



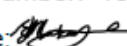
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|---|--------------------------|---------------------|------------------|-----|-----|
|  Eskom | Design Approval Template | Template Identifier | 240-43921804     | Rev | 5   |
|   |                          | Document Identifier | 240-105988382    | Rev | 1.1 |
|   |                          | Effective Date      | 20 February 2014 |     |     |
|   |                          | Review Date         | February 2018    |     |     |



**Enquiries:**

PJ Burger  
Network Engineering & Design  
Eskom Distribution FSOU  
Eskom Centre, 120 Henry Street  
Bloemfontein, 9301  
051 404 2109  
BurgerPJ@eskom.co.za

**NW-STM-1606-2731-00004**  
**33kV Chickadee line from Rouxville Substation to**  
**new Bophelo Substation**  
**WBS No.: C.DO02639.D**  
**Compilation Date: 2024/04/12**

| NETWORK ENGINEERING AND DESIGN: Distribution and Electrification |   |
|--|---|
| <b><u>Compiled by:</u></b>                                       | Name and Surname: PJ Burger<br><b>Designer</b><br>ECSA Registration Number: 21350109<br>Unique Number: 4205883<br>Signature: <br>Date: 20/04/2024                                  |
| <b><u>Approved by:</u></b>                                       | Name and Surname: Rigard Sander<br><b>Senior Design Engineer/Technologist:</b><br>ECSA Registration Number: 200070118<br>Unique Number: 0726180<br>Signature: <br>Date: 23/04/2024 |
| <b><u>Supported by:</u></b>                                      | Name and Surname: Emmanuel Mokalanyane<br><b>Functional Responsible Manager</b><br>ECSA Registration Number: 20015090<br>Unique Number: 1068085<br>Signature: <br>Date: 24/04/2024 |

**Final Design Package** approved as detailed in accordance with the statutory requirements of the OHS Act 1993, Construction Regulations 2014 and the applicable Eskom processes and governance in a manner that upholds the rules of conduct for Registered Persons: Engineering Profession Act, 200 (Act No. 46 of 2000).

**Controlled Disclosure**

**\* Document Details (List)**

| *<br>EDMS/SPF<br>Document<br>Identifier | * Document Title  | *<br>Rev | * Document<br>Type                | * Re-<br>view<br>Sta-<br>tus | * Docu-<br>ment Date | * Electronic File Name  |        |  |
|---|---|----------|-----------------------------------|------------------------------|----------------------|---|--------|--|
|   | NW-STM-1606-2731-00004<br>33kV Chickadee line from<br>Rouxville Substation to new<br>Bophelo Substation | 0        | Design Package<br>Electronic copy |                              |                      | NW-STM-1606-2731-00004 33kV Chickadee line from<br>Rouxville Substation to new Bophelo Substation |        |  |
|   |   |          |                                   |                              |                      |   |        |  |
| * Main Recipients<br>Name               |   |          | * Unique<br>Number                |                              | * Signature          |   | * Date |  |



**Free State Operating Unit  
Bloemfontein**

**ECSC3 ENGINEERING AND CONSTRUCTION**

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
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**Design Package**

## **Free State Operating Unit Bloemfontein**

### **ECSC3 ENGINEERING AND CONSTRUCTION**

**NW-STM-1606-2731-00004**

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## **Contents**

|             |           |                                 |
|-------------|-----------|---------------------------------|
| <b>Part</b> | <b>C3</b> | <b>Scope of Works</b>           |
| <b>Part</b> | <b>C4</b> | <b>Site Information</b>         |
| <b>Part</b> | <b>C5</b> | <b>Schedule of Prices</b>       |
| <b>Part</b> | <b>C6</b> | <b>Design Bill of Materials</b> |

## Free State Operating Unit Bloemfontein

### ECSC3 ENGINEERING AND CONSTRUCTION

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

## Part C3 Scope of Works

### PART C3.1: WORKS INFORMATION

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C3.1 | Project Works Information         |
| Part | C3.2 | Project Specifications            |
| Part | C3.3 | Detailed Technical Specifications |
| Part | C3.4 | Health and Safety Specifications  |
| Part | C3.5 | Project Critical Tasks            |
| Part | C3.6 | Project Risk Analysis             |
| Part | C3.7 | Project Drawings                  |

## 1. Description of the Works

The Works described in **2.1** below, should be executed in total to the *Employer's* discretion, as per **Detail Designs** and in accordance with the relevant **Specifications, Eskom Standards, the Environmental Requirements and Construction Regulations Health & Safety Requirements**

## 2. Work to be performed by the Contractor for the Works

### 2.1 Description of the Works

#### 2.1.1 The works comprise of:-

- a) Construction of **±33,975km** Chickadee distribution line section from Rouxville Substation to Proposed Bophelo Substation site. This line will be constructed with 33kV insulators and operated at 22kV.
- b) Construction of **±2,944km** Hare distribution line section from Bophelo Substation proposed Site to Zastron substation. This line will be constructed with 22kV insulators and operated at 22kV.
- c) Including 31m transfer bar at Rouxville Substation with load break switch and Load break switch bypass at Zastron Substation.

#### 2.1.2 Scope of Works

- Refer to **Part C3.3 - Detailed Technical Specifications**

##### Activity Stage 1: Preliminary & General, Environmental, Health & Safety and Site establishment

- 1.1 Preliminary and General cost;
- 1.2 Environmental requirements;
- 1.3 Health & Safety requirements;
- 1.4 Site establishment.

##### Activity Stage 2: Establish construction access

- 2.1 Supply and transport of new power line servitude gates;
- 2.2 Complete replacement of existing power line servitude gates;
- 2.3 Complete installation of new power line servitude gates;
- 2.4 Complete establishment of proper construction access;
- 2.5 Closure of construction roads;
- 2.6 Bush clearing and cutting of trees.

##### Activity Stage 3: Survey activities

- 3.1 Pegging of line route, structure setting-out & stays positions;
- 3.2 Marking of servitude and access gates;
- 3.3 Measuring of all over and under crossing clearances.

##### Activity Stage 4: Drilling/Excavating of holes for structure foundations and stays

- 4.1 **Geotechnical investigation and soil/foundation type nominations;**
- 4.2 Detail setting-out of structure foundation excavations;
- 4.3 Drilling/Excavating of holes for structure foundations;
- 4.4 Excavation shoring;
- 4.5 Drilling/Excavating of holes for permanent and temporary structure stays;
- 4.6 Barricading/Protecting of all open excavations.

##### Activity Stage 5: Installation of power line structures

- 5.1 Supply and transport to site of all structures and structure stay material;
- 5.2 Safe stock-piling/storage, handling and transport of structures, structure material and stays;
- 5.3 Assembly and erection of all structures;
- 5.4 Installation of permanent and temporary stay assemblies;
- 5.5 Supply of all foundations material and complete construction of all structure foundations.

##### Activity Stage 6: Power line earthing activities

- 6.1 Supply and transport of power line structure earthing material;
- 6.2 Complete installation of power line structure earthing;
- 6.3 Complete installation of substation earth bonding connections.

##### Activity Stage 7: Dressing of all structures

- 7.1 Supply, safe storage of all phase conductor and shield wire line hardware and insulators;
- 7.2 Safe storage, handling and transport to peg of line hardware and insulators;
- 7.3 Safe handling and dressing of structure with line hardware and insulators.

**Activity Stage 8: Stringing activities**

- 8.1 Supply and transport of phase conductor and shield wire stringing hardware;
- 8.2 Safe storage, handling and transport of phase conductor and shield wire stringing hardware;
- 8.3 Safe handling, transport to drum sites and complete stringing, regulating clamping of phase conductors and shield wires.

**Activity Stage 9: Power line labelling activities**

- 9.1 Supply and transport to site of line and structure identification labels and accessories;
- 9.2 Safe storage, handling and transport to peg of line and structure identification labels and accessories;
- 9.3 Safe handling and complete installation of power line and structure identification labels.

**Activity Stage 10: Taking over of the works and clearance of site**

- 10.1 Re-instate entire construction site;
- 10.2 Final inspection of the line;
- 10.3 Handing over, test & commissioning;
- 10.4 Submission of 'As Built' Information;
- 10.5 Site clearance.

**2.2 Temporary works**

- 2.2.1 All temporary construction roads shall be constructed by the *Contractor*, only if required for the successful execution of the construction activities or as instructed by the *Project Manager* or *Clerk of Works*, as specified in **Part C3.3 - Detailed Technical Specifications**
- 2.2.2 All temporary construction stays installed for the erection and securing of structures and for stringing purposes must be completely removed after completion of these activities.
- 2.2.3 All temporary installations (Scaffolding, Goal posts, etc.) required for the crossing of roads, railway lines, power lines, telephone lines, etc. must be completely removed after completion of the stringing activities.
- 2.2.4 For a detail scope of work for temporary works refer to **Part C3.3 - Detailed Technical Specifications**

**3. Works and things supplied by the *Employer/Contractor* for the Works**

**3.1 Plant**

- 3.1.1 *The Employer will supply no plant for the execution of the Works;*
- 3.1.2 *All plant required for the successful completion of this project shall be provided by the Contractor.*

**3.2 Materials**

- 3.2.1 For a detailed Detail Design Bill for Materials refer to **PART C6**
- 3.2.2 Apart from items specified in **clauses 3.2.3 & 3.2.5** below, the *Contractor* shall be responsible for the supply of all relevant construction material such as sand, stone, cement, reinforcing, concrete manhole sections, HD bolts, shoring, steel shutters, temporary crossing installations and any miscellaneous items. which might be required for the successful completion of the project.
- 3.2.3 A **Detail Design Bill of Materials**, of all materials to be supplied by the *Employer* and the *Contractor* will be specified in **PART C6** of this document.
- 3.2.4 Unless otherwise agreed upon between the *Project Manager* and the *Contractor* the following components will be supplied by the *Employer*:- **Part C6.3**
- 3.2.5 The *Contractor* will supply the following: **Part C6.4**
- 3.2.6 Suppliers samples and/or detail drawings of all line material, supplied by the *Contractor* shall be technically evaluated and approved by the *Employer's* SI (Standards Implementation) Department prior to the purchasing thereof.
- 3.2.7 A list of all "**Eskom Approved Suppliers**" can be obtained from the SI department.

- 3.2.8 Once any material delivered by the *Employer* to the *Contractor's* yard on site, the loading, transporting to the construction site, off-loading and safekeeping thereof becomes the responsibility of the *Contractor*. The *Contractor* must make the necessary arrangements for safe storage on site, offering adequate protection against theft, damage, wind and weather.
- 3.2.9 The *Contractor* will be responsible for the insurance of materials against any form of damage or theft after delivery thereof.
- 3.2.10 At all times it will be assumed that the *Contractor* has been ensured upon the acceptance of material supplied by the *Employer*, that no visible damage has occurred to it and that it also complies with the latest **Eskom Buyer's Guide Standard**. In the case of damaged and/or unacceptable material, acceptance thereof must be refused.
- 3.2.11 Should a dispute arise, with regards to the quality of any material delivered to site the assistance of the Project Engineer must be called upon for a decision.
- 3.2.12 If any damaged material is found on site after delivery and acceptance thereof, it will be replaced at the cost of the *Contractor* and no extension of contract time will be granted for the extra delivery time.
- 3.2.13 It is essential that a good "**Record-keeping System**" exist whereby control over quantities on site can be kept. All new deliveries to the site-store and all materials and structures issued for construction must be recorded. At any time, it must be possible for the *Project Manager* to establish from these records exactly what material or structures is kept in site store/yard or has been installed. These figures will regularly be compared to the actual quantities measured on site and the formal delivery notes.
- 3.2.14 Liability for inherent defects in material issued by the *Employer* does not lie with the *Contractor*. If defects in material or in the Works, due to the use of patently defective material are discovered, new material will be replaced by the *Supplier* free of charge.
- 3.2.15 If, however, it is established that defects in material or the Works were due to damage caused to material after issue, the *Contractor* will be held responsible for all replacement and repair costs to the material or the Works, as well as loss of time. The decision concerning the caused and responsibility of defects, as well as the extent of compensation (if any), rests with the *Project Manager*.

### 3.3 Equipment

- 3.3.1 No equipment will be supplied by the *Employer* for the completion of this project.
- 3.3.2 All equipment required for the successful completion of this project shall be provided by the *Contractor*.

### 3.4 Site services provided by the *Employer*

- 3.4.1 The line route, all structure and stay positions will be pegged by the *Employer's* Surveyor as specified in **PART C3.3** and will be handed over to the *Contractor*.
- 3.4.2 The *Clerk of Works* will be the one and only mediator between the *Employer*, the *Contractor* and the relevant Landowners.

### 3.5 Site services provided by the *Contractor*

- 3.5.1 For detail site services to be provided by the *Contractor* for the successful completion of the Works, refer to **PART C3.3 – Activity Stage 1**

## 4. Project Constraints

### 4.1 Constraints on how the *Contractor* provides the Works

- 4.1.1 Environmental Constrains
- The **Environmental Requirements, Environmental Management Plan and Record of Decision Document** for this project are specified in **PART C4.3 – Environmental Documents**
- 4.1.2 Health and Safety Constrains
- The *Contractor* shall submit a complete a **project specific Health and Safety Plan** with this Tender.
  - The following **Environmental, Health and Safety** documents/specifications are included in **PART C3.4**



**– Health and Safety Specifications:**

- a) Project Health and Safety Specification;
- c) Health and Safety Specifications for *Contractors* conducting work within the Free State Operating Unit;
- d) Construction Safety, Health and Environmental Management;
- e) OSH Act Requirements to be met by Principal *Contractors* employed by the *Employer*;
- f) Construction Regulations.

**4.1.3 Quality Assurance**

- The *Contractor* shall control his activities and processes in such a way as to ensure compliance with the **Employer's Specifications and Standards**. He shall carry out, as a minimum requirement all the tests laid down in the specifications and shall submit all the test results to the *Employer*.
- The **Employer's Specifications and Standards**, as indicated in **PART C3.2** of this document, are requirements of this contract.
- The *Contractor* shall be responsible for the relevant **Quality Assurance Requirements** to be imposed on his Sub-contractors and Suppliers of materials and structures in terms of the above standards.
- The *Contractor* shall submit "**Project Specific Construction Method Statements**" for all construction and tests and activities to be executed on site, for acceptance by the *Employer*;
- The *Contractor* shall submit with this Tender, a complete list of Sub-contractors, he intends to make use of for this project, for the *Employer's* approval.
- The *Contractor* will not be allowed to appoint any Sub-contractor without the acceptance of such a Sub-contractor by the *Employer*.

**4.2 Holding points of the Works**

**4.2.1** No construction activities at "**Hold points**" will commence without the written approval from by the *Clerk of Works* to continue with a specific activity.

**4.2.2** The holding points shall be agreed between the *Contractor* and the Employer Representative

**4.2.3** For the detail description of each hold point refer to **Part C3.3**. Following is a summary of the most critical requirements prior to the continuation of the project:

- a) Official hand over of the site to the *Contractor*;
- b) Submission of a **Detail Construction Programme**;
- c) Submission of a **Health and Safety Plan**;
- d) Submission of **Project Specific Construction Method Statements**;
- e) A proper inspection and approval of all construction equipment, tools and vehicles to be used by the *Contractor*;
- f) Submission of **Calibration Certificates** for all tension, crimping and testing equipment;

**4.2.4** Construction activities will only commence after the written instructions from the *Clerk of Works* are obtained, at the following project stages:-

- a) Acceptance of all pegging information (Pegging co-ordinates and/or pegs on site);
- b) Complete installation and approval of servitude gates;
- c) Completion and approval of all bush clearing activities;
- d) Completion of the geo-technical sub-soil investigation and acceptance thereof; **(DCP soil classification testing)**
- e) Approval of all structure and stay positions and excavations;
- f) Approval of all structure planting depths;
- g) Submission and approval of stabilized backfilling compaction test results.
- h) No earth wire and or phase conductor stringing activities will commence prior to:-
  - i) Submission and approval of compression joint sample test results;
  - ii) Submission and approval of stringing sag and tension charts.

**4.2.5** The *Contractor* will be held responsible for any construction errors, defects, claims, etc. for continuing with construction activities at the "**Hold Point**" stages without the written instructions from the *Clerk of Works*, to proceed with the applicable activity.

**5. Requirements for the construction program**

**5.1 Format of the program and procedure for revisions and submission**

**5.1.1** The *Contractor* must submit a **Detail Construction Program** of each Activity Stage, the Rand value thereof and also stating the starting and completion dates of each activity with this Tender.

5.1.2 Progress meetings shall be held as required by the *Project Manager* and these may be held more frequently to meet demands of the situation.

5.1.3 Representatives of the *Contractor* as well as the *Project Manager* shall be obliged to attend these meetings.

**5.2 Other information to be shown on the program**

5.2.1 The *Contractor* must clearly state all statutory and other non-working days included in the contract/construction period.

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**5.3 Completion of the works.**

5.3.1 Only the protection of construction access roads as well as the rehabilitation of the construction terrain on the line route, where required and to the satisfaction of the relevant Landowners, may be done after the Completion date (Commissioning of the power line).

## Free State Operating Unit Bloemfontein

### ECSC3 ENGINEERING AND CONSTRUCTION

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## Part C3 Scope of Works

### PART C3.2: PROJECT SPECIFICATIONS

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C3.1 | Project Works Information         |
| Part | C3.2 | Project Specifications            |
| Part | C3.3 | Detailed Technical Specifications |
| Part | C3.4 | Health and Safety Specifications  |
| Part | C3.5 | Project Critical Tasks            |
| Part | C3.6 | Project Risk Analysis             |
| Part | C3.7 | Project Drawings                  |

## Project Specifications and Standards

- This is a list of all the specifications and other documentation referenced or described as being part of the Works Information.
- This list includes publicly available standard specifications which may not be attached, but which are part of the Works Information.
- A detailed description of each part of the Works is given in **Detail Technical Specification**.

**Table 1: Reference to detail specifications**

| Document  | Rev./issue | Title and Publisher   |
|---|------------|---|
| <b>1. NATIONAL DOCUMENTS</b>  |            |   |
| SANS 121  | 2011       | Hot Dip Galvanized Coatings On Fabricated Iron And Steel Articles – Specifications And Test Methods             |
| SANS 1200 AA  | 1986       | Standardized Specification For Civil Engineering Construction Section A: General (Small Works)                  |
| SANS 1200 DA  | 1988       | Standardized Specification For Civil Engineering Construction Section DA: Earthworks (Small Works)              |
| SANS 1200 GA  | 1982       | Standardized Specification For Civil Engineering Construction Section GA: Concrete (Small Works)                |
| SANS 9001   | 2008       | Requirements For Quality Management Systems   |
| SANS 10280  | 2001       | Code Of Practice For Overhead Power Lines For Conditions Prevailing In South Africa                             |
| SANS 14001  | 2005       | Environmental Management Manual International Standards – EMS   |
| Act No. 73  | 1989       | Environment Conservation Act And  |
| Act No. 85  | 1993       | Occupational Health And Safety  |
| Government Gazette no. 25207  | 2003       | Construction Regulations  |
| <b>2. TRANSMISSION GUIDELINES, PROCEDURES, SPECIFICATIONS &amp; STANDARDS</b> |            |   |
| TWN41-675   | 1          | Installation Of Guy Grips   |
| TRMSCAAC1   | 3          | Specification For Transmission Line Towers And Line Construction  |
| TRMSCAAH2   | 5          | Specification For Suspension And Strain Assemblies And For Hardware For Transmission Lines                      |
| TRMSCABG8   | 0          | Corrosion Protection Of New And Weathered Steel Power Line Structures   |
| <b>3. DISTRIBUTION GUIDELINES, PROCEDURES, SPECIFICATIONS &amp; STANDARDS</b> |            |   |
| DST_34-146  | 1          | Authorisation Procedure For Operating On High Voltage Systems   |
| DST_34-962  | 1          | Management Of Certificates Of Compliance For Electrical Installations   |
| DST_34-1954   | 0          | Supervision Of People In Electrically Hazardous Locations   |
| DISSCABA5   | 2          | Specification For A Fall Arrest System  |
| DSP_34-1488   | 1          | Specification For Master Locks And Master Keys For Electrical And Related Equipment                             |
| DPC_34-908  | 0          | Procedure For Barricading   |
| EPC_32-846  | 0          | Operating Regulations For High-Voltage Systems  |
| DST_34-2052   | 0          | Power Lines, Buildings, Telecommunication Towers, Wind Turbines And Related Structures With Regards To Aviation |
| <u>DST_34-2052</u>  | 0          | Power Lines, Buildings, Telecommunication Towers, Wind Turbines And Related Structures With Regards To Aviation |
| SCSASACF5   | 0          | Planning Of Power Lines In The Vicinity Of Rifle Ranges   |
| DPC_34-1812   | 0          | Statutory Approval Application To Rail Authorities  |
| SCSPVADG6   | 0          | Statutory Applications To Water Authorities   |
| SCSPVADA4   | 0          | Procedure: Statutory Approval Application To Rail Authorities   |
| SCSPVADO3   | 0          | Statutory Applications To Local Authorities   |
| DGL_34-600  | 0          | Building Line Restrictions, Servitude Widths, Line Separations And Clearances From Power Lines                  |
| EPL 32-727  | 0          | Safety, Health, Environment, And Quality (Sheq) Policy  |
| EPL 32-97   | 0          | Land Management Policy  |
| DST_34-132  | 0          | Fire Risk Management  |
| ESKASABG3   | 0          | Standard For Bush Clearing And Maintenance Within Overhead Powerline  |

|             |   | Servitudes   |
|-------------|---|--|
| EPC_32-96   | 0 | Guidelines For The Rehabilitation And Vegetation Management Of Herbicides Treated Sites  |
| DGL_34-190  | 0 | Access To Farms (Includes Strategy On Dealing With Game Farms)   |
| EPC 32-96   | 0 | Environmental Procedure: Environment Control Document  |
| EPC_32-245  | 0 | Environmental Procedure: Waste Procedure   |
| EPC_32-247  | 0 | Environmental Procedure: Bush Clearing   |
| EPC_32-248  | 0 | Environmental Procedure: EMP Guide   |
| DPC_34-350  | 0 | Procedure For The Reporting, Recording, Investigation, Costing And Follow-Up Of Incidents/Accidents  |
| SCSPVABP7   | 0 | Procedure For Environmental Assessment Of Reticulation And Sub-Transmission Projects   |
| DPC_34-333  | 0 | OHS Act Requirements To Be Met By Principal Contractors Employed By Eskom Distribution   |
| DGL_34-190  | 1 | Access To Farms (Includes Strategy On Dealing With Game Farms)   |
| DSP_34-1658 | 0 | Corrosion Protection Specification For New Indoor And Outdoor Distribution Equipment, Components, Materials And Structures Manufactured From Steel |
| DST_34-705  | 0 | Quality Requirements For Qualified Suppliers   |
| DSP_34-1667 | 0 | Hump Back Split Pins For New And Refurbished Power Lines Up To 132kV   |
| DSP_34-1681 | 0 | Standard For Aircraft Warning Devices Used On Overhead Transmission , Sub-Transmission And Distribution Lines                                      |
| DSP_34-1657 | 0 | Specification For Conventional Stay Planting, Percussion Stay And Rock Anchor Installations And Compaction Testing                                 |
| DSP_34-377  | 1 | Specification For Phase Conductor For Distribution Lines And Substations   |
| DSP_34-194  | 1 | Specification For Helically Formed Line Hardware.  |
| DSP_34-329  | 1 | Colour Coding For Line Hardware, Including Helical, To Be Used On Conductors   |
| DSP_34-1681 | 0 | Specification For Aircraft Warning Devices Used On Overhead Sub-Transmission And Distribution Lines  |
| DSP_34-433  | 1 | Requirements And Tests For Stockbridge Type Aeolian Vibration Dampers  |
| DSP_34-510  | 1 | Outdoor Post And Long Rod Insulators For New And Refurbished Power Lines For 66kv And 132kv  |
| DSP_34-1213 | 1 | Zinc-Coated Earth Conductor, Guy And Stay Wire For Distribution Lines  |
| DSP_34-1659 | 0 | Current-Carrying Compression Fittings For Overhead Sub-Transmission Systems  |
| DSP_34-1680 | 0 | Refurbishment Of Steel Power Line Structures   |
| DSP_34-1683 | 0 | Distribution Specification For Steel Mono-Pole Compact Line Towers For Sub-Transmission Lines  |
| DSP_34-2051 | 1 | Design, Manufacturing And Testing Requirements For Fabricated Steel Overhead Line Structures And Components  |
| DST_34-1202 | 0 | Sub Transmission Lines Section 1: General  |
| DST_34-1207 | 2 | Conductors   |
| DISASAB1    | 2 | Insulators   |
| DST_34-1204 | 2 | Vibration Dampers  |
| SCSASABF9   | 0 | Earthing   |
| DST_34-1206 | 0 | Sub Transmission Lines Section 9: Steel Mono Pole 132kV Compact Line Tower Series  |
| DST_34-1231 | 0 | Distribution Standard Part 6: Sub-Transmission Lines Section 9: Steel Mono-Pole 132kV Suspension Structures (Suspension Arm)                       |
| DST_34-1230 | 0 | Distribution Standard Part 6: Sub-Transmission Lines Section 11: Steel Guyed Mono-Pole Suspension Structure 132kv (Suspension Arm)                 |
| DST_34-1228 | 0 | Sub-Transmission Lines Section 14: Assembly And Informative Drawings For 66kV And 132kV Lines  |
| DST_34-1235 | 0 | Sub Transmission Lines Section 15: Steel H-Structures For 132kv Lines  |
| 06TB-08     | 0 | Bifurcation (Splitting) Of Shield Wires  |
| 04TB-040    | 0 | Testing Of Compression Fitting Sample Assemblies   |
| 00TB-022    | 0 | Dead End Clamping Of Standard Greased Overhead Line Conductors.  |
| 13TB-015    | 0 | Standard Greases For Use On Overhead Conductors  |
| DST_34-1454 | 0 | Clearing And Maintenance Of Servitude Routes   |
| SCSASAAX8   | 0 | Standard On The Implementation Of The Standardisation Of Disc Insulators To IEC 120 Standards  |
| DISASAA0    | 2 | Standard For The Labelling Of High Voltage Equipment   |
| SCSASAAY0   | 0 | Standard For Blasting Under Or Adjacent To Eskom Overhead Power lines and  |

|            |   |  |
|------------|---|--|
|            |   | Substations  |
| DSP_34-254 | 1 | Manufacturing Specification for Distribution Equipment Labels          |
| DGL_34-550 | 0 | Guide For The Storage, Transport And Handling Of Composite Insulators. |

**Free State Operating Unit  
Bloemfontein**

**ECSC3 ENGINEERING AND CONSTRUCTION**

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

**Part C3 Scope of Works**

**PART C3.3: DETAILED TECHNICAL  
SPECIFICATIONS**

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C3.1 | Project Works Information         |
| Part | C3.2 | Project Specifications            |
| Part | C3.3 | Detailed Technical Specifications |
| Part | C3.4 | Health and Safety Specifications  |
| Part | C3.5 | Project Critical Tasks            |
| Part | C3.6 | Project Risk Analysis             |
| Part | C3.7 | Project Drawings                  |

**Activity Stage 1: Preliminary & General, Environmental, Health & Safety and Site establishment****1.1 Preliminary and General cost**

- 1.1.1 Preliminary and general costs include any other costs not required for site establishment, as specified below:
- Contractual requirements i.e., insurance's, statutory contributions, etc;
  - Material Surety Bond;
  - Contract Programming;
  - Off-site staff & overhead costs;
  - Additional provision to conduct a planned outage inclusive of all transport, labour and material (**To be re-measured at completion**);
  - Environmental requirements;
  - Health and Safety requirements.
- 1.1.2 The *Contractor* is referred to the contract documents for the full intent and meaning of each clause or item and he shall allow opposite each clause or item herein contained whatever payments he may consider necessary for the carrying out and observance of such item.
- 1.1.3 The *Contractor* shall price the Preliminaries and General Bill in respect of all payments required for any item of work, risk, contingency or obligation whatsoever that is not described in the Bills of Quantities and which is the responsibility of the *Contractor* under the contract.
- 1.1.4 The *Contractor* shall, when requested by the *Employer*, make available the detailed breakdown of each priced.
- 1.1.5 In the event of the *Contractor* not pricing the items of the **Preliminaries and General Bill** in sufficient detail, the *Employer* reserves the right to exercise his own discretion in the apportionment to individual items of the total **Preliminary and General Prices** within the contract documents.

**1.2 Environmental requirements**

- 1.2.1 The *Clerk of Works* and the *Contractor* will see that the **Environmental Management Plan** for this project is strictly adhered to, refer to **Part C4.3** of this document.
- 1.2.2 The *Contractor* shall:
- Appoint his **internal or external Environmental Control Officer** to ensure proper implementation and day-to-day monitoring of the **Environmental Management Plan**;
  - Demonstrate environmental competence by providing evidence of his / her companies' environmental policy;
  - Keep an **Environmental Incident Register** on site, which must be regularly updated by the *Contractor* throughout the entire construction period.
- 1.2.3 Sanitary Facilities and Refuse Disposal:
- Temporary and/or mobile toilet facilities shall be provided at the *Contractor's* yard by the *Contractor* and removed on completion of the Works.
  - Under no circumstances shall the use of the veld be permitted. To prevent the occurrence of measles in cattle, Construction Employees may be require to be examined for tapeworm and treated or treated irrespective of whether they are infected or not. Proof of such treatment must be supplied to the *Clerk of Works*. The drug "Niclosamide" (Yomesan, Bayer) is freely available and highly effective against tapeworms in humans.
  - The use of only chemical toilets as temporary facilities will be accepted. No other temporary system will be allowed on site.**
  - The *Contractor* shall establish a refuse control system. All waste shall be collected and disposed or as required by the Landowner and the *Clerk of Works* and the Environmental Practitioner.
  - The *Contractor* shall make his own arrangements for the disposal of unsuitable excavated material, surplus material and construction waste resulting from the Works, to the *Clerk of Works* approval.
  - The *Contractor* shall furthermore ensure:
    - That waste is disposed of on a permitted waste site, for the applicable waste type, in terms of the Environment Conservation Act, 73 of 1989.
    - A disposal certificate is issued to the *Employer* prior to final payment, as proof of disposal.
    - That where appropriate, waste is being recycled or re-used.



