



ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

**PROSPECTS FOR IMPLEMENTING MULTIPLE CIRCUIT
SUPPORTING TOWERS ON HIGH VOLTAGE
TRANSMISSION LINE IN ETHIOPIA**

A thesis submitted to the school of graduate studies of
Addis Ababa University
In partial fulfilment of the requirements for the Degree of
Master of Science in Civil Engineering
(Structural Engineering)

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As members of the examining board of the final M.Sc. Open Defense, we verify that we have read and evaluated the thesis prepared by **Addis Mehari**, entitled: **Prospects for Implementing Multiple Circuit Supporting Towers on High Voltage Transmission Line in Ethiopia** and recommend for acceptance as a fulfilment of the requirement for the degree of **Master of Science in Civil Engineering (Structural Engineering)**.

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Abstract

Currently Ethiopia is under growing economy related to infrastructure, agriculture as well as industry parks. And for all these activities electric power is very essential to execute the said works effectively. On current basis, there are numerous power transmission and substation construction projects that have been executed and also on progress which are intended to fulfill the demands of the society by supplying the needed power for its intended purpose.

Among the works that contribute for the growing economy in Ethiopia is, the construction of power plants, which can generate up to 6450MW, dispersed all over the country. A good example will be the Grand Ethiopian Renaissance Dam Project. This power generated from such sources should be transmitted to the intended destination (like industries, city electrical systems, etc...) successfully and cost effectively. Meanwhile, it is observed that only single and double circuit steel tower structures being used in Ethiopia which for the growing demand of the society, related to power, implementation of modified steel structures that can carry many conductors will be of great help in relation to construction cost as well as effectiveness especially in Urban area.

This paper studies the prospects in instigating Multi – Circuit steel tower structures to the current practice in Ethiopia. And accordingly about 9.5% gain on material, transportation as well as construction cost was seen comparing two 500kV double circuit transmission line with the proposed ideal 4 – Circuit carrying transmission line assuming almost suave terrain. In addition to that, more than 50% benefit was also observed from the analysis with regards to the right of way compensation cost. Besides, while comparing suspension ($0^0 - 2^0$), tension ($0^0 - 30^0$) and angle towers ($30^0 - 60^0$) between single and double circuit 132kV and 230kV transmission line projects constructed in Ethiopia, more than 50% saving in weight has been observed for suspension towers of both 132kV and 230kV lines. And while implementing Multi – Circuit tower structures maintenance difficulty as well as security issues (i.e. regarding theft against members of the tower) should also be given due attention. Above all the findings of this paper will be expected to assist as an additive in the creation of an Ethiopian Code Standards for the planning, modeling, analysis, design, detailing and erection of power transmission structures.

1. Chapter One

Introduction

To this end in Ethiopia, the high voltage power transmission system projects have been commonly executed from 132kV to 400kV which exercises only single or double circuit transmission line systems. In the later stages, it was possible to upgrade up to 500kV where a good example will be the project from the Great Ethiopian Renaissance Dam to Holeta substation via Dedessa substation. But still the transmission line uses double circuit phase sequence where only six quadruple conductors will be carried on one structure resulting in the need to construct two towers to carry the designed amount of conductors.

Future researches should also focus on extra high voltage (EHV) transmission lines for Ethiopia which will help the power demand – supply phenomenon following its growing economy.

This paper will be focusing on implementing Multiple - Circuit transmission line supporting structures by studying the prospects to see the demerits in relation to security and maintenance or the adverse advantages as it is deemed to follow the green technology ideology and in relation to cost minimization aspects.

1.1 Background of Transmission Lines

Transmission line is an integrated system consisting of conductor subsystem, ground wire subsystem and one subsystem for each category of support structure [1]. Generally power transmission tower structures support phase conductors and shield wires of a transmission line [2]. Mechanical support of transmission line represents a significant portion of the cost of the line and they play an important role in the reliable power transmission. They are designed and constructed in wide variety of shapes, types, sizes, configuration and materials to meet their intended purpose [1]. One of the criteria to say a transmission line is cost effective is Right Of Way (ROW). It is the right to claim a land strip by various Electrical utilities for erection, operation, maintenance and repair the transmission line facilities. Its width relies on the line voltage rating, height of the structure, electromagnetic fields intensity and structure of the tower [3]. Configuration of new MVMCT (Multi Voltage Multi Circuit Transmission) lines using same old ROW with tolerable broadening can be applied to the old transmission lines in order to dismantle or renovate so that transmission line of higher voltage rating of MVMCT line can transmit power between major substations while that of lower voltage line

