imported soil shall not contain notable quantities of organic matter or stones of average dimension exceeding 150mm.
- Transporting imported soil from borrow pits to pole position.
- In areas where the excavated soil is Black Turf, imported soil shall be used for the soil/cement mixture.
- The *Contractor* shall make his own arrangements for the provision of a suitable borrow-pit for importing soil.
- Free haul shall be the distance within a radius of 1.5km from the pole position.
- Limited haul shall be the first 1km beyond the end of the free haul distance by the shortest practical route.
- Long haul shall be the remainder of the distance beyond the limited haul by the shortest practical route.

3.5 MV overhead distribution system, which includes stringing, jointing, damage repair and making off of conductors.

All work shall be done according to Eskom's Specifications.
All labour cost shall be included in quoted rate.
All joints and connections shall be the compression type and shall comply with the requirements of SCSSCAAG5.
Copies of calibration certificates, test reports, etc. for all the instruments and equipment used in the stringing and regulation process shall be submitted to Employer for review.
Unless otherwise specified, *Contractor* to supply all nuts, washers, bolts needed for the works as per Bill of Materials, Part E.

❖ Stringing conductors shall include:

- Conductors shall not be left in contact with the ground, vegetable matter or any conducting or semi-conducting material.
- Wood lagging shall be used to protect the conductor when working at ground level.
- Where temporary stays are required, the *Contractor* shall be responsible for making the suitable arrangements.

❖ Conductor joints shall include:

- Only persons who have passed *Employer* approved compression jointing training and have proof of this are permitted to perform this work on the *Employer*s network.
- Each coded jointer shall further be issued with his own unique identification number or sign, which he shall use to punch completed joints as a register of his acceptance.
- The number of joints over the total length of the line shall be kept to a minimum.
- Joints shall not be installed in spans crossing railways, proclaimed roads, power or communication lines.
- In no case shall there shall be more than one joint in a given span.
- Joints shall not be installed in spans that are dead-ended at both ends.
- No joint shall pass through a stringing pulley.
- Joints shall, as far as possible, be made in the middle third of a span. No joint shall be placed within 20m of a structure.

❖ Conductor damage repair shall include:

- Damage to conductors caused by the *Contractor* shall be repaired in a manner determined by *the Clerk of Works*, at the expense of the *Contractor*.
- Where there is repeated damage in the same span, or in consecutive spans, the entire conductor in such spans shall be replaced.

3.6 Labelling of Structures

All labels shall be in according to Employer Specification ESKASAAN0, SRDOC001 and SRDOC002
Labels shall be manufactured to Employer Specification SCSSCAAP5, Rev2.
Unless otherwise specified, all material necessary for installing the line labels shall be supplied by Employer
All labour cost shall be included in quoted rate.
All MV labels, except line crossing labels, shall be black lettering on yellow background. Line crossing labels shall be a black cross on an orange background.
Denso tape / masking tape etc is not considered permanent labelling and shall not be used under any circumstances.
Multiple pole structures are to be considered as a single pole and given one pole number only. Unless otherwise specified, Contractor to supply all nuts, washers, bolts needed for the works as per Bill of Materials, Part E.

- Pole identification labels shall include:

  - Fitting of labels 1.8m above ground level, stamped onto an aluminium plate.
  - Label as in D-DT-3049.

3.7 LV Overhead Distribution System

- Conductor stringing, jointing and damage repair shall be in accordance with section 3.5 above.
- The assembling and erection of the LV structures such be in accordance with the relevant drawings. The applicable structure drawings are specified elsewhere in this document.
- The fuse switch unit shall be installed at below the transformer just below the LV open wire conductors. Refer to D-DT-0309 sheet 4 for the relevant details.
- The pole top boxes shall be the 2,4 and 8-way type with a 50A miniature circuit breaker. Where a 60A customer is connected to the same pole top box a 63A miniature circuit breaker shall be included in accordance with D-DT-3055.
- The LV distribution earthing system employed would be the T-N-C-S earthing system in accordance with SANS 10142-1 and the Eskom Distribution Standard Earthing Standard.
- An LV crow's foot earthing resistance shall be performed at each transformer.
- At earth continuity test shall be performed at the LV distributor point of each customer and must be recorded. This is to ensure the integrity of the earthing system and important to ensure safety of the customer installation.
- All LV earthing at the transformer shall be done as per D-D-T0627.
- When testing LV earthing at the transformer Crows' foot, the resistance value of the soil should not be less than 70 ohms, if so the contractor and the COW of works to consult the Project Engineer.

