Eskom National Transmission Company South Africa ™	**Scope of Work**	**NTCSA**

Title: **Scope of Works for Steel Member Replacement and Anti-Climb Devices on NTCSA Power Lines in Central Grid**

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Compiled by	**Functional Responsibility**	**Authorized by**
NBM Mthiyane	MS Masilana	M Nyalunga
Initials and Surname	**Initials and Surname**	**Initials and Surname**
Technical Support	**Senior Advisor**	**Middle Manager L&S**
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1. Introduction

Tower steel member thefts remain a critical issue within National Transmission Company South Africa (NTCSA). Perpetrators systematically dismantle tower steel members, either by unbolting or cutting them, with the intent to profit from selling the steel to scrapyards or the black market. The consequences are twofold, in that there is a risk of towers collapsing with the potential for permanent line failure leading to prolonged outages, and the exorbitant cost of repairs.

As a result, there exists an ongoing imperative to replace stolen or damaged tower steel members promptly in an effort to maintain the structural integrity of the towers. In extreme cases, complete tower replacement becomes necessary following a collapse due to such theft. These incidents carry substantial financial implications and pose serious safety risks for National Transmission Company South Africa.

This scope of work documented here outlines the remedial measures to be executed proactively on towers situated within Central Grid. The aim is to mitigate the impact of tower steel member theft, enhance structural integrity, and ensure continuity of supply.

In addition to the theft of steel members from the towers, there is also a concern regarding the theft of anti-climb devices during these criminal activities. The theft of anti-climb devices poses a statutory risk as it allows perpetrators and members of the public to access live parts of the power line. Anti-climb devices are a statutory requirement for safeguarding personnel and the public, and therefore, the scope of work outlined in this document also includes the repair and installation of these devices.

2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

The purpose of this scope of work is to outline the requirements for work to be carried out safely and in accordance to the standards during the replacement and/or repair of tower steel members and anti-climb devices on NTCSA tower structures.

2.1.2 Applicability

This document shall apply to National Transmission Company South Africa, SOC Ltd Reg No 2021/539129/30, within Central Grid.

2.1.3 Effective date

This document is effective from the date it is authorised.

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] ISO 9001 Quality Management Systems

[1] 240-47172520 - TRMSCAAC6, The Standard for The Construction of Overhead Power lines.

[2] 32-418 - Work at Height Standard.

[3] 32-846, Eskom Operating Regulations for High Voltage System (ORHVS).

[4] 240-75883230 - Refurbishment of Steel Power Line Structures Standard.

[5] Equivalent group sizes for tower retrofits MEMO.

[6] 240-75884508 - Specification for Anti-Theft measures

[7] 240-147174608 – Anti-Vandal measures guideline for overhead power lines

[8] 240-132479779 - Climbing of Structures on Live Power Lines to Gain Access for Non-electrical Activities.

[9] 32-727: Safety, Health, Environment, and Quality (SHEQ) Policy

2.2.2 Informative

[10] Occupation Health and Safety Act and Regulations: Act 85 of 1993.

2.3 Definitions

2.3.1 Anti-Climb Device

Is part of a tower structure preventing unauthorized access to the upper part of the tower structure. It can consist of barbed, or razor wire supported by steel brackets which is strung around the tower with a certain spacing. It can also consist of metal spikes suitably attached and spaced around the tower legs or tower body.

2.3.2 Central Grid

Central grid is a Business Unit of National Transmission Company South Africa which is situated within the borders of Gauteng province, where some lines also transverse into neighbouring provinces but demarcated to Central Grid.

2.3.3 Contractor

An employer who performs construction work and includes principal contractors.

2.3.4 Construction Work

The installation, erection, dismantling or maintenance of a fixed plant where such work includes the risk of a person falling.

2.3.5 Swage Bolt

Is a fastener, alternative to a bolt-nut pair, where the joint strength is obtained by applying an axial force to the bolt and which is maintained by deforming a metal collar in contact with the bolt shaft and one of the components of the joint.

2.3.6 Tower Steel Member

Section of angled steel forming part of the general structure of a lattice steel structure.