- 1.2.4 Vegetation Management:
- a) The *Contractor* shall ensure:
    - i) That all indigenous and protected trees (in terms of National and Provincial Legislation) are identified and permits obtained from the relevant authority prior to the cutting of such trees.
    - ii) That written permission is obtained from the owner of protected trees prior to the cutting of such trees.
    - iii) That permits be available on site where such trees are cut.
    - iv) That the owner is consulted, and his/her consent being obtained, prior to the cutting of trees.
- 1.2.5 Environmental Risks:
- a) The *Contractor* shall ensure:
    - i) That all environmental risks associated with the activity be assessed and documented prior to the execution of the activity.
    - ii) Identified environmental risks must be avoided where possible and where it cannot be avoided, be remediate to the satisfaction of the *Employer*, the relevant Landowner, or any relevant Government Authority.
    - iii) That all environmental incidents and complaints are reported to the *Clerk of Works* within **24 hours** after the occurrence thereof.
- 1.2.6 Other special environmental restrictions which must be adhered to and as stipulated in the **Environmental Management Plan** are:
- a) The irresponsible use of welding equipment, oxy-acetylene torches and other naked flames which could result in veld fires or constitute a hazard.
  - b) Indiscriminate disposal of rubbish or rubble.
  - c) Deliberate littering of the site.
  - d) Spillage of potential pollutants, such as petroleum products.
  - e) Lighting of fires for cooking, heating or other purposes, and failure to exterminate any fires.
  - f) Use of any facility other than the chemical toilets provided.
  - g) Burning of wastes and cleared vegetation under any circumstances.
  - h) The use of rivers, streams, dams or any watercourses/surface water for washing purposes.
  - i) Entering areas outside of the demarcated construction area.
  - j) The presence of construction staff at the construction site outside of the designated construction times (06h00-18h00) i.e. no construction staff are allowed to overnight on site, outside of the demarcated construction camp.
- 1.3 Health & Safety requirements**
- 1.3.2 The Employer's Health and Safety Specifications and the Department of Labour's Construction Regulations for this project are specified in **Part C3.4 Health and Safety Specifications**.
- 1.3.3 The *Contractor* shall:
- a) Submit with this Tender, a complete **Health and Safety Plan** for this project, for the *Employer's* approval;
  - b) Comply in full with all the *Employer's* requirements for Security and Safety;
  - c) Maintain an active accident prevention program;
  - d) Appoint a responsible Health and Safety Officer and he is to co-operate fully with the *Project Manager* in all matters pertaining to accident prevention and safety on the construction site;
  - e) Hold safety meetings as required under the Occupational Health and Safety Act 85 of 1993, and shall submit copies of the minutes to the *Project Manager* no later than **2 days** after the date of the meeting.
  - f) Provide first aid facilities as required by the **Occupational Health and Safety Act, 85 of 1993**.
  - g) Allow and ensure safe access for other *Contractor's* and the *Employer's* personnel when required.
  - h) Make provision for special transport of workers to, at and from site as per **OHS Act/Construction Regulations** requirements;
  - i) Complete and submit an **Expanded Public Works Programme** report, prior to the commencements of any construction activities;
  - j) Compile and submit for acceptance by the *Employer* **"Detailed Construction Method Statements"** for any test and construction activities to be executed on site;
  - k) Keep a **Health and Safety Incident Register** on site, which must be updated daily throughout the entire construction period. Refer to **Part C3.4** for **"Construction Safety, Health and Environmental Management"**.
- 1.3.4 The *Employer's* Standard **DPC 34-333** "Occupational Health and Safety Requirements to be met by principal contractors and sub-contractors employed by Eskom Distribution" forms part of the Health and Safety Specification specified in **Part C3.4** of this document and applies for the compilation of the **'Health & Safety Plan'** for this project.

- 1.3.5 The *Contractor* as well as the *Clerk of Works* shall ensure that the proper implementation, co-ordination and management of safety aspects during the project life cycle and that all statutory and Eskom Regulations are implemented and adhered to, as specified in the **Distribution Procedure DPC-34-333** and **SHEQ Policy EPL 32-727**.

#### 1.4 Site establishment

- 1.4.1 The *Contractor* will be responsible to locate a suitable site to establish a construction camp.
- 1.4.2 Site establishment costs include any other costs not specified as preliminary and general costs, as stated below:
- a) Establish, use and maintain notice boards and construction access road indicators;
  - b) Establish, use and maintain site office;
  - c) Establish, use and maintain site stores & construction camp;
  - d) Establish, use and maintain staff accommodation and sanitation;
  - e) Establish, use and maintain all telecomm and telephone installations and remove on completion, if required;
  - f) Establish, use and maintain *Contractor's* water supply, if required;
  - g) Establish, use and maintain *Contractor's* electricity supply, if required;
  - h) Establish, use and maintain *Contractor's* drainage and waste disposal at all camps;
  - i) Establish, use and maintain site toilet facilities;
  - j) Establish, use and maintain temporary works;
  - k) Establish, use and maintain all constructional plant.
- 1.4.3 Erection of a site office & construction camp:
- a) A fully equipped site office, suitable for regular site meetings must be erected, which must also serve as the office for the *Contractor's* Site Supervisor.
  - b) Adequate workspace must also be provided for the *Clerk of Works*, as well as a place of safekeeping of his site plans and documentation.
  - c) On completion of the project, all temporary structures and installations shall be removed from site and the site shall be re-instated to the satisfaction of the *Project Manager*.
  - d) For temporary installations, only chemical toilet facilities will be allowed at the construction office/camp for the use by construction workers and visitors to the construction camp.
  - e) The *Contractor* shall:
    - i) Ensure that the entire camp site(s) is fenced and gates locked after hours and over weekends.
    - ii) Ensure that firebreaks are made along the inside perimeter of the fence (where appropriate).
    - iii) Ensure that appropriate sanitation and cooking facilities are provided and maintained at all work sites.
    - iv) Ensure that no open fires are permitted at the camp site(s). The establishment of fencing and firebreaks must be negotiated with the relevant Landowner(s).
- 1.4.4 Erection of Stores for safekeeping of materials:
- a) The responsibility for the safe storage of material on site as well as protection against damage due to wind or weather lies with the *Contractor*.
  - b) The construction camp and material yard shall be properly fenced off and all access gates shall be kept locked during periods where no construction activities are taking place.
  - c) No conductor, shield wire, line hardware, insulators and steel structures shall be stockpiled directly on the ground.
  - d) The construction camp and material yard shall be maintained and kept in a clean and tidy condition, throughout the construction period and also to the satisfaction of the *Clerk of Works*.
- 1.4.5 Laboratory Facilities:
- a) The *Contractor* shall provide laboratory facilities for his own use on site to carry out all routine testing of materials and construction, as required by the specifications;
  - b) The *Contractor* may make use of approved commercial laboratories, if he so wishes.
- 1.4.6 Telephone and Telecommunications:
- a) The *Contractor* shall be responsible for the supply, on site, of his own telephone or radio-telephone, if required.
- 1.4.7 Accommodation of Employees:
- a) The *Contractor* shall make his own arrangements for the provision of married and single accommodation for his employees.
- 1.4.8 Electrical Equipment/Appliances:
- a) Any electrical equipment or appliance used by the *Contractor* shall be maintained in safe and proper

working conditions;

- b) The *Project Manager* shall have the right to stop the *Contractor's* use of any electrical equipment or appliance, which, in his opinion, does not conform to the foregoing.

#### 1.4.9 Concrete Batching and Mixing Plant:

- a) The *Contractor* shall negotiate a proper site for the establishment of a batching plant with the Landowner;
- b) The *Contractor* will be responsible for the proper management of the batching plant and it shall be dedicated solely to the Works;
- c) Upon completion of the Works, the soil at the batching plant area shall be rehabilitated and the site cleaned and left in its original state or to the approval of the *Clerk of Works* and Landowner.
- d) The use of local water for concrete mixing must first be negotiated with the relevant Landowner and/or appropriate authorities.
- e) Such water shall be analysed for its suitability for the use in concrete. The water analyses shall be submitted to the Project Engineer for the approval thereof.

#### 1.4.10 Fuel depots:

- a) The *Contractor* shall when making use of bulk fuel tanks on site, shall have these fuel depot sites protected with under laying plastic sheeting with a trench and/or bund wall around it to avoid unnecessary soil pollution.
- b) In cases of severe soil pollution at fuel depots a certified *Contractor* shall remove the polluted soil to an approved toxic dumping site or otherwise the soil must be treated chemically. In both cases a certificate for the removal and/or rehabilitation of the soil must be submitted to the *Project Manager*.

#### 1.4.11 Provision of Standard Specifications:

- a) Where any specification is listed and references are made to other published standards, or specifications of a similar nature, the *Contractor* shall arrange at the inception of the contract, to make available at least one complete control set of the latest edition of all documents so referenced.
- b) The documents shall be kept in the *Contractor's* site office where they shall be made available for reference at all times by the *Contractor's* personnel or the *Project Manager* until completion of the Works.

## Activity Stage 2: Establish construction access

### 2.1 Supply and transport of new power line servitude gates

2.1.1 The following Standards, Specifications, Guidelines and Drawings apply:

- **TRMSCAAC1 Rev. 3 - Section 4.5 Transmission line tower and Line construction;**
- **Fencing Act No. 31 of 1963**
- **DGL 34-190 Guideline for access to farms;**
- **DGL 34-600 Building line restrictions, servitude widths, line separations and clearances from power lines;**
- **D-FS-12051 Rev 6 Sheets 1-5 Small stock fence servitude gate details;**
- **D-FS-13409 Rev 0 Sheets 1-5 Game fence servitude gate details;**
- **D-FS-18239 Rouxville Zastron Route Plan and PLSCadd design profile sheets.**

2.1.2 All new power line servitude and access required for this project shall be completely supplied and transported to site by the *Contractor*.

2.1.3 Gate quantities measured on the Route Plan are subjected to re-measurement based on a proper site evaluation by the *Contractor* in conjunction with the *Clerk of Works* and *Customer Network Centre Representative*.

2.1.4 Prior to the commencement of any other construction activities on this project, proper construction access on and to the line route/construction site shall be established.

### 2.2 Complete refurbishment/replacement of existing power line servitude gates

2.2.1 The *Contractor* in conjunction with the *Clerk of Works* and *Customer Network Centre Representative* shall do a proper assessment on the conditions of all existing gates along the line route.

2.2.2

2.2.3 Existing farm gates situated near and/or in the power line servitude and which are required for access, but are unsuitable for construction-vehicle access must be thoroughly assessed and evaluated.

2.2.4

- 2.2.5 All existing access/servitude gates shall be refurbished/replaced ensure proper construction access, as follow:
- Existing gates in a still good workable condition shall be properly cleaned and repainted as specified on drawing **D-FS-12051 Rev 6 Sheet 5**. All fencing wires shall be properly tightened.
  - Existing gates in a poor not workable condition shall be completely removed and replaced with new gates to drawings **D-FS-12051 Rev 6 Sheets 1-5** for small stock fences & **D-FS-13409 Rev 0 Sheets 1-5** for game fences, see **paragraph 2.3** below for installation detail.
- 2.2.6 Existing access gates outside the power line servitude shall only be used after written approval is obtained from the relevant Landowner, for the use thereof.
- 2.2.7
- 2.2.8 The Contractor shall temporarily remove the existing standard Eskom padlocks from existing gates and replace it with his own padlocks for the full duration of the construction period.
- 2.3 Complete installation of new power line servitude gates**
- 2.3.1 New power line access/servitude gates shall be installed at all points where the power line crosses any fence in which there is no suitable gate within extend of the power line servitude, unless otherwise determined on site by the *Clerk of Works*.
- 2.3.2 All construction vehicles shall pass through gates when crossing fences and the *Contractor* shall not be allowed to drop fences temporarily for the purpose of driving over it. No construction work shall be allowed to commence on any section of the power line, unless all gates in that line section have been installed.
- 2.3.3 The *Contractor* in conjunction with the *Clerk of Works* shall do a proper assessment of all the marked fences for new gate installations to obtain proper access to the construction site.
- 2.3.4 The *Clerk of Works* will be responsible to evaluate all marked fences and gates, prior to the installation of new power line servitude gates and/or replacement of existing gates.
- 2.3.5 The *Contractor's* work comprises:
- Supply, safe handling, storage and transport to peg of all power line servitude gates, gate & fencing material and all other gate construction material;
  - Setting-out of gate & fence post and strut positions;
  - Evaluating sub-soil conditions for foundation nominations;
  - Drilling/excavating of holes for poles and struts;
  - Excavating of earth strap trenches;
  - Complete installation of all gate & fence posts and struts in **15MPa** concrete footings;
  - Curing of concrete footings;
  - Install gate leafs and cut and re-tension existing fence wires;
  - Install earth straps, backfill and compact trenches;
  - Treatment of all damaged sections on gate leaf frames, poles, struts, etc.
- 2.3.6 Power line servitude gates shall be erected to follow the natural ground profile. The gate post where the gate leaf is installed on will be on higher ground than the gate post where the gate is locked to ensure the gate does not fall open when unlocked.
- 2.3.7 The in-situ soil condition at each gate position will determine the type of gate post foundation to be installed.
- 2.3.8 Power line servitude gates shall be erected with a gap not larger than **100mm** between the bottom of the gate leaf and the natural ground level.
- 2.3.9 Where gates are to be installed in jackal proof fences and game fences, a suitable concrete threshold as shown on the detail drawings shall be constructed at the gate opening. Gate leafs shall be covered with diamond mesh as specified on detail drawings.
- 2.3.10 All gate and fence posts as well as post struts are to be installed in **15MPa** concrete footings. The concrete footings must be properly cured, in the most suitable method, for at least **14 days** prior to the tensioning of the fence wires.
- 2.3.11 Earth strap trenches to backfilled slightly watered and thoroughly compacted in layers not exceeding **250mm** in thickness.
- 2.3.12 For soil formations with a very high resistivity the earth strap trenches to be backfilled with a **3:1 soil/agricultural gypsum** mixture.
- 2.3.13 The initial tensions to be maintained in all existing fence wires. Where required, the *Contractor* shall replace

rusted or damaged wire strands on either side of the gate with similar new wiring to prevent the movement of livestock and other animals. The *Clerk of Works* will determine the extent of replacing fence wires and a written instruction shall be given accordingly.

- 2.3.14 The *Contractor* shall provide padlocks for all servitude gates for the entire construction period, where after it will be replaced by the *Employer* with standard maintenance padlocks, on completion of the project.
- 2.3.15 Landowners will be allowed to attach their personal padlocks in the lock chain, only after the approval of the *Clerk of Works*.
- 2.3.16 At the completion of all construction activities after the complete taking over of the works the *Contractor* shall recover all his padlocks and replace it with standard maintenance padlocks supplied by the *Employer*.
- 2.3.17 Installation of gates in fences on National Road Reserves shall comply with the ordinances of the relevant Provincial Authority. No power line servitude gates shall be installed in Freeway servitude fences.
- 2.3.18 No power line servitude gate shall be installed in the Spoornet Railway Servitude fences, unless otherwise negotiated and agreed upon with the relevant Transnet Authorities.

## **2.4 Complete establishment of proper construction access**

- 2.4.1 The *Clerk of Works* and the *Contractor* will see that the Landowner's Conditions stipulated during the negotiations for this project is strictly adhered to. See **Part C4 Site Information**, of this document.
- 2.4.2 No property will be entered by the *Contractor* or his employees, prior to an acceptable official notification to the specific Landowner.
- 2.4.3 The *Contractor* shall only use the private farm roads with the necessary permission from the specific Landowner, use it with the necessary respect and maintain it throughout the construction period.
- 2.4.4 The access to the site to be clearly marked by *Contractor* in the form of access road indicators. The *Contractor* shall also establish and maintain notice boards at private roads used for construction purposes and special conditions clearly stipulated on these notice boards.
- 2.4.5 In situations where private roads must be used for construction purposes, the condition of the said roads must be recorded (e.g. Photographed) prior to the use thereof and be agreed upon by the *Employer*, the Landowner and the *Contractor*.
- 2.4.6 All private roads used as access to the construction site by the *Contractor*, shall be maintained by him at all times at his expense, and upon completion of the work, be left in at least the condition prior to the commencement of the construction activities.
- 2.4.7 Where possible access along the power line must be established by vehicles passes over the same track on natural ground.
- 2.4.8 Temporary access roads shall only be constructed and maintained where necessary at watercourses, steep slopes or where boulders and rocks prohibit vehicular traffic.
- 2.4.9 No access roads shall be constructed in and/or outside the power line servitude without the written instructions from the *Clerk of Works*.
- 2.4.10 Where construction of a new road has been agreed, the road width shall be determined by need, such as equipment size, and shall be no wider than necessary.
- 2.4.11 In areas over 4% side slope, roads may be constructed to a 4% out-slope. The road shall be constructed so that material will not be accumulated in one pile or piles, but distributed as evenly as possible.
- 2.4.12 The material shall be side-cast as construction proceeds, and shall not be side-cast so as to make a barrier on the downhill side.
- 2.4.13 The cut banks shall not overhang the road cut, and shall if necessary be trimmed back at an angle which would ensure stability of the slope for the duration of the works. The sides or shoulders of roads shall not act as a canal or watercourse.
- 2.4.14 Water diversion berms shall be built immediately after the opening of the new access road. In addition, water outlets shall be made at intervals where berms are installed, and suitably stone pitched if instructed by the *Clerk of Works*.



- 2.4.15 No cutting and filling shall be allowed in areas of 4% side slope and less.
- 2.4.16 Existing land contours shall not be crossed by vehicles and equipment unless agreed upon, in writing, by the landowner and the *Clerk of Works*.
- 2.4.17 Existing drainage systems shall not be blocked or altered in any way.
- 2.4.18 Loose boulders which obstruct the construction access as well as for running out the conductors shall be removed from the power line servitude.

## 2.5 Closure of construction roads

- 2.5.1 Upon completion, only roads as indicated by the *Clerk of Works* shall be closed, unless otherwise specified by the *Employer* and/or Landowner.
- 2.5.2 In areas where no cut or fill has been made, barriers of earth, rocks or other suitable material shall affect closure.
- 2.5.3 In areas 30 % slope and less, the fill of the road shall be placed back into the roadway using equipment that does not work outside the road-cut (e.g. back-hoe). In areas of greater than 30 % slope, the equipment shall break the road shoulder down so that the slope nearly approximates to the original slope of the ground. The cut banks shall be pushed down into the road, and a near normal side slope shall be re-established and re-vegetated.
- 2.5.4 Replacement of earth shall be at slopes less than the normal angle of repose for the soil type involved.
- 2.5.5 Construction of water diversion berms
- a) Water diversion berms shall be spaced according to the ground slope and actual soil conditions, but no greater than the following:
    - Where the track has a slope of less than 2% : 50m apart;
    - Where the track has a slope of 2% - 10% : 25m apart;
    - Where the track has a slope of 10% - 15% : 20m apart;
    - Where the track has a slope of more than 15% : 10m apart.
  - b) Berms shall be suitably compacted to a minimum height of 350mm.
  - c) The breadth of the water diversion berm shall be 4m at the base, and extend beyond the width of the road for 2,0m on the outlet side to prevent water flowing back into the road. It shall be angled to a gradient of 1% to enable the water to drain off slowly.
  - d) Berms are to be constructed in such a manner that a drainage canal is formed at the upslope side.
  - e) Where the in-situ material is unsuitable for the construction of water diversion berms, alternative methods of construction must be investigated and proposed by the *Contractor* and submitted to the *Project Manager* for acceptance.
  - f) Borrow pits:
    - The *Contractor's* decision as to the location of borrow pits, shall be at the *Clerk of Works* acceptance;
    - The *Contractor* shall be responsible for the rehabilitation and re-vegetation of the borrow pits.
    - It is the *Contractor's* responsibility to negotiate the royalties for borrows pits with the relevant Landowners.

## 2.6 Bush clearing and cutting of trees

- 2.6.1 The following Standards, Specifications, Guidelines and Drawings apply:
- **TRMSCAAC1 Rev. 3 - Section 4** Transmission line tower and Line construction;
  - **Environmental Conservation Act No. 73 of 1989**
  - **Conservation of Agricultural Resources Act No. 43 of 1983;**
  - **Environmental Management Plan**
  - **EPC 32-96** Guidelines for the rehabilitation and vegetation management of herbicides treated sites;
  - **ESKASABG** Standards and Specifications for the control and cutting of trees and bush within overhead line servitude's;

- 2.6.2 Trees and bush to be cut and/or trimmed on a careful and selective basis to ensure the required electrical clearances from all conductive equipment and to ensure the safety of the power line structures.
- 2.6.3 All equipment required for bush clearing shall be supplied by the *Contractor*.
- 2.6.4 All approved herbicides required for the prohibiting of re-growth of trees and bush to be supplied by the *Contractor*.
- 2.6.5 All actual bush clearing areas and quantities of trees cut by the *Contractor* shall be measured and recorded by the *Clerk of Works*. Actual measured bush clearing records shall be submitted to the *Employer* for acceptance.
- 2.6.6 Minimum **One Week** written notice must be given to the *Employer's* Environmental Practitioner before commencement with bush clearing activities.
- 2.6.7 The *Contractor* shall use only well trained approved and/or accredited weed killer applicators.
- 2.6.8 The *Contractor* will not be allowed to cut and/or trim any **endangered** trees or shrubs in the servitude, unless written prove of the required permits, obtained by the *Contractor*, is submitted to the *Clerk of Works*.
- 2.6.9 Any endangered trees or shrubs to be cut shall be identified and marked by the Contractor in conjunction with the Environmental Control Officer and *Clerk of Works*.
- 2.6.10 The use of existing gates and private roads in or outside the power line servitude for bush clearing purposes must be discussed with and accepted by the relevant Landowner, prior to the use thereof.
- 2.6.11 All vehicles used for bush clearing shall pass through gates when crossing fences and the *Contractor* shall not be allowed to drop fences temporarily for the purpose of driving over it.
- 2.6.12 A minimum **4,0m wide strip** on the centre of the power line servitude all trees, bush and shrubs shall be cut **at ground level** to ensure proper access for construction purposes along the line. All wood must be removed from the power line servitude.
- 2.6.13 Additional maximum **3,0m wide strips** on either side of the mentioned **4,0m centre strip** all trees, bush and shrubs shall be cut **at maximum 150mm above ground level** to ensure no interference with construction activities along the power line. All wood must be removed from the power line servitude.
- 2.6.14 All trees, bush and shrubs shall be cut at **ground level** for **11,0m radius circles** construction working areas at all guyed intermediate suspension and in-line strain structure sites. All wood must be removed from the power line servitude.
- 2.6.15 All trees bush and shrubs shall be **cut at ground level** for **20,0m radius circles** construction working areas at all guyed angle strain structure sites. All wood must be removed from the power line servitude.
- 2.6.16 Where tall trees are to be cut in the power line servitude, the total width of the servitude must be cleared, as well as the selective trimming of trees outside the servitude to ensure the safety of the overhead conductors and power line structures. The *Clerk of Works* will give the *Contractor* a written instruction for any trees to be trimmed outside the power line servitude.
- 2.6.17 Trees that are felled shall be cut within **150mm** above ground level, with the exception of a **four meter (4,0m)** wide access down the centre of the power line servitude in which the trees shall be cut as close as possible to ground level. Stumps need not be removed, unless conflict with a structure, guy anchor or access is involved, or if requested by the *Clerk of Works*.
- 2.6.18 All stumps from trees, bush and shrubs shall be chemically treated immediately after cutting, to prevent any re-growth thereof. The chemical treatment must be approved by the *Employer's* Environmental Practitioner prior to the purchasing and application thereof.
- 2.6.19 Where no trees, bush or shrubs are present the clearing of access shall be done by crushing of small brush rather than the uprooting thereof. Scalping of the earth, or any unnecessary disturbance, will not be allowed as any means of clearing the servitude, except on steep side slopes where cuts and fills are required.

- 2.6.20 Between structures, where no traffic is required, there shall be no removal of grasses except as required for stringing of the power line. Access for the stringing of the power line shall be limited to one single track for all pulls.
- 2.6.21 No cutting of bush and shrubs will be permitted across bush filled ravines or gullies where the bush will not interfere with the strung conductor. Alternative means shall be used to string the power line conductors.
- 2.6.22 All chopped trees and bush will remain the property of the relevant Landowners, unless otherwise negotiated with the *Clerk of Works*.

### Activity Stage 3: Survey activities

#### 3.1 Pegging of line route, structure setting-out & stays positions

- 3.1.1 The following Standards, Specifications, Guidelines and Drawings apply:
- **TRMSCAAC1 Rev. 3 - Section 5** Transmission line tower and Line construction;
  - **D-FS-18239** Rouxville Zastron Route Plan and PLSCadd design profile sheets.
- 3.1.2 Setting Out of the Works:-
- a) The **Employers Land Development Department Bloemfontein** will be responsible for the setting-out of the power line route servitude centre positions at all bends.
  - b) The **Employers Land Development Department Bloemfontein** will also be responsible for the pegging and marking of all intermediate suspension and angle strain structure positions, as well as the setting-out of all structure stay positions, temporary stay positions and structure line pegs and determining of structure off-set distances (if required), according to the line profile drawings and within the tolerances stated in **TRMSCAAC1, Sections 5.5.3 & 6.2.4.3 (a)**. Unless otherwise specified in this contract.
  - c) All material required for the detail pegging of the line will be supplied by the *Employer*.
  - d) Other reference pegs (Line pegs and bi-sector line pegs) required for construction purposes will be provided and set out by the *Employer*.
  - e) Line pegs and flags at **max. 1 500m** intervals along the centre line of the power line servitude will be provided and pegged by the *Employer*, only on special written request from the *Contractor*.
  - f) A completed list of scaled co-ordinates for all structure, stay, line peg and bi-sector line peg positions will be submitted by the Project Engineer, for the use by the *Employer's* Surveyor and the *Contractor*.
  - g) All "As-staked" structure and structure stay positions, to be checked and verified by the *Contractor* prior to the commencement of any construction activities. The *Contractor* must immediately report any discrepancies between the "As-staked" and "Design" information to the *Clerk of Works* or Project Engineer.
  - h) All other detailed setting-out of the works will be the *Contractor's* responsibility.



3.1.3 Standard setting-out, structure and stay peg colour codes used by **Free State Operating Unit:**

- a) H-pole structure centre position - **WHITE** wooden peg;
- b) H-pole structure leg position - **RED** wooden peg;
- c) Permanent stay position - **BLUE** wooden peg;
- d) Temporary stay position - **BLUE/WHITE** wooden peg;

## 3.1.4 Structure position labelling:

- a) Every structure position (**RED** or **WHITE** peg) to be marked with a steel, wood or PVC tubing dropper **±1,5m** long and painted **RED/WHITE** or with a **RED/WHITE** fabric attached to it. Each rods shall carry a tag, with a structure identification description similar to the structure identifications on the applicable **PLSCadd Profile Design Sheets**.
- b) The structure number, structure type and pole length shall be clearly legible on the identification tag e.g. "**RVZT1 D-FS-18233 14m 200mm**" or "**RVZT3 D-FS-18231 14m 200mm**" or "**RVZT11 D-FS-18233 14m 200mm**".
- c) Each peg shall be left in its position until the structure is assembled and approval is given by the *Clerk of Works* for the erection thereof.

## 3.1.5 Marking of power line route for bush clearing purposes

- a) The power line route shall be clearly marked by the *Employer's* Surveyor for bush clearing purposes, measured as part of the **Bush Clearing Activities**.
- b) At dense bush terrain, the centre of the power line route shall be marked entering the bush as well as at the exit of the bush.
- c) At scattered bush terrain, the centre of the power line route shall be marked at **max. 250m** intervals.
- d) At tall tree plantations, trees to be cut only within the power line servitude shall be marked for clear identification by the *Contractor*.

**3.2 Marking of servitude and access gates**

3.2.1 All fences in which servitude gates are to be installed, at the point where the fence intersects with the centre of the power line servitude, shall be marked by the *Employer's* Surveyor.

3.2.2 In situations where a structure position is close to the fence in which a power line servitude gate needs to be installed, the gate position must be marked off-line in such a position that the structure and/or structure stays will not obstructed the access through the gate along the line.

3.2.3 All fences in which servitude gates are to be installed, shall be marked as follow:

- a) A **Red** coloured fabric strip will be tied onto the fence wire, inside the power line servitude, at positions where servitude gate centre must to be installed;
- b) A **Red & White** coloured fabric strip will be tied onto the gate frame, inside or outside the power line servitude, at positions where existing farm gates are to be refurbished and/or replaced with new access/servitude gates.
- c) A **White** coloured fabric strip will be tied onto the gate frames, outside the power line servitude, at positions where existing farm gates can be used by the *Contractor*, for construction purposes only.

3.2.4 Permission and written approval for the use and/or replacement of private access gates inside and outside the power line servitude must first be obtained from the relevant Landowners, prior to the use and/or replacement thereof.

**3.3 Measuring of all over and under crossing clearances**

3.3.1 The *Employer's* Surveyor will also be responsible for the measuring and recording of all over and under crossing clearances, after the completion of the stringing activities on the line and prior to the commissioning of the line.

3.3.2 Ambient temperature measurements shall be taken and recorded by the Surveyor in conjunction with the clearance measurements. The complete set of '**Clearance & Ambient Temperature Records**' shall be submitted to the Project Engineer for evaluation and acceptance thereof.

**Activity Stage 4: Drilling/Excavating of holes for structure foundations and stays****4.1 Geotechnical investigation and soil/foundation type nominations**

- 4.1.1 The following Standards, Specifications, Guidelines and Drawings apply:
- **TRMSCAAC1 Rev. 3 - Section 6** Transmission line tower and Line construction;
  - **SANS 1200 D - 1988** Earthworks;
  - **Chickadee Line Section** D-FS-18231, D-FS-18232, D-FS-18233, D-FS-18234, D-FS-18235, D-FS-18236;
  - **Hare Line Section** **D-DT-1740**, D-DT-1749, D-DT-1767, D-DT-1768, D-DT-1769, D-DT-1783, D-DT-1805, D-DT-1858, D-DT-1857;
  - **D-FS-18239** **Rouxville Zastron Route Plan and PLSCadd design profile sheets.**
- 4.1.2 Prior to the commencement of any drilling/excavation activities, the *Contractor's* shall do proper investigations of the sub-soil conditions at all structure positions, in the presence of the *Clerk of Works* and/or Project Engineer.
- 4.1.3 The *Contractor* shall appoint his own professional **Civil Engineer/Civil Technologist** to do the sub soil geotechnical survey and nomination of the specific soil types at each structure position. (DCP Testing)
- 4.1.4 The Chickadee and Hare portion of the line will be tested as described in 240-75883148 Table 1 detailed in Annex A at each structure and stay. Any other method proposed for the sub-soil investigations and soil nominations must be approved by the Project Engineer, prior to the implementation thereof.
- 4.1.5 A soil profile with identified material layers and depths, including a photograph thereof, as well as the nominated foundation type schedule to be submitted to the Project Engineer for acceptance, prior to the commencement of the foundation excavations.
- 4.1.6 If any dispute with regards to the nominated foundations types arises between the *Contractor* and the *Employer*, the assistance of an independent professional Civil and/or Geotechnical Engineer shall be called upon.
- 4.1.7 Standard soil classifications:
- a) **"Type 1" soils:** Competent soil with equal or better consistency (strength or toughness) than one would encounter in stiff cohesive soils or dense cohesionless soils above the water table. This soil must have a broad balanced texture (constituent particle sizes) with high average combinations of un-drained shear strength and internal angle of friction, with minimum values of 80kN/m<sup>2</sup> and 30° respectively. The minimum natural specific weight shall not be less than 18kN/m<sup>3</sup>. Maximum soil bearing pressure **300kPa**.
  - b) **"Type 2" soils:** A less competent soil than **"Type 1"**, with equal or weaker consistency than one would encounter in firm to stiff swelling cohesive soils, or dry poorly graded loose to medium dense cohesionless soils above the water table. The minimum un-drained shear strength shall be 40kN/m<sup>2</sup>, and the minimum natural specific weight shall not be less than 16kN/m<sup>3</sup>. Maximum soil bearing pressure **150kPa**.
  - c) **"Type 3" soils:** Dry loose cohesionless soil or very soft to soft cohesive soil. Maximum soil bearing pressure **100kPa**.
  - d) **"Type 4" soils:** Submerged cohesionless and cohesive soils. This includes all soils below the permanent water table, including soils below a re-occurring perched water table, or permeable soil in low-lying areas subjected to confirmed seasonal flooding. Maximum soil bearing pressure **50kPa**.
- 4.1.8 Standard rock classifications:
- a) **"Type A" hard rock:** Hard to very hard solid or moderately fractured continuous rock, and including hard to very hard rock of any other description which meets the strength requirements. The maximum bearing or toe pressure at foundation depth shall be **2 000kPa**.
  - b) **"Type B" soft rock:** Weathered or decomposed very soft to soft continuous rock, and including rock of any other description which does not satisfy the requirements for classification under **clause 5.1.8 a)**. The maximum bearing or toe pressure at foundation depth shall be **800kPa**.
- 4.1.8 Standard boulder classifications:
- a) **"Class A" Boulder excavation** shall be excavations in material containing **more than 40%** by volume of boulders of size in the range 0,03m<sup>3</sup>-20m<sup>3</sup> in a matrix of soft material or smaller boulders;

Excavations in dolomite formations other than solid dolomite will be classed as boulder excavations **“Class A”** if the formation contains more than 40% by volume of lumps of hard dolomite of size in the range 0,03m<sup>3</sup>-20m<sup>3</sup> in a matrix of soft material or smaller lumps of hard dolomite;  
Excavations of solid boulders or lumps of size exceeding 20m<sup>3</sup> will be classed as hard rock excavations;  
Excavations of fissured or fractured rock will not be classed as boulder excavations but as hard rock or intermediate excavations, according to the nature of the material.

