KETRACO
Kenya Electricity Transmission Company Limited
"Building a World Class National Grid"

Kawi Complex, Block B,
Popo Lane, off Red Cross, South C,
P. O. Box 34942 - 00100, NAIROBI
Phone: 020 4956000, 0719018000, 0732128000
Web: www.ketraco.co.ke I email: info@ketraco.co.ke

Our ref: KETRACO/PT/015/2020

26th November, 2020

NOTICE TO ALL INTERESTED BIDDERS

RE: TENDER ADDENDUM AND CLARIFICATION 1

TENDER FOR RE-DESIGN, CONSTRUCTION & COMMISSIONING OF REROUTING OF SECTION FOR MANG'U-GITHAMBO 132KV TRANSMISSION LINE - TENDER NO: KETRACO/PT/015/2020

The following amendments are made to the specified provisions of the tender for procurement of Contractor for Re – Design, Construction and Commissioning of Rerouting of Section for Mang'u – Githambo 132kV Transmission Line Tender Number KETRACO/PT/015/2020. Save where expressly amended by the terms of this clarification, the Principal Tender Document shall continue to be in full force and effect.

Find herein the ADDENDUM and CLARIFICATION No. 1, consisting of FOUR (4) pages into the Principal Tender Documents. This document should be returned along with dully filled Form of Tender.

S/NO	BIDDERS QUERY	KETRACO RESPONSE
1.	The measurement list does not match the design provided. The design and the BOQ do not provide tower measurement	Please refer on clause 2.2.5 of preliminary design and appendix 1A-1 of the tender document. The same attached on this clarification.
2.	The transmission line is 50km, but the conductor is long 4km.OPGW also has this problem	The 4KM length of conductor is what is needed as per contractor's scope of works. The same is specified as 5km for the OPGW.
3.	The design doesn't have the quality of fittings, insulators and ground materials. The unit is LOT. The price cannot be quoted if there is no quantity clearly stated	LOT means Lump sum. It is the responsibility of the bidder to determine the total items and total cost associated with each particular item as stated in BOQ and give a lump sum figure (as LOT where applicable) for such item.
4.	The number of towers provided in the design is 150 bases, but BQ contain LOT and there are only two types of towers, we don't understand the meaning. Can we get a clarification or explanation	The bidder to quote for the only type of tower (Type S or Type T or both towers inclusive of all fittings/extensions) to use to execute the scope of works as per his/her design. The

		design must meet the prevailing ground situations.

For any clarifications, kindly email ftsuma@ketraco.co.ke, pkubasu@ketraco.co.ke,

The Tender Closing Date remains as per the bid document. All other terms and conditions of the tender document remains the same. Attached are the preliminary designs and drawings.

PETER NJEHIA
SENIOR MANAGER, SUPPLY CHAIN

132 kV OH line single circuit between Thika and Githambo. Preliminary design

TCS
Technical Consulting Engineering Services

Avenue Pasteur, 6H
1300 Wavre
Belgium

MINISTRY OF ENERGY

132kV OVH Line THIKA-GITHAMBO (SINGLE CIRCUIT)

Preliminary design

Technical note

Written : R. Sverzutti

Summary

1 Scope of work

The project shall involve the construction of a 132kV single circuit OVH transmission line from Thika to Githambo. The line will be constructed in self-supporting lattice steel towers and with ACSR 175mm² "Lynx" conductor.

The scope of work for the OVH transmission line will cover design, testing, manufacturing, supply, shipping, transport from docks to stores, delivery on site, unloading, transporting to site, installation of foundations and all associated civil works, erection of the towers, installation of insulators, conductors, earth wire and all associated fittings.

The OVH transmission line shall be constructed completely in accordance with the specifications and associated design and general arrangement/outline drawings.

The OVH transmission line 132kV Thika - Githambo is approximately 50 km of single circuit three-phase with ACSR 175mm² "Lynx" conductor per phase and single OPGW earth wire.

2 Characteristics of the line

2.1 Conductors and fittings

The power conductor proposed shall be Aluminium Conductor Steel Reinforced (ACSR) 175mm² - code name: Lynx and shall comply with IEC 60889.