2.4 Abbreviations

Abbreviation	Explanation
ACD	Anti-Climb Device
AVB	Anti-Vandal Bolts
BOQ	Bill of Quantities
OI&E	Open, Isolated and Earthed
OHS Act	Occupational Health and Safety Act 85 of 1993
ORHVS	Operating Regulations For High Voltage Systems
NGL	Natural Ground Level
NTCSA	National Transmission Company South Africa
SOW	Scope of Work
PPE	Personal Protective Equipment

2.5 Roles and Responsibilities

2.5.1 Lines & Servitudes Manager

The Lines & Servitudes Manager shall ensure that there is a budget and resources available to execute this scope of work.

2.5.2 Contract Manager

The Contract Manager shall ensure that the contract is managed as per NTCSA procurement and contract standards and policies.

2.5.3 Compliance Manager

The Compliance Manager shall ensure that all work is done according to the ORHVS regulations and that the contractor complies and is authorised to execute the scope in NTCSA Central Grid.

2.5.4 Senior Advisor

The Senior Advisor shall provide the specifications and requirements for tower steel members and anti-climb devices replacements.

2.5.5 Technical Support

The Technical Support shall compile the scope of work document which is to be used for the replacement of tower steel members and anti-climb devices.

2.5.6 Senior Supervisor

The Senior Supervisor shall ensure that the line inspection maintenance is done to identify damaged/Stolen/vandalised tower steel members and anti-climb devices that need to be replaced/repaired.

2.6 Process for Monitoring

N/A

2.7 Related/Supporting Documents

N/A

3. Scope of Work

The following points must be adhered to before any work can commence on the tower structures: and any.

- NTCSA shall provide the required materials to the contractor to execute the scope, i.e. steel lattice members, AVB, ACD.
- The contractor shall provide all necessary tools, machinery, vehicles and resources required to execute the scope safely and according to the relevant standards and procedures.
- No work may commence without an approved Safe Work Procedure and all work at heights must adhere to “32-418 - Work at Height” and “240-132479779 - Climbing of Structures on Live Power Lines to Gain Access for Non-electrical Activities” standards.
- Work in close proximity of live conductors must be done during an outage (OI&E) and ORHVS must be adhered to.
- For site access, “Access to Private Property (Includes Strategy on Accessing Game Reserves/Farms/Small Holdings)” 240-80605256 standard must be adhered to.
- Once a contractor has been appointed, it will be their duty to liaise with landowners to access towers during execution.
- Work will be issued on an “as and when” required basis and a representative from the grid team shall escort the contractor at the start of the project to the towers in question to familiarise the contractor with the routes and landowners. Additional work will be issued as and when required.
- It should be noted that certain towers will require 4 x 4 vehicles to gain access due to difficult terrains and uneven servitude roads.

- Access roads used during a project that have been damaged will need to be rehabilitated by the contractor before leaving the site.
- It should be noted that some sites have access issues like waterlogging, illegal dumping & illegal mining, etc. and such should be reported and extra security precautions be taken at the cost of the contractor. The site must be thoroughly inspected by the contractors and Central Grid personnel to determine the BOQ before any work commences. Ensure that security has been arranged as these are high risk arears (Crime) where the towers are vandalised.
- All steel members and anti-climbs on the tower must be closely inspected. Any damaged members or anti-climbs must be replaced. Where a tower has been vandalised to a point that it is deemed unsafe to climb, Central Grid and Lines Engineering Services must be informed to provide and assessment report of the tower and recommendations.
- Adherence to 32-727: Safety, Health, Environment, and Quality (SHEQ) Policy when establishing site and during execution. All waste generated during execution to be disposed as per regulations at a registered and approved waste disposal site.
- The use of a fire-retardant ground sheet will be advantageous as it will minimise fire risk and ensure clean working conditions.
- First aid kit, fire extinguisher and additional water for firefighting to be readily available at worksite. (Sparks by cut of saw).
- All relevant PPE must be available and used.
- Risk assessment and toolbox talks to be held prior to commencement with work.

Error! Reference source not found., shows the minimum safe working clearances between the live conductors and persons, machinery or objects that needs to be adhered to at all times during inspection and/or execution. When the minimum safe working clearance between persons, machinery or objects and live **apparatus** or **lines** cannot be maintained such live **apparatus** or **lines** shall be **isolated** and **earthed** as a **safety panel (OI&E)**.