can transmit power between smaller substations [3]. And speaking of extra high voltage (EHV) transmission line systems, Korea also constructed and completed its first double-circuit (EHV) transmission line in the year 1998. It is environmentally acceptable design with the capacity to transmit 765kV with east to west and south to north interconnections. These circuits were operated at 345 kV until the 765-kV gas-insulated substations were commissioned in May 2002. Since then, the circuit lines have been operating at 765 kV system without troubles. About 689 tubular-steel towers support these transmission lines having an average height of 95 m (312 ft.) [9].

In Germany, new transmission lines are designed not less than 2 circuits. The most common situation is 4 circuits on one tower, and the maximum circuits are 6 on one tower. Other situation is 4 circuits of 400kV on one tower, 400kV+220kV+110kV on one tower, 6x110kV on one tower, 2x380+1x230+1x110kV on one tower [16]. See Figure 1 for Double Circuit and Figure 2 for Multi – Circuit structural arrangements [18]:

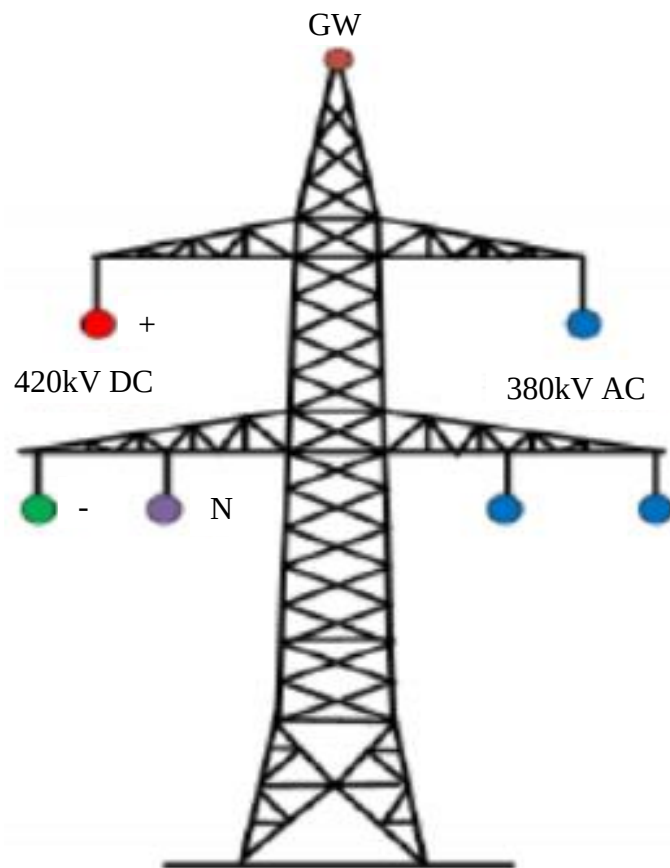


Figure 1: Double Circuit Line Supporting Lattice Steel Structure

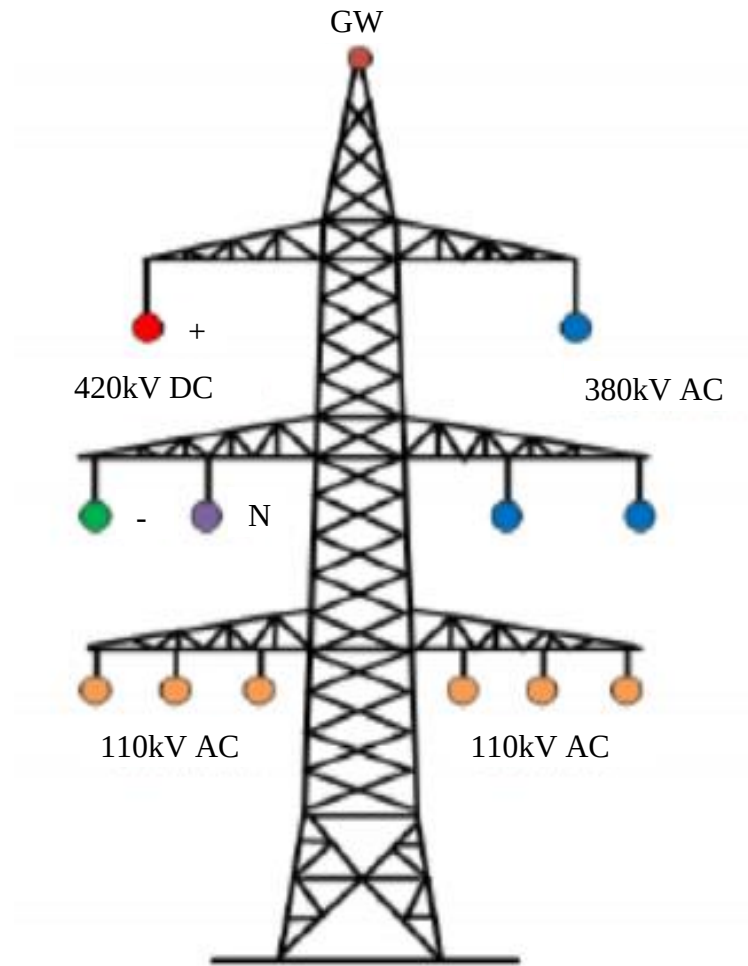


Figure 2 : Multiple Circuit Line Supporting Lattice Steel Structures

The figure above is a Multiple Circuit Multiple Voltage Tower Structure supporting 420kV, 380kV & 110kV high voltages together in one for a certain transmission line [18].

The supporting structure types used in transmission line generally fall into one of the three categories: lattice, pole and guyed. In one of the three types, the cost ranges from one fourth to half of the transmission line cost and hence optimum design gives reasonable savings. Consequently, transmission line towers should be designed for structural and electrical requirements for a safe and economical design [2].

Thus giving due attention for the different types of structures supporting high voltage transmission line conductors will be of great use in order to study the best option to minimize cost as well as environmental friendly design.

1.2 Statement of the Problem

Power demand from the society needs to be supplied in a safe, effective, reasonable investment cost as well as environmental friendly way. But, currently in Ethiopia, such practice is not exercised well on different transmission line projects that have been executed and also that are on progress. In other words the right of way corridor requirements as well as investment cost escalations seen from the existing projects shows that further adoption of new technologies in the type of structure to be implemented for future projects should be assessed rigorously.