In order to prevent fatigue of power conductor and earth wire due to repeated vibrations caused by breeze, the countermeasures shall be applied:

2.1.1 Technical details of conductor

Technical details	Proposed
Type	ACSR Lynx
Nominal section	175
Tolerance of diameter : Aluminium Steel	 ± 1,0 % ± 2,0 %
Minimum tensile strength after stranding : Aluminium Steel	 17,2 kg/mm² 128,5 kg/mm²
Minimum coating weight of zinc	
Calculated section : Aluminium Steel	 184,73 mm² 43,10 mm²
Outside diameter	19,60mm
Unit weight of conductor	864 kg/km
Ultimate tensile strength (UTS)	
DC resistance at 20° C	0,181 ohm/km
Approximate current carrying capacity	527A

2.1.2 Technical details of earth wire

Technical details	Proposed
Type	OPGW
Number of fibres	12
Fault current (1 sec) (in kA)	10
Initial temperature (°C)	25
Leading edge (µs)	1.2
Lightning initial peak current (kA)	100
Tail (µs)	50
Power follow through coulomb	200
Cycling rest TA (°C)	-1
Cycling rest TB (°C)	40
Maximum outer diameter	-
Maximum weight	-

2.1.3 Conductor sag design

The sags shall be computed under the following conditions:

Conditions	Proposed
Most severe design conditions	Max. wind pressure under min. T°
Max. wind pressure on conductor	385 N/m²
Max. air temperature	40° C
Min. air temperature	5° C
Min. conductor temperature	0° C
Max. conductor temperature	75° C
Average conductor temperature (EDS)	25° C
Safety factor : Max. working tension to UTS Every day stress to UTS	 More than 2,50 More than 5,00
Young's modulus of : Aluminium Steel	 6 300 kg/mm² 21 000 kg/mm²
Linear expansion coefficient	17,8 x 10-6

2.1.4 Insulator units and fittings

The insulator units shall be designed to withstand the design service voltages including lightning, switching and power frequency, the mechanical loads relevant to the installation service maintenance conditions, the service temperature and environmental effects.
The insulators should withstand wind pressures of up to a maximum of 385N/m².
All fittings to make insulator set complete for beneficiary use shall be supplied and included in the rate for each insulator unit.

The electrical and mechanical specifications for the insulators are:

Specifications	Proposed
Maximum System Voltage (kV)	145
Pollution category	Standard
Dielectric	Silicon rubber
One minute power frequency withstand voltage, 50Hz, wet (kV)	275
Lighting impulse withstand voltage 1,2/50 pos. (kV)	650
Power arc current	25kA, 0,5sec
Minimum creepage distance (mm)	4495
Specified mechanical load tension (kN)	70 / 100
Minimum arc gap (mm)	1250
Material fittings	Steel
Material of rod	E-CR Glass
Material of housing and sheds	HTV silicone
Socket	IEC 60120/16
Ball	IEC 60120/16
Arcing rings material	Steel
Arcing rings	IEC 61284

2.2 Towers

2.2.1 Type of towers

The towers shall be self supporting galvanised steel lattice type with body and hillside extensions. The hillside extensions shall be applied for towers legs on the slope so that legs are suited to the original slope of tower site and also that excessive land cutting around foundations and land collapse is prevented.

The following tower types shall be designed for the project in order to meet various tower positions and loadings economically.

- Type **S** use at tangential positions or angle points up to 2° of horizontal deviations, provided with suspension insulator sets.
- Type **L** use at positions of light angle up to 15° of horizontal deviations, with tensions insulator sets.
- Type **M** use at positions of medium angle up to 30° of horizontal deviations, with tensions insulator sets.
- Type **H** use at positions of heavy angle up to 60° of horizontal deviations, with tensions insulator sets.
- Type **HS** use at positions of specifically heavy angle up to 75° of horizontal deviations, with tensions insulator sets.
- Type **T** use at positions of line termination or 60° of horizontal angle deviations, with tensions insulator sets.

2.2.2 Design of towers

Towers shall have the arrangements and configurations shown in the drawings included with the technical note. They shall be designed to resist the specified ultimate system loading. Clearances between live parts and supporting steelwork, and between the phase conductors and ground or other obstacles shall be as specified.

All tower designs shall be such as to facilities inspection, painting, maintenance, repairs and operation with the continuity of supply being the prime consideration.

The design shall be such that the number of different parts shall be as few as possible to facilitate transport, erection and inspection. The maximum weight of heaviest single member should be limited to that within the normal capability of the proposed erection equipment

Main leg members of lattice steel towers shall be formed of the maximum single lengths appropriate to the body or leg extensions and shall not without the employer's approval incorporate additional spliced sections.

For lattice steel towers, a fully triangulated system of bracings shall preferably be adapted. If full triangulation is not adapted, the overall stability and secondary bending stresses must be considered in the design.

Cross arms shall be so arranged that they can be disconnected in the plane of the horizontal face of the support without disturbing any members forming part of the support body.