3.8 LV House Connections

- A 4mm^2 concentric airdac shall be used to connect the houses from the pole top box and/or service poles.
- The following commissioning tests shall be performed on every new installation, in the order listed. The first three tests are tests of the supply to the installation. The test shall be performed in accordance with Distribution standard **DISASAAS3**. The last two tests are tests of the installation itself.

  - Insulation test on the service cable;
  - Test to ensure that the live and neutral connectors have not been reversed on the supply side;

- Test of effectiveness of supplier's protective conductor (Earth loop impedance test) (defined in SANS10142-1).
- Voltage level and Polarity test (defined in SANS10142-1).
- Earth leakage trip test.

Note 1: A full COC must be issued for 20 amp installations where the meter is installed outside the house or for 60 Amp installations. Only an accredited person may issue a full COC.
Note 2: The person who carries out the tests for the issue of an abridged COC must be suitably trained to do so. He need not be accredited in terms of the OHS act Electrical Installation Regulations, but his direct supervisor must be

- A total of 597 20A PLC prepaid split meters shall be installed. Included shall be 597 CIU's. All meters shall be sealed as required.
- Direct house connections (from pole top box to house) shall be made for approximately 310 connections and 287 indirect connections (from pole top box to 7m service pole to house) shall be made for connections.

LOW VOLTAGE PROTECTION PHILOSOPHY FOR LOW CONSUMPTION AREAS

The association between fault level and fuse operating time is as follows:

a) 80 A fuse (10 s pre-arcing time) = 290 A fault level;
80 A fuse (100 s pre-arcing time) = 200 A fault level;
b) 63 A fuse (10 s pre-arcing time) = 210 A fault level;
63 A fuse (100 s pre-arcing time) = 150 A fault level.

LV DISTRIBUTOR PROTECTION

The assumed range of LV conductors will be protected against overload and short-circuit by an 80 A fuse as the current ratings of the conductors are greater than the fuse rating.

ABC LV DISTRIBUTORS

In order to ensure that the fuse is able to detect a fault the minimum fault current must be at least 1,6 times the fuse rating. The operating time of the fuse for this condition will be a maximum of 2 h. Using this criterion Table 1 is derived:

Table 1 — Maximum LV distributor length (fault level = 1,6 fuse rating)

Conductor	80 A fuse	63 A fuse
	Length (m) Fault level = 128 A	Length (m) Fault level = 101 A
35 mm ABC	920	1170
70 mm ABC	1450	1850

BARE WIRE LV DISTRIBUTORS

In order to ensure fuse operation within 10 s to 100 s the maximum LV distributor lengths that will provide the required fault level are shown in Table 3, Table 4.

Table 3 — Maximum LV distributor length (fault level = 10 s min melt time).

Conductor	**80 A fuse**	**63 A fuse**
	Length (m)	Length (m)
	Fault level = 290 A	Fault level = 210 A
Squirrel	210	300
Fox	310	450
Mink	530	770
35 mm ABC	370	540
70 mm ABC	590	850

Table 4 — Maximum LV distributor length (fault level = 100 s min melt time).

Conductor	80 A fuse	63 A fuse
	Length (m)	Length (m)
	Fault level = 200 A	Fault level = 150 A
Squirrel	320	440
Fox	470	650
Mink	810	1100
35 mm ABC	560	770
70 mm ABC	870	1230

4.

5. SAFETY RISK ANALYSIS SPECIFICATIONS

1. PROCEDURES

All Safe Work Procedures must be adhered to. Special attention must be given to the following procedures:

Stringing (Tension and Terminate)
Dismantling of MV and LV overhead power lines
Stringing of conductors across a road
How to do closing span on existing/new lines
Outages

The following sections are extracts from the above procedures.

2. STRINGING (TENSION AND TERMINATE)

2.1 Definition

Stringing means the tensioning and termination of conductors in the prescribed manner and specifications.