3.1 Anti-Climb Device Installations & Repairs (Under Non-Outage Conditions)

In compliance with the OHS Act, it is a statutory requirement that all towers be fitted with effective anti-climbing devices. The ACD installed on existing towers will be as per Figure 1: Razor flat wrap ACD drawing for inland applications as shown in Appendix A.

Installation of anti-climbing devices shall adhere to the following requirements as stated in “240-47172520 - TRMSCAAC6, The Standard for The Construction of Overhead Powerlines” under section 5.2.7 along with the relevant task manual/s. Refer to “240-75884508 - Specification for Anti-Theft measures” section 4.4 & 4.5 and “240-147174608 – Anti-Vandal measures guideline for overhead power lines” for additional details on the anti-vandalism requirements to be used while executing the scope.

a) Anti-climbing devices shall be designed and installed for each tower. These are to be attached at a height of approximately 3.5 m above ground level as per the relevant tower drawing. Swaged bolts should be used for attaching the anti-climbing devices to the tower.

b) Anti-climbing devices should be razor wrap-type as shown in Figure 2: Connection of support wire, end connections and crimping methods.

c) Razor wire anti-climbing devices shall be formed by stringing onto projecting steel supporting members, fencing wire consisting of 2.5 mm double-strand uni-directional twist pattern, galvanised steel razor wire. Spacing between strands shall not be more than 100 mm centres, the first wire being not more than 100 mm from the tower face and forming an overhang of not less than 500 mm beyond the outer face of the tower. This overhang distance shall be maintained at the tower corners. On small anti-climbing devices such as on legs of guyed "V" towers, twin single strand razor wire may be used.

d) The strands of razor wire shall be secured at intervals, not exceeding 2 m, by spacers formed by pieces of the same razor wire bound to the strung barbed wire by galvanised binding wire. Where razor wire other than galvanised steel is specified, the spacers and binding wire shall be compatible.

e) Where the design of the towers is such that they can be climbed on the inner face, a similar anti-climbing device shall extend from the inner face of the tower inwards.

f) Where the need arises, palisade type anti-climb shall be installed instead of razor wire anti-climb. This will be done to further prevent theft of the anti-climb devices. Palisade anti-climb devices will be installed around each leg of the tower and secured with swage bolts.

g) Remove damaged / old barbed / razor wire from structure

h) Ensure all mounting brackets are in a good working condition and properly secured to the structure.

Therefore the summarised scope of work detailed above is as follows:

- Identify and quantify vandalised towers.
- Collect material from the Grid.
- Install/repair defective or missing anti-climb devices.
- Conduct quality checks together with the Grid.
- All steel and/or nuts/bolts (AVB) not used as well as off-cuts needs to be returned to NTCSA Central Grid at a venue provided by the grid.

3.2 Tower Steel Member Replacements (Under ARC-OFF & Non-Outage Conditions)

NTCSA Central grid shall supply the steel lattice members, AVB and anti-theft measures to the contractor before execution. Measurements need to be done in order to determine the specific length, size and whole spacing of replacement member and ensure that all loose hanging steel is removed or secured by means of bolts, safety ropes, heavy-duty cable ties or chains. Where there are challenges obtaining the exact steel or tower member sizes that have been stolen, Table 2: Tower member replacement sizes is to be used which stipulates the steel sizes that should be used when replacing stolen members

All members, at least up to anti-climbing device level, must be fitted with swaged bolts in all holes. In addition, the same members must be marked with the words “NTCSA” every 300 to 500 mm where off-cuts have not been made, the grid will provide steel that is marked and contractor to mark as and when required where off-cuts are not marked.

Refer to “240-75884508 - Specification for Anti-Theft measures” and “240-147174608 – Anti-Vandal measures guideline for overhead power lines” for additional details on the anti-vandalism requirements to be used while executing the scope.

Therefore the summarised scope of work detailed above is as follows:

- Replacement of vandalised/stolen tower members on various lines.
- Collect material from the Grid
- Install/repair defective or missing tower members
- Conduct quality checks together with the Grid
- All steel and/or nuts/bolts not used as well as off-cuts needs to be returned to NTCSA Central Grid.