2.2.3 Minimum clearance of live parts to towers

The minimum electrical clearance of live parts to earthed structures for the project shall be as follows:

- In still air (vertical position) : 1350 mm
- Under 20° swing of suspension insulator set or jumper conductors : 1350 mm
- Under 40° swing of suspension insulator set or jumper conductors : 1140 mm
- Under 60° swing of suspension insulator set or jumper conductors : 830 mm

2.2.4 Minimum ground clearances of conductors

- Above general terrain : 7,10 m
- Above main roads : 7,50 m
- Above other power lines : 3,20 m
- Above other telephone lines : 3,20 m
- Above railways : 8,50 m

2.2.5 Height of towers

Height of towers shall be determined in the under mentioned way:

$H = Gc + Sg + Li + Hc + Hg$

Where :

H = total height of tower;
Gc = necessary ground clearance of power conductor above ground or other objectives;
Sg = maximum conductor sag;
Li = length of a suspension insulator;
Hc = vertical spacing of upper conductor cross arm spacing;
Hg = vertical spacing between upper conductor cross arm and overhead earth wire.

Towers shall be provided with body extensions in a 3m step to a standard height. In addition in the body extensions, each leg will have hillside extensions in a 1m step to suit for the original ground slope.

2.2.6 Design spans

The design of all towers shall provide for the following basic, wind and weight spans:

- Basic span (in m): 350m;
- Wind span (in m): 350m;
- Weight (in m):
  700m (for tower type S)
  1200m (for other tower types)
- Uplift weight (in m):
  0m (for tower type S)
  -300m (for other tower types)

2.2.7 Design loads

The following loads shall be applied in the design of towers:

- Wind loads :

  On power conductor and earth wire: 385N/m²

  On insulators sets: 385N/m²

  On tower structure: 690N/m²
  (On the projected area of structure members)

- Maximum working tensions of conductor and earth wire :

  Conductor "Lynx": 22 500N

  Earth wire: 14 100N

- Vertical loads :

  Tower structures: actual weights of towers structures including accessories.

  Power conductor and earth wire: weights of cables of specified weight span with accessories.

  Erection loads: such loads as "workers "weights on tower members, reaction of temporarily backstays during stringing operation, etc.

- Horizontal angle effect: horizontal component of maximum working tension of conductors and earth wire due to the specified horizontal angle deviation.

2.2.8 Design conditions

- **Assumed Normal Loading Condition**

The assumed maximum simultaneous working loading on towers shall be as follow:

Vertical loads:	as above mentioned;
Transversal loads:	wind loads horizontal and angle deviation effects;
Longitudinal loads:	wind loads and erection loads but together with maximum working tensions of conductors and earth wire for towers type T.

- **Assumed Broken Wire Condition**

Under the condition, any one conductor or the earth wire is assumed to be broken at their maximum working tensions in addition to the loads under the normal condition. In the case of tower type S, the pull will be assumed to be reduced to 70% of the specified maximum working tensions.

- **Safety factors**

The following safety factors for the tower structures shall be applied in the design.

More than 2,50 for the synthetic maximum load under the normal loading condition.

More than 1,25 for the synthetic maximum load under the broken wire condition.

2.2.9 Towers accessories

The following accessories shall be provides for every tower.

- **Anti-climbing device and climbing steps.**

All towers will be provided with the device on each leg at the height of 3 to 5m above the highest ground level at tower locations.

Each tower shall be provided with step bolts of an approved type on one side of the tower at a space no more than 380mm, starting immediately above the anti-climbing device and continuing to the earth wire.

- **Danger, Number and Helicopter patrol plates.**

  All towers will be provided with the device on each leg at the height of 3 to 5m above the highest ground level at tower locations.

2.2.10 Materials

All steel shall comply with BS EN 10025 or equivalent, unless otherwise specified and shall be suitable for all the usual fabrication processes, including hot and cold working within the specified ranges.

The quality of finished steel shall be in accordance with BS EN 10163 or equivalent. All steel shall be free from blisters, scale, laminations, segregations and other defects. There shall be no rolling laps at toes of angles or rolled in mill scale.

The following grades of steel shall be applicable:

- Mild steel : S235JRG2 or S275JR
- High tensile steel : S355JR for section less than 20mm thick
  S355JO for section greater or equal to 20mm thick

2.2.11 Minimum width and thickness of members

The required minimum thickness and diameter to be applied in member and bolts design as follow:

	Proposed
Minimum thickness for leg member and cross arm	6 mm
Minimum thickness for other members	4 mm
Minimum bolt diameter for members carrying calculated stress	12 mm
Minimum bolt diameter for secondary members without calculated stress	12 mm

2.2.12 Design criteria – compression formulae

The detailed tower design shall be in accordance with the principles set out in the "Guide for design of Steel Transmission Towers, manual 52 published by the American Society of Civil Engineers.