In addition to the above narration, the transmission line tower congestion (i.e. on the outgoing and incoming faces of a certain substation due to lines carrying the same or different voltages aligned in parallel) will also create land acquisition problems by raising the amount of compensation money to be paid to the related society, especially in the urban areas, because only single or double transmission line is being exercised resulting in a requirement of larger right of way clearance area as they will be aligned parallel.

Therefore if the capacity of the steel tower structure is increased by altering the above stated usual trend to a different type (like a Multiple Circuit supporting steel structure), at least the same amount of power will be transmitted with a single tower instead of twin or three towers thereby decreasing the compensation cost, clearing of trees (i.e. in relation to the environmental prospect) as well as investment costs.

1.3 Objective of the Study

1.3.1 General Objective

The main aim of this study is to introduce Multi – Circuit power transmission lines in the light of the country's huge power generation program which will reflect the possibility of enhancing the supply of high voltages with a cost effective and environmental friendly way.

1.3.2 Specific Objective

- Analysis of the different countries practice regarding the use of optimized structures (like Multi – Circuit transmission line towers) for long distance transmission lines.
- Reflecting on pros and cons of implementing Multi – Voltage and Multi – Circuit transmission lines on the current practice in Ethiopia.
- Conceptual discussion on the requirements and analysis procedure needed for the design of transmission line towers using different tower related software like PLS-TOWER.
- Provision of recommendations, with respect to the analysis results, that will assist the power supply construction industry and policy makers.

2. Chapter Two

State of the Art Review

General Overview

Multiple – Circuit High voltage transmission line system technology have been have used since 1970's in developed countries, such as USA, Germany and Japan. And in developing country, it is started from 1990s, such as: Brazil, India, Korea and China. Japan is the first country in Asia for using this technology. The most circuits on one tower is 8, and most of the 110kV Transmission Line is 4 circuits on one tower. For 500kV Transmission Line, it is always with 4 circuits (2x500kV+2x154kV) [16]. These type of transmission line systems should also be practiced in Ethiopia following the growing electricity demand in the future as it will enhance the power transmission process in an environmental friendly and cost effective manner. And of course, the demerits in relation to maintenance or security should also be given due attention.