- b) **“Class B”** Boulder excavation shall be excavations in material containing **less than 40%** by volume of boulders of size in the range 0,03m<sup>3</sup>-20m<sup>3</sup> in a matrix of soft material or smaller boulders and which require individual drilling and blasting in order to be loaded by a track type front-end loader or back-acting excavator;  
The excavation of the rest of the material shall be classed as soft or intermediate excavations, according to the nature of the material.

4.1.9 Geotechnical design parameters for various soil types:

|  | <b>“Type 1”</b> | <b>“Type 2”</b> | <b>“Type 3”</b> | <b>“Type 4”</b> |
|--|-----------------|-----------------|-----------------|-----------------|
| a) Maximum soil bearing pressure (kPa) | 300             | 150             | 100             | 50              |
| b) Maximum toe bearing pressure (kPa)  | 375             | 200             | 125             | 65              |
| c) Frustum angle degrees               | 30              | 20              | 0               | 0               |

- 4.1.10 For maximum soil bearing pressure and maximum toe bearing pressure, use the tabled pressure or 80% of the ultimate tested bearing pressure determined from appropriate tests.

- 4.1.11 The soil profile excavations shall be suitably backfilled immediately after the relevant inspections and tests have been completed.

- 4.1.12 Where site conditions, such as difficult access or environmentally sensitive areas, etc. preclude the excavation of a soil profile hole, alternative soils identification procedures shall be proposed by the *Contractor* and acceptance obtained from the Project Engineer.

- 4.1.13 Should the foundation conditions at the actual foundation location be found to differ from those identified at the corresponding soil profile, the *Contractor* shall immediately inform the *Clerk of Works* and a revised assessment shall be made.

- 4.1.14 Foundation type excavation quantities measured in the **PART C5:- Schedule of Prices** are based on assumptions and will be subjected to final re-measurement based on the detail sub-soil geotechnical investigation or soil nominations at each structure and stay position.

**4.2 Detail setting-out of structure foundation excavations**

- 4.2.1 After acceptance of the geotechnical survey and the foundation nominations by the Project Engineer and prior to the commencement of any drilling/excavation activities the *Contractor's* shall do the following preparations:-

- a) Check and verify all structure pole and stay anchor positions, as per design and detail drawings and within the tolerances specified in **TRMSCAAC1 Section 6.2.4.3**;  
b) Set-out of all nominated foundation details as per *Employers* Standard foundation design details for each structure.

- 4.2.2 All stay excavation positions to be marked **±1,30m for 2m stay rods, ±1,52m for 2.4m stay rods and ±1,80m for 3m stay rods** in-line and backwards from the pegged stay positions. This position is directly above the upper outside edge of the stay plate (for 600mmx600mm stay plates)

**4.3 Drilling/Excavating of holes for structure foundations**

- 4.3.1 All loose top soil containing grass, plants and /or plant roots whatsoever, shall be removed and temporary stockpiled for re-use at the structure site re-instatement. None of these materials are to be re-used for backfilling in structure foundations.

- 4.3.2 Drill and/or excavate of holes for structure foundations/poles, as specified in **TRMSCAAC1 Section 6.2**, as per detail designs or as agreed upon with the Project Engineer for alternative methods suitable for site conditions.

- 4.3.3 At each structure position, the *Contractor* shall excavate the appropriate foundation. Excavations in this instance shall be the removal of soil/rock by any accepted means for the purpose of constructing a particular foundation system.

4.3.3.1 Structures to be planted with stay plates that will serve as pad as shown on D-DT-0330 based on soil classification reports as submitted by the contractor. The Project / Design Engineer will specify on the report what type of pad to be used next to each structure.

- 4.3.4 No excavation work, other than for soil investigation, shall be commenced on a section of line until the following conditions have been met:
- The *Contractor* has submitted the proposed foundation and soil type schedule to the *Project Manager*;
  - If drilled cast-in-situ piles or rock anchors are proposed, soil samples and pile/anchor tests have been conducted, if so instructed by the *Project Manager*.
- 4.3.5 Excavations shall be made to the full dimensions required and shall be finished to the prescribed lines and levels. The bottom or sides of excavations upon or against which concrete is to be poured shall be undisturbed. If, at any point in excavation, the natural material is disturbed or loosened, it shall be filled with **10MPa** concrete, including the application of a blinding layer at the base of foundations where these eventualities are likely to occur during the construction process. **Soil backfilling will not be accepted.**
- 4.3.6 In soil type which is incapable of withstanding the design loads which will be imposed upon it by a pad foundation, the *Contractor* shall propose a method of increasing the effective bearing area of the foundation. This may entail the installation of a foundation with a larger pad or other suitable solutions proposed by the *Contractor*. Any such proposal shall be submitted to the *Project Manager* for acceptance prior to excavation.
- 4.3.7 When the material at foundation depth is found to be partly rock or incompressible material, and partly a soil or material that is compressible, all compressible material shall be removed for an additional depth of 200mm and filled with **10MPa** concrete.
- 4.3.8 Excavations for cast-in-situ concrete, including pile caps cast against earth, shall be concreted within **seventy-two hours** after beginning the excavations. In addition to this general requirement, pile and/or anchor holes that are not adequately protected against the elements to the satisfaction of the *Clerk of Works*, shall be cast on the same day that drilling/excavation has taken place.
- 4.3.9 Excavations that remain not concreted longer than **seventy-two hours** may, at the option of the *Clerk of Works*, be required to be enlarged by **150mm** in all dimensions.
- 4.3.10 The *Contractor* shall notify the *Clerk of Works* upon completion of the excavation for the foundations. No concrete is to be placed until the excavation finishes, shuttering and reinforcing steel has been inspected and accepted in writing by the *Clerk of Works*.
- 4.3.11 Structure foundation excavation side walls and edges shall be smooth and square.
- 4.3.12 Excavations shall be properly cleaned, all loose sand, stones, vegetation, etc. shall be removed from the excavations prior to the casting of concrete and/or backfilling of excavations.
- 4.3.13 All excavated material suitable for backfilling and compaction of structure foundations to be kept clean and free from any vegetation and/or plant roots.
- 4.3.14 All unsuitable backfill material, such as soft clay and loose non-compactable sand shall be spoiled and dumped at a suitable dumping site or re-used for structure site re-instatement
- 4.3.15 FA

#### 4.4 Excavation shoring

- 4.4.1 The *Contractor* shall supply and install temporary shoring for securing of all structure foundations excavation side walls in collapsible **“Type 3 & 4” soils**.
- 4.4.2 Temporary shoring shall only be removed immediately before the backfilling of excavation commences.
- 4.4.3 The *Contractor* shall ensure that excavation shoring strictly conforms to the Occupational Health and Safety Act 85 of 1993 – Construction Regulations Section 11 “Excavations”

#### 4.5 Drilling/Excavating of holes for permanent and temporary structure stays

- 4.5.1 Drill and/or excavate maximum **1,75m** deep hole for 2m stay or, **2.15m** for **2.4m** stay rod and **2.375m** for 3m stay rod for **conventional stay installations**, complete with a **45° 80mm** wide stay slot for the stay rod, as per detail drawing **D-DT 350** or as agreed upon with the Project Engineer for alternative methods suitable for site conditions.

- 4.5.2 The stay installation angles to be **45°** with the vertical, unless otherwise specified by the Project Engineer.
- 4.5.3 At site conditions where solid rock/granite is present at very shallow levels, alternative methods for structure and stay anchor installations will be evaluated and considered as a cost saving measure, only. The Project Engineer shall evaluate and approve the *Contractor's* proposal for such rock anchor installations.
- 4.5.4 Rock anchors shall be installed at **45°** with the vertical (**see D-DT 0357**).
- 4.6 Barricading/Protecting of all open excavations**
- 4.6.1 All excavated/drilled holes for poles and stays shall be kept covered, protected and/or barricaded in a manner acceptable for the *Clerk of Works* and also to prevent any possible injuries to pedestrians, livestock, game and smaller wild animals and rodents.
- 4.6.2 Failure to maintain proper protection of excavated holes by the *Contractor* shall result in the suspension of all excavation/drilling activities until proper protection has been restored.
- 4.6.3 The *Contractor* shall ensure that excavation barricading/protection strictly conforms to the Occupational Health and Safety Act 85 of 1993 – Construction Regulations Section 11 “Excavations”

## Activity Stage 5: Installation of power line structures

### 5.1 Supply and transport to site of all structures and structure stay material

- 5.1.1 The following Standards, Specifications, Guidelines and Drawings apply:
- **TRMSCAAC1 Rev. 3 - Section 6** Transmission line tower and Line construction.
  - **D-FS-18231 Sheets 1-2** MV Heavy Conductor H-Pole Braced Suspension Structure Modified D-DT-1793
  - **D-FS-18232 Sheets 1-2** MV Heavy Conductor H-Pole Braced In-Line Strain Modified D-DT-1794
  - **D-FS-18233 Sheets 1-2** MV Heavy Conductor H-Pole Braced Angle Strain Structure 1-60° Modified D-DT-1795
  - **D-FS-18234 Sheets 1-2** MV Heavy Conductor H-Pole Braced Terminal Structure Modified D-DT-1796
  - **D-FS-18235 Sheet 1** Air Termination
  - **D-FS-18236 Sheet 1** Modified Stay Assembly
  - **D-DT-1740** MV Three Phase Delta 2500 Wooden Cross Arm Intermediate – 0 Deg Deviaton, with spark gap device D-DT-0310 Sheet 4
  - **D-DT-1748** MV Three Phase Delta 2 x 2500 Wooden Crossarm Strain – Medium (1-60) Deg. Deviation
  - **D-DT-1749** MV Three Phase Delta – 2 x 2500 Wooden Crossarm Strain - Terminal
  - **D-DT-1767** MV Three Phase H-Pole / 2 x 3500 Wooden Crossarm Strain – 0 Deg. Deviation
  - **D-DT-1768** MV Three Phase H-Pole / 2 x 3500 Wooden Crossarm Strain – Medium (1-60) Deg. Deviation
  - **D-DT-1769** MV Three Phase H-Pole / 2 x 3500 Wooden Crossarm Strain - Terminal
  - **D-DT-1805** MV Three Phase Take – Off 2 x 2500 Wood Crossarm Option 2
  - **D-DT-1857** 3 Phase Switch Disconnecter Ganged, Link Stick Operated Assembly Single Pole Mounted
  - **D-DT-1858** 3 Phase Switch Disconnecter Ganged, Link Stick Operated H-Pole 1800 and 2200 Centres
  - **D-DT-1873** MV Three Phase H-Pole / 2 x 4500 Wooden Crossarm Strain – Large (61-90) Deg Deviation
  - **D-FS-18239** **Rouxville Zastron Route Plan and PLSCadd design profile sheets.**
  - **PART C6.1** Project structure order BOM.



- 5.1.2 The quantities specified for temporary stays are the **minimum** required to keep the structures as plumb as possible during stringing activities. The *Contractor* shall add to these quantities to ensure the safety of his workmen during stringing activities.
- 5.1.3 The *Contractor* shall collect all material required for this project. The structure material will be delivered to **Welkom Stores**.
- 5.1.4 For structure details refer to "**Design BOM**"
- 5.2 Safe stock-piling/storage, handling and transport of structures, structure material and stays**
- 5.2.1 The *Contractor* shall collect and check with Clerk of Works, all material required for this project. The structure material will be collected at Welkom Stores.
- 5.2.1.1 It is the *Contractors* responsibility to ensure that wooden poles delivered on site is stacked according to the required standard, 240-75881496
- 5.2.2 The *Contractor* will be responsible for the proper and safe stockpiling of the structure material as well as the safe handling and delivery to peg thereof. Refer to **PART C6.2** of this document for all structure quantities and details to be supplied for this project.
- 5.2.3 All permanent and temporary stay material and stay wire shall be safely handled and transported to peg by the *Contractor* for the complete installation thereof, see **paragraph 5.4** below.
- 5.2.4 All "**D-FS-18231**" (based on D-DT 1793) shall be braced H-Pole 33kV intermediate suspension structures with bonding as indicated on the drawing, and fitted with an air termination device as specified in "**D-FS-18235**". 50 structures as indicated on the profile and route plan "**D-FS-18239**" will require covered down wires 3m above ground level and 0.5m below ground level. 3 structures will require butyl mastic tape applied to 3 extruding eyebolts above 4.5m cross arm to ensure structures are touch safe.
- 5.2.5 All "**D-FS-18232**" (based on D-DT 1794) in-line and "**D-FS-18233**" (Based on D-DT 1795) angle strain H-Pole structures shall be braced 33kV structures and shall be fitted with air termination devices as specified in "**D-FS-18235**" and with applicable offsets based on line angle as specified on structure drawing. The number of required stays will be shown on the profile and route plan, "**D-FS-18239**" as well as on D-DT-0312 sheet 2. Jumpers will be covered with LDPE pipe.
- 5.2.6 All "**D-FS-18234**" (based on D-DT 1796) shall be braced H-Pole 33kV terminal structures and shall be fitted with air termination devices as specified in "**D-FS-18235**". The number of required stays will be shown on the profile and route plan, "**D-FS-18239**" as well as on D-DT-0313 sheet 2.
- 5.2.7 All "**D-DT-1740**" shall be 22kV intermediate single pole structures with D-DT 0310 Sheet 4 spark gap devices spaced 150mm.
- 5.2.8 All "**D-DT-1748**" shall be 22kV angle strain single pole structures, delta configured with helical dead ends (D-DT-0250). The number of required stays will be shown on the profile and route plan, "**D-FS-18239**" as well as on D-DT-0312 sheet 3. Jumpers will be covered with LDPE pipe.
- 5.2.9 "**D-DT-1749**" shall be 22kV terminal structures single pole, delta configured/horizontal configured (See D-DT 0320) with helical dead ends (D-DT-0250). The number of required stays will be shown on the profile and route plan, "**D-FS-18239**" as well as on D-DT-0313 sheet 1.
- 5.2.10 "**D-DT-1767**" shall be 22kV/33kV in-line strain H-Pole structures with pistol grip dead ends (D-DT-0251) on road crossing side and with helical dead ends (D-DT-0250) on non-road crossing side or helical dead ends (D-DT-0250) on both sides and may include a load break switch D-DT-1858 33kV as specified on "**D-FS-18239**". The number of required stays will be shown on the profile and route plan, "**D-FS-18239**" as well as on D-DT-0312 sheet 2. Jumpers will be covered with LDPE pipe.
- 5.2.11 All "**D-DT-1768**" shall be 22kV medium angle strain H-Pole structures with helical dead ends (D-DT-0250). The number of required stays will be shown on the profile and route plan, "**D-FS-18239**" as well as on D-DT-0312 sheet 2. Jumpers will be covered with LDPE pipe.
- 5.2.12 "**D-DT-1769**" shall be 22kV/33kV terminal H-Pole structures with helical dead ends (D-DT-0250) as specified on profile and route plan, "**D-FS-18239**". The number of required stays will be shown on the profile and route plan, "**D-FS-18239**" as well as on D-DT-0313 sheet 2.

- 5.2.13 All **"D-DT-1805"** shall be 22kV T-off single pole structures, delta configured, option 2 with helical dead ends (D-DT-0250) as specified on profile and route plan, **"D-FS-18239"**.
- 5.2.14 **"D-DT-1857"** shall be installed below the D-DT1805 assembly at Zastron Substation as specified on profile and route plan, **"D-FS-18239"**.
- 5.2.15 **"D-DT-1858"** shall be installed below the D-DT1768 assembly at Rouxville Substation as specified on profile and route plan, **"D-FS-18239"**.
- 5.2.16 All **"D-DT-1873"** shall be 22kV large angle strain H-Pole structures with helical dead ends (D-DT-0250) and with applicable offsets based on line angle as specified on profile and route plan, **"D-FS-18239"**. . The number of required stays will be shown on the profile and route plan, **"D-FS-18239"** as well as on **D-DT-0312 sheet 2**. Jumpers will be covered with LDPE pipe.
- 5.2.17 The following care must be taken by the Contractor during the handling and transport of the structure material
- a) Line material shall not be dropped from trucks, but shall be carefully off-loaded and stacked on the wooden block spacers;
    - a. It is the Contractors responsibility to ensure that wooden poles delivered on site is stacked according to the required standard, DPC34-1475
  - b) Line material shall be handled with nylon or fabric slings. The use of unprotected wire rope slings or chains will not be allowed;
  - c) Line material, when off-loaded at peg, shall be off-loaded onto wooden blocks in the veld and not left lying in direct contact with the ground;
  - d) Line material, when layout at peg, must be off-loaded in the correct proportions to avoid dragging of the sections on the ground and/or unnecessary double handling.
- 5.2.18 Any damages caused to the structure due to careless and reckless handling by the Contractor shall be rectified by the Contractor at his own cost and to the approval of the Clerk of Works.
- 5.2.17.1 All drilled holes to be treated with creosote.
- 5.2.17.2 All incorrectly drilled holes in wood poles must be painted with creosote and plugged with dowels that fit the hole firmly

### 5.3 Assembly and erection of structures

- 5.3.1 Tools and equipment used by the Contractor for the assembly of structures shall not scar or deform the material, nor damage the supplier's pole label and must be approved by the Clerk of Works, prior to the use thereof.
- 5.3.2 Air termination devices shall be fitted to all Chickadee structures. Suspension structures **"D-FS-18231"** shall be fitted with air termination devices including LDPE covering. Strain structures **"D-FS-18232"**, **"D-FS-18233"** and **"D-FS-18234"** shall be fitted with an air termination device excluding the LDPE covering.
- 5.3.3 50 x **"D-FS-18231"** of suspension structures shall be constructed with covered down wires for approximately 3m at ground level to 0.5m below ground level as specified on profile and route plan, **"D-FS-18239"**. For these bonding parts UV stable cable saddles shall be installed 0.75m from each other and not staples, staples will damage covering.
- 5.3.4 3 x **"D-FS-18231"** Suspension structures shall have butyl mastic tape/putty covering the threaded rods
- 5.3.5 Suspension structures **"D-DT-1740"** for the Hare section shall be fitted with spark gap devices D-DT310 Sheet 4.
- 5.3.6 Strain structures **"D-DT-1748"** for the Hare section shall be constructed according to D-DT 0320 SHEET 1 OPTION B
- 5.3.7 Terminal structures **"D-DT-1749"** for the Hare section shall be constructed according to D-DT 0320 SHEET 1 OPTION B
- 5.3.8 T-Off structures **"D-DT-1805"** for the Hare section shall be constructed according to D-DT 1805 OPTION 2.
- 5.3.9 Strain structures **"D-DT-1767"** for the Hare section shall be constructed according to D-DT 1767

- 5.3.10 Strain structures “**D-DT-1768**” for the Hare section shall be constructed according to D-DT 1768
- 5.3.11 Strain structures “**D-DT-1769**” for the Hare section shall be constructed according to D-DT 1769
- 5.3.12 Strain structures “**D-DT-1873**” for the Hare section shall be constructed according to D-DT 1873 with cross arms appropriately off set as specified in drawing.
- 5.3.13 Strain structures “**D-DT-1857**” for the Hare section shall be constructed according to D-DT 1857
- 5.3.14 Strain structures “**D-DT-1858**” for the Hare section shall be constructed according to D-DT 1858 at 1.8m spacing.
- 5.3.15 No structure shall be erected by the *Contractor* prior to the complete installation of permanent and temporary underground stay assemblies, the approval of the pole excavations as well as foundation base construction and curing by the *Clerk of Works*.
- 5.3.16 The erection of H-pole and mono-pole structures shall be subjected to the following criteria:
- a) All structures shall be erected vertically within **2mm in 1,0m** in both transversal and longitudinal directions. For the correct structure orientations in relation to the line direction refer to layout drawings;
  - b) During the structure erection the tension in all stays shall be **10% (±2%)** of the minimum breaking strength of the stay wire, after all rigging equipment has been removed.
- 5.3.17 All structures shall be properly cleaned prior to the erection thereof. Sand, mud and other dirt must be thoroughly cleaned with nylon brushes.
- 5.3.18 The planting depths of the **wood poles** are specified on **PLSCadd Design Profile sheet D-FS-18239 and D-DT332**. For structure foundation backfilling specifications refer to structure standard **240-75883148** and part C5.1



**5.4 Installation of permanent and temporary stay assemblies**

5.4.1 All underground stay assembly types as well as soil types in which permanent stays are to be installed shall be recorded by the *Clerk of Works* and records shall be submitted to the *Employer* for acceptance.

5.4.2 Permanent stay arrangements for guyed structures are as follow:

- a) **“D-FS-18232” (based on D-DT 1794)** 0° in-line strain structures:
  - **4 x Inline stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**
- b) **“D-FS-18232” (based on D-DT 1795)** angle strain structures:
  - 1-30° line angle
    - **4 x Inline stays, 1x Bisector stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**
  - 30-60° line angle
    - **4 x Inline stays, 2x Bisector stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**
  - 60-90° line angle
    - **4 x Inline stays, 3x Bisector stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**
- c) **“D-FS-18234” (based on D-DT 1796)** terminal structures:
  - **4 x Inline stays** according to **D-DT-0313 sheet 2, D-FS-18236, D-DT-0350.**
- b) **“D-DT-1748”** angle strain structures:
  - 1-30° line angle
    - **2 x Inline stays, 1x Bisector stays** according to **D-DT-0312 sheet 3, D-FS-18236, D-DT-0350.**
  - 30-60° line angle
    - **2 x Inline stays, 2x Bisector stays** according to **D-DT-0312 sheet 3, D-FS-18236, D-DT-0350.**
  - 60-90° line angle
    - **2 x Inline stays, 3x Bisector stays** according to **D-DT-0312 sheet 3, D-FS-18236, D-DT-0350.**
- d) **“D-DT-1749”** terminal structures:
  - **2 x Inline stays** according to **D-DT-0313 sheet 1, D-FS-18236, D-DT-0350**
- e) **“D-DT-1767”** 0° in-line strain structures:
  - **4 x Inline stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**
- f) **“D-DT-1768”** angle strain structures:
  - 1-30° line angle
    - **4 x Inline stays, 1x Bisector stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**
  - 30-60° line angle
    - **4 x Inline stays, 2x Bisector stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**
  - 60-90° line angle
    - **4 x Inline stays, 3x Bisector stays** according to **D-DT-0312 sheet 2, D-FS-18236, D-DT-0350.**

## 5.4.3 Standard permanent conventional stay assembly Chickadee structures

| ITEM CODE | ITEM DESCRIPTION                         | QTY |
|-----------|--|-----|
| 163343    | WIRE STRAND,ST 7x4.0 1100MPA 1500m D3124 | 13  |
| 163399    | THIMBLE,ST TO FIT 14mm DIA. WIRE D3026   | 1   |
| 163405    | STAYROD 133kN 2400x24 NON-ADJUST D7023   | 1   |
| 163420    | PLATE,STAY 600x600x6 80x26 SLOT D3172    | 1   |
| 163803    | COACH SCREW,GALV 75x12 HEX HD D3090      | 3   |
| 185949    | GUY GRIP,DBL WRAP MAKE OFF 7/4.00 D7047  | 1   |
| 189400    | INSUL:STRAIN STAY 97KN IL 150/60KV       | 1   |
| 402509    | GUYGRIP, D/END ST COND 7/4 D3069         | 3   |

## 5.4.4 Standard permanent conventional stay assembly Hare structures

| ITEM CODE | ITEM DESCRIPTION                         | QTY |
|-----------|--|-----|
| 163343    | WIRE STRAND,ST 7x4.0 1100MPA 1500m D3124 | 13  |
| 163399    | THIMBLE,ST TO FIT 14mm DIA. WIRE D3026   | 1   |
| 163402    | STAYROD 2000xM20 97kN NON-ADJUST D7023   | 1   |
| 163420    | PLATE,STAY 600x600x6 80x26 SLOT D3172    | 1   |
| 163803    | COACH SCREW,GALV 75x12 HEX HD D3090      | 3   |
| 185949    | GUY GRIP,DBL WRAP MAKE OFF 7/4.00 D7047  | 1   |
| 189400    | INSUL:STRAIN STAY 97KN IL 150/60KV       | 1   |
| 402509    | GUYGRIP, D/END ST COND 7/4 D3069         | 3   |

5.4.5 For the complete installation of underground permanent stay assemblies, the *Contractor's* work comprises:

- Install all permanent **M24 x 2,4m** non-adjustable stay assemblies at all "**Chickadee Structures**" in-line, angle strain and terminal structures, complete with **600 x 600 x 6mm** stay plates and **150 x 150 x 6mm** backing washers, angles between **45°** with the vertical, unless otherwise specified by the Design Engineer;
- Rock anchors shall be installed to prescribed stay angles into solid rock formations only, as per manufacturer's specification.
- For conventional stays installations the stay plates shall be positioned as firm as possible against the virgin soil inside the excavation;
- A maximum **80mm** wide stay rod slot shall be cut into the stay excavation side wall at the prescribed stay angles;
- Stabilize, backfill and compact stay excavation as specified in **paragraph 5.4.10** below.
- Proper Dynamic Cone Penetrometer (DCP) tests, as specified in **240-75883148**, to be executed during the backfilling and compaction of each stay.

5.4.6 5% of permanent stays shall be proof load tested. For the installation and testing of all conventional stays and rock anchors refer to documents **TRMSCAAC1 Rev 3 Section 6.2.5.1** and Eskom Procedure **240-75883148** for the conventional stay planting and compaction and rock anchor installation and testing.5.4.7 The *Contractor* shall provide equipment on site, during the installation of the guy anchors, capable of loading the anchor to a load equal to the un-factored foundation reaction for critical loading conditions.5.4.8 Where instructed by the *Clerk of Works*, the *Contractor* shall apply a construction proof load test equal to the un-factored foundation reaction for critical loading conditions to the completed anchors. The method of the load application shall be subject to the Project Engineer's acceptance. All anchor tests shall be conducted in the presence of the *Clerk of Works*.5.4.9 The load shall be applied to the anchor in appropriate increments to 50%, 75%, 90% and 100% of the proof test load, and then unloaded to 50% and again loaded to 100% of the proof test load, twice, i.e. during two further cycles of loading. The *Contractor* shall monitor anchor movement along the guy slope. Successive load increments shall not be applied until the rate of creep is less than or equal to 0,5mm/minute. The three cycles of loading from 50% to 100% shall each be of duration of not less than 5 minutes. The anchor shall

be considered acceptable if the total creep from 50% to 100% load over 3 cycles is less than 15mm. If the creep exceeds 15mm, the anchor shall be modified or replaced by the *Contractor* and re-tested.

- 5.4.10 Where stay excavations are done in very poor, loose sandy or soft clayey cohesionless soils, the first third of the backfill material to be imported. Imported material to consist of a clean and good compactable material such as natural gravels.
- 5.4.11 Where stay excavations are done in cohesionless non-compactable material the first third of the backfilling to be stabilized. Vegetation and plant roots to be removed from excavated material, well mixed to a **1:8** cement/soil mixture, slightly watered, backfill and compacted.
- 5.4.12 Backfill material to be slightly watered and thoroughly compacted in layers not exceeding **300mm** in thickness to a height **±500mm** above stay plate level as specified in the Eskom Procedure **DSP\_34-1657**. The remaining part of the stay excavation to be backfilled and thoroughly compacted excavated material.
- 5.4.13 The *Contractor* shall make provision for the sufficient quantity of temporary stays at all in-line and angle strain structures, to ensure the stability and plumpness of the structures, as well as the safety of the *Contractor's* Workmen.
- 5.4.14 All temporary stays shall remain intact and tensioned until completion of the stringing, regulating and clamping activities of the phase conductors.
- 5.4.15 The *Contractor* can install temporary stays on the conventional method or alternatively pre-cast stay anchor blocks per phase can be used. For both situations all temporary installed stays and stay anchor blocks must be completely removed from site after completion of the stringing activities.
- 5.4.16 All excavations left from the removed conventional installed stay assemblies must be properly backfilled, compacted and sites re-instated.
- 5.4.17 A maximum **45°** with the horizontal or flatter stay installation angle is required for temporary stays, under all circumstances.

**5.5 Supply of all foundations material and complete construction of all structure foundations**

5.5.1 The following foundation material to be supplied by the *Contractor*:

- a) Excavation shoring, where required;
- b) Foundation formwork required for all specified foundation types;
- c) Concrete material such as, sand, stone, cement and water, if concrete is batched on site;
- d) Ready Mix concrete as per specification, if concrete is delivered to site;
- e) All reinforcing required for concrete foundations;
- f) Cement required for planted structure backfilling stabilization;
- g) Imported soil required for planted structure backfilling stabilization, where specified only;
- h) **I.D. 1,2m** "Rocla" pre-cast concrete manhole sections or alternatively purpose manufactured steel rings;
- i) Any other material and/or equipment for the proper construction of the structure foundations.

5.5.2 As part of **Activity Stage 4** the soil types for foundation installation will be identified by means of a Geotechnical sub-soil investigation (DCP Method) done by a Civil Engineer/Technologist appointed by the *Contractor*. The foundation types will be nominated and recorded accordingly. Nominated foundation type records shall be submitted to the *Employer* for acceptance.

5.5.3 Foundation excavation side walls and edges shall be smooth and square. Foundation excavations shall be clean prior to the casting of concrete and/or backfilling of excavations. All loose sand, stones, vegetation, etc. shall be removed from the excavations prior to the casting of concrete and/or backfilling of excavations.

5.5.4 Water for the use in concrete shall be clean and free from all earthy, vegetable or organic matter, acids or alkaline substances in solution or suspension.

5.5.5 Foundation construction tolerances

- a) The intent of this paragraph is to establish tolerances that are consistent with construction practice and the effect that permissible deviations will have upon the structural action or operational function of the structure.
- b) Where tolerances are not stated for any individual structure or feature, permissible deviations will be interpreted in conformity with the provisions of this paragraph.
- c) The *Contractor* shall be responsible for setting out and maintaining concrete excavations, shuttering and structural steelwork within the tolerance limits so as to ensure completed work within the specified tolerances.
- d) Concrete work, that exceeds the tolerance limits specified shall be remedied, or removed and replaced.
- e) Variation in structure location:
  - Transverse to centre-line: Less than **50mm**
  - Longitudinal displacement: Less than **300mm**
- f) Rotation - maximum deviation of transverse axis of structure from bisector of interior line angle
  - Less than **0°12'**
- g) Elevation - variation of tower base from centre-line peg
  - Minus **150mm**
  - Plus **1 000mm**
- h) Height of concrete foundations above ground level
  - Minimum **150mm**
  - Maximum **550mm**
- i) Variation in relative placement of foundation components from those indicated on drawings, including piles, shuttering and structural steelwork
  - Less than **50mm**
- j) Tolerances for placing reinforcing steel
  - Variation of protective cover: **5mm**
  - Variation from indicated spacing: **25mm**
- k) Tolerances for guy anchors
  - Guy anchors shall be installed such that the attachment point of the anchor is within **250mm** of the correct calculated position.
  - The attachment point shall be a minimum of **150mm** and a maximum of **650mm** above the ground level.
  - Guy anchors designed for use with anchor rods extending below ground level shall have the anchor rod installed in line with the guy wire slope, within **5%** or such lesser tolerance as required by the design.
- m) Tolerances for pole foundations.
  - Pole foundations shall be constructed such that the pole, and the associated foundation works are within **50mm** of the correct calculated position.

## 5.5.6 Workmanship

- a) Concrete shall be proportioned, mixed, placed and finished in such a manner as to be free of honeycomb, segregation and other defects of workmanship.