2.3 Foundations

2.3.1 Type of foundations

Standard foundations shall be of concrete pad and chimney type and will be classified into the following 4 types to suit the various soil conditions at tower sites.

Type of foundations	Ultimate bearing capacity (daN/cm²)	Unit weight of soil (T/m³)	Angle of repose (°)
Light (L)	6	1.6	30
Medium (M)	4	1.5	20
Heavy (H)	2	1.4	10
Special	-	-	-

In implementation the project, every tower position shall be sounded for determination foundation type to be applied.

Special foundations will be of rock anchor, piled or raft type which shall be finally designated in accordance with results of soil tests at each site.

Piled foundations shall be of either pre cast concrete or in situ concrete pile.

2.3.2 Design of foundations

For assuming soil resistance for uplifting load foundations, undercut practice will be specified to be applied at stiff ground.

For the design of foundations, the safety factors will be:

- 2,50 for the synthetic maximum load under the normal loading condition.
- 1,50 for the synthetic maximum load under the broken wire condition.

3 Preliminary design of towers

3.1 132kV OHV line Thika - Githambo (single circuit)

The line route not yet determine, we have to estimated ± 150 towers as follow:

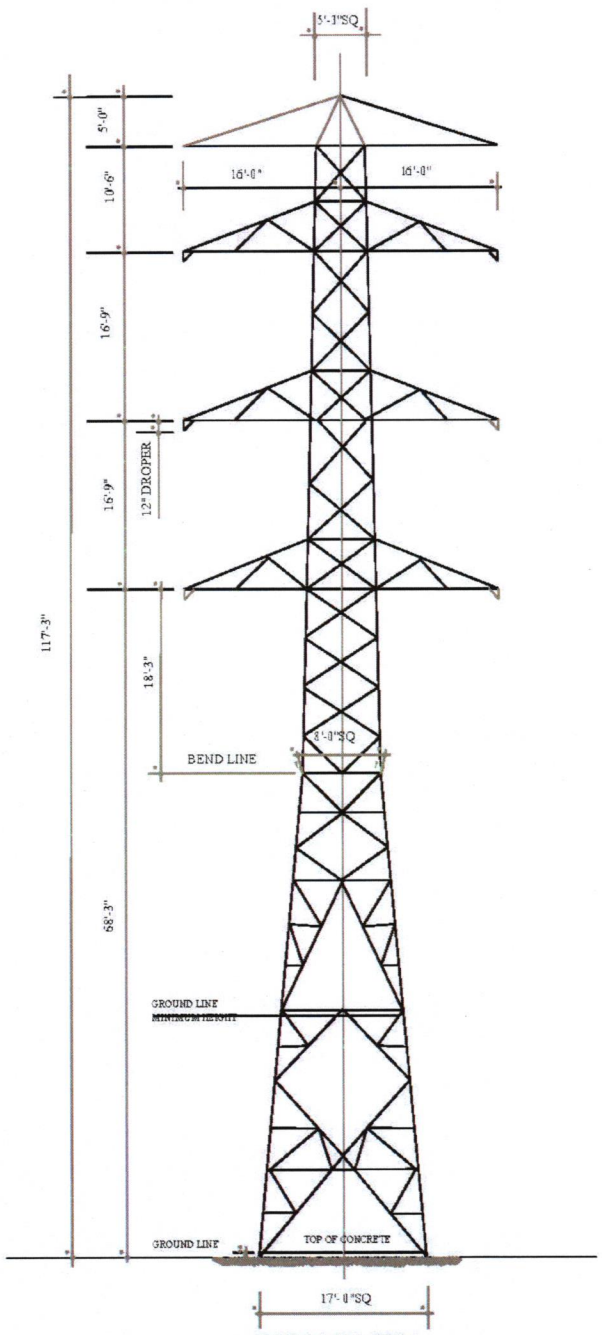
Tower type	Number	Weight/tower	Total weight	Foundations	
				Concrete (m³/tower)	Steel (kg/tower)
S±0	66	2495	164 670	6.17	494
S+3m	21	2835	59 535	6.17	494
S+6m	10	3175	31 750	6.17	494
L±0	15	3015	45 225	8.61	689
L+3m	10	3455	34 550	8.61	689
L+6m	4	3895	15 580	8.61	689
M±0	13	3325	43 225	8.97	718
M+3m	1	3835	3 835	8.97	718
M+6m	2	4345	8 690	8.97	718
H±0	2	4595	9 190	12.17	974
H+3m	0	5265	0	12.17	974
H+6m	1	5935	5 935	12.17	974
HS±0	2	4655	9 310	13.16	1053
HS+3m	1	5315	5 315	13.16	1053
HS+6m	0	5985	0	13.16	1053
T±0	1	4595	4 595	12.26	981
T+3m	1	5265	5 265	12.26	981
T+6m	0	5935	0	12.26	981
Total	**150**		**446 670**	**1092.21**	**87430**

For the foundations, the values are estimated with a type of soil "light" (L).