Table 1: Safe working clearances between

MINIMUM SAFE WORKING CLEARANCES			
A.C. Voltages	**Clearance**	**D.C. Voltages**	**Clearance**
765 kV	6.0m	600 kV	5.0m
400 kV	4.0m	450 kV	4.0m
275 kV	3.0m	300 kV	3.0m
220 kV	2.5m	150 kV	2.0m
132 kV	2.0m		
88 kV	1.5m		
66 kV	1.3m		
1-44 kV	1.0m		

Note 1: If the above clearances cannot be adhered to the line shall be opened, isolated and earthed (OI&E) in accordance with ORHVS Section 5 and the clearances contained in this section shall be applicable
Note 2: Supervision and dedicated control measures shall be in place to guarantee adherence to the above clearances while non-electrical activities are in progress.
Note 3: Atmospheric conditions such as wind, lightning and air moisture content, as well as the proximity of other services and structures to the safe zone, shall be considered and risks mitigated.
Note 4: The safe zone on the structure shall be sufficient to accommodate all team members safely. The amount of people on the structure shall be kept to a minimum.
The method to be used will be determined prior to commencement of work (OI&E, Off ARC or Non-outage conditions). There must be a thorough pre task plan and risk assessment done to ensure the method selected can be done safely and in accordance to the ORHVS.

Table 2: Tower member replacement sizes

Required size (Original Tower Design)	**Replacement size**
• 45x45x3/45x45x4/45x45x5 • 50x50x3/50x50x4/50x50x6	50x50x6
• 60x60x4/60x60x5/60x60x6/60x60x8/60x60x10 • 65x50x6/65x50x8 • 70x70x6/70x70x8/70x70x10 • 80x80x6/80x80x10 • 75x50x6/75x50x8 • 80x60x6/80x60x8	80x80x10
• 80x80x12/90x90x6/90x90x8/90x90x10/90x90x12 • 90x65x6/90x65/8/90x65x10 • 100x100x8/100x100x10x100x100x12 • 100x65x8/100x65x10 • 100x75x8/120x75x8/100x75x10/100x75x12	100x100x12
• 120x75x8/120x75x10/120x75x12 • 120x120x8/120x120x10/120x120x12/120x120x15	120x120x15

4. Acceptance

This document has been seen and accepted by:

Name	**Designation**
Biko Dzhalagome	Middle Manager Compliance & Assurance
Mbali Nyalunga	Middle Manager Lines and Servitude
Heavyman Kobani	Contract Manager
Mac Masilana	Senior Advisor Lines and Servitude
Abduraghman Hassen	Senior Advisor Lines and Servitude
Rethabile Mzizi	Engineer Lines and Servitude
Patrick Thwala	Senior Supervisor
Nathan Molapo	Senior Supervisor
Koketso Molekwa	Senior Supervisor
Edwin Mafolo	Senior Supervisor
Collin Sibeko	Senior Supervisor

Name	Designation
Ronald Chauke	Quantity Surveyor

5. Revisions

Date	Rev.	Compiler	Remarks
August 2024	0	NBN Mthiyane	Compilation of Scope

6. Development Team

The following people were involved in the development of this document:

- Mac Masilana
- Zandile Zwane
- Nokuthula Mthiyane

7. Acknowledgements

N/A

Appendix A – Anti-Climb Device Drawings

Figure 1: Razor flat wrap ACD drawing for inland applications is a generic drawing of the razor flat wrap ACD for inland and it must be noted that for transmission towers there are usually six or ten rows of steel wire.