2.1 Types of Tower

The main factor of any electrical power transmission line is transmission tower. The Main parameters of high voltage transmission lines are mainly dependent on voltage levels. There are different types of towers used for electrical power transmission lines [5]. And these towers are generally categorized in several ways (i.e. based on use, based on configuration and based on number of circuits).

I. Based on Use

Suspension Tower

Mainly the Suspension towers are on the way of that straight line of transmission line. It may also vary to a maximum degree of 5 angle. The high voltage suspension towers are designed to carry the weight of the conductor in straight line position. Most of towers in any transmission lines fall into this type of tower category and construction cost of suspension type transmission lines are much cheaper compared to other types of transmission lines. These type of towers are used on transmission lines for straight run or for small angle of deviation up to 2° or 5°. Conductor on suspension towers may be supported by means of I-string, V- string or the combination of I & V strings [5].

Tension Tower

Electrical Tension towers are used at locations where the angle of deviation is more than degree of 5. These towers are also known as angle towers and the tower are designed to take the tension load of the cable. Tension towers are mostly used for turning points and for the section isolating locations. The piece of line from one angle tower to other angle tower is known as section where the length may vary and depend on the geographical location. All the towers in between the section are suspension towers. In addition, tension towers can further be according to deviation angles: For instance; $0^{\circ} - 10^{\circ}$, $10^{\circ} - 30^{\circ}$, $30^{\circ} - 60^{\circ}$ [5]. See below the suspension and angle tower arrangement figure.

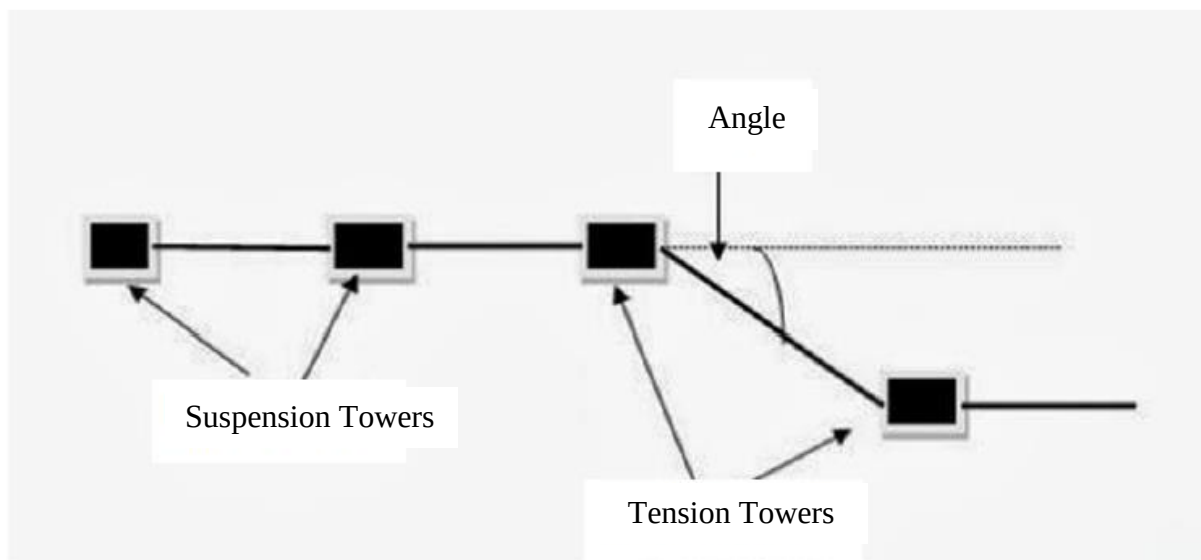


Figure 3 : Suspension and Angle Tower

The case of practice in Ethiopia dictates that the angle of deviation varies as tabulated below [6]:

Table 1 : Angle of Deviation Practice in Ethiopia

Tower Type	Suspension	Tension - I	Tension - II	Terminal
Angle of Deviation	$0^{\circ} - 2^{\circ}$	$0^{\circ} - 30^{\circ}$	$30^{\circ} - 60^{\circ}$	$0^{\circ} - 60^{\circ}$