## 5.5.7 Formwork

- a) Forms shall be of wood, metal or other suitable material.
- b) The forms shall be mortar-tight and shall be designed, constructed, braced and maintained such that the finished concrete will be to true line and elevation, and will conform to the required dimensions and contours.
- c) Formwork shall be designed to withstand the pressure of concrete, the effect of vibration as the concrete is being placed and all loads incidental to the construction operations without distortion or displacement.
- d) Where the bottom of the form is inaccessible, provision shall be made for cleaning out extraneous material immediately before placing the concrete.
- e) All exposed corners of the concrete shall be chamfered approximately **25mm**. A suitable nosing tool may be used for horizontal chamfers only if approved by the *Clerk of Works*.
- f) All formwork dimensions shall be checked, and if necessary, corrected before any concrete is placed.
- e) All forms shall be treated with a form-release agent accepted by the *Clerk of Works* before concrete is placed.
- f) Any material, which will adhere to, discolour or be deleterious to the concrete, shall not be used.

## 5.5.8 Construction joints

- a) In general, foundations shall be placed monolithically. Construction joints are to be avoided. If construction joints cannot be avoided and are accepted by the *Clerk of Works*, the *Contractor* may be permitted to make a construction joint if the following criteria are met:
  - i) The concrete is reinforced and the reinforcing steel will develop full bond strength both sides of the construction joint.
  - ii) No construction joints will be allowed in un-reinforced concrete.
  - iii) In single cast-in-situ piles, the construction joint is located one third the depth of the excavation, **±300mm** and at least **150mm** below the bottom of the structural steelwork or anchor bolts.
  - iv) In multiple cast-in-situ piles, the construction joint is to be **75mm**, and in rock anchors **100mm**, above either the base of the pile cap excavation or the top of blinding level.
  - v) If the piles are constructed after the excavation for the pile cap has taken place, suitable ring shutters of the same diameter of the piles shall be used to construct the above mentioned pile/anchor projections.
- b) No construction joints will be allowed in pile caps.
- c) At all construction joints, the surfaces of the previously placed and hardened concrete shall be thoroughly cleaned of all foreign matter and primed with a **15mm** thick layer of a wet mix of cement and sand in equal proportions, in the presence of the *Clerk of Works* before new concrete is placed. The grout coating shall be brushed over the concrete surface to ensure thorough coverage, particularly between the reinforcing bars. The new concrete shall be placed before the grout coating has taken its initial set.

## 5.5.9 Material mixture for structure backfilling shall consist of:

- a) **10 Parts** of good, clean compactable excavated or imported soil;
- b) **1 Part** of ordinary Portland cement.

5.5.10 Backfilling material shall be well mixed, slightly watered and thoroughly compacted in layers not exceeding **150mm** in thickness.

## 5.5.11 Planted guyed and backfilling to be constructed as follow:-

- a) All backfilling and compacting of pole excavations to be done in strict accordance with the relevant detail drawings;
- b) The excavated material from suitable soil types must be properly cleaned from vegetation and plant roots, etc.
- c) After cleaning the excavated material must be mixed with cement in the relation **1** part of cement to **10** parts of soil, prior to the backfilling thereof;
- d) Unsuitable excavated material, such as vegetation contaminated topsoil, soft clay or very loose sand, must be spoiled and a good compactable type of material such as natural gravel shall be imported and used for backfilling, as described in **(c)**, above;
- e) The stabilized soil must be backfilled, slightly watered and thoroughly compacted in layers not exceeding **150mm** in thickness;
- f) Proper Dynamic Cone Penetrometer (DCP) compaction tests, as specified in **240-75883148**, to be executed during the backfilling and compaction of each pole foundation;
- g) Random backfilling compaction tests as instructed by the *Clerk of Works* shall be done by the

- Contractor*;
- h) A copy of all compaction test records taken must be submitted to the Design Engineer for approval and the approved copies must be kept on file for future references;
  - i) **I.D. 1,2m x 0,25m-1,0m** high "Rocla" pre-cast manhole sections must be installed in pole excavations where poor, collapsible and sandy soil conditions are present;
  - j) All over-excavations outside manhole rings and also deeper as required holes shall be backfilled and compacted as specified in **(b)** and **(c)** above, at the *Contractor's* own cost;
  - k) All excess excavated and/or spoiled material not required for backfilling must be removed from site and dumped at a suitable dumping site, unless otherwise specified by the *Clerk of Works*;

**Activity Stage 6: Dressing of all structures****6.1 Supply, safe storage of all phase conductor and shield wire line hardware and insulators**

6.1.1 The following Standards, Specifications, Guidelines and Drawings apply:

- **TRMSCAAC1 Rev. 3 - Section 8.2** Transmission line tower and Line construction;
- **D-FS-18239** Rouxville Zastron Route Plan and PLSCadd design profile sheets.

6.1.2 Refer to **PART C3.1 - Works Information- Section 3** of this document for the responsibility of the supply, transport, safe handling and storage of all insulators and line hardware.

6.1.3 The quantities for the supply and transport of insulators and fittings shall be in strict accordance with the **PART C6.1 – Design Bill of Materials for each structure**.

6.1.4 All insulators, hardware for all suspension and strain assemblies supplied for the project shall comply with the relevant items specified in the **Eskom Distribution Standards Part 9 - Buyer's Guide**.

6.1.5 All insulators and line hardware fittings supplied for the project (by the contractor), shall be technically evaluated and approved by the *Employer's* SI Manager prior to the ordering/purchasing thereof.

**6.2 Safe storage, handling and transport to peg of line hardware and insulators**

6.2.1 The *Contractor* will be responsible for the safe storage, handling and transport to peg of insulators and fittings.

6.2.2 Special care and precautions shall be taken by the *Contractor* not to cause any damage and/or deformation what so ever to the suspension, strain and horizontal stand-off insulators, in the storage, handling, transportation thereof.

6.2.3 Insulators with defects shall be brought to the attention of *Clerk of Works*, who will determine the extent of the damage for possible use thereof.

6.2.4 Any damage and/or deformation caused to any insulator, due to negligence by the *Contractor* will be replaced by the *Contractor* at his own costs.

**6.3 Safe handling and dressing of structure with line hardware and insulators**

6.3.1 The *Contractor* shall assemble all components used for attaching phase conductor and shield wires to the structures, and install the appropriate attachment points on the structures.

6.3.2 Insulators shall be clean when hung by the *Contractor*. Clean rags, free from abrasive material, or other methods accepted by the *Clerk of Works*, shall be used to remove mud, grease, dirt and other foreign matter.

6.3.3 Wire brushes shall not be used by the *Contractor* for the cleaning of any parts, metal surfaces shall be free from any noticeable contamination.

6.3.4 The cleaning the insulators with a high-pressure water spray by the *Contractor* during structure erection will be permitted; only if done with a non-conductive degreasing solvent.

6.3.5 Security clips shall be fully inserted in insulator caps. Insulator assemblies shall be lifted to the structure from one end of the assembly only. Bending of insulator strings to the point of bending ball pins, deforming security clips or damaging hardware is prohibited.

6.3.6 The *Contractor's* Workmen shall not climb insulators after installation, nor shall such insulators be exposed to possible damage or contamination by any other means.

6.3.7 During construction, loads shall not be imposed on insulator strings in excess of the Manufacturer's recommended safe working load. Any insulator that is exposed to such overload shall be rejected by the *Clerk of Works*, and shall be replaced at the *Contractor's* expense.

6.3.8 Overall dimensions shown on drawings of insulator and hardware assemblies are approximate only. Assemblies shall be measured for accurate determination of jumper length and conductor cut-offs before installing dead-end accessories.

6.3.9 Orientation of socket fittings:-

- a) All sockets fitted with "W" security clips. On single insulator strings the mouth of the socket must face

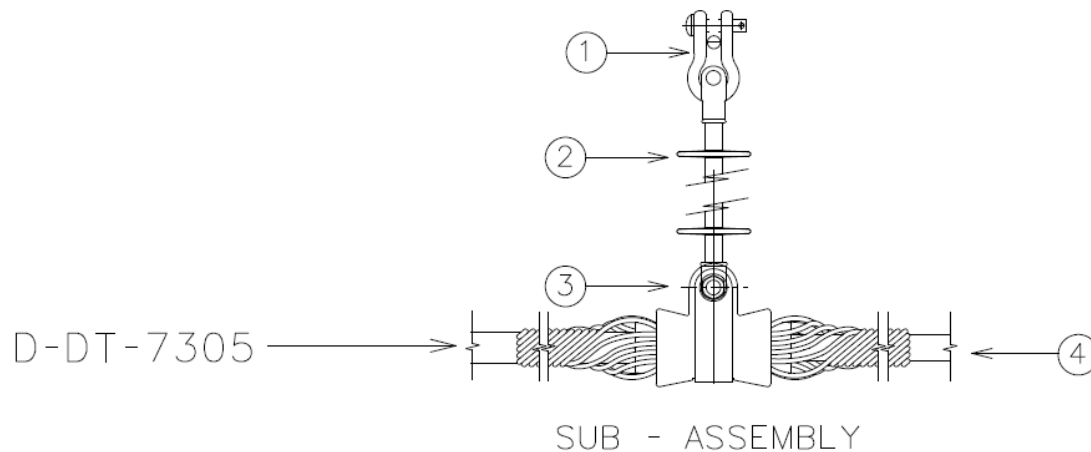
the structure;

- b) Sockets fitted with "P" security clips. On single insulator strings the eye of the "P" clip must face the structure.

6.3.10 All split pins required on the hardware, when fitted, shall be split and bent back tightly around the bolt. The use of hump back split pins must be in strict accordance with the specifications **DSP 34-1667**.

#### 6.4 Phase conductor assemblies

6.4.1 Phase conductor single suspension assembly for single "Chicadee" ACSR for **"1793\_Mod D-FS-18231"** intermediate suspension structures:-

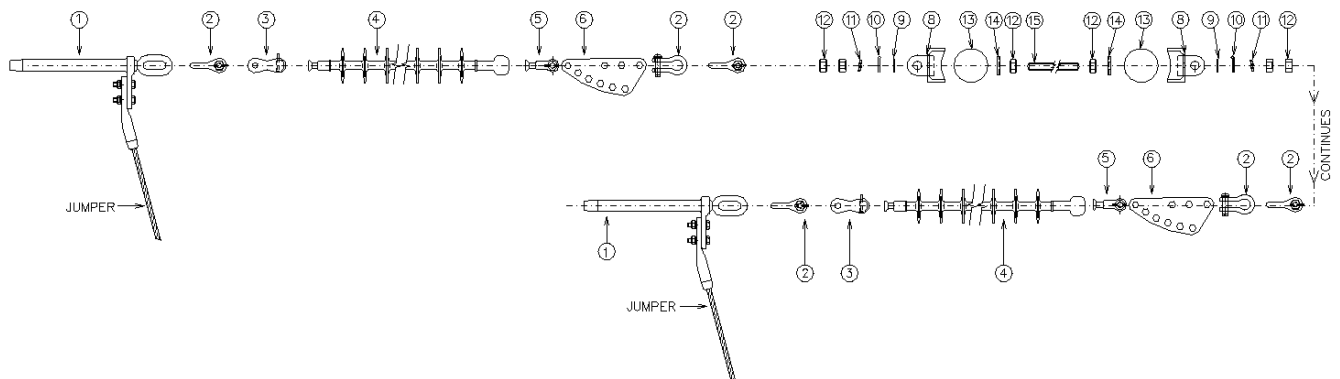


| REF | DESCRIPTION                         | DRAWING NO. |
|-----|-------------------------------------|-------------|
| 1   | D SHACKLE                           | (D-DT-3010) |
| 2   | 33kV LONG ROD INSULATOR<br>40kN HVH | (D-DT-3190) |
| 3   | ARMOUR GRIP SUSP. UNIT              | (D-DT-7033) |
| 4   | CONDUCTOR                           | (D-DT-3136) |

Required:- **3** assemblies per structure



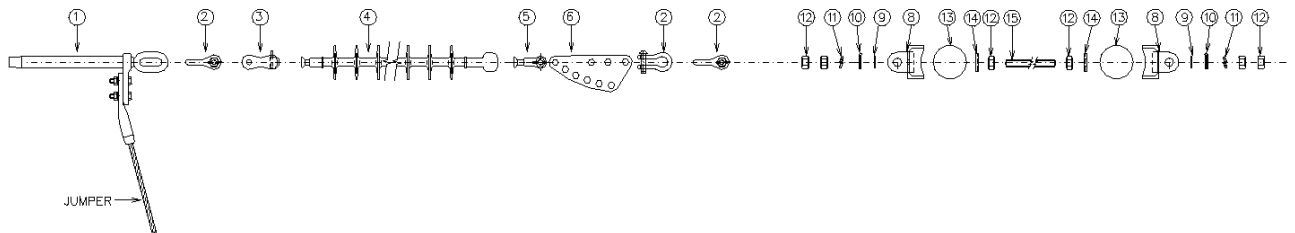
#### 6.4.2 Phase conductor single strain assembly for single “Chicadee” ACSR for “1794\_Mod D-FS-18232” and “1795\_Mod D-FS-18233” strain structures:-



| REF | DESCRIPTION             | DRAWING NO. | REF | DESCRIPTION             | DRAWING NO. |
|-----|-------------------------|-------------|-----|-------------------------|-------------|
| 1   | CLAMP COMPRESSION D/END | D-DT-7000   | 9   | WASHER ROUND FLAT M20   | D-DT-3014   |
| 2   | SHACKLE STRAIGHT 120kN  | D-DT-7017   | 10  | CLIP BONDING M20        | D-DT-3033   |
| 3   | SOCKET TONGUE 120kN     | D-DT-6061   | 11  | WASHER SPRING M20       | D-DT-3014   |
| 4   | INSUL L/ROD 33kV 120kN  | D-DT-3190   | 12  | NUT M20                 | D-DT-3173   |
| 5   | BALL CLEVIS 120kN       | D-DT-6059   | 13  | CROSSARM WOOD 4500 LONG | D-DT-0064   |
| 6   | SAG ADJUSTER 16mm       | D-DT-7042   | 14  | WASHER CURVED M20x65    | D-DT-3014   |
| 8   | BRACKET STRAIN          | D-DT-7039   | 15  | ROD THREADED M20x750    | D-DT-3015   |

Required:- **3** assemblies per structure

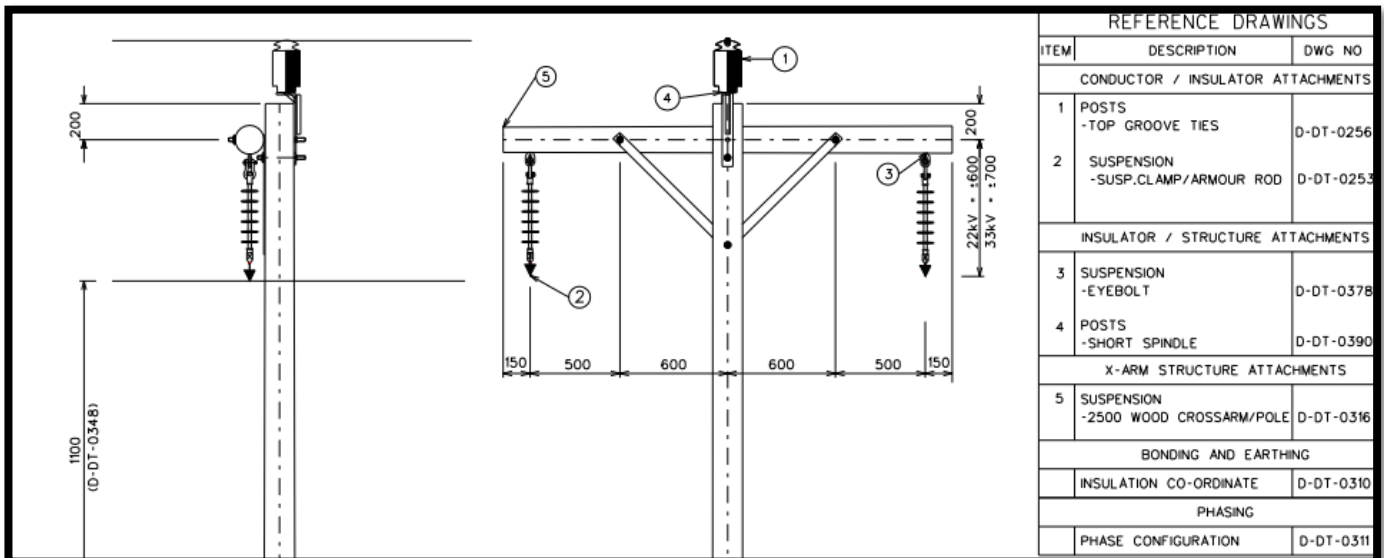
#### 6.4.3 Phase conductor single strain assembly for single “Chicadee” ACSR conductor for “1796\_Mod D-FS-18234” H-pole terminal structures (Closing span side):-



| REF | DESCRIPTION             | DRAWING NO. | REF | DESCRIPTION             | DRAWING NO. |
|-----|-------------------------|-------------|-----|-------------------------|-------------|
| 1   | CLAMP COMPRESSION D/END | D-DT-7000   | 9   | WASHER ROUND FLAT M20   | D-DT-3014   |
| 2   | SHACKLE STRAIGHT 120kN  | D-DT-7017   | 10  | CLIP BONDING M20        | D-DT-3033   |
| 3   | SOCKET TONGUE 120kN     | D-DT-6061   | 11  | WASHER SPRING M20       | D-DT-3014   |
| 4   | INSUL L/ROD 33kV 120kN  | D-DT-3190   | 12  | NUT M20                 | D-DT-3173   |
| 5   | BALL CLEVIS 120kN       | D-DT-6059   | 13  | CROSSARM WOOD 4500 LONG | D-DT-0064   |
| 6   | SAG ADJUSTER 16mm       | D-DT-7042   | 14  | WASHER CURVED M20x65    | D-DT-3014   |
| 8   | BRACKET STRAIN          | D-DT-7039   | 15  | ROD THREADED M20x750    | D-DT-3015   |

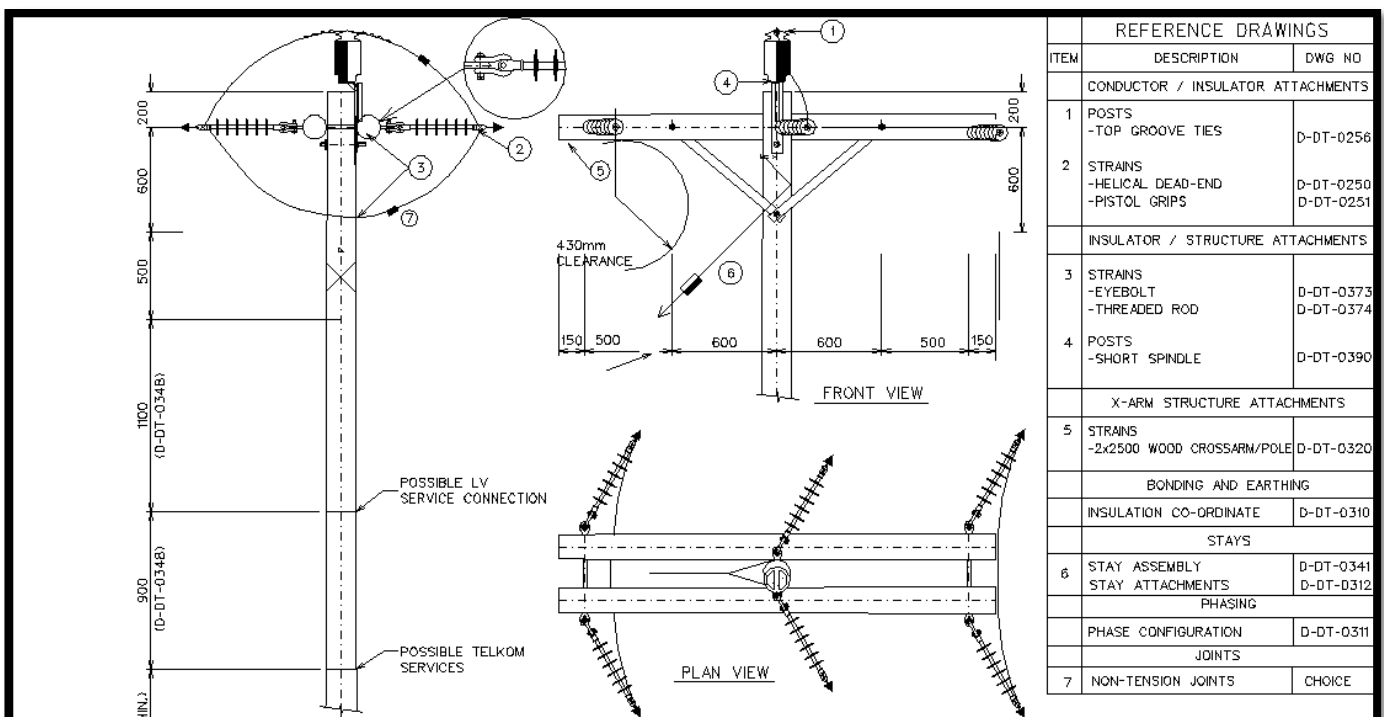
Required:- **3** assemblies per structure

#### 6.4.4 Structure assembly for "Hare" ACSR conductor for "D-DT-1740" single pole intermediate structures:-



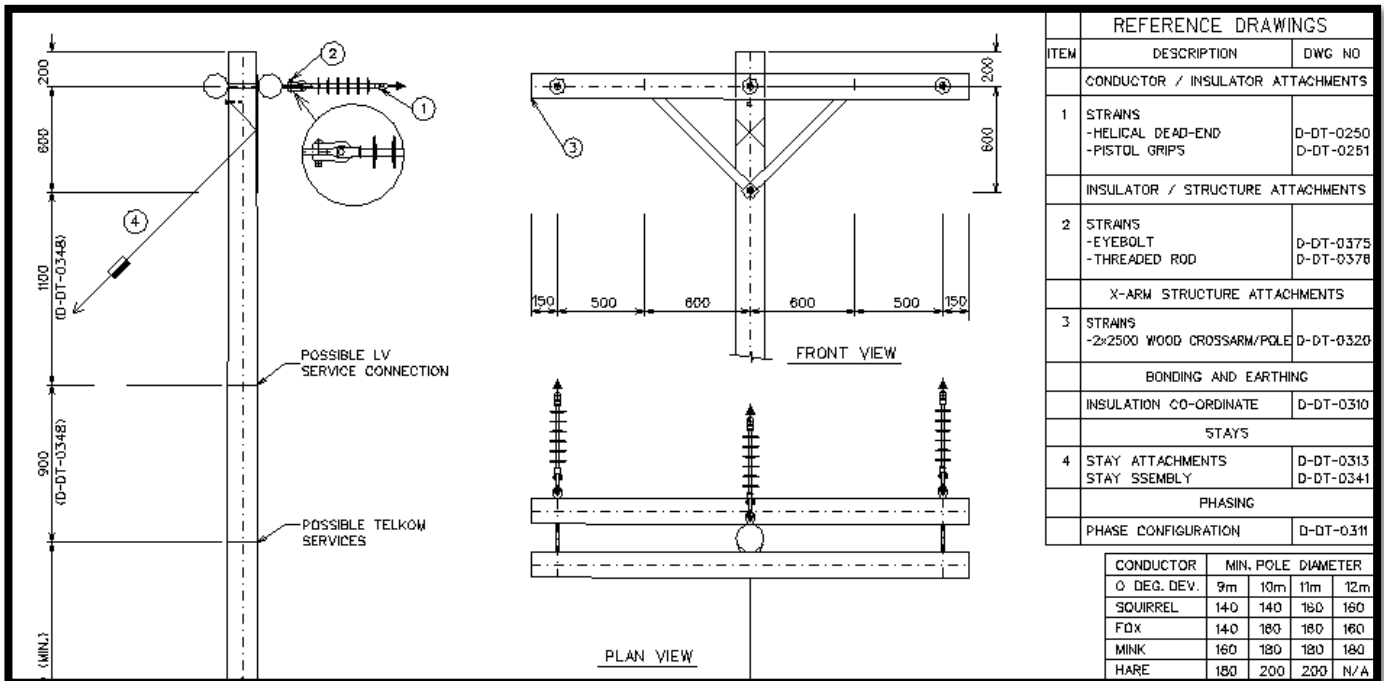
Required:- 1 assembly per structure with 22kV long rod suspension assemblies

#### 6.4.5 Structure assembly for "Hare" ACSR conductor for "D-DT-1748/D-DT-1747" single pole angle strain structures:-



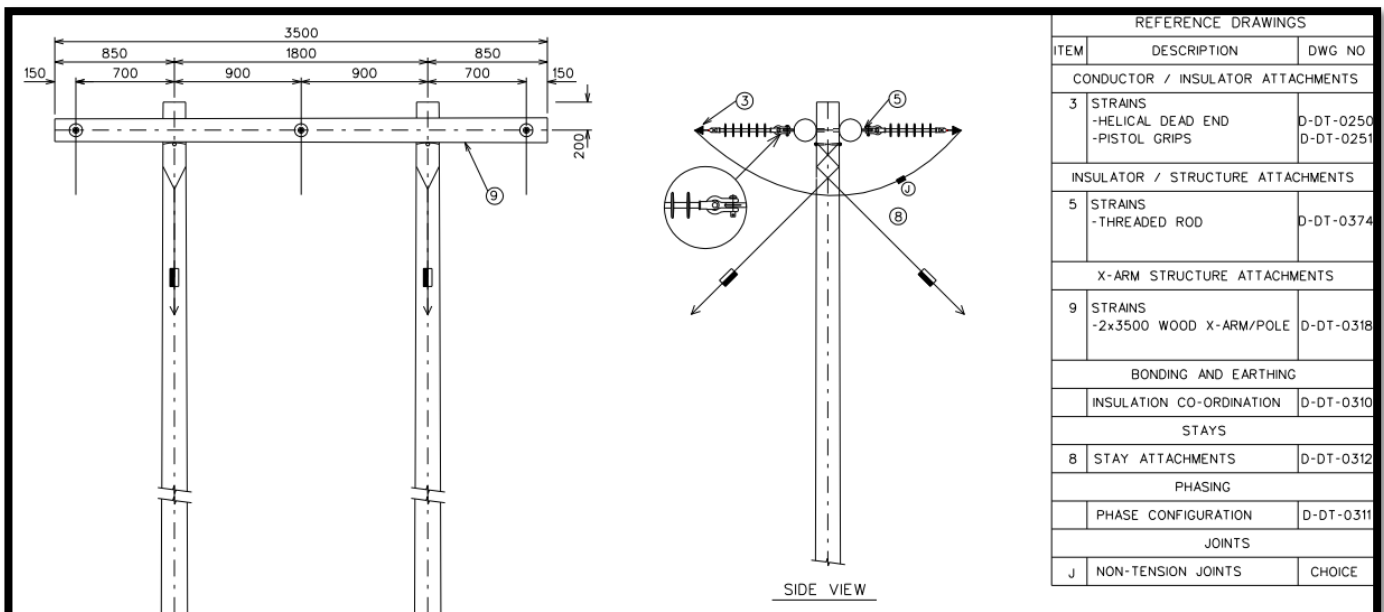
Required:- 1 assembly per structure with helical dead ends and 22kV long rod insulators and P/G clamp non tension joints

#### 6.4.6 Structure assembly for "Hare" ACSR conductor for "D-DT-1749" single pole terminal structures:-



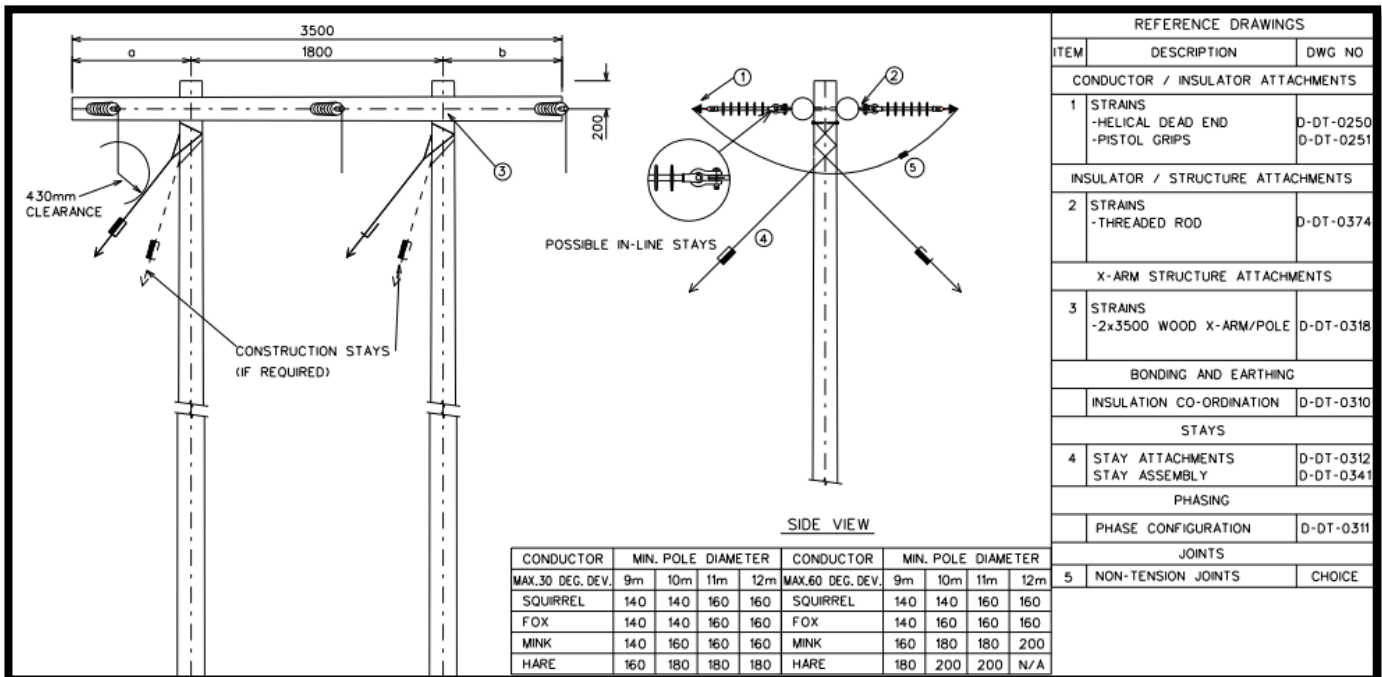
Required:- **1** assembly per structure with helical dead ends and 22kV long rod insulators

#### 6.4.7 Structure assembly for "Hare" ACSR conductor for "D-DT-1767" H-pole strain structures:-



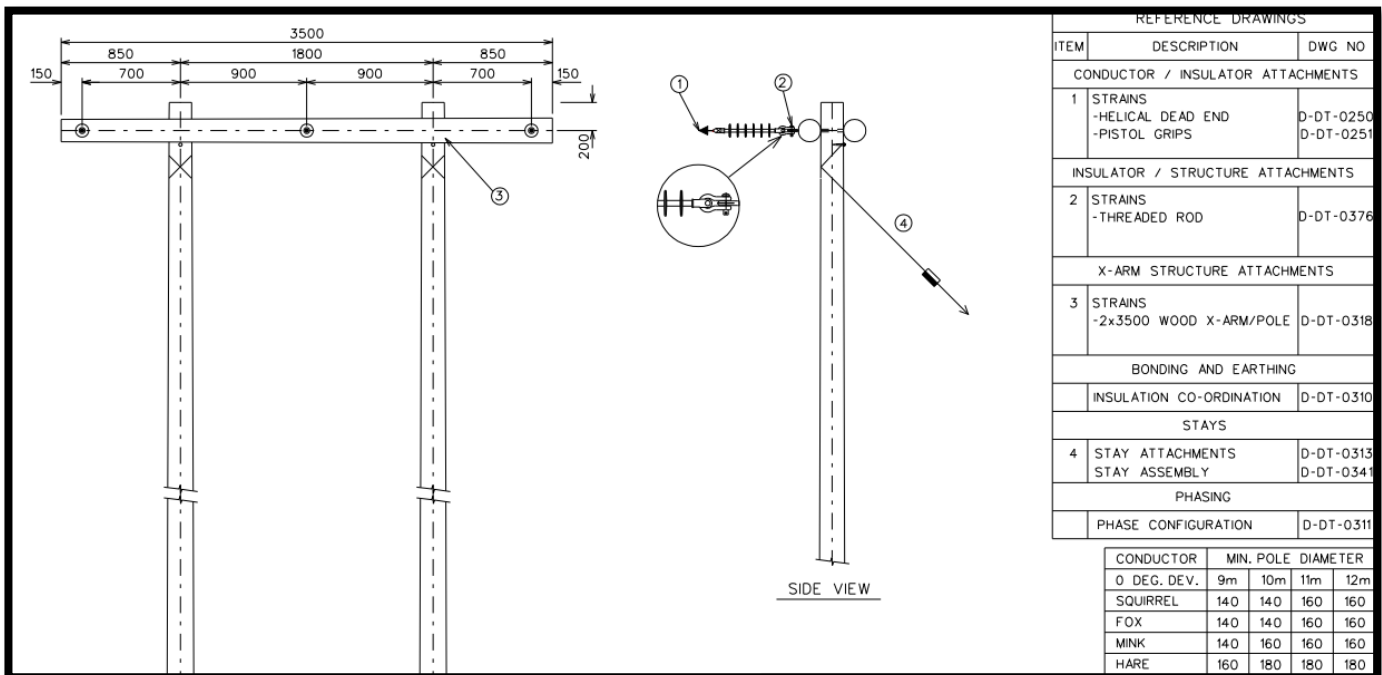
Required:- **1** assembly per structure with helical dead ends and 22kV long rod insulators or 33kV long rod insulators for bypass at substation and P/G clamp non tension joints