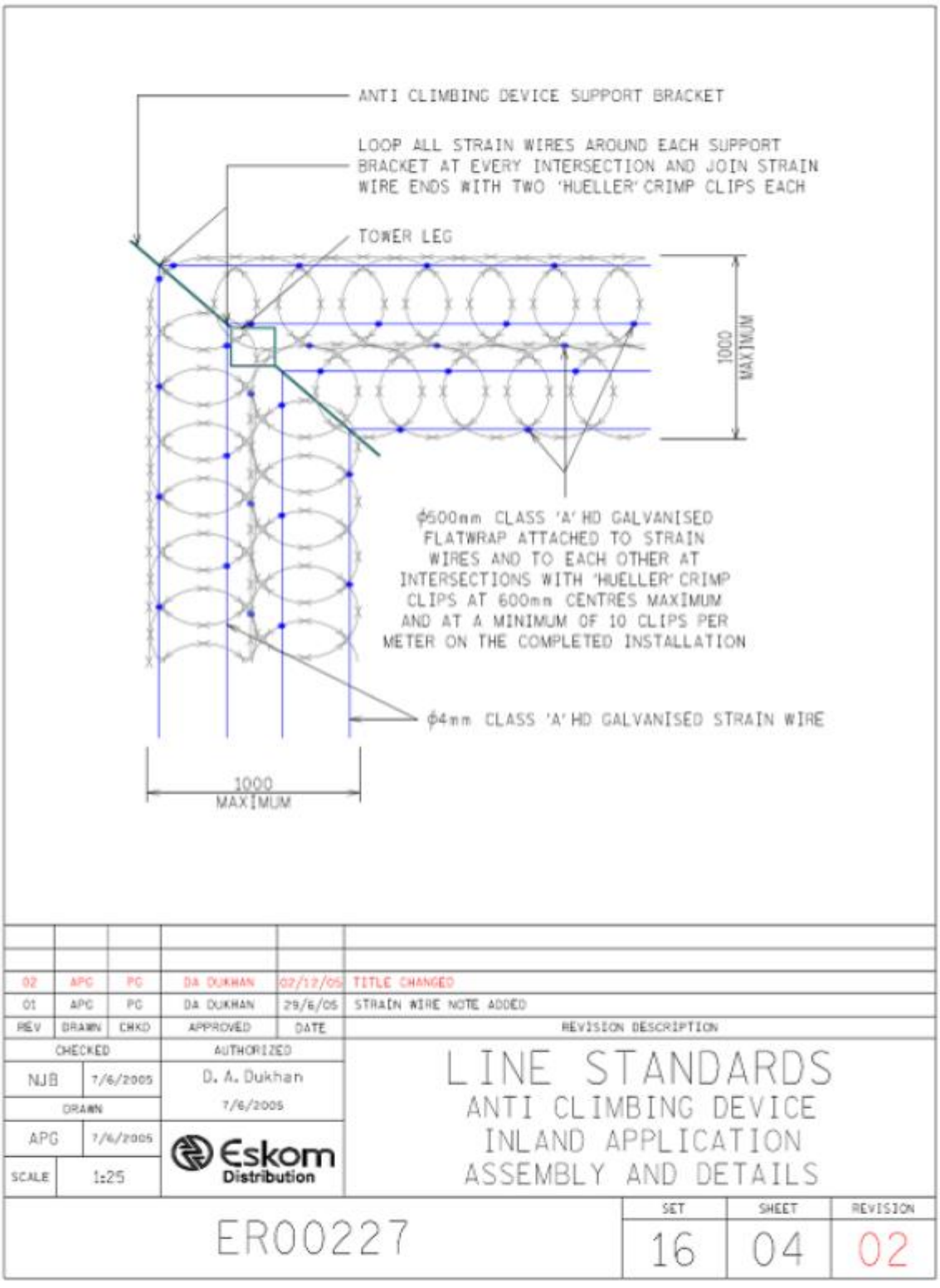
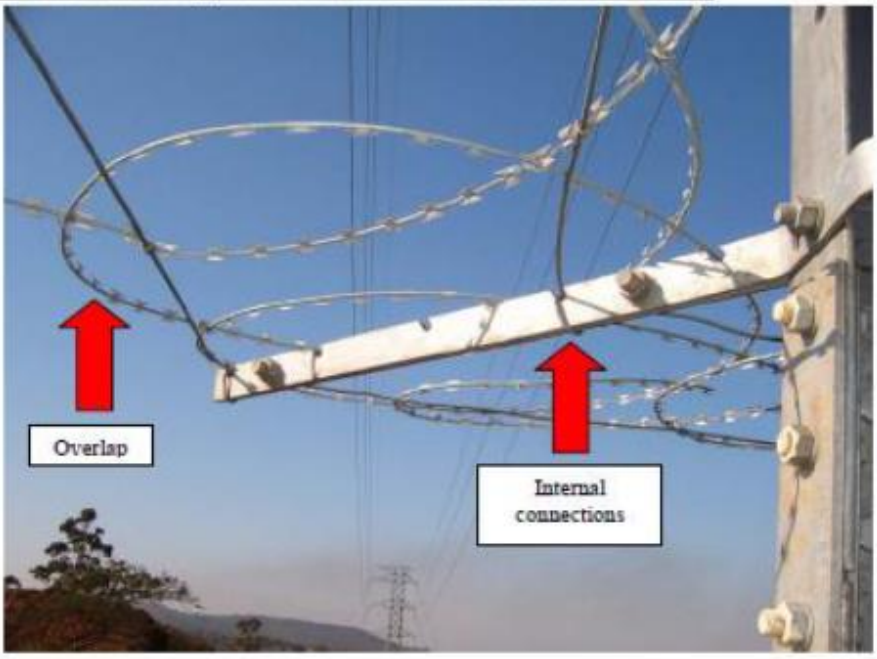