Transposition Tower

Transposition towers are specially used for transposing the conductors of three-phase line. Transposition arrangement is also called span transposition. These type of towers are widely used in long transmission line [5]. See figure 4 below example of transposition tower with vertically configured conductors for a double circuit transmission line [12]:

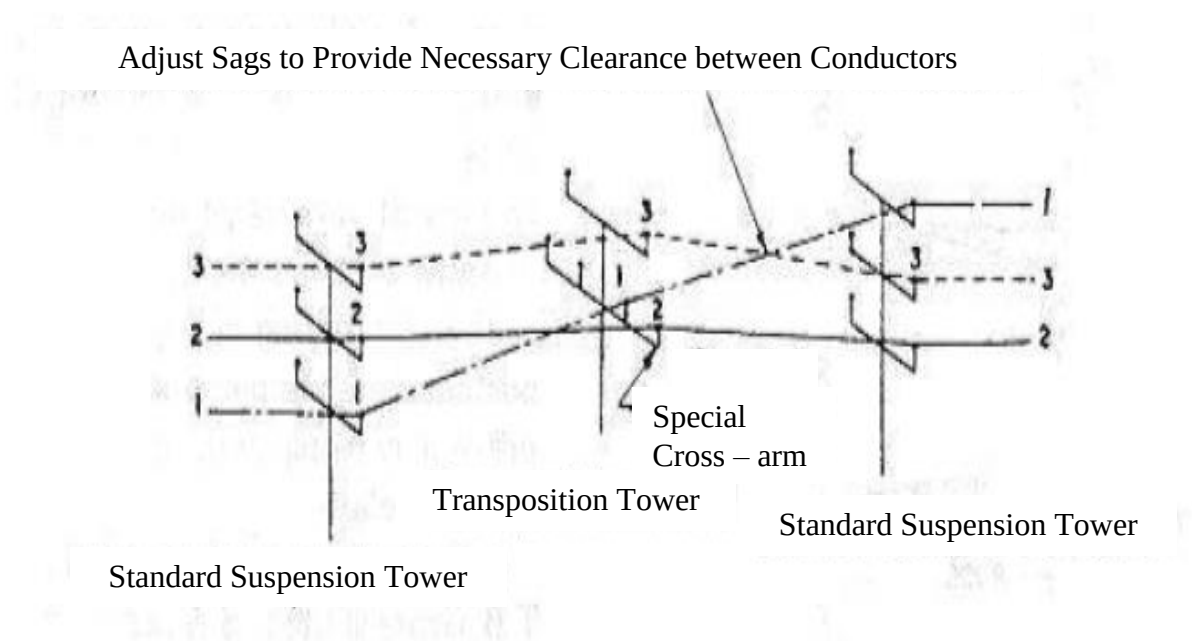


Figure 4 : Transposition Tower for Double Circuit Transmission Line

Special Tower

These towers are used at locations such as those involving long-span river crossings, valley crossings, power line crossings from above existing lines, power line crossings bellow existing lines (Gantry type structures), tapping to existing lines, special termination towers etc. The cost for special tower is much higher than suspension tower line costs. The design of special tower bases mainly on the location. These towers are also widely used for tapping existing lines and special termination towers falling on the line route [5].

II. Based on Configuration

Horizontal Configuration of Conductors

In such configurations, the conductors are aligned horizontally with suspended and tensioned insulators where the tower height will be minimized compared with other type of towers. This is because, the ground clearance requirement is equal for all the conductors that are aligned in parallel horizontally thereby resulting in a greater right of way clearance requirement.

Vertical Configuration of Conductors

As its name indicates, in this type of configuration, conductors are aligned vertically. And the height of these type of tower structure configuration is higher than towers with horizontal configurations due to the clearance requirements between conductors vertically. Since conductors are aligned vertically the length of cross arms are shorter than that of horizontally configured towers and hence, there will be a lesser right of way requirement.

Insulator Configuration

Insulators support conductors either by I-string or V-string configuration. Meanwhile, the application of V-string design is becoming increasingly common particularly at higher voltage levels and in areas of restricted right of way where the reduction in the right of way results from the elimination of the insulator swing. Saving of steel weight for the tower will also be experienced due to the reduced clearance requirements. However the flash over strength is significantly reduced for a V-string in the center phase due to proximity effects and therefore greater number of insulators is required.