3.2 Outline of the towers

See appendix 4.1.

Appendix 1 A-1



STANDARD HEIGHT

G/A OF 132KV STEEL TOWER
SUSPENSION TOWER

	DATE	SIGN
APPROVED		
CHECKED ENGINEER I/C		
CHECKED HEAD D'MAN		
DRAWN		
TRACED		

REF	REVISION	DATE	SIGN

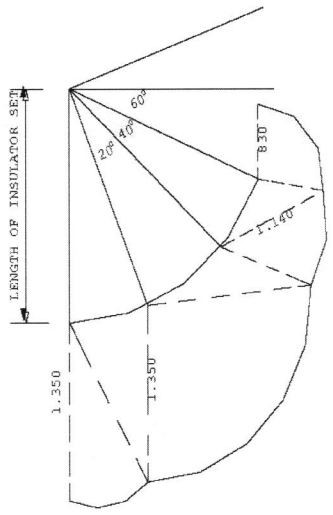
TITLE

GENERAL ARRANGEMENT OF TOWER

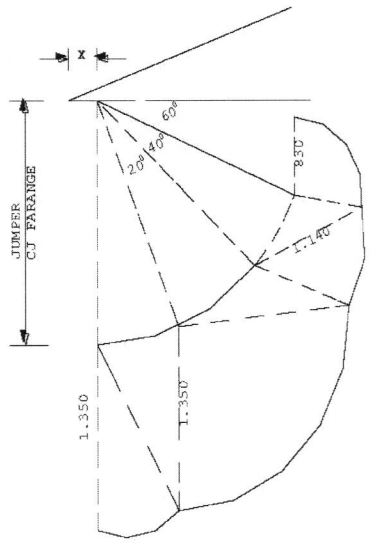
APPENDIX 1.A.1

Appendix 1 A-2

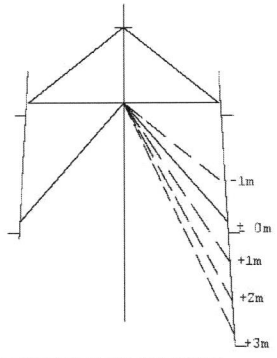
CLEARANCE DIAGRAMS



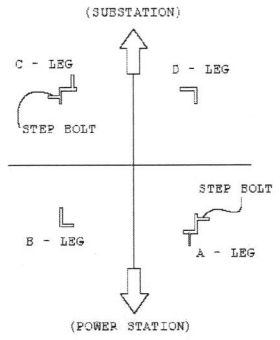
SUSPENSION TOWER



TENSION TOWER



LOWEST PANEL OF TOWER