Figure 1: Razor flat wrap ACD drawing for inland applications

Insert 4: Connection of support wire onto ACD arm and razor wire overlap



Placement and fitting of flat wrap razor wire

The flat wrap razor wire shall be laid on top of the galvanized support wire. The radius of the razor wire shall extend over the inner and outer support wires to allow an overlap. This is depicted on the above photograph. Attention shall be paid to the inner corner where the wires numbered 5 meet at the leg of the tower. The razor wire shall extend over this area sufficiently to prevent any person from passing through it. At the intersection points of the support wire and the flat wrap razor wire a C-crimp shall be applied to connect the two together. There shall be no loose connections at any point where the razor wire overlaps the galvanized wire. All critical points shall be connected with a maximum distance between C-crimps of 500mm.

Insert 5: Crimps and method of end connection

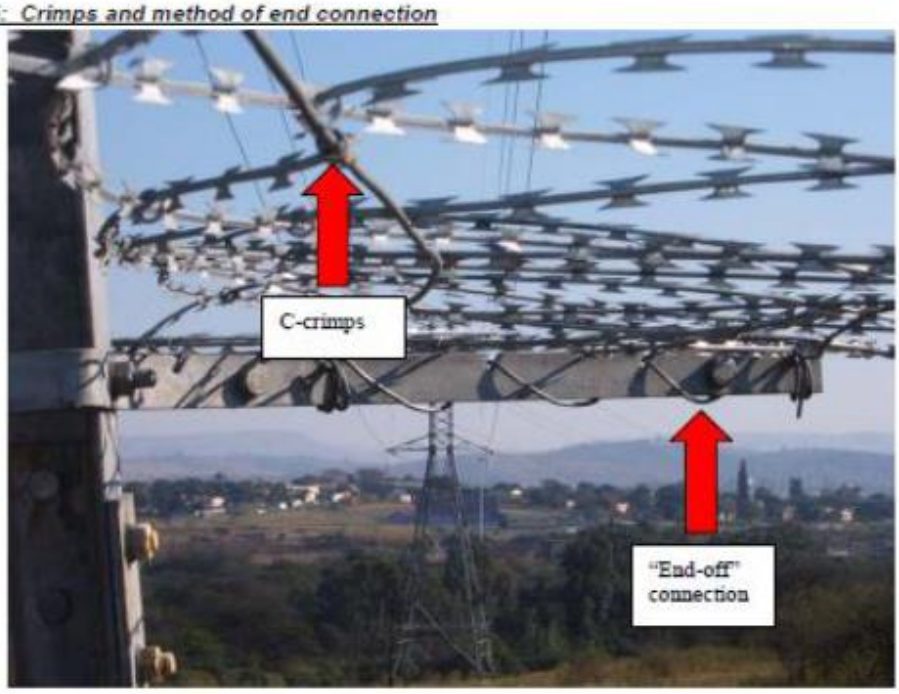


Figure 2: Connection of support wire, end connections and crimping methods