#### 6.4.8 Structure assembly for "Hare" ACSR conductor for "D-DT-1768" H-pole strain structures:-



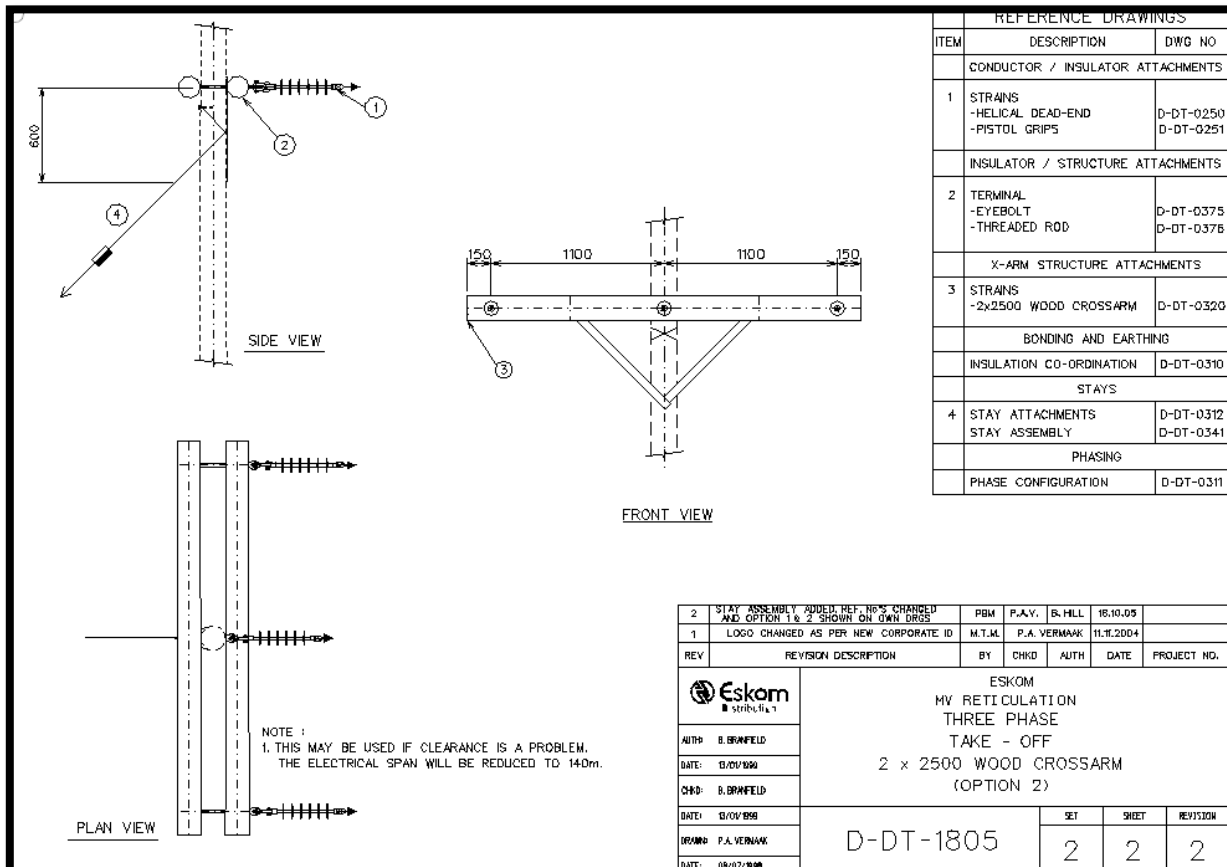
Required:- **1** assembly per structure with helical dead ends and 22kV long rod insulators and P/G clamp non tension joints

#### 6.4.9 Structure assembly for "Hare" ACSR conductor for "D-DT-1769" H-pole terminal structures:-



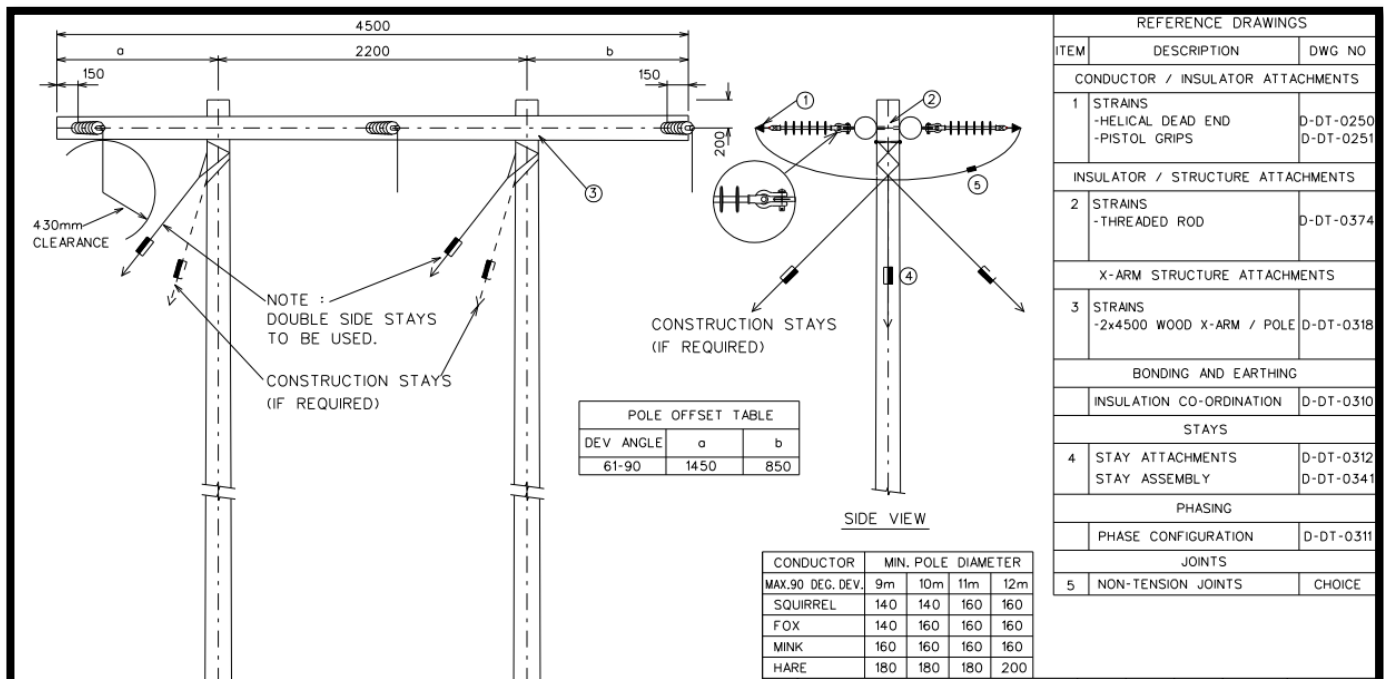
Required:- **1** assembly per structure with helical dead ends and 22kV long rod insulators or 33kV long rod insulators for bypass at substation

#### 6.4.10 Structure assembly for "Hare" ACSR conductor for "D-DT-1805" single pole T-off structures:-



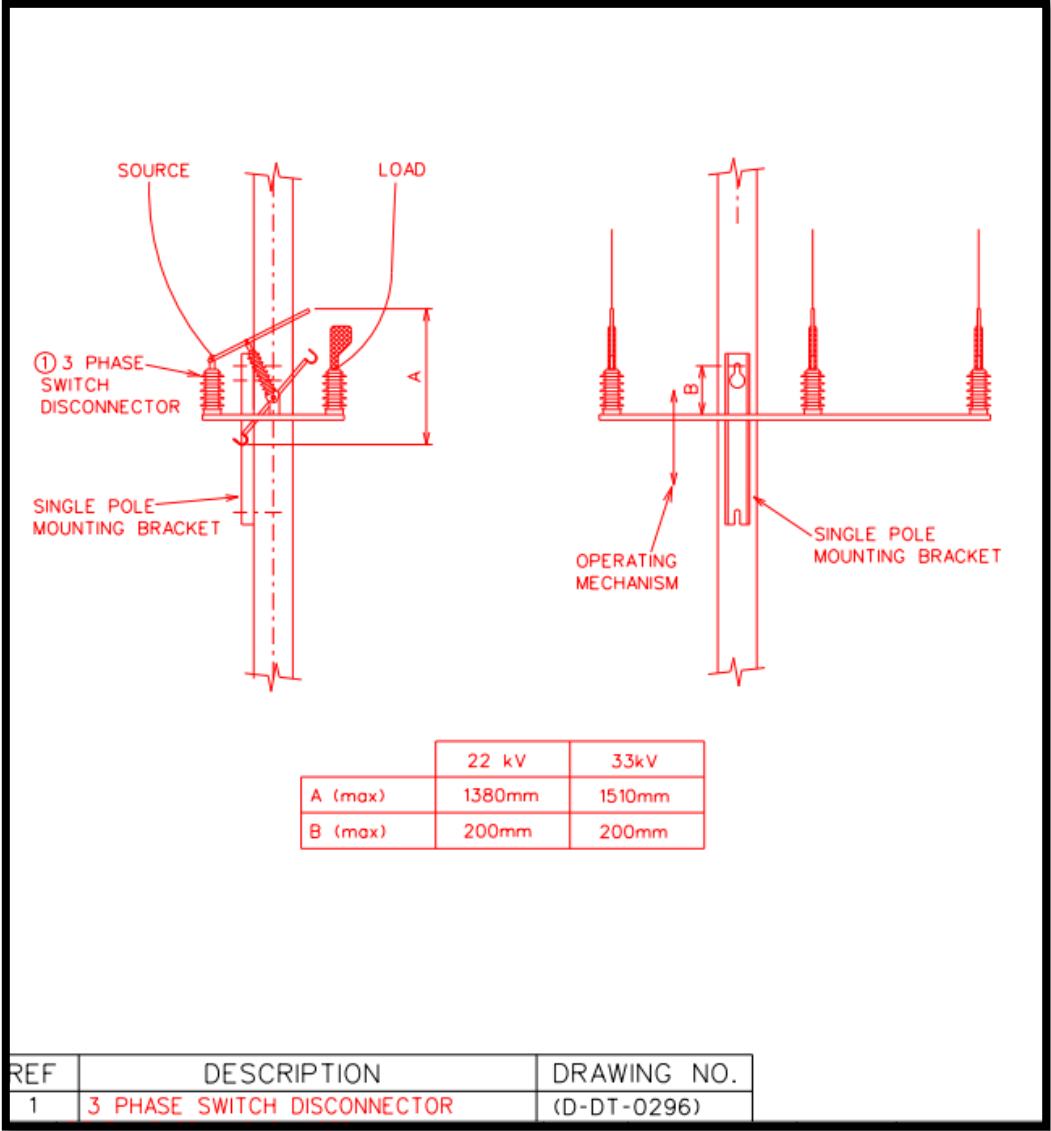
Required:- 1 assembly per structure with helical dead ends and 22kV long rod insulators

#### 6.4.11 Structure assembly for "Hare" ACSR conductor for "D-DT-1873" H-pole strain structures:-



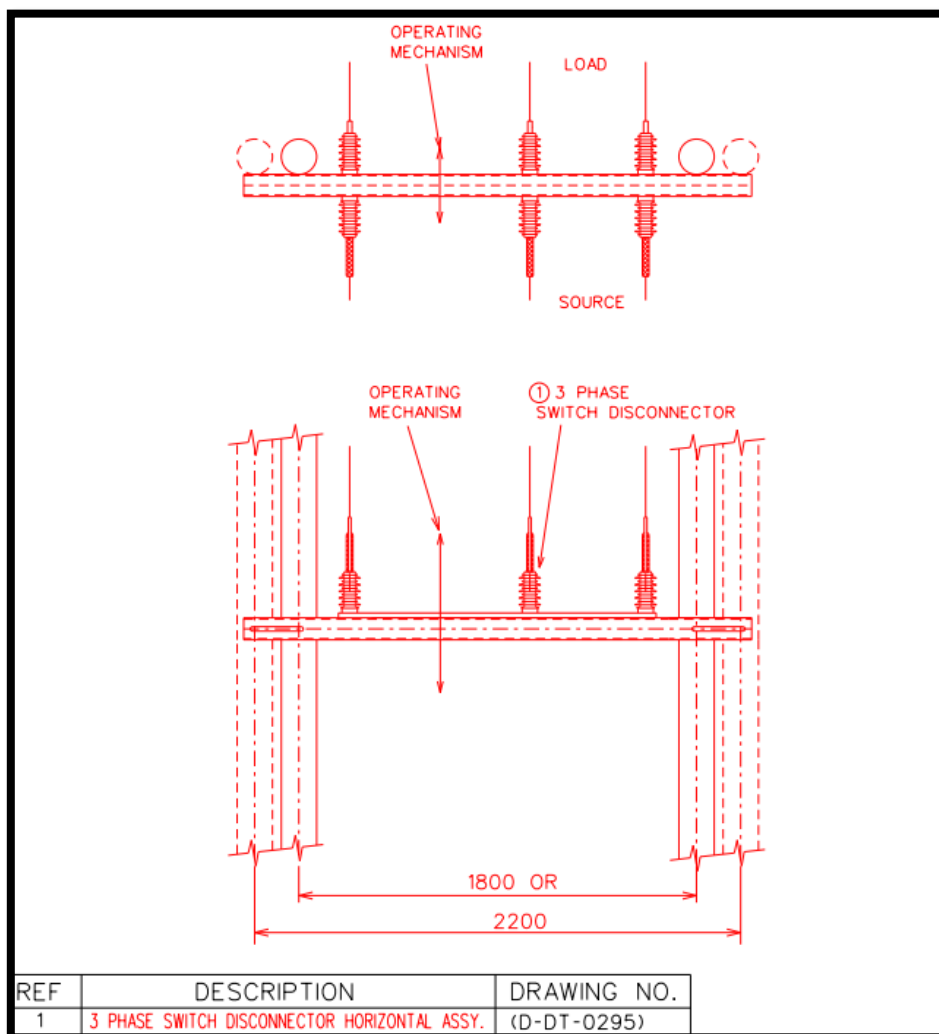
Required:- 1 assembly per structure with helical dead ends and 22kV long rod insulators

6.4.12 Structure assembly for "Hare" ACSR conductor for "D-DT-1857" Single pole load break switch



Required:- 1 assembly per structure

## 6.4.13 Structure assembly for "Hare" ACSR conductor for "D-DT-1858" H-pole pole load break switch (Spaced 2.2m)



Required:- **1** assembly per structure

## Activity Stage 7: Stringing activities

### 7.1 Supply and transport of phase conductor and shield wire stringing hardware

7.1.1 All compression and preformed joint fittings, as well as miscellaneous phase conductor and shield wire repair fittings shall be supplied and delivered to site by the *Contractor*.

7.1.2 Refer to **PART C6.4** for summary of stringing material to be supplied by the *Contractor*.

### 7.2 Safe storage, handling and transport of phase conductor and shield wire stringing hardware

7.2.1 The *Contractor* shall be responsible for the safe storage, handling and delivery to the construction site of all the phase conductors, shield wires supplied by the *Employer*.

7.2.2 All compression type fittings shall be stores in an enclosed storage facility.

7.2.3 The **“Chicadee” ACSR** and **“Hare” ACSR** phase conductors shall be supplied and delivered to the *Contractor’s* construction yard site by the *Employer*.

7.2.4 Refer to **PART C3.1 - Works Information- Section 3.2** and **PART C6.2 – Design Bill of Materials** of this document for the quantities of the phase conductor supplied by the *Employer* for this project.

7.2.5 The *Contractor* and *Clerk of Works* shall check and record all phase conductor drum numbers delivered to site. Records shall be submitted to the *Project Manager* for acknowledgement.

### 7.3 Safe handling, transport to drum sites and complete stringing, regulating clamping of phase conductors and shield wires

7.3.1 The following Standards, Specifications, Guidelines and Drawings apply:

- **TRMSCAAC1 Rev. 3 - Section 8** Transmission line tower and Line construction;
- **D-FS-18239** **Rouxville Zastron Route Plan and PLSCadd design profile sheets;**
- **Roux Zas Stringing Charts** PLSCadd Stringing Sag & Tension Charts

7.3.2 The Design Engineer shall provide all **PLSCadd** generated **Stringing sag and Tension Charts** for the project to the *Contractor*. The **Stringing Sag and Tension Charts** shall be verified and accepted by the *Contractor* prior to the stringing and regulating activities. Any discrepancies with regards to the **Stringing Sag and Tension Charts** shall be immediately reported to the Design Engineer via the *Clerk of Works*.

7.3.3 Sag & Tension loading criteria

- a) The calculations of sag corrections for creep and clamping off sets, shall be the responsibility of the *Contractor* and will be based on the **Stringing Sag and Tension Charts** supplied by the Project Engineer.
- b) Criteria for the calculations for the **Stringing Sag and Tension Charts** for the **“Chicadee ACSR”** phase conductor must be based on a final conductor loading of **20.02% UTS @ 15°C** in still air or **C-value = 1 425m** for its “Ruling Condition”.
- c) Criteria for the calculations for the **Stringing Sag and Tension Charts** for the **Hare ACSR”** shield wire must be based on a final conductor loading of **16.58% UTS @ 15°C** in still air or **C-value = 1 425m** for its “Ruling Condition”
- d) The **initial tension criteria** for the phase conductor at any temperature shall under no circumstances exceed **50%** of the conductor specified UTS value.
- e) The **final tension criteria** for the phase conductor at **-5°C with 575Pa wind loading** shall under no circumstances exceed **40%** of the conductor specified UTS value.

7.3.4 The *Contractor’s* work comprise

- a) Sampling and testing of all phase conductor compression fittings, prior to the commencement of stringing activities, see **sections 7.3.11 & 7.3.12** below.
- b) The safe handling & transport to drum station, stringing, jointing, regulating and clamping of **“Chicadee” ACSR** phase conductor.
- d) The safe handling & transport to drum station, stringing, jointing, regulating and clamping of **“Hare” ACSR** phase conductor.



- 7.3.5 The phase conductor numbers shall be recorded by the *Contractor*, when delivered to “Drum Sites” and verified by the *Clerk of Works*.
- 7.3.6 Stringing method
- a) **All phase conductors shall be tension strung over the entire length of the line, unless otherwise permitted by the Design Engineer;**
  - b) The equipment and methods used for stringing the phase conductors shall be such that the phase conductors will not be damaged. Particular care must be taken at all times to ensure that the phase conductors and shield wires do not become kinked, twisted or abraded in any matter.
  - c) Vehicle traffic passing over phase conductors lying on the ground will not be permitted in any sense. The *Contractor* at his own cost will replace all damaged conductors caused by such incidents.
  - d) The *Contractor* shall make suitable arrangements for temporary staying of structures and anchoring of conductors when necessary.
  - e) Conductors may not be anchored to any portion of any structure, except strain towers and then only at the points designed for conductor attachment.
  - f) Temporary anchoring to footings and guy anchors will not be permitted. Where temporary anchoring is required, suitable temporary anchors shall be provided. Installation and removal of temporary anchors will be the *Contractor's* responsibility.
  - g) At no time shall the pulling tension in the conductors shall exceed the tensions shown on the stringing sag charts. Pulling of more than one drum length of conductor shall be subject to the *Clerk of Works* acceptance.
  - h) Adequate protection shall be provided where there is danger of conductors being damaged by vehicles or other equipment and objects. Conductors shall not be left in contact with the ground, vegetable matter or any conducting or semi-conducting material. Wood lagging or similar material shall be used to protect the conductor when working at ground level.
  - i) 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 a stringing-tensioning operation. An outage of radio communications at any station will require immediate cessation of conductor pulling operations.
  - j) The placement of tensioning and pulling equipment shall be such that the vertical angle of pull on a cross-arm during stringing operations shall not be more than **20°**. Conductors shall not be pulled around angles that exceed **20°**.
  - k) During stringing operations and before regulating, if it becomes necessary to leave the conductor in the blocks for longer than eighteen hours, the conductor shall be left at reduced tension, and the *Clerk of Works* immediately notified. The percentage of sag, spans involved, time interval, and correction for creep shall be noted, and records forwarded to the *Clerk of Works*. In no case shall conductors be left with less than the following clearances:
 

|                              |   |              |
|------------------------------|---|--------------|
| ▪ Cultivated or open country | : | <b>5,5m,</b> |
| ▪ Roads and trails           | : | <b>6,5m,</b> |
| ▪ Railway tracks             | : | <b>9,9m.</b> |
  - l) **Stringing shall be done in “Daylight-hours” only.**
  - m) **String shall not be allowed to commence in abnormal windy conditions.**
  - n) The use of phase conductor are to be optimized to avoid excessive waste. All off - cuts and surplus phase conductor shall be returned to the *Employer* upon completion of the project.
  - o) Matched conductor drums, marked with the same number followed by the suffix A, B, C etc., shall be used for each pull of multiple conductors per phase to ensure even sag characteristics and a minimum number of joints. The *Contractor* shall select the most suitable sets of matched conductor drums for each stringing position to minimize wastage of conductor. The *Contractor* shall keep an accurate record of the phase conductor drum numbers and their position in the line. On completion a copy of these records shall be submitted to the Project Manager.

### 7.3.7 Stringing equipment

- a) Calibration and test certificates for all dynamometers and stringing equipment shall be submitted to the *Clerk of Works* for evaluation and approval, well in advance of the commencement of any stringing activities.
- b) Swivels shall be used to attach the pulling line and conductors to the running board. Swivels shall be small enough to pass through the blocks without damage to either, and shall have ball bearings and be free turning under load.
- c) The sheaves shall conform to the conductor manufacturer's recommendation as to diameter, and to size and shape of groove for the size of conductor used. **Sheaves shall have a minimum diameter of fifteen times the conductor diameter at the base of the groove.**
- d) Block surfaces that will be in contact with the conductor shall be coated with neoprene or rubber. This covering shall be kept clean and free of materials that might damage the conductor surface.
- e) The conductor sheaves shall have a separate groove for the pulling line. The pulling line shall not run on the rubber covered conductor grooves. The sheaves shall be inspected for damage or contamination before each usage.
- f) The *Contractor* shall not use any sheaves rejected by the *Clerk of Works* due to damage or excessive wear. The *Contractor* shall immediately remove such sheaves from the site.

#### 7.3.8 Stringing program

- a) The *Contractor* shall submit a complete stringing program to the *Project Manager* at least **50 days** in advance of the stringing activities. The *Project Manager* will then arrange all crossing permits with the relevant Service Owners from this stringing program;
- b) All existing overhead services for example, Telkom lines, Railway lines, Power lines and Proclaimed Roads, etc. are indicated on the profile drawings. All crossing notices and permits will be obtained and coordinated by the *Clerk of Works*;
- c) The *Contractor* shall notify the *Clerk of Works* at least **35 days** in advance, of the time he intends to make a crossing over any existing overhead services;
- d) All crossings over existing services shall be done in accordance with **TRMSCAAC1 Section 8.2.1.**

#### 7.3.9 Crossings

- a) No crossing over above mentioned services will commence without proof of the official Eskom Land Development application for these services crossings, as well as the written acceptance and approval from the relevant service authorities.
- b) Special scaffolding to be erected at Spoornet Railway line crossings to ensure the safe passing of trains at all times during the stringing activities. Special scaffolding only to be removed on completion of the regulating and clamping of the phase conductors and shield wires.
- c) Special scaffolding to be erected at National road crossings to ensure the safe passing of traffic at all times during the stringing activities. Special scaffolding only to be removed on completion of the regulating and clamping of the phase conductors and shield wires.
- d) Temporary "Goal post" type structures to be erected at all service crossings to ensure safe clearances over these crossing at all times during the stringing activities. Temporary structures to be removed on completion of the regulating and clamping of the phase conductors and shield wires, only.

#### 7.3.10 Table A- Public crossings: Refer to Rouxville Zastron Route plan drawing D-FS-18239

| Between Structures no. | Proclaimed Road no. | Min. Design Clearances | Crossing Description    |
|------------------------|---------------------|------------------------|-------------------------|
| RVZT 2-3               | S/378               | 10.3m                  | Secondary road (Gravel) |

|              |       |               |                          |
|--------------|-------|---------------|--------------------------|
| RVZT 11-12   |       | 1.8m          | 22kV power line          |
| RVZT 13-14   |       | 10m           | Old Railway Line         |
| RVZT 14-15   | S/375 | 8m            | Secondary road (Gravel)  |
| RVZT 20-21   |       | 1.4m          | 22kV power line          |
| RVZT 49-50   |       | 1.9m          | 22kV power line          |
| RVZT 76-77   |       | 2.4m          | 22kV power line          |
| RVZT 84-85   |       | 1.3m          | 22kV power line          |
| RVZT 99-100  | P18/1 | 11.6m<br>4.9m | Primary road<br>Tel Line |
| RVZT 121-122 | P18/1 | 11.3m<br>3.7m | Primary road<br>Tel Line |
| RVZT 122-123 |       | 1.7m          | 22kV power line          |
| RVZT 136-137 | T1260 | 8.8m          | Tertiary road            |
| RVZT 142-143 | P18/1 | 9.1m<br>4.5m  | Primary road<br>Tel Line |
| RVZT 155-156 |       | 1.6m          | 22kV power line          |
| RVZT 172-173 |       | 1.4m          | 22kV power line          |
| RVZT 175-176 | P18/1 | 9m<br>3.5m    | Primary road<br>Tel Line |
| RVZT 189-190 | A107  | 8.4m          | Primary road             |

**NOTE:** Minimum design clearances are measured at:

- 50°C conductor temperature for over-crossings;
- -5°C conductor temperature for under-crossings.

#### 7.3.11 Compression joint sampling and testing

- Before any stringing activities commences, the *Contractor* shall compress **one** sample of phase conductor dead/end & mid span joint assembly, as well as **one** sample of shield wire mid span joint and preformed dead ends, in the presence of the *Clerk of Works*.
- The *Contractor* shall, at the his expense, arrange for the samples to be mechanically tested, in the presence of himself and the *Clerk of Works*, at an approved laboratory;
- Four (4)** copies of the test report shall be forwarded to the Project Engineer for his review and approval prior to stringing.

#### 7.3.12 Compression joint sampling and testing procedure

- The matched numbered dies and compressors the *Contractor* is intended to use on the line for stringing must be used for the sampling.
- The length of conductor between any two fittings on the sample shall be not less than **100 times** the overall diameter of the conductor.
- The *Contractor*, using the following testing procedure, shall conduct a tensile test, At an acceptable testing authority, on the samples:
  - A tensile load of about **10%** of the breaking load of the conductor shall be applied and the conductor shall be marked in such a way that movement relative to the fitting can easily be detected;
  - Without any subsequent adjustment of the fitting, the load shall be steadily increased to **90%** of the breaking load and maintained for **1 min**;
  - There shall be no movement of the conductor relative to the fitting due to slip during this period of 1 min. and no failure of the fitting;
  - The conductor shall then be loaded to failure, and shall again withstand a minimum load of **95%** of the minimum breaking strength of the conductor for it to be deemed acceptable.
- Compression joint test failures
  - If the sample fails in any sense during the testing thereof, a further **three (3)** samples shall be tested and shall all be required to pass the above test procedure;
  - A copy of the test report shall be forwarded to the Design Engineer prior to stringing. The test report should include the project name and all relevant measurements such as "across-flat"

widths, length of samples, suppliers of conductor and compression fittings, equipment used for crimping and dies used for crimping.

- If any one or more of these samples fail, no stringing shall commence until the Design Engineer has satisfied himself that the equipment is acceptable.

### 7.3.13 Jointing general

- a) As far as possible, complete drum lengths of phase conductor and earth wire shall be used to reduce the number of joints;
- b) Joints shall not be closer than **15,0m** from the nearest suspension structure and **30,0m** from the nearest strain structure;
- c) **Joints shall not be installed in spans crossing Railway lines, Proclaimed roads, Power lines, major communication lines and rivers;**
- d) In no case shall more than one joint be installed in any given span, nor shall a joint be installed in a span dead-ended at both ends;
- e) The minimum distance between joints on the same phase shall be **300m**.
- f) Whenever joints or dead-ends are made, auxiliary erection clamps and hauling devices shall not be placed closer than **8,0m** to the point of joint or dead-end. The auxiliary erection clamps shall not allow relative movement of strands or layers of wire, and shall not birdcage, over tension or deform individual wires.
- g) 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 hacksaw blades be used to cut conductor.
- h) The conductor shall be laid out for a distance of **15,0m** and straightened at the ends before preparation for installation of joints or dead-ends. Compression jointing shall be carried out on a clean tarpaulin or jointing trailer. The lay of wires shall be tightened before the first compression is made. The conductor strands shall be cleaned by wire brushing and an accepted non-oxidizing paste applied.
- i) Compression shall be carefully made so that the completed joint or dead-end is as straight as possible. To minimize distortion, the joint should be rotated 180° between each compression operation, the joint and conductor being fully supported in the same plane as the compression jaws.
- e) If, in the opinion of the *Clerk of Works*, the completed joint or dead-end requires straightening, it shall be straightened on a wooden block by use of a sledgehammer and shaper or wooden mallet.
- f) If, in the opinion of the *Clerk of Works*, the joint or dead-end has not been satisfactorily straightened or has been damaged in the process, the *Contractor* shall replace it at his own cost.
- g) After compression has been completed, all corners, sharp projections and indentations resulting from compression shall be carefully rounded. All other edges and corners of the fitting that have been damaged shall be carefully rounded to their original radius. Nicked or abraded surfaces shall be carefully smoothed. Tape, tape residue and filler paste shall be removed from fittings and conductors.
- h) Sufficient notification must be given to *Clerk of Works* prior to the installation of compression fittings. Unless previously agreed all joints and dead-ends shall be installed in the presence of the *Clerk of Works*.
- i) Under no circumstances shall compression joint be allowed to pass through the travelers (stringing pulleys).
- j) During the progress of the stringing, the *Contractor* shall keep an accurate record of the spans in which conductor and earth conductor joints are made, the date of assembly onto the conductor. A copy of these records shall be supplied to the *Project Manager*.
- k) Only coded jointers authorized by the *Project Manager* shall carry out compression joints on the phase conductors & shield wires.
- l) Each coded jointer shall be issued with his own unique identification number or sign, which he shall use to punch completed joints as a register of his acceptance.