AND HILL SIDE EXTENSION



LEG AND STEP BOLTS

	DATE	SIGN
APPROVED		
CHECKED ENGINEER I/C		
CHECKED HEAD D/MAN		
DRAWN		
TRACED		

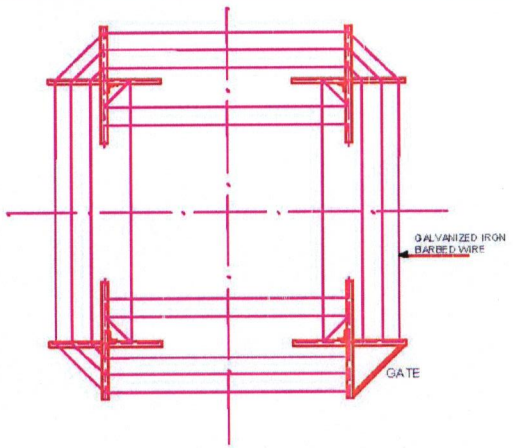
REF	REVISION	DATE	SIGN

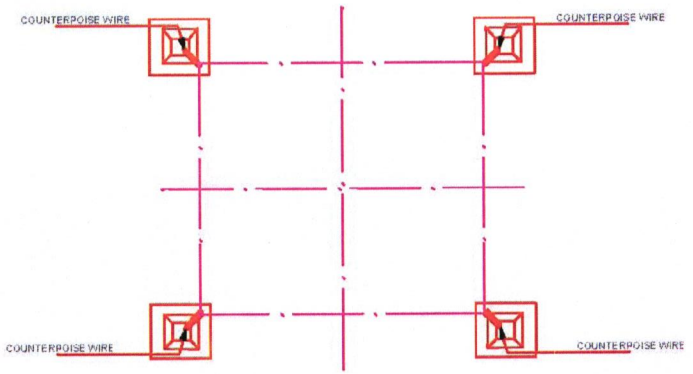
TITLE

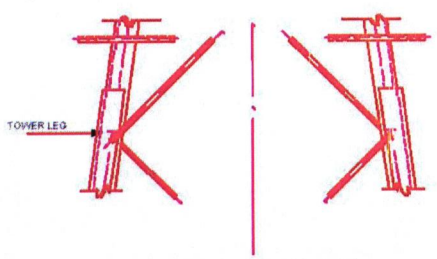
CLEARANCE OF TOWER

APPENDIX 1.A.2

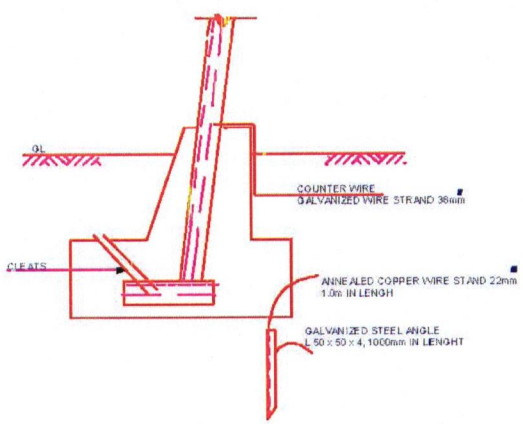
Appendix 1 A-3







ANTI - CLIMBING DEVICE



CLEAT AND GROUNDING ANGLE

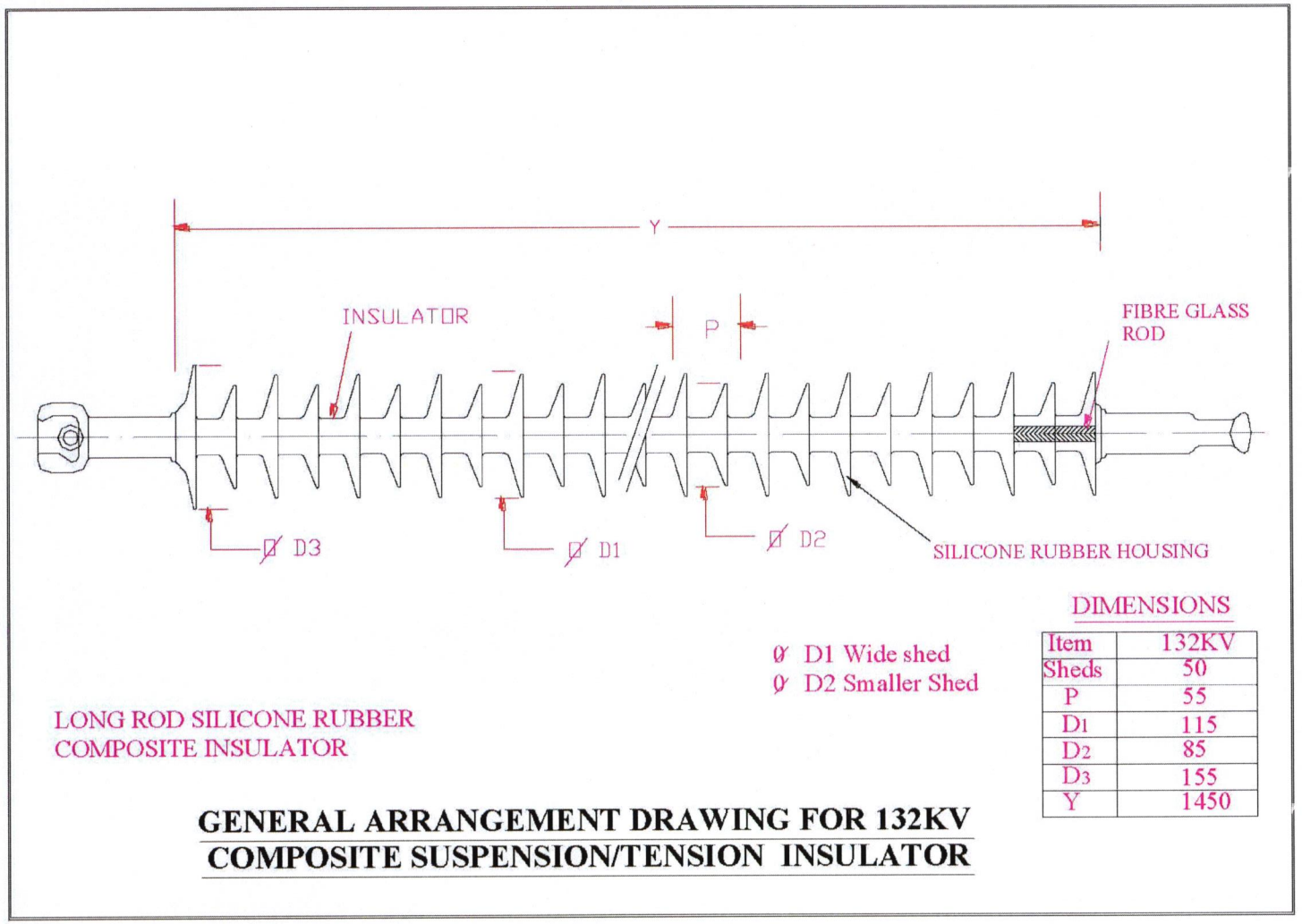
	DATE	SIGN
APPROVED		
CHECKED ENGINEER I/C		
CHECKED HEAD D'MAN		
DRAWN		
TRACED		