2.2 Dangers

2.2.1 Falling objects
2.2.2 Workmen can fall from towers
2.2.3 Induction from other lines
2.2.4 Traffic-Roads and/or railway

2.3 Procedure

2.3.1 The equipment and methods used for stringing the conductors (including earth conductors) shall be such that the conductors will not be damaged. Particular care shall be taken at all times to ensure that the conductors do not become kinked, twisted or abraded in any manner.
2.3.2 Stringing shall be done in daylight hours only.
2.3.3 Tensions, while pulling, must be sufficient to clear all obstacles safely without damage to the conductor. At no time shall the pulling tension exceed the tension shown on the sag charts.
2.3.4 Adequate protection shall be provided where there may be danger of a conductor being crossed over by vehicles, or damaged by other equipment and objects.
2.3.5 Radio communications shall be used to relay information and instructions between the conductor tensioning station, intermediate check points, mobile stations and the pulling station at all times during the stringing-tensioning operation.
2.3.6 Whenever joints or dead-ends are made, auxiliary erection clamps and hauling devices shall not be placed closer than 8m to the point of joint or dead-end.
2.3.7 The conductor shall be cut with a ratchet or guillotine cutter to produce a clean cut, retaining the normal strand lay and producing minimum burrs. The aluminium strands shall then be stripped from the steel core by using an acceptable stripper. Under no circumstances shall high tensile hack-saw blades be used to cut conductor.
2.3.8 The contractor shall string all conductors and earth conductor to the appropriate sags and tensions as determined from the conditions specified in the contract documents.
2.3.9 Conductors and earth conductors shall be strung to the appropriate sag determined for the actual span length, and the equivalent span of the strain section involved.

2.3.10 The contractor shall provide, and maintain in good condition, suitable dynamometers, sag boards or other accepted apparatus for the proper checking of the work. Dynamometers shall read in Newton's and shall be tested and re- calibrated at regular intervals

2.3.11 In pulling the conductor, caution shall be used to avoid pulling the conductor above sag.

2.3.12 All conductors, except for conductors in sag sections over flat terrain, shall be plumb-marked at each structure for the complete section regulated, before clamping-in or dead-ending of the conductor is begun.

3. DISMANTLING OF MV AND LV OVERHEAD POWER LINES

3.1 Definition

Dismantling means to break down redundant structures in a safe way under dead conditions.

3.2 Dangers

3.2.1 Falling from heights
3.2.2 Induction from other lines
3.2.3 Electrical contact with other lines
3.2.4 Falling objects

3.3 Procedures

3.3.1 Ensure that the system is isolated and earthed.
3.3.2 Disconnect the line to be dismantled (redundant line) from the network by cutting away the first span to create a visible gap.
3.3.3 Ensure that working earths are applied on the line to be dismantled (redundant line).
3.3.4 Ensure that existing poles are not rotten.
3.3.5 If poles are rotten refer to procedure.
3.3.6 Cut and remove all earth wires on the overhead line.
3.3.7 Remove software from all attachment points on intermediate poles.
3.3.8 Lay conductor on cross arm or insulated spindle.
3.3.9 Cut off the conductor at the straining points.
3.3.10 Ensure that the worker doing the cutting is clear of the cross arm, to avoid injuries in case of the cross arm swinging.
3.3.11 Coil the conductor.
3.3.12 Remove insulators from structures, where applicable.
3.3.13 Cut off stay wires at attachment point at stay rod.
3.3.14 Remove poles and backfill holes.
3.3.15 Dismantle hardware from structures.
3.3.16 Recover stay rod and backfill hole.
3.3.17 If stay rod is not recovered, stay rod must be cut off at least 500mm under ground level.
3.3.18 All recovered material must be returned to stores.

4. STRINGING OF CONDUCTOR ACROSS A ROAD

4.1 Definition

Stringing means the tensioning and termination of conductors in the prescribed manner and specifications.