- r) All current carrying connections, contact surfaces, clamps, conductor and terminals shall be prepared as follows:
- Wipe the mating surfaces free from grease and dirt (except the bores of compression sleeves);
  - Apply **1mm** thick coating of approved jointing compound to the surfaces using a non-metallic spatula or similar tool;
  - Scrub all the coated surfaces thoroughly with a wire brush which is new or which has been used solely for this purpose;
  - Wipe off the jointing compound;
  - Apply a fresh **1mm** thick coating of compound; and
  - After a period of not more than one minute make the connection in the normal manner and remove excess extruded compound.
- s) **NOTE:** No compound squeezed out by clamping pressure shall be used in making further joints. The *Contractor* shall apply such compound as necessary for making the connections by the method outlined above. On bolted connections care shall be taken during the tightening to avoid overstressing the bolts or components of the clamps. A torque wrench shall be used for tightening each bolt to the required torque.
- Tighten all bolts and U-bolts to their specified torque.
  - Leave clamps for **24 hours** to allow Aluminium conductor to expand and contract.
  - Check all bolts to ensure that they are still at the required torque.

#### 7.3.14 Regulate of phase conductors

- a) The *Contractor* shall string all phase conductors and shield wires to the appropriate sags and tensions as determined from the conditions specified in **7.3.3**, above. The calculation of sag corrections for creep and clamping offsets shall be the responsibility of the *Contractor*, based on charts supplied by the Project Engineer. Such calculations shall be submitted to, and accepted by the Project Engineer prior to regulating.
- b) Phase conductors and shield wires shall be strung to the appropriate sag determined for the actual span length, and the equivalent span of the strain section involved.
- c) The appropriate conductor temperature to be used for sagging shall be determined by means of a Celsius-thermometer inserted in the end of a suitable length of phase conductor or shield wire from which a **150mm** length has been removed from the center strand, or other accepted method. The wire with the thermometer inserted shall be hung at cross-arm level for at least two hours before the temperature is read.
- d) The length of a section of phase conductors and shield wires to be regulated at any one time shall be limited to that length that will assure attainment of correct sag based upon terrain and obstructions.
- e) Where there are a large number of suspension towers between strain towers, regulating of phase conductors and shield wires shall be done at intervals of **3 to 5 spans**. In hilly country the conductors may require to be temporarily anchored one span away from the spans being regulated. The sag spans chosen shall be near each end of the section pulled for single conductor lengths, and near each end and at the middle for double conductor lengths. In addition, the sags shall be checked in all spans over **500m**. In unusual situations, the *Clerk of Works* may require additional checks.
- f) 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** and shall be tested and re-calibrated at regular intervals, at least for every major line project. The *Contractor* shall keep dynamometer calibration certificates at the site office.
- g) The *Contractor* shall notify the *Clerk of Works* at least twenty-four hours prior to any planned regulating operation. No regulating shall be done except in his presence, unless otherwise authorized. The *Contractor* shall furnish labour and equipment, for signaling and climbing purposes as requested by the *Clerk of Works*, to facilitate his inspection of the sag.
- h) In pulling up the conductor, caution shall be used to avoid pulling the conductor above sag.
- i) The maximum elapsed time from the beginning of the pulling operation to the completion of the regulating operation, shall not exceed **seventy two hours**, nor shall the maximum elapsed time between the completion of the regulating operation, and the completion of the clamping operation exceed **seventy two hours**. Conductor remaining in the blocks longer than the established limits shall be subject to inspection and, if damaged, replaced. The *Contractor* shall furnish labour and equipment as requested by the *Clerk of Works* for this purpose, as well as for inspection in the event of sudden windstorms.

- j) No minus regulating tolerance will be allowed. A plus regulating tolerance of **0,01 times** the theoretical sag, but not exceeding **150mm** will be allowed, provided all conductors in the regulating span assume the same relative position to true sag. Sags of conductors in the same bundle shall not vary more than **35mm** relative to one another. Sag variances between phases shall not be apparent to the naked eye.
- k) When finally adjusting the sags of the phase conductors, the sag shall be checked with sag boards, or other accepted methods in spans where the levels of the two structures are approximately the same, and the span length is approximately equal to the equivalent span length of the strain section. Upon completion of this regulating operation, as many successive spans as can be observed from the sag board position shall be checked for uniformity of sag.
- l) 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. Conductors shall be marked with paint crayon or wax pencil - not with metal objects.
- m) Insulator strings on three suspension towers adjacent to a new section to be regulated must be clamped to the conductor before temporary anchors are removed and regulating of the new section begins. These insulators shall remain in the plumb position upon completion of regulating of the new section and during plumb-marking.
- n) **Regulating operations shall be conducted during daylight hours only.** Regulating operations shall be suspended at any time, when in the opinion of the *Clerk of Works*, **wind or other adverse weather conditions would prevent satisfactory regulating.**
- o) Records of temperature sag and tension for each section regulated shall be kept by the *Contractor*, and a copy submitted to the *Project Manager*.
- p) On completion of regulating of a section of the line, the *Contractor* shall measure and record all clearances over roads, power lines, communication lines, railways etc. along the route. A copy of these records is to be submitted to the *Project Manager*. The *Clerk of Works* is to be notified immediately of any discrepancy found between the actual clearance and that shown on the profiles.

#### 7.3.15 Clamp of phase conductors

- a) The phase conductors shall be clamped-in by the *Contractor* after the *Clerk of Works* has accepted the regulating operation as being in full compliance with the specifications and stringing data. Where offsets are required, the conductors shall be accurately adjusted in accordance with the offset clamping information developed by the *Contractor*.
- b) All conductors in a sag section shall normally be clamped-in, beginning at the second structure from the forward end of the pull, and shall progress structure by structure, until the conductors at all structures are clamped-in.
- c) The *Contractor* shall exercise extreme care in moving the phase conductors and shield wires from the stringing blocks to the suspension clamps.
- d) Where armor rods or conductor clamps incorporating armor rods are called for, they shall be installed in strict accordance with the manufacturer's recommendations. Armor rods shall be centered in each suspension clamp in such a manner that the clamp is not more than **50mm** from the center of the rods. Variations between the ends of the individual rods shall not exceed **12mm**.
- e) Aluminium rods shall be handled with the same care as the phase conductor.
- f) Properly calibrated torque wrenches shall be used to tighten suspension clamp and dead-end bolts to the Manufacturer's specified torque values. U-bolts shall be drawn up evenly to torque values.
- g) Bolts shall not be tightened excessively. Proof of calibration must be submitted to the *Clerk of Works*.
- h) All phase conductor support assemblies shall be installed such that the insulator string will hang in a vertical plane through points of insulator string attachment to structure, with the structure properly aligned.

#### 7.3.16 Conductor repairs

- a) Damage caused by the *Contractor* shall be repaired in a manner determined by the *Clerk of Works*.
  - Damage is any deformity on the surface of the conductor that can be detected by eye or by feel.



- Damage includes, but is not limited to nicks, scratches, abrasions, kinks, birdcaging, and popped out and broken strands.
- b) Depending upon the severity of the damage and the length of damaged section, the repair shall be made by careful smoothing with extra fine sandpaper, covering with preformed repair rods, installing a compression-type repair sleeve, or by cutting and splicing.
- c) Kinked, birdcaged or severely damaged sections of conductor shall be cut out. When there is repeated damage in the same span, or in consecutive spans, the entire conductor in such spans shall be replaced.
- d) All damage caused by auxiliary erection clamps or other gripping devices shall be repaired or cut out, as instructed by the Supervisor, before the conductor is sagged.
- e) Preformed repair rods shall be installed if no more than one strand is broken or nicked deeper than one third of the strand diameter, or when a number of strands are reduced in area not exceeding the area of one strand. Not more than two sets of preformed repair rods shall be installed on any one conductor in any given span.
- f) A compression-type repair sleeve shall be installed, if not more than one third of the outer strands of the conductor are damaged over a length of not more than 100mm, or not more than two strands are broken in the outer layer of conductor and the area of any other damaged strands is not reduced by more than **25%**.
- g) Compression-type repair sleeves shall not be installed on one conductor in a given span if it already contains a conductor splice, conductor dead-end or another compression-type repair sleeve.
- h) Damage to the steel strands or aluminium strands, exceeding the stated limits for repair sleeves, shall be cut out and spliced by means of a compression type mid-span joint.
- i) Any foreign matter such as pitch, paint and grease placed on the conductor and fittings by the *Contractor* shall be removed by methods approved by the Supervisor prior to regulating.

#### 7.3.17 Installation of vibration control devices

- a) All work to be done in strict accordance with specification **DST 34-1204**
- b) **All spans exceeding 180m must be fitted with vibration dampers. About 122 spans fit this criteria.**
- c) The number of vibration dampers to be installed per span shall be as recommended by the manufacturer. The spacing from the mouth of the strain clamp or the center of the suspension clamp shall be in accordance with the manufacturer's recommendations.
- d) If the use of armor rods makes it impossible to meet this spacing, the first damper shall be positioned at the end of the armor rods, and any additional dampers shall then be spaced from the first damper. Dampers shall be located within **25mm** of their correct position.
- e) Vibration dampers shall be installed when clamping the conductor, but only after the conductor has been securely fastened in the conductor support assembly.
- f) Multi frequency Stockbridge type vibration dampers shall be installed so that they hang directly under the conductor on Chicadee conductor (122 spans  $\pm$  488 dampers) and spiral vibration dampers on Hare conductor (1 span  $\pm$  4 dampers).
- g) The installation of vibration dampers shall be in accordance with the manufacturer's recommendations.
- h) Vibration dampers shall be installed within **72 hours** after clamping of the phase conductors and shield wires.
- i) All vibration control devices supplied by the *Contractor* for the project shall be technically approved by the Project Engineer prior to the installation thereof.

#### 7.3.18 Phase conductor vibration damper positioning

- a) Helically attached "Multi frequency Stockbridge or Dogbone type" vibration dampers are to be installed on Chicadee ACSR type phase conductor; and spiral vibration dampers on Hare ACSR.



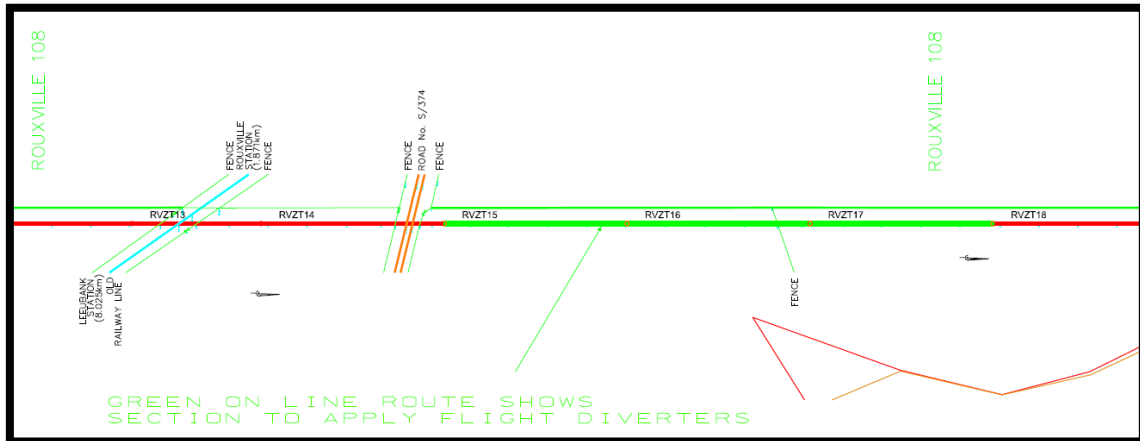
- b) The dampers must be installed in strict accordance with the Manufacturer's specifications;
- c) The number of multi frequency vibration dampers per span shall be:-
  - Spans up to **550m** : **4** (2 Subsets of 2);
- d) Multi frequency vibration damper positioning is specific conductor related and specified per project.
- e) Min. **50mm** bare conductor between armor rod ends to be maintained at all times;
- f) No damper must be positioned with the overlapping of the amour rods of any clamp.
- g) Before stringing request damper positioning per span from Design Engineer through Clerk of Works.**

7.3.19 Installation of jumper assemblies

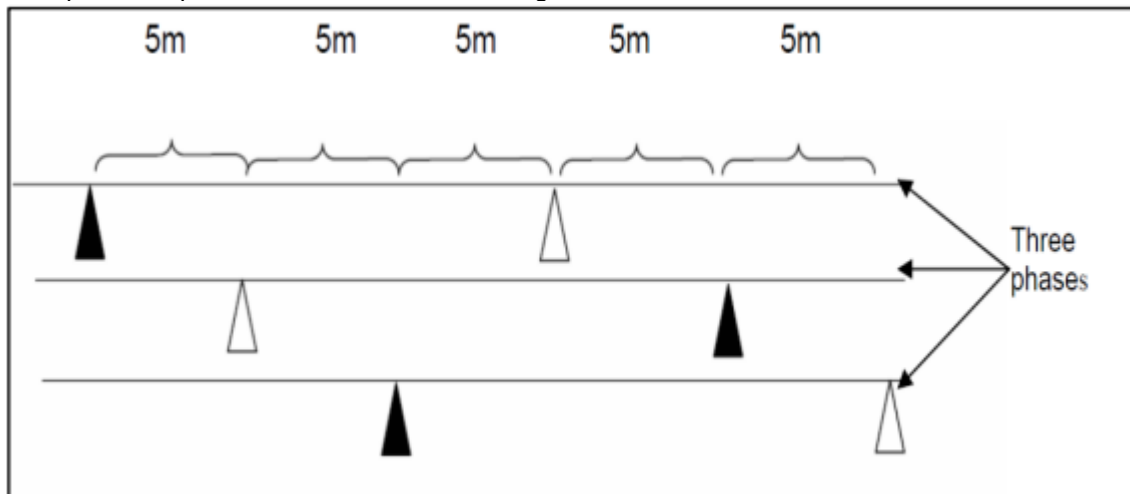
- a) The *Contractor* will be responsible for the supply, safe storage, handling, transport of all jumper assembly fittings to the specified structures and the complete installation thereof.
- b) The phase conductor jumpers shall be formed to provide the maximum amount of clearance from earthed hardware and structure steelwork. The positioning of phase conductor jumpers shall comply with the clearances stated under the specified displacements.
- d) All phase to earth jumper clearances at phase conductor jumpers shall be measured by the *Contractor* in the presence of and as instructed by the *Clerk of Works* and records shall be submitted to the Project Engineer for acceptance.
- e) Jumper clearances not meeting the requirements shall be removed and replaced at the *Contractor's* own cost.
- f) Compression type jumper terminals shall be installed at all phase conductor jumper ends (on Chicadee Phase conductor) and double PG clamp joined jumpers (on hare Phase conductor)

## 7.3.20 Installation of bird flight diverters

- a) The following Standards, Specifications, Guidelines and Drawings apply:
- **D-FS-18239** Rouxville Zastron Route Plan and PLSCadd design profile sheets;
  - **Environmental Management Plan Rouxville-Zastron 33kV powerline project- NW-STM 1606-2731-00004**
- c) The **Environmental Management Plan** for the project will specify the bird flight routes and bird sensitive areas for the installation of “Bird diverters”. Bird flight diverter positions are indicated on **D-FS-18239** as shown below



- d) “Bird diverters” shall be installed according to **240-93563150**, spaced 5m apart and effectively 15m apart on 3 phase networks with alternating colours.



- e) “Bird diverters” will be technically approved by the *Employer's* Environmental Manager prior to the purchasing and installation thereof.

## Activity Stage 8: Power line labelling activities

### 8.1 Supply and transport to site of line and structure identification labels and accessories

8.1.1 The following Standards, Specifications, Guidelines and Drawings apply:

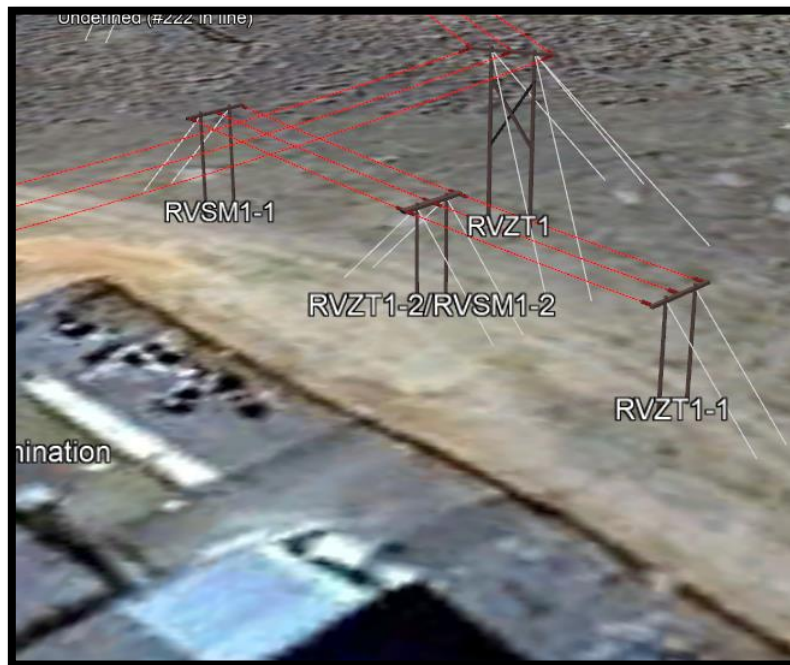
- **TRMSCAAC1 Rev. 3 - Section 7.7.4** Transmission line tower and Line construction;
- **DISASAAN0** Eskom's Labelling Standard;
- **DISASZAA2 Section 2** Application standard for Distribution Equipment Labels;
- **D-FS-18239** **Rouxville Zastron Route Plan and PLSCadd design profile sheets;**

8.1.2 The power line labels as well as all material required for the installation power line labels shall be supplied and delivered to site by the *Contractor*.

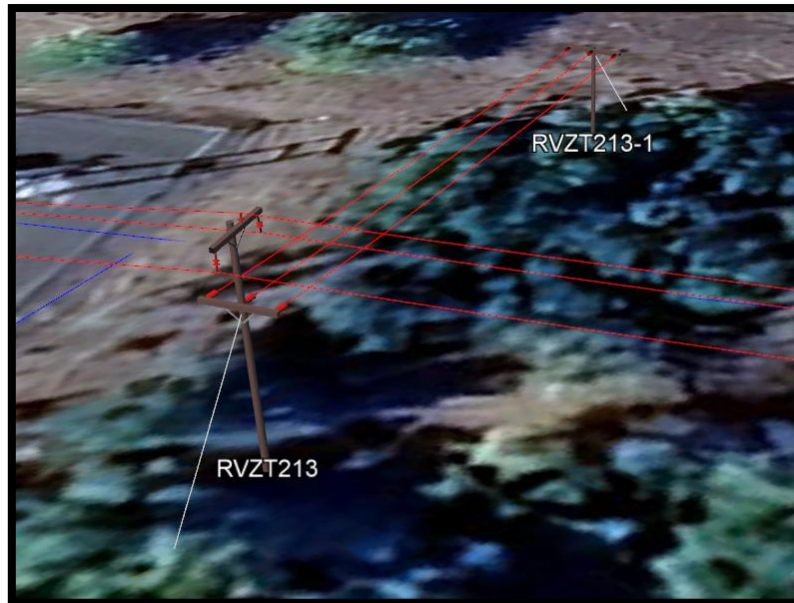
8.1.3 The labels to be supplied by the *Contractor*:

a) **Line designation labels:**

- Label 1:- **"RVZT 1-2/ RVSM 1-2"** to be installed at the bypass switch at **Rouxville substation as shown in Figure 1.**
- Label 2:- **"RVZT 213"** to be installed at the bypass connection at **Zastron substation.**
- The labels shall be manufactured to **Figure 3.**

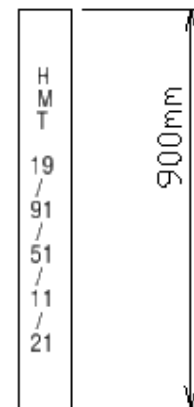


**Figure 1: RVZT1-2/ RVSM1-2**



**Figure 2: RVZT 213**

LABEL ACCORDING TO  
 D-DT 5050 SHEET 3, 240-75660336 , 240-120804300  
 LEGEND HEIGHT: 40MM  
 COLOUR: BLACK LETTERING, YELLOW BACKGROUND  
 YELLOW CODE: SANS 1091: 1070-Y20R, RAL: RAL1003  
 FONT: HELVETICA MEDIUM  
 MOUNTING HOLES: SLOTS



**Figure 3: Equipment Label**

b) **Structure identification labels:**

- Structures to be labelled with 150x25mm aluminium plates (supplied by the employer) and fixed to wooden poles with a nail on each side (2 nails per label. Nails will be supplied by the employer)
- Contractor to stencil structure identification labels with a 6mm stencil kit. Structure identification labels are shown on **D-FS-18239** as code RVZT (Rouxville Zastron Two) followed by the pole number (RVZT 3 for example). Provision has been made for a single label per structure and must be installed on the opposite side as the pole specification label or slightly above.
- The label must be installed on the same leg and side of the structure to ensure operators can easily see them while on line patrols.

**8.2 Safe storage, handling and transport to peg of line and structure identification labels and accessories**

- 8.2.1 The *Contractor* will be responsible for safe storage of all power line labels and accessories.
- 8.2.2 Labels shall be stored on a flat surface not to cause any bend and cracks to the finished label surfaces.
- 8.2.3 Special care shall be taken in handling and transport of line labels not to cause any surface damage to the line labels.

**8.3 Safe handling and complete installation of power line and structure identification labels**

8.3.1 The labels shall be installed by the *Contractor*:

a) **Equipment labels:**

- Labels shall be fitted vertically below the bottom of the equipment facing the source (Rouxville substation), at the specified structures.
- Each label shall be properly strapped to the pole structure with **4 x 12mm x 1,7mm thick** heavy-duty bandit strapping.

b) **Structure identification labels:**

- Labels shall be fitted vertically midway between the lowest conductor attachment and ground level on every structure on the line, ideally at the same height as the structure specification label, not covering the label, the label will be oriented horizontally. The label shall be fitted to the same leg on each structure to ensure operators can easily see the labels while doing line patrols.
- The label shall face towards the substation first mentioned on the label code.
- Each label shall be fastened to the structure with nails (one on each side, 2 nails in total)

## Activity Stage 9: Taking over of the works and clearance of site

### 9.1 Re-instate entire construction site

- 9.1.1 The Contractor shall clear the entire construction site. All construction waists, cement bags, conductor strand off-cuts, shall be removed from site and disposed as prescribed in the **Environmental Management Plan**.
- 9.1.2 Closing of construction access roads and providing of the necessary erosion protection measures on all construction areas, as specified in **TRMSCAAC1 Clause 4.5 and 4.6** and to the relevant Landowner's satisfaction, refer to **Activity Stage 2.5**.
- 9.1.3 Any position along the line route showing signs of possible soil erosion caused by construction activities shall be properly re-instated by the *Contractor*.
- 9.1.4 Arrangements shall be made by the *Contractor* to rip and re-instate all cultivated lands compacted due to construction activities.
- 9.1.5 Landowners shall be compensated by the *Employer* for any crop damages caused inside the servitude due to construction activities. Any damages caused to crops outside the servitude by the *Contractor* during construction activities shall be compensated by the *Contractor*.

### 9.2 Final inspection of the line

- 9.2.1 The pre-commissioning final inspection on the line shall be carried out in accordance with the relevant **Eskom Specifications and Standards, Design Profile Drawings** and **Route Plan**, as well as the **"Installation Records"** of the line and the **"Contract Documentation"** for the project.
- 9.2.2 A pre-arranged final inspection on the entire line shall be held, **at least 10 days prior** to the commissioning of the new line.
- 9.2.3 The compulsory final inspection shall be accompanied by the following individuals:
- The *Contractor*;
  - The *Project Manager*;
  - The *Clerk of Works*;
  - The Design Engineer;
  - The Environmental Control Officer and the Employers Environmental Official;
  - The Field Services and Plant Officials responsible for the line.
- 9.2.4 The final quality inspection shall be held **"Pole-to-Pole"** covering all aspects of the new installation.
- 9.2.5 All quality related defects from the **"Defects List"** compiled during the final inspection shall be rectified by the *Contractor*, prior to the commissioning of the line.
- 9.2.6 The contractor and Clerk of works must complete the handing over document **240-75884058** and all relevant sections. The format must be according to **Annex B "Total Network Check sheets"**

### 9.3 Handing over, test & commissioning

- 9.3.1 Indemnity forms shall be signed by all relevant Landowners in the presence of the *Clerk of Works*, expressing their satisfaction or dissatisfaction with the *Contractors* performance and behavior on his/her property, prior to the handing-over of the project to the Field Services Manager.
- 9.3.2 All jumper clearances shall be measured and submitted for handing-over by the *Contractor*.
- 9.3.3 The *Contractor* shall assist the *Employer* in commissioning the new power line.

### 9.4 Submission of "As Built" information

- 9.4.1 The *Contractor* in conjunction with the *Clerk of Works* will be responsible for the compilation of the **"As Built"** information on the newly constructed power line.
- 9.4.2 **Four** copies of a complete "Line Inventory" of the total line shall be submitted to the *Employer* on completion of all the work on site.
- 9.4.3 The following information to be included in the "Line Inventory":
- Copies of the "Introduction Agreements" and "Indemnity Agreements" between the *Employer*, the *Contractor* and all the Landowners on the power line;

- b) "As Built" Line route data (Gate installation/refurbishment; Bush clearing; Herbicides application and Access road data);
- c) Structure and structure label data;
- d) Structure foundation type data;
- e) Insulator assembly and hardware data;
- f) Phase conductor drum data;
- g) "As Built" Sag & tension data;
- h) Mid span joint and conductor repair data;
- i) Crossing clearances data;
- j) Jumper clearances data;
- k) Stringing equipment calibration certificates;
- l) Compression joint test certificates;
- m) "As Built" drawings.

## **9.5 Site clearance**

- 9.5.1 In the event of the *Contractor* not pricing the items of the **Taking over of the Works and Clearing of site Activities** in sufficient detail, the *Employer* reserves the right to exercise its own discretion in the apportionment to individual items of the total **Taking over of the Works and Clearing of site Activity** prices within the contract documents.
- 9.5.2 The *Contractor* will be responsible for the proper clearance of the construction as well as camp sites:
- a) Removal of all temporary established items by the *Contractor*, see **Activity Stage 1**;
  - b) Clearing of construction camp sites from all rubble, waste and rubbish resulting from construction activities and re-instatement of these terrains.
  - c) Removal of all excess material supplied by the *Employer* (Hardware, insulators, copper, etc.) from site and returning of such material to the nearest **Eskom Customer Network Center at Zastron**.



## Technical Requirements

### 1. Technical requirements for the line

#### 1.1 Introduction

- 1.1.1 Technical details regarding the line in general and the Single steel pole suspension, strain and terminal structures series are provided here. Specifications **TRMSCAAC1** and **SCSASABG1** apply.

#### 1.2 General line details:-

- 1.2.1 Line voltage phase to phase:  
Built and insulated at 33kV from RVZT 1 to RVZT184-1 – Operated at 22kV  
Built and insulated at 22kVA from RVZT184 to RVZT 214. Operated at 22kV
- 1.2.2 Three-phase; single or double circuit : Single circuit
- 1.2.3 Phase configuration :  
  
Horizontal configured at terminal positions and strainers  
Horizontal configured at suspension structures.
- 1.2.4 Number of conductors per phase : One

#### 1.3 Phase conductor detail

- 1.3.1 Phase Conductor (Phase conductor will be supplied by the *Employer*)
- |                               |   |                 |
|-------------------------------|---|-----------------|
| a) Conductor type             | : | "Chicadee" ACSR |
| b) Conductor overall diameter | : | 18.87mm         |
| g) Conductor mass             | : | 643kg/m         |
| h) Ultimate tensile strength  | : | 44,9kN          |
| l) Standard drum length       | : | 3 000m          |
- 1.3.2 Phase Conductor (Phase conductor will be supplied by the *Employer*)
- |                               |   |             |
|-------------------------------|---|-------------|
| a) Conductor type             | : | "Hare" ACSR |
| b) Conductor overall diameter | : | 14.16mm     |
| g) Conductor mass             | : | 429kg/m     |
| h) Ultimate tensile strength  | : | 36kN        |
| l) Standard drum length       | : | 1 500m      |
- 1.3.3 The Design Engineer to supply the **PLSCadd Stringing Sag and Tension Charts** for the phase conductor and shield-wire.