REF	REVISION	DATE	SIGN

TITLE **ANTI - CLIMBING DEVICE AND GROUNDING SYSTEM**

APPENDIX 1.A.3

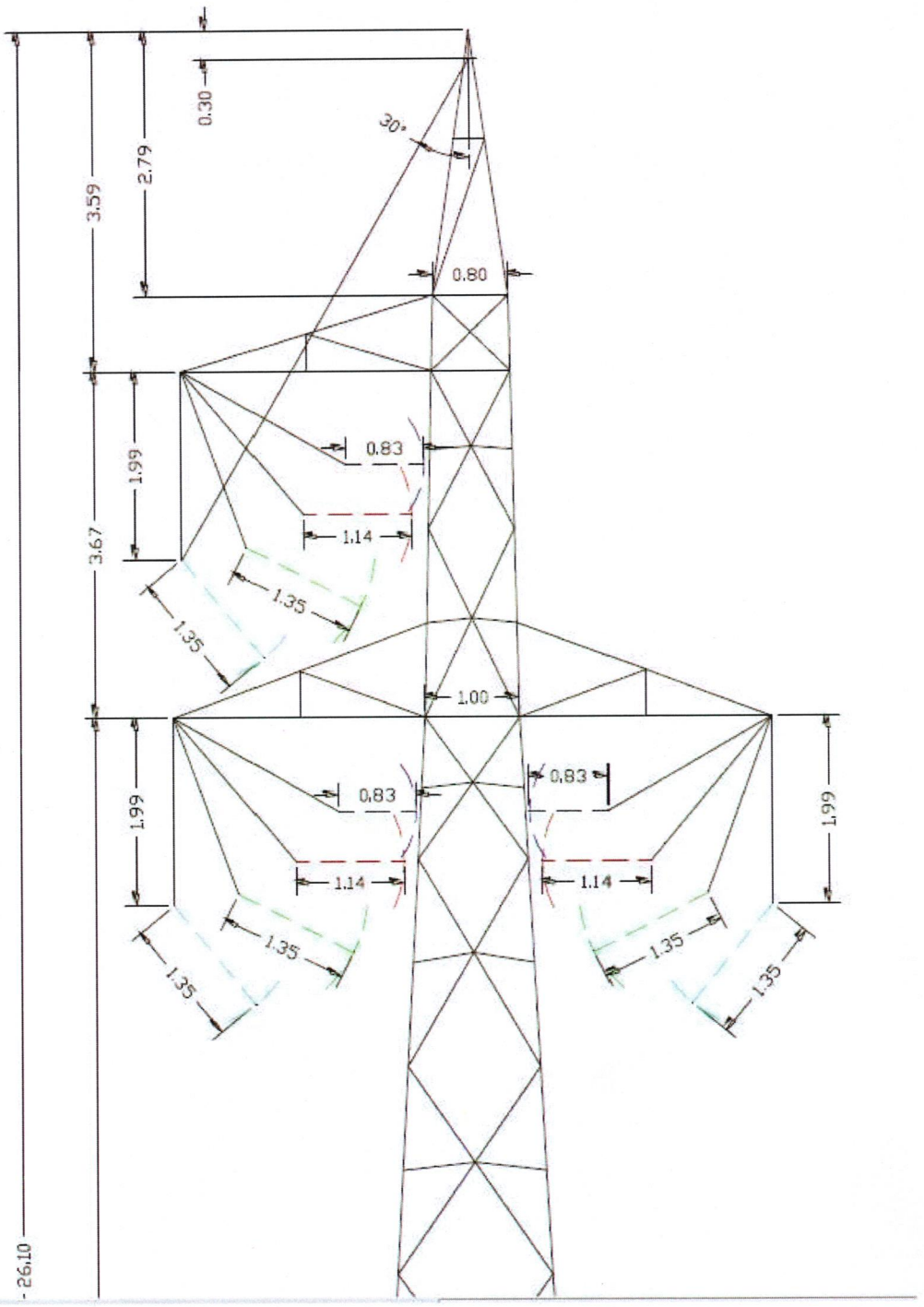
Appendix 1.A.4

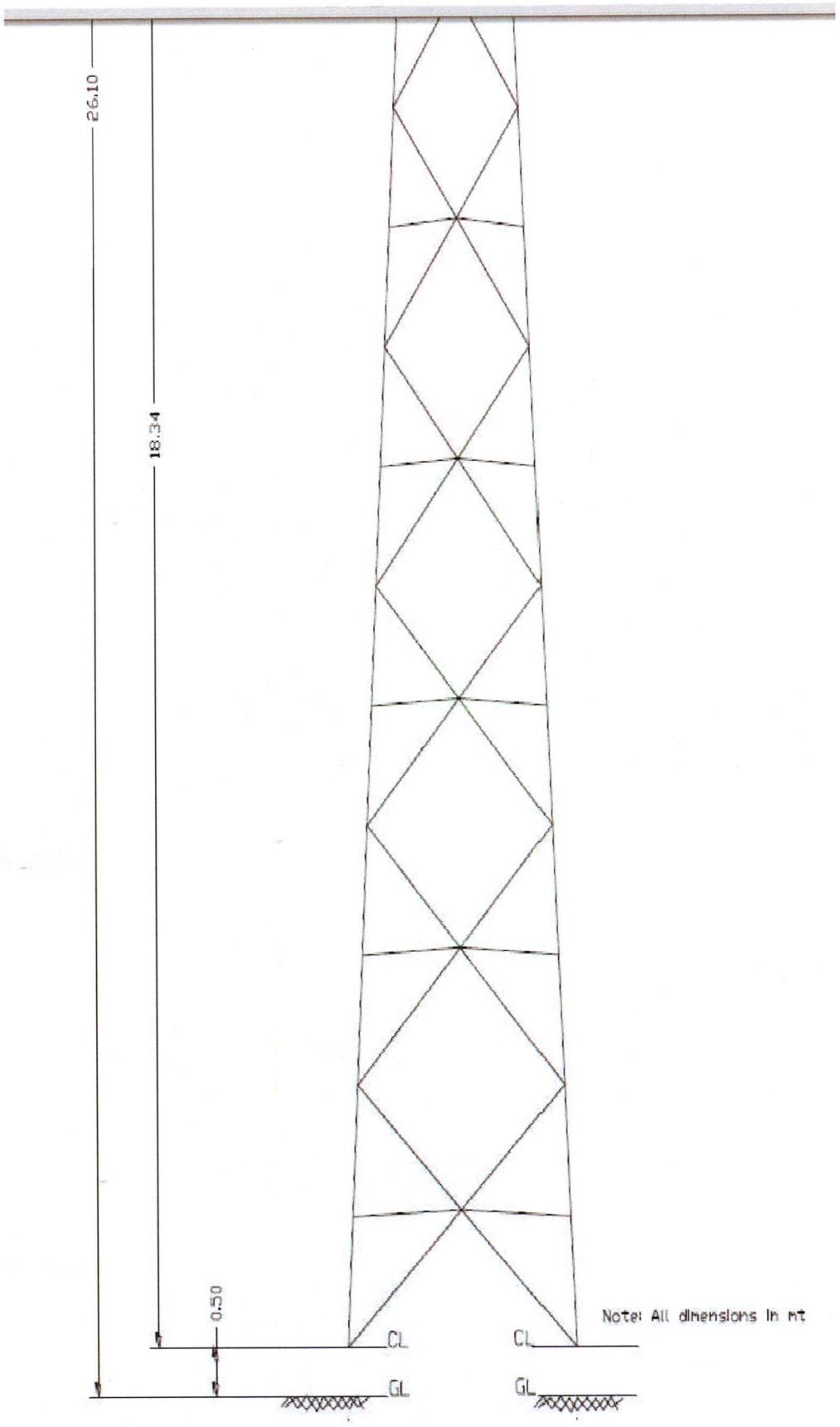


DIMENSIONS

Item	132KV
Sheds	50
P	55
D_1	115
D_2	85
D_3	155
Y	1450

GENERAL ARRANGEMENT DRAWING FOR 132KV COMPOSITE SUSPENSION/TENSION INSULATOR


0.30
30°
2.79
3.59
0.80
0.83
1.99
1.14
3.67
1.35
1.35
1.00
0.83
0.83
1.99
1.99
1.14
1.14
1.35
1.35
1.35
1.35
26.10


26.10
18.34
0.50
CL
CL
GL
GL
Note: All dimensions in mt