4.2 Dangers

4.2.1 Traffic/Pedestrians

4.2.2 Falling from heights
4.2.3 Falling objects
4.2.4 Hand injuries

4.3 Procedures

4.3.1 Assign workers with red flags and road signs to strategic points on either side of the road crossing position.
4.3.2 The assistance of the Traffic Department can be requested where national roads are invoLVed.
4.3.3 Regulate traffic as required to execute the work safely.
4.3.4 Run out conductor as per procedure.
4.3.5 String conductor as per procedure.
4.3.6 Tension and sag conductor as per procedure.
4.3.7 Ensure correct clearances are obtained as indicated on profile.
4.3.8 Recall workers with flags and road signs.

5. HOW TO DO CLOSING SPAN ON EXISTING/NEW LINES

5.1 Definition

Closing span means the connection of newly built lines onto an existing live line.

5.2 Dangers

5.2.1 Energised overhead power lines
5.2.2 Falling objects

5.3 Procedures

5.3.1 Ensure existing live line is isolated and earthed in accordance with Reg. 5.04.5 (HV Regs).
5.3.2 Dress the existing pole with the necessary hardware.
5.3.3 String conductor according to Procedures.
5.3.4 Install jumpers according to procedure.
5.3.5 Remove all personnel, equipment and tools.
5.3.6 Cancel permit (if issued).

6 OUTAGES

6.1 Definition

Outages mean the switching off of all sources of supply of power so that work can be done on a specific point or apparatus.

6.2 Dangers

6.2.1 Switching, linking and earthing errors
6.2.2 Static
6.2.3 Fall from heights
6.2.4 Falling objects
6.2.5 Weather (e.g. lightning)
6.2.6 Back feed through network
6.2.7 Work on wrong line

6.3 Procedure

Prior to outage date

6.3.1 Ensure work planning is complete and reflected in the duration of outage required.

6.3.2 Supervisor liaise with Project Management timeously to allow a 14 day notification period to regional control liaison may occur on site with all stake holders present. A date, time and duration is set and minuted.

On outage date

6.3.3 O&M represented by the Appointed Operator performs the required operating. Makes the area required safe for work and issues a work permit to Constructions appointed Responsible Person.

6.3.4 Responsible Person ensures asset to be worked on is safe according to regulations and accepts the permit by signing as Responsible Person.

6.3.5 Responsible Person informs all Construction persons under his supervision of the status of the asset as well as to their specific duties.

6.3.6 Responsible Person constantly supervises to ensure adherence to ORHVS and general safe working practices during the outage period.

Completion and handing over

6.3.7 Responsible Person ensures that all elements of the asset are as per contract requirement and that all materials, personnel, equipment and machinery are removed to enable safe operation of the asset.

6.3.8 Responsible Person hands back the asset to the Appointed Operator by signing off the permit after which the Appointed Operator will carry out his function. This is also done in liaison with regional control. In the case of a new asset being put into operation, a handing over certificate to O&M by Project Management.

7 EARTHING

7.1 Earthing at equipment installations

7.1.1 Transformer MV and LV earths may be combined only where their overall resistance to earth does not exceed 1 Ω or where there is an ECC (earth continuity conductor) back to the source substation.

Otherwise, the practice of earthing involves separation of the medium and low voltage earths at all transformer installations providing a supply to a customer at nominal voltages up to and including the intermediate voltage (IV) range, i.e. for nominal voltages up to and including 1 900 V, single-phase and 3300V, three-phase.

7.1.2 There is an exception to the general rule that the MV and LV earths may not be combined unless the total resistance of the combined electrode to remote earth is less than 1 Ω or unless there is an ECC back to the source substation. This is when a remote transformer would require a very expensive MV earth electrode to achieve an MV electrode impedance of less than 30 Ω. For the purpose of this clause, a remote transformer is defined as a transformer that supplies a single unmanned installation and the installation is suitably far from any place where people are often present to ensure that the risk of a person being in the vicinity of the transformer during an earth fault is extremely low. In this case the MV and LV earth electrode of the transformer can be combined into one electrode. The combined electrode installed shall have sufficiently low impedance to allow the sensitive earth fault protection to operate. This is to ensure that a fault will not remain on the network for an extended period of time which would increase the risk of a person being in the vicinity of the installation while a fault is present.

The limits of the earth electrode impedance that should not be exceeded in order to ensure that the sensitive earth fault protection will operate in the event of a fault are given in Table 2.