# Construction Guidelines

## 1.1 General Information

### 1.1.1 Information Tables

**Table 1: Conductor Properties**

| Conductor Type | Stranding & wire diameter (mm) | Overall diameter (mm) | Al area (mm <sup>2</sup> ) | Steel area (mm <sup>2</sup> ) | Total area (mm <sup>2</sup> ) | Weight Mass (kg/m) | N/m     | UTS (kN) |
|----------------|--------------------------------|-----------------------|----------------------------|-------------------------------|-------------------------------|--------------------|---------|----------|
| MAGPIE         | 3/4/2.118                      | 6.35                  |                            |                               | 24.71                         | 0.1397             | 1.3705  | 18.57    |
| SQUIRREL       | 6/1/2.11                       | 6.33                  |                            |                               | 24.48                         | 0.0852             | 0.8358  | 8.02     |
| FOX            | 6/1/2.79                       | 8.37                  | 36.68                      | 6.11                          | 42.80                         | 0.1490             | 1.4617  | 13.10    |
| MINK           | 6/1/3.66                       | 10.98                 | 63.13                      | 10.52                         | 73.65                         | 0.2570             | 2.5212  | 21.90    |
| HARE           | 6/1/4.72                       | 14.16                 | 104.98                     | 17.50                         | 122.48                        | 0.4270             | 4.1889  | 36.00    |
| WOLF           | 30/7/2.59                      | 18.13                 | 158.06                     | 36.88                         | 194.94                        | 0.7300             | 7.1613  | 69.20    |
| CHICADEE       | 18/1/3.77                      | 18.87                 | 200.93                     | 11.16                         | 212.09                        | 0.6430             | 6.3078  | 44.90    |
| LYNX           | 30/7/2.79                      | 19.53                 | 183.4                      | 42.77                         | 226.20                        | 0.8460             | 8.2993  | 79.30    |
| PANTHER        | 30/7/3.00                      | 21.00                 | 212.06                     | 49.48                         | 261.54                        | 0.9700             | 9.5157  | 90.80    |
| PELICAN        | 18/1/4.21                      | 20.70                 | 242.31                     | 13.46                         | 255.77                        | 0.7750             | 7.6028  | 53.80    |
| BEAR           | 30/7/3.35                      | 23.45                 | 264.42                     | 61.70                         | 326.12                        | 1.2200             | 11.9682 | 112.00   |
| GOAT           | 30/7/3.71                      | 25.97                 | 324.31                     | 75.67                         | 399.98                        | 1.5000             | 14.7150 | 136.00   |
| KINGBIRD       | 18/1/4.78                      | 23.88                 | 323.01                     | 17.95                         | 340.20                        | 1.0280             | 10.0847 | 69.80    |
| TERN           | 45/3.38+7/2.25                 | 27.00                 | 403.77                     | 27.83                         | 431.60                        | 1.3400             | 13.1454 | 98.70    |
| ZEBRA          | 54/7/3.18                      | 28.62                 | 428.88                     | 55.60                         | 484.48                        | 1.6300             | 15.9903 | 133.00   |
| BERSFORT       | 48/4.27+7/3.32                 | 35.58                 |                            |                               | 747.96                        | 2.369              | 23.24   | 177.65   |
| Steel 19/2.65  | 19/2.65                        | 13.25                 |                            |                               | 104.8                         | 0.826              | 8.1     | 113      |
| Steel 7/3.35   | 7/3.35                         | 10.50                 |                            | 61.70                         | 61.70                         | 0.4850             | 4.7579  | 67.45    |
| Steel 3/3.35   | 3/3.35                         | 7.35                  |                            | 26.44                         | 26.44                         | 0.2150             | 2.1092  | 29.10    |

**Table 2: Standard Electrical Clearances**

| System Nominal Voltage (kV) | System Highest Voltage (kV) | Minimum clearance (mm) |                | Working clearance (m) |            |
|-----------------------------|-----------------------------|------------------------|----------------|-----------------------|------------|
|                             |                             | Phase to Earth         | Phase to Phase | Vertical              | Horizontal |
| 3.3                         | 3.6                         | 80                     | 110            | 2.5                   | 1.2        |
| 6.6                         | 7.2                         | 150                    | 200            | 2.6                   | 1.2        |
| 11                          | 12                          | 200                    | 270            | 2.7                   | 1.3        |
| 15                          | 17.5                        | 230                    | 310            | 2.7                   | 1.3        |
| 22                          | 24                          | 320                    | 430            | 2.8                   | 1.4        |
| 33                          | 36                          | 430                    | 580            | 2.9                   | 1.5        |
| 44                          | 48                          | 540                    | 730            | 3                     | 1.6        |
| 66                          | 72                          | 770                    | 1050           | 3.2                   | 1.8        |
| 88                          | 100                         | 840                    | 1150           | 3.3                   | 1.9        |
| 132                         | 145                         | 1200                   | 1650           | 3.7                   | 2.3        |
| 220                         | 245                         | 1850                   | 2300           | 4.3                   | 2.9        |
| 275                         | 300                         | 2350                   | 2950           | 4.8                   | 3.4        |
| 330                         | 362                         | 2900                   | 3600           | 5.4                   | 4          |
| 400                         | 420                         | 3200                   | 4000           | 5.7                   | 4.3        |

**Table 3: Power Line Servitudes and Building Restrictions**

| Line Voltage (kV)    | Building Restriction | Separation     | Timber Restriction |
|----------------------|----------------------|----------------|--------------------|
|                      | From Line Centre     | Parallel Lines | Forestry Area      |
| 22 and below         | 11                   | 12             | -                  |
| 33 (H-pole)          | 15.5                 | 14             | -                  |
| 66                   | 15.5                 | 14             | 33                 |
| 88 (Horizontal)      | 15.5                 | 21             | 33.5               |
| 88 (Delta)           | 15.5                 | 15             | 33.5               |
| 132 (Mono pole)      | 15.5                 | 15             | 36                 |
| 132 (Horizontal)     | 15.5                 | 21             | 36                 |
| 132 (Double circuit) | 15.5                 | 32             | 36                 |
| 275                  | 23.5                 | 32             | 38.5               |
| 400                  | 23.5                 | 35             | 38.5               |
| 765                  | 40                   | 60             | -                  |

**Table 4: Standard Insulation Levels and Creepage Distances**

| System Nominal Voltage (kV) | System Highest Voltage (kV) | BIL at sea level (kV) | 60 sec power Hz withstand test (kV) | Creepage distance over external insulation |              |              |
|-----------------------------|-----------------------------|-----------------------|-------------------------------------|--|--------------|--------------|
|                             |                             |                       |                                     | Normal (mm)                                | Special (mm) | Extreme (mm) |
| 3.3                         | 3.6                         | 45                    | 16                                  | 70   | 70           | 125          |
| 6.6                         | 7.2                         | 75                    | 22                                  | 140  | 140          | 180          |
| 11                          | 12                          | 95                    | 28                                  | 240  | 240          | 300          |
| 15                          | 17.5                        | 110                   | 38                                  | 350  | 350          | 440          |
| 22                          | 24                          | 150                   | 50                                  | 480  | 480          | 600          |
| 33                          | 36                          | 200                   | 70                                  | 720  | 720          | 900          |
| 44                          | 48                          | 250                   | 95                                  | 960  | 960          | 1200         |
| 66                          | 72                          | 350                   | 140                                 | 1400                                       | 1400         | 1800         |
| 88                          | 100                         | 380                   | 150                                 | 2000                                       | 2000         | 2500         |
| 132                         | 145                         | 550                   | 230                                 | 2900                                       | 2900         | 3600         |
| 220                         | 245                         | 825                   | 360                                 | 3700                                       | 4900         | 6100         |
| 275                         | 300                         | 1050                  | 460                                 | 4500                                       | 6000         | 7500         |
| 330                         | 362                         | 1300                  | 570                                 | 5500                                       | 7300         | 9000         |
| 400                         | 420                         | 1425                  | 630                                 | 6300                                       | 8400         | 10500        |

**Table .5: Minimum Vertical Clearances of Power Lines at Maximum Sag and Swing**

| Description  |           |  | Note   | Data/Minimum Clearance |      |                                      |      |      |                                   |      |                  |      |      |
|--|-----------|--|--|------------------------|------|--------------------------------------|------|------|-----------------------------------|------|------------------|------|------|
| System Nominal Voltage (kV)  |           |  |  | 6.6                    | 11   | 22                                   | 33   | 44   | 66                                | 88   | 132              | 275  | 400  |
| Highest System Voltage (kV)  |           |  |  | 7.2                    | 12   | 24                                   | 36   | 48   | 72                                | 100  | 145              | 300  | 420  |
| Minimum Safety Clearances  |           |  |  |                        |      |                                      |      |      |                                   |      |                  |      |      |
| Phase to Ground (m)  |           |  |  | 0.15                   | 0.20 | 0.32                                 | 0.43 | 0.54 | 0.77                              | 1.00 | 1.45             | 2.35 | 3.20 |
| Phase to Phase (m)   |           |  |  | 0.20                   | 0.30 | 0.40                                 | 0.60 | 0.70 | 1.00                              | 1.20 | 1.70             | 3.00 | 4.00 |
| Minimum Vertical Clearances  |           |  |  |                        |      |                                      |      |      |                                   |      |                  |      |      |
| Above ground outside townships (m)   |           |  | 1  | 5.0                    | 5.1  | 5.2                                  | 5.3  | 5.4  | 5.7                               | 5.9  | 6.3              | 7.2  | 8.1  |
| Above ground inside townships (m)  |           |  | 1  | 5.5                    | 5.5  | 5.5                                  | 5.5  | 5.5  | 5.7                               | 5.9  | 6.3              | 7.2  | 8.1  |
| Above roads in townships (m)   |           |  | 7  | 7.5                    | 7.5  | 7.5                                  | 7.5  | 7.5  | 7.5                               | 7.5  | 7.5              | 8.4  | 9.3  |
| Above proclaimed roads outside townships (m)                                   |           |  | 7  | 7.5                    | 7.5  | 7.5                                  | 7.5  | 7.5  | 7.5                               | 7.5  | 7.5              | 8.4  | 9.3  |
| To building, poles and structures not part of the power line (m)               |           |  |  | 3.0                    | 3.0  | 3.0                                  | 3.0  | 3.0  | 3.2                               | 3.4  | 3.8              | 4.4  | 5.6  |
| To other power lines (m)   |           |  | 2  | 0.7                    | 0.8  | 0.9                                  | 1.0  | 1.1  | 1.4                               | 1.6  | 2.0              | 2.9  | 3.8  |
| To telephone lines - Angle of crossing from right angle                        |           |  |  | 45°                    | 45°  | 30°                                  | 30°  | 30°  | 30°                               | 30°  | 30°              | 30°  | 30°  |
| To TELKOM telephone lines (m)  |           |  | 3  | 1.8                    | 1.8  | 1.8                                  | 1.8  | 1.8  | 1.8                               | 1.8  | 2.0              | 2.9  | 3.8  |
| To SPOORNET telephone lines (m)  |           |  | 3  | 1.4                    | 1.4  | 1.5                                  | 1.7  | 1.8  | 2.0                               | 2.2  | 2.7              | 3.6  | 4.5  |
| To SPOORNET railways non-electrified (m)                                       |           |  | 4 & 5  | 9.6                    | 9.7  | 9.8                                  | 9.9  | 10.0 | 10.2                              | 10.4 | 10.9             | 11.8 | 12.7 |
| To SPOORNET railways non-electrified (m)                                       |           |  | 6  | 11.2                   | 11.3 | 11.4                                 | 11.5 | 1.6  | 11.8                              | 12.0 | 12.4             | 13.3 | 14.2 |
| To SPOORNET electrification structures (m)                                     |           |  |  | 3.0                    | 3.0  | 3.0                                  | 3.0  | 3.0  | 3.2                               | 3.4  | 3.8              | 4.8  | 5.5  |
| To SPOORNET electrification live wires & track earth wires (m)                 |           |  |  | 2.0                    | 2.1  | 2.2                                  | 2.3  | 2.4  | 2.5                               | 2.8  | 3.3              | 4.2  | 5.0  |
| To SPOORNET earth wires (Power Lines) (m)                                      |           |  |  | 0.7                    | 0.8  | 0.9                                  | 1.0  | 1.1  | 1.4                               | 1.6  | 2.1              | 2.9  | 3.8  |
| To SPOORNET other power lines (m)  |           |  | 2  | 1.4                    | 1.4  | 1.5                                  | 1.7  | 1.8  | 2.0                               | 2.2  | 2.4              | 3.5  | 4.5  |
| EXPLOSIVE MAGAZINES  |           | QUARRIES   |  |                        |      | ROADS (From road reserve)            |      |      | Parallel to roads                 |      | Crossings roads  |      |      |
| Spans  | Clearance | Only single shot blasting is permitted within 457m of a power line |  |                        |      | National roads                       |      |      | 60m to structure                  |      | 20m to structure |      |      |
| Under 30m  | 15.2m     |  |  |                        |      | Important main roads                 |      |      | 32m to line centre                |      | 16m to structure |      |      |
| 30 - 167m  | 31.3m     | AERODROMES & RIFLE RANGES  |  |                        |      | Less important main roads            |      |      | 32m to line centre                |      | 16m to structure |      |      |
| Over 167m  | 30.5m     | See Land Survey Manual Vol. 1                                      |  |                        |      | Low traffic dust roads (from centre) |      |      | 40m to line centre                |      | 16m to structure |      |      |
| NOTES:   |           |  | 4. Single power lines not at station yard                                |                        |      |                                      |      |      | 7. For abnormal load route = 7.5m |      |                  |      |      |
| 1. +0.6m on major line templating  |           |  | 5. Where electrification is not foreseen (See Land Survey Manual Vol. 1) |                        |      |                                      |      |      |                                   |      |                  |      |      |
| 2. Higher conductor at 50°C, Lower conductor at -5°C                           |           |  | 6. Multiple crossings & single power lines at station yard               |                        |      |                                      |      |      |                                   |      |                  |      |      |
| 3. Min. clearance as per letter Distribution Engineering Manager (A.Y.Poulton) |           |  |  |                        |      |                                      |      |      |                                   |      |                  |      |      |

# Basic Stringing Procedure

## 1. INTRODUCTION

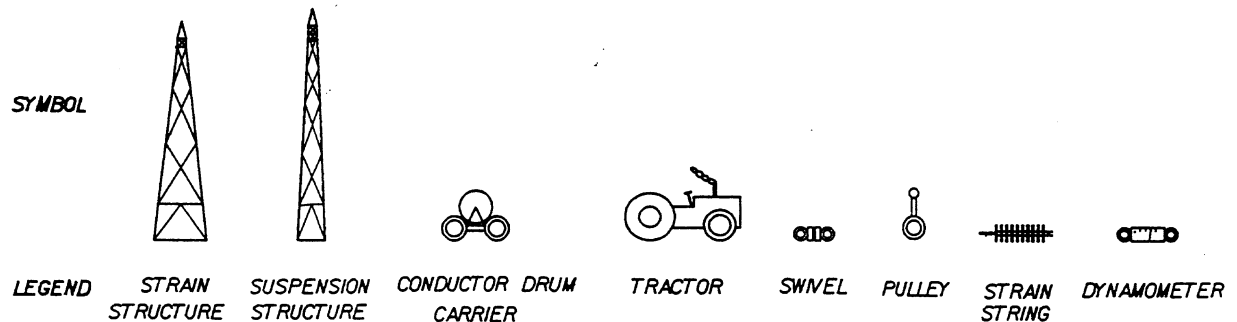
- 1.1 With the phasing out of the glass disc insulators and the introduction of the long rod polymer type insulators, new stringing precautions must be taken.
- 1.2 The new type long rod insulators have some disadvantages. The rubber-like appearance gives one the idea that they cannot break and that they cannot take any cantilever or torsion loads
- 1.3 Care should thus be taken whenever one does stringing with this type of insulators.
- 1.4 Tension stringing is the recommended stringing technique but if it is not possible the alternative stringing procedure as described below must be used.

## 2. STRINGING EQUIPMENT PER PHASE

### 2.1 Equipment:

- |  |   |   |
|--|---|---|
| a) Conductor drum carrier                                | : | 1;  |
| b) Swivels   | : | 2;  |
| c) Dynamometer (Calibrated not longer than 6 months ago) | : | 1;  |
| d) Running out pulleys                                   | : | X amount to suit no. off suspension structures in strain section; |
| e) Come along  | : | 1;  |
| f) Tractor   | : | 1.  |

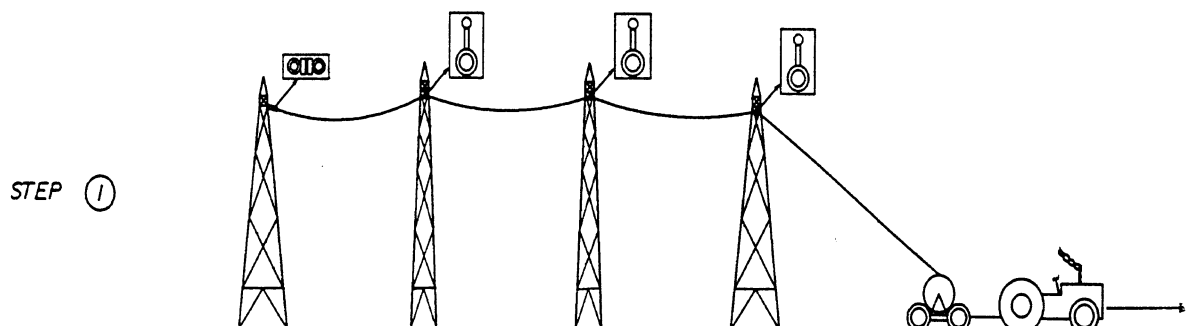
### 2.1 Symbols:



## 3. STRINGING PROCEDURE

### 3.1 STEP 1: Running out of the conductor

- a) Secure swivel onto the strain structure (anchor end).
- b) Terminate the conductor with the compression dead-end onto the swivel.
- c) Use a conductor drum carrier to run out the conductor along the line and lock the conductor onto the running blocks.
- d) All unnecessary slack shall be eliminated to prevent conductor friction during tensioning.
- e) The conductor must never be dragged on the ground, if it is not possible to achieve this, the conductor must be protected with wooden planks from damaging.
- f) Under no circumstances shall any vehicle be allowed to drive over conductors.

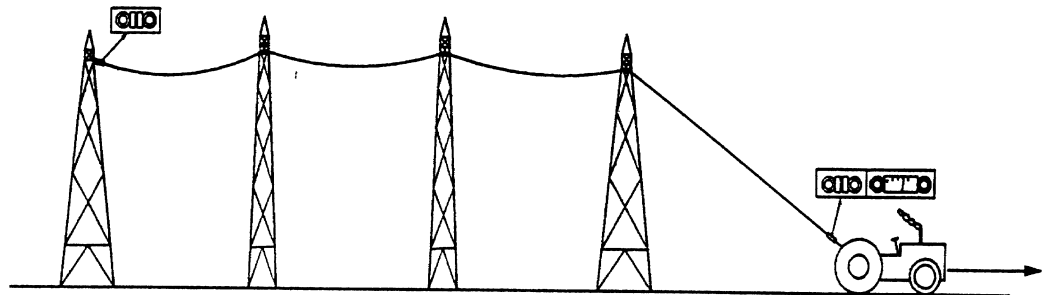


**3.2 STEP 2: Unwinding of the conductor**

- Cut the conductor.
- Install a swivel and dynamometer at the pulling end.
- Tighten conductor slightly and give the conductor time to unwind.

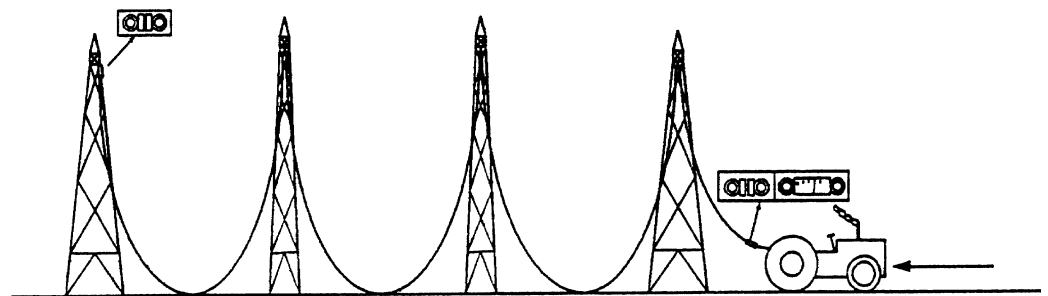
**NOTE:** The conductor shall not be tensioned more than 17,96kN for "Chicadee" or more than 14,40kN for Hare

STEP ②

**3.3 STEP 3: Slacking of conductor**

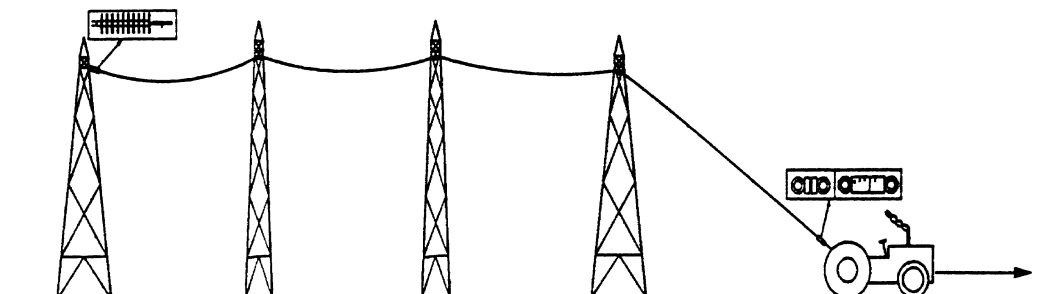
- Conductor to be slacken after it has unwound.

STEP ③

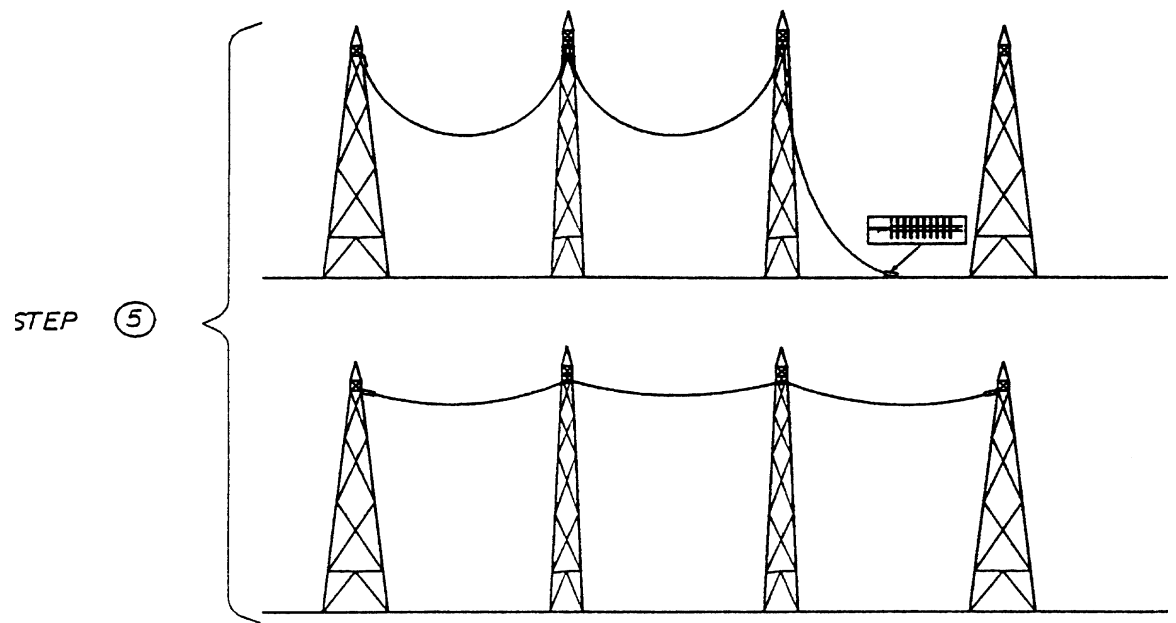
**3.4 STEP 4: Sagging**

- Remove the swivel at the anchor end.
- Install the strain insulator.
- Sag conductor according to the provided Sag and Tension Chart.
- Ensure that conductor has not snagged on any of the running blocks.

STEP ④

**3.5 STEP 5: Regulation**

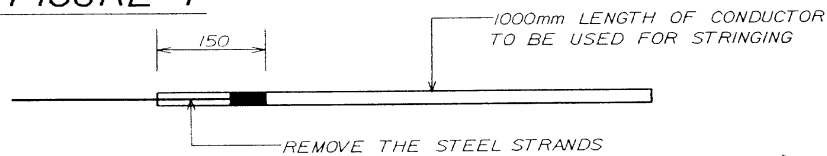
- Install the strain insulator at the pulling end.
- Hook conductor into position.
- Do regulation (fine tuning) with the turn buckle.
- Remove the running blocks and secure the conductor with the suspension clamps.



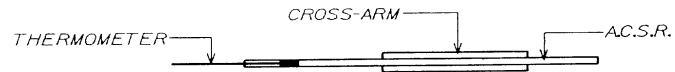


# Ambient Temperature Measuring Technique


**FIGURE 1**



**FIGURE 2**




**NOTES:**

1. USING 1m OF A.C.S.R. REMOVE 15cm FROM CENTRE STEEL STRANDS  

  
 INSERT MERCURY BULB END OF THERMOMETER TO PREVENT THERMOMETER FROM FALLING OUT
2. ATTACH TO CROSS-ARM. AFTER TWO HOURS THE TEMPERATURE CAN BE READ

THIS DRAWING HAS BEEN CREATED ON A C.A.D. SYSTEM AND ANY AMENDMENT TO THE DRAWING MUST BE EFFECTED ON THE SAME CAD SYSTEM ONLY.

THE C.A.D. REFERENCE NUMBER IS:  
( ELEC/0382542/CONTEMP/LV-1 )

|          |             |        |   |            |       |                     |     |
|----------|-------------|--------|---|------------|-------|---------------------|-----|
| 1        |             | 7/3/95 | REDRAWN WITH AMMENDEMENTS   | XEL        |       |                     |     |
| 0        |             |        | FIRST ISSUE / EERSTE UITREIKING   |            |       |                     |     |
| REV      | AUTH        | DATE   | REVISION/REVISIES   | BY         | CHKD  | REFERENCE DRAWINGS  |     |
|          | MAG         | DATUM  | INDEX REF/INDEXVERW   | DEUR       | NAGES | VERWYSINGSTEKENINGE |     |
| DWG. TEK |             |        | PRETORIA  |            |       |                     |     |
| REGISTR  |             |        |  |            |       |                     |     |
|          |             |        | design  |            |       |                     |     |
| CHKD     |             |        |   |            |       |                     |     |
| NAGES    |             |        |   |            |       |                     |     |
| DRAWN    | XELDEARNE   | 3/3/90 | APPROVED  | GOEDGEKEUR |       |                     | REV |
| GETEKEN  | LIVINGSTONE |        | K.ROZWIAREK   |            |       |                     |     |
| SCALE    | N.T.S       |        | 3/9/90  |            |       | 2-ET/13736          | 1   |
| SKAAL    |             |        |   |            |       |                     |     |

## Free State Operating Unit Bloemfontein

### ECSC3 ENGINEERING AND CONSTRUCTION

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

## Part C3 Scope of Works

### PART C3.4: HEALTH &SAFETY SPECIFICATIONS

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C3.1 | Project Works Information         |
| Part | C3.2 | Project Specifications            |
| Part | C3.3 | Detailed Technical Specifications |
| Part | C3.4 | Health and Safety Specifications  |
| Part | C3.5 | Project Critical Tasks            |
| Part | C3.6 | Project Risk Analysis             |
| Part | C3.7 | Project Drawings                  |

## Free State Operating Unit Bloemfontein

### ECSC3 ENGINEERING AND CONSTRUCTION

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

## Part C3 Scope of Works

### PART C3.5: PROJECT CRITICAL TASKS

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C3.1 | Project Works Information         |
| Part | C3.2 | Project Specifications            |
| Part | C3.3 | Detailed Technical Specifications |
| Part | C3.4 | Health and Safety Specifications  |
| Part | C3.5 | Project Critical Tasks            |
| Part | C3.6 | Project Risk Analysis             |
| Part | C3.7 | Project Drawings                  |

**Critical Task Analyses from Design Point of View**

The contractor is expected to acquaint himself with the contents of the following documents which are not necessarily attached to the contract document but definitely form part thereof:

1. OHS Act Requirements to be met by Principal contractors employed by Eskom Distribution (Reference 34-333).
2. Construction Safety, Health and Environmental Management (Reference 32-136)

| Item | Main Task | Safe Method of Execution | Risks Dealing with. |
|------|-----------|--------------------------|---------------------|
| 1    | NA        |                          |                     |
| 2    |           |                          |                     |
| 3    |           |                          |                     |
| 4    |           |                          |                     |

## Free State Operating Unit Bloemfontein

### ECSC3 ENGINEERING AND CONSTRUCTION

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

## Part C3 Scope of Works

### PART C3.6: PROJECT RISK ANALYSIS

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C3.1 | Project Works Information         |
| Part | C3.2 | Project Specifications            |
| Part | C3.3 | Detailed Technical Specifications |
| Part | C3.4 | Health and Safety Specifications  |
| Part | C3.5 | Project Critical Tasks            |
| Part | C3.6 | Project Risk Analysis             |
| Part | C3.7 | Project Drawings                  |

## PROJECT RISK ANALYSIS

Project: **33kV Chickadee line from Rouxville Substation to new Bophelo Substation ,**

PE (1):**PJ Burger**

Portion of route affected:

Analysis No: 1

Date: **09/04/2024**

| Final Rating =                  | 32 | Risk Rating |     |     |      | Effect on Cost | Effect on Time | Proposed Action Plan / Contractors Comments      |
|---------------------------------|----|-------------|-----|-----|------|----------------|----------------|--|
|                                 |    | 0           | 1   | 2   | 3    | None           | None           | Low risk / non-sensitive area                    |
| <b>Risk Factors Description</b> |    | Zero        | Low | Med | High |                |                | Construction to standards and environmental plan |

**ENVIRONMENTAL RISKS (to be identified by Environmentalist and/or Surveyor)**

**Weather**

|             |   |   |  |  |      |      |  |
|-------------|---|---|--|--|------|------|--|
| Rainfall    |   | 1 |  |  | None | Yes  | Allow for rain as per Weather Bureau long term forecasts with construction scheduling      |
| Winds       |   | 1 |  |  | None | Yes  | Allow for wind conditions with stringing scheduling (No stringing during wind storms)      |
| Heat Stroke |   | 1 |  |  | None | Yes  | Allow for heat during construction scheduling (Non-working hours)                          |
| Snow / Hail |   | 1 |  |  | None | Yes  | Allow for hail storms during construction scheduling (Non-working hours)                   |
| Floods      |   | 1 |  |  | None | Yes  | Allow for floods during construction scheduling (Non-working hours, accessibility to site) |
| Fire        | 0 |   |  |  | None | None |  |

**Agricultural Activity**

|                             |   |   |  |  |      |      |   |
|-----------------------------|---|---|--|--|------|------|---|
| Cultivated Lands            | 0 |   |  |  | None | None |   |
| Irrigation Equipment        | 0 |   |  |  | None | None |   |
| Maize Crops (young, mature) | 0 |   |  |  | None | None |   |
| Sugarcane (young, mature)   | 0 |   |  |  | None | None |   |
| Other Crops (veg.)          | 0 |   |  |  | None | None |   |
| Livestock                   |   | 1 |  |  | Yes  | None | Excavations to be properly protected during construction to avoid unnecessary claims for livestock getting injured or killed when falling into open excavations |
| Tree stumps – logs          | 0 |   |  |  | None | None |   |
| Trees - young / old         | 0 |   |  |  | None | None |   |

**Natural Features**

|                          |  |   |  |  |      |      |  |
|--------------------------|--|---|--|--|------|------|--|
| Bush                     |  |   |  |  | None | None |  |
| Indigenous trees         |  |   |  |  | None | None |  |
| Grasslands (tall grass)  |  |   |  |  | None | None |  |
| Grasslands (short grass) |  |   |  |  | None | None |  |
| Wetlands                 |  |   |  |  | None | None |  |
| Boulders                 |  |   |  |  | None | None |  |
| Dongas                   |  |   |  |  | None | None |  |
| Dams                     |  |   |  |  | None | None |  |
| Streams / Water Furrows  |  | 1 |  |  | None | Yes  | Special care must be taken by the contractor not to cause any unnecessary construction damage in these environmental sensitive areas |
| River Crossings          |  | 1 |  |  | None | Yes  | Special care must be taken by the contractor not to cause any unnecessary construction damage in these environmental sensitive areas |

**Fauna and Flora**

|                      |   |   |  |  |      |      |   |
|----------------------|---|---|--|--|------|------|---|
| Bird Interaction     | 0 |   |  |  | None | None |   |
| Dogs                 |   | 1 |  |  | Yes  | None | Free running domestic dogs can attack construction workmen - Be aware, awake and avoid such incidents |
| Game                 | 0 |   |  |  | None | None |   |
| Snakes               | 0 |   |  |  | None | None |   |
| Wild Animals (lions) | 0 |   |  |  | None | None |   |

0 1 2 3

| <b>Risk Factors Description</b>   | <b>Zero</b> | <b>Low</b> | <b>Med</b> | <b>High</b> |      |      |  |
|---|-------------|------------|------------|-------------|------|------|--|
| <b>Human Aspects</b>  |             |            |            |             |      |      |  |
| Houses - Normal / Informal  | 0           |            |            |             |      |      |  |
| Local Population  | 0           |            |            |             |      |      |  |
| Schools / Clinics   | 0           |            |            |             |      |      |  |
| Archaeological Sites  | 0           |            |            |             |      |      |  |
| Access for Vehicles   |             | 1          |            |             | None | Yes  | All access must be within the existing servitude   |
| <b>ENGINEERING RISKS (to be identified by Surveyor, Project Engineer and Construction Supervisor)</b> |             |            |            |             |      |      |  |
| Legal access to site  |             | 1          |            |             | None | Yes  | Permission from Local Authorities will be required prior to commencement of any construction activities  |
| Statutory Approvals   | 0           |            |            |             |      |      |  |
| Incorrect survey pegs   |             | 1          |            |             | Yes  | Yes  | Survey pegs can be removed by locals or others - <i>Contractor</i> to verify all pegs and peg positions, prior to construction   |
| Quality of drawings   | 0           |            |            |             |      |      |  |
| Materials delivery delay  |             | 1          |            |             | Yes  | Yes  | Timeous ordering of material by the <i>Employer</i> and <i>Contractor</i>  |
| Quality of materials delivered  |             |            | 2          |             | Yes  | Yes  | Quality of materials to be checked and accepted when delivered to site   |
| Incorrect materials delivered   |             | 1          |            |             | Yes  | Yes  | Incorrect material should not be accepted on site - Replacement with correct material to be done immediately   |
| Vandalism of materials  |             |            | 2          |             |      |      | A proper protected and guarded construction site to be established by the <i>Contractor</i>  |
| Protection of site & materials  |             |            | 2          |             | Yes  | Yes  | A proper protected and guarded construction site to be established by the <i>Contractor</i>  |
| Use of appropriate equipment  |             | 1          |            |             | None | None | A pre-construction inspection will be held on the <i>Contractor's</i> equipment in order to determine if it will be fit for purpose  |
| Machinery failure   |             | 1          |            |             | Yes  | Yes  | <i>Contractor</i> & <i>Clerk of Works</i> to ensure that machinery used for construction will be in a good working condition (Verify service/maintenance records)              |
| Existing cables   | 0           |            |            |             |      |      |  |
| Induction from other power lines  | 0           |            |            |             |      |      |  |
| Proximity to other power lines  |             |            | 2          |             | None | None | Safe electrical and working clearances to be maintained when working in close proximity of other lines. Proper under-crossing safety netting shall be erected, where required. |
| Telkom lines  |             | 1          |            |             | None | None | Safe electrical and working clearances to be maintained when working in close proximity of telkom lines  |
| Water pipes   |             | 1          |            |             | Yes  | Yes  | No obvious underground services were located during the survey of the site - Special care must be taken by contractor when excavating.   |
| Main / farm roads   | 0           |            |            |             | None | None |  |
| Motor vehicles / traffic  | 0           |            |            |             | None | None |  |
| Rail line crossings   | 0           |            |            |             | None | None |  |
| Damaged/rusted pylons   | 0           |            |            |             | None | None |  |
| Damaged/rusted hardware   | 0           |            |            |             | None | None |  |
| Damaged/rotten poles  | 0           |            |            |             | None | None |  |
| Damaged conductors  | 0           |            |            |             | None | None |  |
| Personnel skill level   | 0           | 1          |            |             | Yes  | Yes  | Well trained linesmen to be used for specialized construction activities   |
| Correct method application  | 0           | 1          |            |             | None | None | Correct construction procedures and methods to be implemented and standards to be adhered to by the contractor and his employees   |

|                                 |             |            |            |             |  |  |  |
|---------------------------------|-------------|------------|------------|-------------|--|--|--|
|                                 | <b>0</b>    | <b>1</b>   | <b>2</b>   | <b>3</b>    |  |  |  |
| <b>Risk Factors Description</b> | <b>Zero</b> | <b>Low</b> | <b>Med</b> | <b>High</b> |  |  |  |

**OTHER RISKS**

|                            |          |           |           |          |     |     |  |
|----------------------------|----------|-----------|-----------|----------|-----|-----|--|
| Hi-jacking                 |          |           | 2         |          | Yes | Yes | All workmen on site to be well informed w.r.t. hi-jacking and the victim's behaviour during such an incident |
| Theft                      |          |           | 2         |          | Yes | Yes | No material, tools to be left unguarded on site during or after construction hours                           |
| Communications – radio     | 0        |           |           |          |     |     |  |
| Communications – telephone | 0        |           |           |          |     |     |  |
| <b>TOTAL</b>               | <b>0</b> | <b>20</b> | <b>12</b> | <b>0</b> |     |     |  |

**Risk scoring method:** If risks are identified then the maximum score = 189. When all the scores are added up on a specific project and the total = 145, then the project is considered to be in a “high risk / sensitive area”. If however the total score is only 80, then the project is considered to be in a “low risk / non-sensitive area”.

**Contractor**.....  
PRINT NAME.....  
SIGNATURE.....  
DATE**Design Engineer**.....  
PRINT NAME.....  
SIGNATURE.....  
DATE**Risk & Environmental**.....  
PRINT NAME.....  
SIGNATURE.....  
DATE**Project Management**.....  
PRINT NAME.....  
SIGNATURE.....  
DATE





## Free State Operating Unit Bloemfontein

### ECSC3 ENGINEERING AND CONSTRUCTION

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

## Part C3 Scope of Works

### PART C3.7: PROJECT DRAWINGS

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C3.1 | Project Works Information         |
| Part | C3.2 | Project Specifications            |
| Part | C3.3 | Detailed Technical Specifications |
| Part | C3.4 | Health and Safety Specifications  |
| Part | C3.5 | Project Critical Tasks            |
| Part | C3.6 | Project Risk Analysis             |
| Part | C3.7 | Project Drawings                  |

| Drawing No:           | Title / Description   |
|-----------------------|---|
| D-FS-18239            | Rouxville Zastron Route Plan and PLSCadd design profile sheets;   |
| D-FS-18231 Sheets 1-2 | MV Heavy Conductor H-Pole Braced Suspension Structure Modified D-DT-1793, complete structure including supporting poles   |
| D-FS-18232 Sheets 1-2 | MV Heavy Conductor H-Pole Braced In-Line Strain Modified D-DT-1794, complete structure including supporting poles   |
| D-FS-18233 Sheets 1-2 | MV Heavy Conductor H-Pole Braced Angle Strain Structure 1-90° Modified D-DT-1795, complete structure including supporting poles                                   |
| D-FS-18234 Sheets 1-2 | MV Heavy Conductor H-Pole Braced Terminal Structure Modified D-DT-1796, complete structure including supporting poles   |
| D-DT-1740             | MV Three Phase Delta 2500 Wooden Cross Arm Intermediate – 0 Deg Deviation, with spark gap device D-DT-0310 Sheet 4, complete structure including supporting poles |
| D-DT-1748             | MV Three Phase Delta 2 x 2500 Wooden Crossarm Strain – Medium (1-60) Deg. Deviation, complete structure including supporting poles                                |
| D-DT-1749"            | MV Three Phase Delta – 2 x 2500 Wooden Crossarm Strain - Terminal, complete structure including supporting poles  |
| D-DT-1767             | MV Three Phase H-Pole / 2 x 3500 Wooden Crossarm Strain – 0 Deg. Deviation, complete structure including supporting poles   |
| D-DT-1768             | MV Three Phase H-Pole / 2 x 3500 Wooden Crossarm Strain – Medium (1-60) Deg. Deviation, complete structure including supporting poles                             |
| D-DT-1769             | MV Three Phase H-Pole / 2 x 3500 Wooden Crossarm Strain - Terminal, complete structure including supporting poles   |
| D-DT-1805             | MV Three Phase Take – Off 2 x 2500 Wood Crossarm Option 2 Assembly  |
| D-DT-1857             | 3 Phase Switch Disconnecter Ganged, Link Stick Operated Assembly Single Pole Mounted, bolts, nuts & washers   |
| D-DT-1858             | 3 Phase Switch Disconnecter Ganged, Link Stick Operated H-Pole 1800 and 2200 Centres, bolts, nuts & washers   |
| D-DT-1873             | MV Three Phase H-Pole / 2 x 4500 Wooden Crossarm Strain – Large (61-90) Deg Deviation, complete structure including supporting poles                              |
| D-FS-12051            | STANDARD POWER LINE SERVITUDE GATE FOR SMALL STOCK FENCES   |



D-FS-18239\_R1.pdf

# **PLS-CADD DESIGN PROFILE SHEETS**



Rouxville Zastron  
Drawings R1.zip

# **DETAIL DESIGN DRAWINGS**

## Free State Operating Unit Bloemfontein

### ECSC3 ENGINEERING AND CONSTRUCTION

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

## Part C4 Site Information

### PART C4.1: INFORMATION ABOUT THE SITE

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C4.1 | Information about the <i>site</i> |
| Part | C4.2 | GPS Coordinates                   |
| Part | C4.3 | Environmental Document            |

## C4: Site Information

### C4.1: Information about the site at time of tender which may affect the work in this contract

#### 1.1. Access limitations (Site Specific)

Substations are situated +/- 2.2 km south from Rouxville exiting Louw street. Access to the site is dirt roads from Rouxville. Road surfaces are in a fair condition.

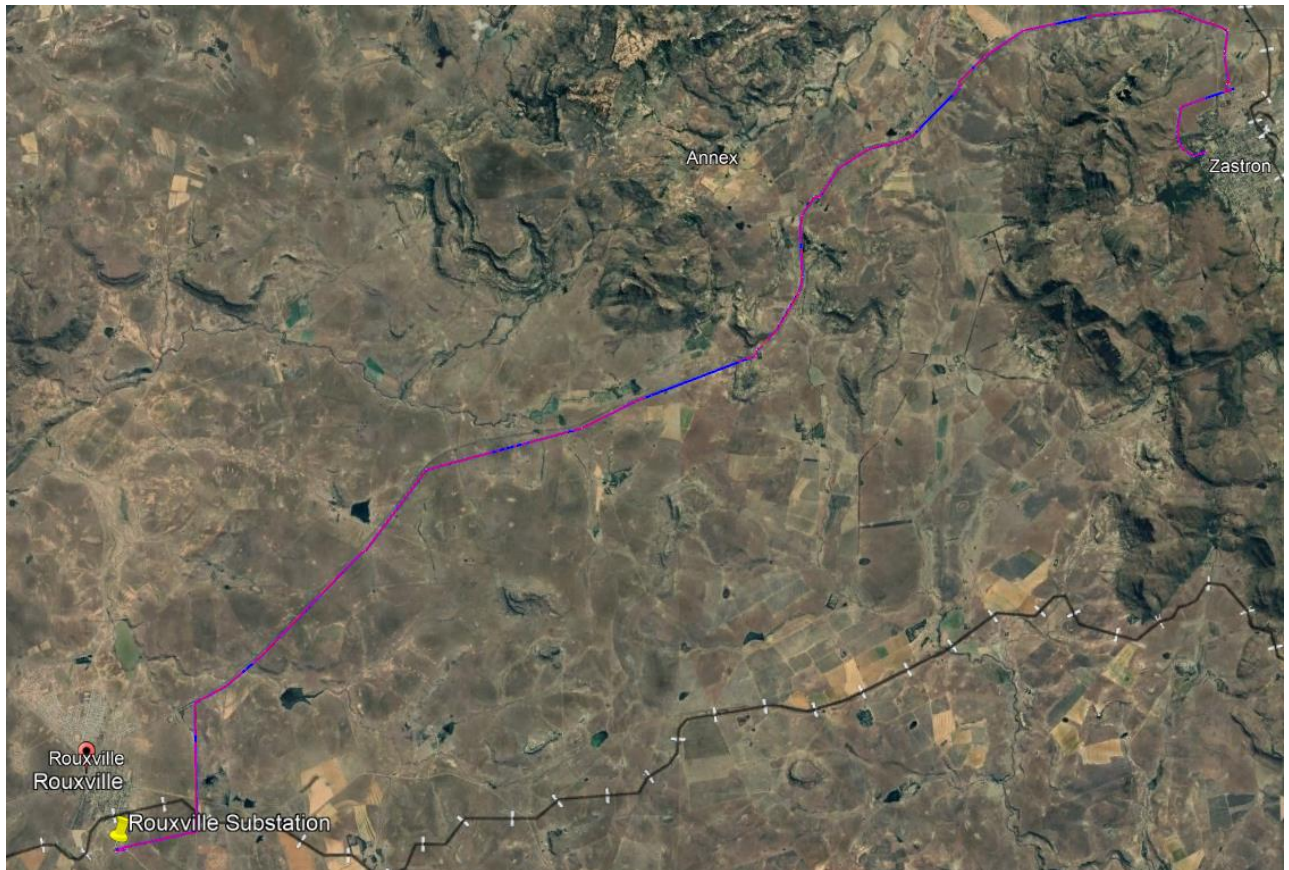


Figure 4 Locality Plan

#### 1.2. Ground conditions in areas affected by work in this contract

It shall be the *Contractors* responsibility to grade all excavations according to the classifications as specified SANS 1200. The *Project Manager* or his authorized representative shall have the right to inspect the holes and reclassify if required. In the event that no agreement on the soils profile can be reached, the *Project Manager* shall appoint an independent soil testing laboratory to conduct subsoil investigations and report the findings.

#### 1.3. Hidden and other services within the site

In the event of a discrepancy between physical condition and the information on a drawing, the *Contractor* shall notify the *Project Manager* immediately if the physical condition found on site is such that the deviation from the drawing requires a change in the design of the works or result in a possible compensation event.

#### 1.4. Details of existing buildings / facilities which *Contractor* is required to work on

Public services and infrastructures are not present and the *Contractor* shall arrange for the following: Sanitation and accommodation on site for own use as specified in Preliminary and General.

**Free State Operating Unit  
Bloemfontein**

**ECSC3 ENGINEERING AND CONSTRUCTION**

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

**Part C4 Site Information**

**PART C4.2: GPS COORDINATES**

|      |      |                            |
|------|------|----------------------------|
| Part | C4.1 | Information about the site |
| Part | C4.2 | GPS Coordinates            |
| Part | C4.3 | Environmental Document     |



**GPS COORDINATES**

| <b>Name</b>          | <b>Latitude</b> | <b>Longitude</b> |
|----------------------|-----------------|------------------|
| Rouxville Substation | 30°25'49.59"S   | 26°50'18.12"E    |
| Zastron Substation   | 30°17'55.30"S   | 27° 4'32.08"E    |

**Free State Operating Unit  
Bloemfontein**

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**Part C4 Site Information**

**PART C4.3: ENVIRONMENTAL DOCUMENT**

|      |      |                            |
|------|------|----------------------------|
| Part | C4.1 | Information about the site |
| Part | C4.2 | GPS Coordinates            |
| Part | C4.3 | Environmental Document     |



Rouxville-Zastron  
EMP April 2024 EMP

**Free State Operating Unit  
Bloemfontein**

**ECSC3 ENGINEERING AND CONSTRUCTION**

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

**Part C5 Schedule of Prices**

**PART C5.1: Schedule of Prices**

|      |      |                    |
|------|------|--------------------|
| Part | C5.1 | Schedule of Prices |
|------|------|--------------------|



PART%20C5.1-NW-S  
TM-1606-2731-0000

**Free State Operating Unit  
Bloemfontein**

**ECSC3 ENGINEERING AND CONSTRUCTION**

**NW-STM-1606-2731-00004**

**33kV Chickadee line from Rouxville Substation to  
new Bophelo Substation**

**Part C6 Design Bill of Materials**

**PART C6.1: DESIGN BILL OF MATERIAL**

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C6.1 | Design Bill of Material           |
| Part | C6.2 | Structure Order Bill of Material  |
| Part | C6.3 | Eskom Order Bill of Material      |
| Part | C6.4 | Contractor Order Bill of Material |

| ITEM CODE | ITEM DESCRIPTION                          | QTY     | Comment |
|-----------|---|---------|---------|
| 10270     | SOCKET-TONGUE 16mm 120kN D6061            | 264     |         |
| 163343    | WIRE STRAND,ST 7x4.0 1100MPA 1500m D3124  | 3978    |         |
| 163345    | WIRE STRAND,ST 3x3.35 1100MPA 1500m D3124 | 8010.1  |         |
| 163399    | THIMBLE,ST TO FIT 14mm DIA. WIRE D3026    | 306     |         |
| 163400    | SHACKLE,STRAIGHT PIN TYPE 70KN D3010      | 561     |         |
| 163402    | STAYROD 2000xM20 97kN NON-ADJUST D7023    | 67      |         |
| 163405    | STAYROD 133kN 2400x24 NON-ADJUST D7023    | 239     |         |
| 163406    | SHACKLE,STRAIGHT BOLT TYPE 120kN D7017    | 792     |         |
| 163419    | PLATE,STAY 340x375x6 80x26 SLOT D3172     | 140     |         |
| 163420    | PLATE,STAY 600x600x6 80x26 SLOT D3172     | 354     |         |
| 163421    | STAYROD 133kN 3000xM24 NON-ADJUST D7023   | 0       |         |
| 163768    | BOLT,EYE:20 MM;70 KN;SHNK LG 250 MM       | 482     |         |
| 163790    | ROD,THD:M20-2.5-6G;LG 350 MM              | 98      |         |
| 163803    | COACH SCREW,GALV 75x12 HEX HD D3090       | 26.06   |         |
| 163862    | ROD,THD:M20-2.5-6G;LG 450 MM              | 21      |         |
| 163865    | ROD THRDD:M20-2.5-6G;LG 600 MM            | 0       |         |
| 163909    | NUT,EYE 70kN FOR M20x2,5-6H BOLT D3004    | 81      |         |
| 163938    | STAPLE,GALVANISED WIRE 40LGx4WD D3129     | 100.345 |         |
| 163941    | Nail,clout 40mm galv D3169                | 9.97    |         |
| 164312    | CLIP,BONDING 22D HOLE GALV D3033          | 2278    |         |
| 164530    | SPACER:BLOCK;TOP DIA 140 X LG 400 MM      | 191     |         |
| 164551    | XARM,WOOD 3.5x140-159 TOP DIA D0063       | 24      |         |
| 164556    | XARM,WOOD 4.5x160-179 TOP DIA D0064       | 766     |         |
| 164561    | POLE:WOOD;160-179MM TOP DIA X LG 9 M      | 0       |         |
| 164567    | POLE:WOOD;180-199MM TOP DIA X LG 11M      | 0       |         |
| 164568    | POLE:WOOD;200-219MM TOP DIA X LG 11M      | 38      |         |
| 164573    | POLE:WOOD;200-219MM TOP DIA X LG 12 M     | 2       |         |
| 164579    | POLE,WOOD 14.0 X 180-199 H4 D0054         | 0       |         |
| 164580    | POLE,WOOD 14.0 X 200-219 H4 D0054         | 365     |         |
| 164583    | POLE,WOOD 16.0X200-219 TOP DIA D0049      | 25      |         |
| 164589    | POLE:WOOD;180-199MM TOP DIA X LG 9 M      | 7       |         |
| 165495    | CLAMP:P/G ;4-15 M; 4-15 T;AL-AL           | 78      |         |
| 165711    | LUG,BOLT BRASS 8-14x16F/H TRF TERM D3126  | 12      |         |
| 167492    | INSUL,L/ROD 22kV 40kN 450C/L LM D3042     | 0       |         |
| 167508    | CLEVIS-BALL 16mm 16L 80CL 120kN D6059     | 264     |         |
| 167574    | INSUL,L/ROD 22kV 40kN 450C/L HVH D3042    | 111     |         |
| 167587    | INSUL,L/ROD 33kV 40kN 570C/L HVH D3190    | 450     |         |
| 167599    | INSUL,L/ROD 33kV 120kN 570C/L HVH D3190   | 264     |         |
| 168552    | BRACKET,POLE TOP 402x60x110 ARM D3046     | 22      |         |
| 168553    | STRAP,TIE ST GALV 910x50x6 D3031          | 50      |         |
| 168745    | CLAMP,C D/END ASSY CHI 18.87 ACSR D7000   | 277     |         |
| 168754    | ARMOUR-GRIP SUSP UNIT CHICAD 18.87 D7033  | 460     |         |
| 172393    | PLATE,BLANK ALU POLE MK 25x150 D3049      | 437     |         |
| 175857    | SAG ADJUSTOR 120kN D7042                  | 264     |         |
| 175963    | SWITCH DSCNCT:3PH; 1P INLD;22 KV;630 A    | 1       |         |

| ITEM CODE | ITEM DESCRIPTION  | QTY     | Comment   |
|-----------|---|---------|---|
| 175964    | SWITCH DSCNNCT:3PH H-PL INLD;33 KV;630 A  | 1       |   |
| 182711    | ROD,THD:M20-2.5-6G;LG 750 MM  | 1977    |   |
| 185949    | GUY GRIP,DBL WRAP MAKE OFF 7/4.00 D7047   | 306     |   |
| 189400    | INSUL:STRAIN STAY 97KN IL 150/60KV  | 306     |   |
| 197853    | PIPE,NON MTLC:16 MM;LDPE;THK 2 MM   | 705.428 |   |
| 210592    | BRACKET,STRAIN OP.2 ST UTS 120kN D7039  | 270     |   |
| 216387    | SPINDLE:LONG M20 X 300MM RATCHET  | 5       |   |
| 216396    | INSUL,CAPPED POST 33kv 4kN HVH D3189  | 2       |   |
| 216687    | INSUL,CAPPED POST 22kv 4kN HVH D3017  | 25      |   |
| 219854    | SPINDLE:SHORT M20 X 50MM RATCHET  | 22      |   |
| 242420    | PIPE,NON MTLC:32 MM;LDPE;THK 2 MM   | 528     |   |
| 242692    | SPARK GAP DEVICE ASSY GALV ST D3134   | 21      |   |
| 401310    | CLAMP,STRAIN:3B;70 KN;15-6 MM   | 18      |   |
| 402493    | ARMOR ROD,HELICALLY FORMED HARE/OAK D3064   | 42      |   |
| 402501    | CLAMP,SUSP CRADLE CON 15.0-24.4 D3008   | 42      |   |
| 402509    | GUYGRIP, D/END ST COND 7/4 D3069  | 918     |   |
| 402511    | DEAD END,HELICALLY FORMED HARE/OAK D3065  | 63      |   |
| 555819    | CLAMP,THIMBLE CLEV A/ALLOY 40kN D3007   | 63      |   |
| 402577    | TIE,TOP GRVE B/HARE INLAND D3081  | 27      |   |
| 571209    | X/ARM,POLE:140-159 22MM HOLES;LG 2.5 M  | 29      |   |
| 243422    | PLATE,STAY 450x450x6 80x26 SLT D3172  | 266     |   |
| 638563    | BIRD DIVERTER:FLAPPER; BLK; SQ-CENT   | 870     |   |
| 212724    | BIRD DIVERTER:FLAPPER;YLW; SQ- CENT   | 870     |   |
| 402533    | DAMPER,VIBRAT SPIRAL 11.72-14.30 D3175  | 5       |   |
| 168960    | DAMPER,M/F VIBRATION 18.13-19.98 D7005  | 513     |   |
| 401742    | CLAMP:EUT-B;BOLT-TEE;12-21 MM;12-21 MM  | 18      |   |
| 403130    | COND,ACSR CHICADEE 18.87D UNGRS D3136   | 108000  |   |
| 403029    | COND,ACSR HARE 14.16D UNGRS D3136   | 10500   |   |
| 165768    | JOINT,M/SPAN COMP CHICADEE 18.87 D7001  | 10      |   |
|           | 10mm crosby clamps  | 337     | Contractor To supply                                |
|           | Air termination excluding LDPE Pipe   | 191     | Contractor To supply                                |
|           | 20mm galvanised conduit saddles   | 560     | Contractor To supply                                |
|           | Butyl mastic tape/putty to cover 3x extruding bolts   | 3       | Contractor To supply                                |
| 241939    | WASHER,SPRING M12 D3014   | 402     | Contractor To supply                                |
|           | D-FS-12051 gates  | 40      |   |
|           | Soil Import (compacted volume)  |         | Determine after soil classification (re-measurable) |
|           | Portland cement bags (50kg)   |         | Determine after soil classification (re-measurable) |
|           | (D-DT-0357) Rock anchor polyester grout or approved cementitious grout  |         | Determine after soil classification (re-measurable) |
|           | (Foundations in collapsible soil) D. 1,2m "Rocla" pre-cast concrete manhole sections or alternatively purpose manufactured steel rings; |         | Determine after soil classification (re-            |



| ITEM CODE | ITEM DESCRIPTION   | QTY | Comment                            |
|-----------|--|-----|------------------------------------|
|           |  |     | measurable and on site conditions) |
|           | Goal-post supports (complete) as specified in Activity stage 7 | 50  |                                    |
|           | Figure 3 labels  | 2   |                                    |

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**Part C6 Design Bill of Materials**

**PART C6.2: STRUCTURE ORDER BILL OF  
MATERIAL**

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C6.1 | Design Bill of Material           |
| Part | C6.2 | Structure Order Bill of Material  |
| Part | C6.3 | Eskom Order Bill of Material      |
| Part | C6.4 | Contractor Order Bill of Material |



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new Bophelo Substation**

**Part C6 Design Bill of Materials**

**PART C6.3: ESKOM ORDER BILL OF  
MATERIAL**

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C6.1 | Design Bill of Material           |
| Part | C6.2 | Structure Order Bill of Material  |
| Part | C6.3 | Eskom Order Bill of Material      |
| Part | C6.4 | Contractor Order Bill of Material |

| ITEM CODE | ITEM DESCRIPTION                          | QTY     |
|-----------|---|---------|
| 10270     | SOCKET-TONGUE 16mm 120kN D6061            | 264     |
| 163343    | WIRE STRAND,ST 7x4.0 1100MPA 1500m D3124  | 3978    |
| 163345    | WIRE STRAND,ST 3x3.35 1100MPA 1500m D3124 | 8010.1  |
| 163399    | THIMBLE,ST TO FIT 14mm DIA. WIRE D3026    | 306     |
| 163400    | SHACKLE,STRAIGHT PIN TYPE 70KN D3010      | 561     |
| 163402    | STAYROD 2000xM20 97kN NON-ADJUST D7023    | 67      |
| 163405    | STAYROD 133kN 2400x24 NON-ADJUST D7023    | 239     |
| 163406    | SHACKLE,STRAIGHT BOLT TYPE 120kN D7017    | 792     |
| 163419    | PLATE,STAY 340x375x6 80x26 SLOT D3172     | 140     |
| 163420    | PLATE,STAY 600x600x6 80x26 SLOT D3172     | 354     |
| 163421    | STAYROD 133kN 3000xM24 NON-ADJUST D7023   | 0       |
| 163768    | BOLT,EYE:20 MM;70 KN;SHNK LG 250 MM       | 482     |
| 163790    | ROD,THD:M20-2.5-6G;LG 350 MM              | 98      |
| 163803    | COACH SCREW,GALV 75x12 HEX HD D3090       | 26.06   |
| 163862    | ROD,THD:M20-2.5-6G;LG 450 MM              | 21      |
| 163865    | ROD THRDD:M20-2.5-6G;LG 600 MM            | 0       |
| 163909    | NUT,EYE 70kN FOR M20x2,5-6H BOLT D3004    | 81      |
| 163938    | STAPLE,GALVANISED WIRE 40LGx4WD D3129     | 100.345 |
| 163941    | Nail,clout 40mm galv D3169                | 9.97    |
| 164312    | CLIP,BONDING 22D HOLE GALV D3033          | 2278    |
| 164530    | SPACER:BLOCK;TOP DIA 140 X LG 400 MM      | 191     |
| 164551    | XARM,WOOD 3.5x140-159 TOP DIA D0063       | 24      |
| 164556    | XARM,WOOD 4.5x160-179 TOP DIA D0064       | 766     |
| 164561    | POLE:WOOD;160-179MM TOP DIA X LG 9 M      | 0       |
| 164567    | POLE:WOOD;180-199MM TOP DIA X LG 11M      | 0       |
| 164568    | POLE:WOOD;200-219MM TOP DIA X LG 11M      | 38      |
| 164573    | POLE:WOOD;200-219MM TOP DIA X LG 12 M     | 2       |
| 164579    | POLE,WOOD 14.0 X 180-199 H4 D0054         | 0       |
| 164580    | POLE,WOOD 14.0 X 200-219 H4 D0054         | 365     |
| 164583    | POLE,WOOD 16.0X200-219 TOP DIA D0049      | 25      |
| 164589    | POLE:WOOD;180-199MM TOP DIA X LG 9 M      | 7       |
| 165495    | CLAMP:P/G ;4-15 M; 4-15 T ;AL-AL          | 78      |
| 165711    | LUG,BOLT BRASS 8-14x16F/H TRF TERM D3126  | 12      |
| 167492    | INSUL,L/ROD 22kV 40kN 450C/L LM D3042     | 0       |
| 167508    | CLEVIS-BALL 16mm 16L 80CL 120kN D6059     | 264     |
| 167574    | INSUL,L/ROD 22kV 40kN 450C/L HVH D3042    | 111     |
| 167587    | INSUL,L/ROD 33kV 40kN 570C/L HVH D3190    | 450     |
| 167599    | INSUL,L/ROD 33kV 120kN 570C/L HVH D3190   | 264     |
| 168552    | BRACKET,POLE TOP 402x60x110 ARM D3046     | 22      |
| 168553    | STRAP,TIE ST GALV 910x50x6 D3031          | 50      |
| 168745    | CLAMP,C D/END ASSY CHI 18.87 ACSR D7000   | 277     |
| 168754    | ARMOUR-GRIP SUSP UNIT CHICAD 18.87 D7033  | 460     |
| 172393    | PLATE,BLANK ALU POLE MK 25x150 D3049      | 437     |
| 175857    | SAG ADJUSTOR 120kN D7042                  | 264     |
| 175963    | SWITCH DSCNCT:3PH; 1P INLD;22 KV;630 A    | 1       |

| ITEM CODE | ITEM DESCRIPTION                          | QTY     |
|-----------|---|---------|
| 175964    | SWITCH DSCNNCT:3PH H-PL INLD;33 KV;630 A  | 1       |
| 182711    | ROD,THD:M20-2.5-6G;LG 750 MM              | 1977    |
| 185949    | GUY GRIP,DBL WRAP MAKE OFF 7/4.00 D7047   | 306     |
| 189400    | INSUL:STRAIN STAY 97KN IL 150/60KV        | 306     |
| 197853    | PIPE,NON MTLC:16 MM;LDPE;THK 2 MM         | 705.428 |
| 210592    | BRACKET,STRAIN OP.2 ST UTS 120kN D7039    | 270     |
| 216387    | SPINDLE:LONG M20 X 300MM RATCHET          | 5       |
| 216396    | INSUL,CAPPED POST 33kv 4kN HVH D3189      | 2       |
| 216687    | INSUL,CAPPED POST 22kv 4kN HVH D3017      | 25      |
| 219854    | SPINDLE:SHORT M20 X 50MM RATCHET          | 22      |
| 242420    | PIPE,NON MTLC:32 MM;LDPE;THK 2 MM         | 528     |
| 242692    | SPARK GAP DEVICE ASSY GALV ST D3134       | 21      |
| 401310    | CLAMP,STRAIN:3B;70 KN;15-6 MM             | 18      |
| 402493    | ARMOR ROD,HELICALLY FORMED HARE/OAK D3064 | 42      |
| 402501    | CLAMP,SUSP CRADLE CON 15.0-24.4 D3008     | 42      |
| 402509    | GUYGRIP, D/END ST COND 7/4 D3069          | 918     |
| 402511    | DEAD END,HELICALLY FORMED HARE/OAK D3065  | 63      |
| 555819    | CLAMP,THIMBLE CLEV A/ALLOY 40kN D3007     | 63      |
| 402577    | TIE,TOP GRVE B/HARE INLAND D3081          | 27      |
| 571209    | X/ARM,POLE:140-159 22MM HOLES;LG 2.5 M    | 29      |
| 243422    | PLATE,STAY 450x450x6 80x26 SLT D3172      | 266     |
| 638563    | BIRD DIVERTER:FLAPPER; BLK; SQ-CENT       | 870     |
| 212724    | BIRD DIVERTER:FLAPPER;YLW; SQ- CENT       | 870     |
| 402533    | DAMPER,VIBRAT SPIRAL 11.72-14.30 D3175    | 5       |
| 168960    | DAMPER,M/F VIBRATION 18.13-19.98 D7005    | 513     |
| 401742    | CLAMP:EUT-B;BOLT-TEE;12-21 MM;12-21 MM    | 18      |
| 403130    | COND,ACSR CHICADEE 18.87D UNGRS D3136     | 108000  |
| 403029    | COND,ACSR HARE 14.16D UNGRS D3136         | 10500   |
| 165768    | JOINT,M/SPAN COMP CHICADEE 18.87 D7001    | 10      |

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**Part C6 Design Bill of Materials**

**PART C6.4: CONTRACTOR ORDER BILL OF  
MATERIAL**

|      |      |                                   |
|------|------|-----------------------------------|
| Part | C6.1 | Design Bill of Material           |
| Part | C6.2 | Structure Order Bill of Material  |
| Part | C6.3 | Eskom Order Bill of Material      |
| Part | C6.4 | Contractor Order Bill of Material |

| ITEM CODE | ITEM DESCRIPTION   | QTY |
|-----------|--|-----|
|           | 10mm crosby clamps   | 337 |
|           | Air termination excluding LDPE Pipe  | 191 |
|           | 20mm galvanised conduit saddles  | 560 |
|           | Butyl mastic tape/putty to cover 3x extruding bolts  | 3   |
| 241939    | WASHER,SPRING M12 D3014  | 402 |
|           | D-FS-12051 gates   | 40  |
|           | Soil Import (compacted volume)   |     |
|           | Portland cement bags (50kg)  |     |
|           | (D-DT-0357) Rock anchor polyester grout or approved cementitious grout   |     |
|           | (Foundations in collapsible soil) D. 1,2m "Rocla" pre-cast concrete man-hole sections or alternatively purpose manufactured steel rings; |     |
|           | Goal-post supports (complete) as specified in Activity stage 7   | 50  |