7.1.3 Where the MV and LV earth electrodes are separated at transformer installations, the transformer's LV windings shall be protected against insulation breakdown by installing a neutral surge arrester between the LV neutral terminal and the tank earth.

7.1.4 A minimum separation distance of 5 m shall be maintained between the MV and LV earth electrodes at transformer installations.

7.1.5 For all other equipment installations in a distribution system a single earth electrode is required.

8 EARTH ELECTRODES

8.1.1 All exceptions, i.e. installations where maximum effort does not satisfy the minimum requirements, shall be recorded by Project Engineering and be made available for investigation whenever required.

8.1.2 A detailed installation record including the earthing arrangement shall be kept by Project Engineering. Maintenance shall be based on the principle of plant condition monitoring and shall be carried out in accordance with Eskom maintenance guidelines.

8.1.3 The buried earthing conductor and earth rods shall be at least 0,5 m below normal ground level.

8.1.4 Earth electrodes may be encased in conductive concrete to reduce the dimensions of a required configuration. Owing to the high application costs, conductive concrete shall be applied by exception

9 TRANSFORMER INSTALLATIONS

Distribution equipment associated with transformer installations that is either ground-mounted or pole mounted and fed by underground cable or overhead line, shall be installed, connected and earthed in accordance with the following requirements:
a) the star point of the transformer LV winding shall be earthed (see also 4.3);
b) the MV surge arresters, transformer tank and other metalwork shall be bonded to the MV earth electrode (see D-DT-0627 for pole-mounted transformers, D-DT-0855 for mini-substations and
D-DT- 0862 for ground-mounted transformers);
c) a combined MV/LV earth electrode may be employed only where the electrode resistance to earth does not exceed 1 Ω or where there is an ECC back to the source substation or for remote supplies (see clause 4.1.1.2);
d) where separate MV and LV earths are used:
• the MV and LV earth electrodes shall be separated by not less than 5 m,
• a neutral surge arrester in accordance with D-DT-3088 shall be installed between the LV neutral terminal and the transformer tank, and
• care shall be exercised to ensure that there is no metallic or other low impedance conducting path between the MV and LV earths,
e) an equipotential MV earth loop shall be installed for mini-substations and for ground-mounted transformer applications irrespective of whether the MV and LV earths are separated or not. This shall be done in accordance with D-DT-0855 and D-DT -0862, respectively. Further details can be found in DST 34-1175, Distribution Standard, Part 22, Section 0: General information and requirements for medium voltage cable systems, clause 4.7.
The philosophy regarding the application of combined or separated MV and LV earths at transformer installations is provided in annex C.

10 SPECIFIC RESISTANCE VALUES OF THE EQUIPMENT EARTHS

The derivations of resistance values specified in this section are included in annex C.
10.1 Transformer earth electrodes
10.1.1 Transformer MV earth electrode
For both 22 kV and 11 kV MV systems, the maximum allowable resistance of the transformer MV earth electrode is 30 Ω. This limit will ensure that for a MV line to transformer tank fault:
a) No dangerous voltages are experienced on the LV neutral;
b) The LV neutral surge arrester energy absorption limits are not exceeded; and
c) Sufficient fault current flows to operate the MV earth fault protection.
10.1.2 Transformer LV earth electrode
The overall resistance to earth of the LV electrode at the transformer shall be such as to ensure that the feeder main earth fault protection at the source will operate in event of a breakdown between the MV and LV windings of the transformer.

The following maximum resistances apply to the transformer LV electrode:
Table 1 – Maximum earth resistance values for transformer LV electrodes

Table 1 – Maximum earth resistance values for transformer LV electrodes

Main earth fault protection setting (A)	Transformer primary 11 kV	Transformer primary 22 kV
	Maximum resistance value (Ω)	
20	70	150
40	30	70
60	20	40
100	10	20
NOTE: A factor of safety of approximately 4 has been used to ensure acceptable protection operation under: a) seasonal variations in soil resistivity, and b) variations in the effectiveness of MV source earthing.		

Main earth fault protection setting

NOTE: A factor of safety of approximately 4 has been used to ensure acceptable protection operation under:
a) seasonal variations in soil resistivity, and
b) variations in the effectiveness of MV source earthing.
The resistance values in Table 1 do not apply to single wire earth return (SWER) distribution systems.
If the maximum values for the MV and LV electrodes cannot be achieved with the standard electrode configurations the Project Engineering Department shall be requested to investigate alternatives, such as setting protection to a lower operating threshold or providing additional earthing. The expenditure of exorbitant amounts of money on additional earthing to achieve these values should be avoided. In annex B possible methods to enhance the earth electrode are also discussed.
10.1.3 Earth electrodes for other equipment
At equipment installations other than transformers, for example, pole-mounted switchgear and surge arrester installations, the maximum electrode resistance values are determined by the sensitive earth fault protection settings shown in Table 2.
Table 2 – Maximum earth resistance values for electrodes at other equipment
Sensitive earth fault protection
Setting

Table 2 – Maximum earth resistance values for electrodes at other equipment

Sensitive earth fault protection setting (A)	Nominal voltage 11 kV	Nominal voltage 22 kV
	Maximum resistance value (Ω)	
5	300	600
10	150	300

NOTE: 1 A safety factor of approximately 4 has been used for the reasons given in table 1.
NOTE 2: Since sensitive earth-fault protection is not used in cable networks, for ground-mounted equipment (other than

transformers) used in these networks, where there is no ECC, the earth electrode resistance values shall be in accordance
with the requirements of table 1 and are therefore based on the main earth fault protection settings.

The electrode dimensions specified in the following tables were derived using the calculation procedure as described in SANS 10199 and DRP_34-1933 Report: Optimization of MV earth electrode design.

Table 3 – Standard earth electrode configurations for 30 Ω resistance

Description	Main earth electrode					
Electrode type	1	2	3	4	5	6
Electrode configuration	Three point star					
Applicable soil resistivity at a depth of 0,5 m to 1,5m (ρ in Ω m)	ρ = 300	ρ = 600	ρ = 900		ρ = 1500	
Electrode dimensions (m)			Option 1	Option 2	Option 1	Option 2
— Trench depth (minimum)	0,5	0,5	0,5	0,5	0,5	0,5
— Radial length (L)	5,0	13,0	22,0	23,0	40,0	41,0
— Rod length	1,5	1,5	1,5	1,5	1,5	1,5
— Rod separation distance	5,0	6,5	11,0	N/A	20,0	N/A

6. SEQUENCE OF EVENTS

The following work shall be undertaken as prescribed below:

- SACS will notify all customers supplied from the affected feeders where work is to be carried out, about the outage and the duration thereof.
- The Customer Network Centre and personnel will be responsible for the switch operations as prescribed in the Switching procedure.
- Appropriate working earths shall be applied within the vicinity where work is to be carried out and from all possible points of supply.
- The work is to be carried out as prescribed in the Project Scope of Work.
- Upon completion of the work, the Hand over document shall be completed with all representatives' present.

7. SWITCHING PROCEDURE

The Customer Network Centre and personnel will be responsible for the switch operations as prescribed in the Switching procedure. The details of the switching procedure shall be discussed with all relevant stakeholders at the monthly outage meeting (MOM) or as prescribed by the *Project Manager*.

8. FINAL INSPECTION, TAKING OVER OF THE WORKS AND CLEARING OF SITE

a) "As Build" drawings will be required for this project, and it will be required from the Contractor to hand over a list of all labels that were changed on the line to the *Project Manager* or his *representative*. *Project Manager* or his *representative* to verify all changes. Label details and As-Built to be handed to the Project Engineer two (1) weeks prior to handing over of site.

b) During final inspection, the *Project Manager* or his *representative* will ensure that a quality control check will be completed and signed by all the interested and affected parties. Only after signing of this document, will the site be handed over for Commercial Operation.

c) Removal of site office and stores and discontinuation of services provided for the site office.

d) Clearing of all rubble, waste and rubbish, resulting from the construction activities, removal from site and re-instatement of terrain.

e) Removal of all excess material (Copper, etc.) from site and returning of such material to the nearest Eskom stores.

f) All the parties concerned at the completion of the *works*, prior to the taking over of the *works*, will hold a final inspection.

9. SHEQ SPECIFICATION

UMtamvuna Pump 2021-SHE SPEC.pdf