In areas with mild or no contamination, application of V or I-string will be based on economy while on vice versa V-strings will function better as they self-clean more effectively than I-strings due to the fact that both sides of each insulator shed are exposed to rain [12]. See figures below for the insulator arrangements [15]:

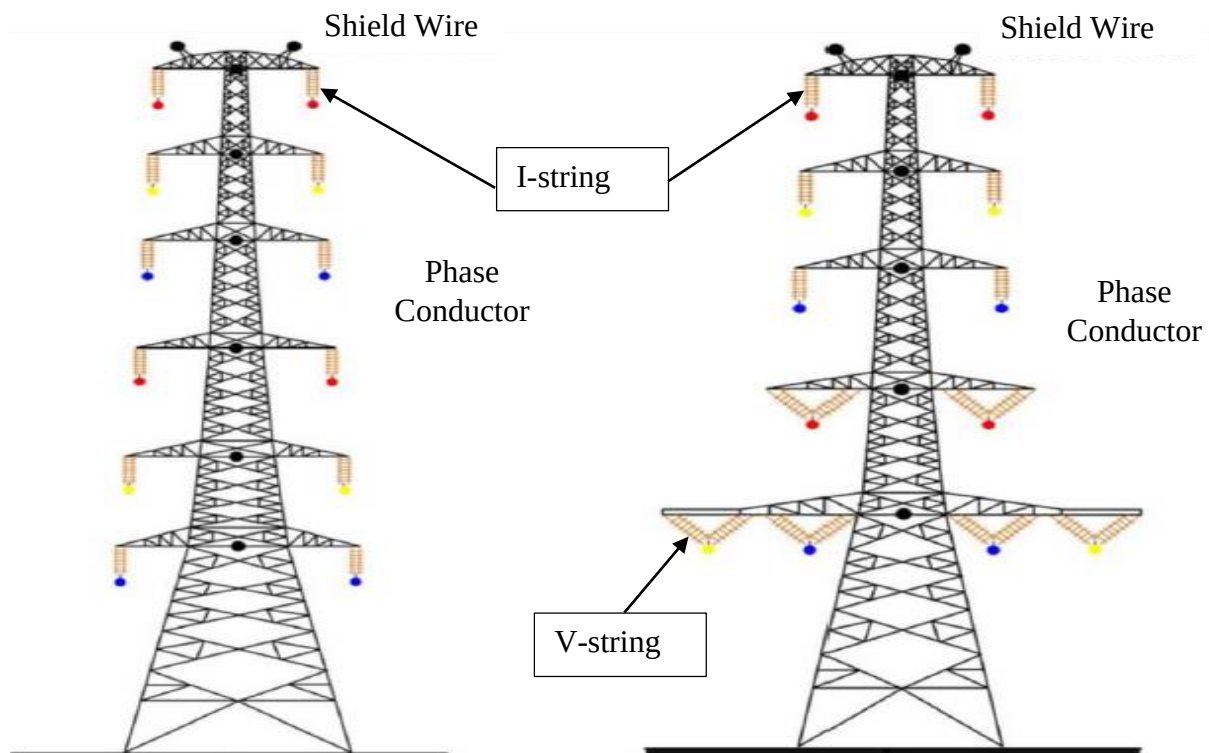


Figure 5 : Multiple Circuit Tower Structures with I-string & V-String Insulators

III. Based on Number of Circuits

Single - Circuit Supporting Towers

These tower structures support only one circuit along the whole transmission line where mostly the configuration is horizontal and triangular (for voltage level 230 and below) where the triangular configuration is the common practice in Ethiopia (i.e. two conductor will be on one side of the supporting structure and one conductor on the opposite side and located at the middle of the two phases to transmit a single circuit).

Multiple - Circuit Supporting Towers

These tower structures are those that are designed to carry more than one circuit along a certain transmission line. Unlike single circuit supporting structure these towers may carry two or more circuits of the same voltage level or of different voltage levels. And the configuration is mostly vertical as there will be numerous conductors to be aligned in parallel so that the phase to phase clearance of each conductors will be maintained and also right of way clearance will also be minimized.

The following tables summarize the merits and demerits of single and multiple circuit transmission line systems:

Table 2 : Single Circuit Supporting Towers

Advantages	Disadvantages
• Cost minimization while planning to transmit lower voltages / power	• Failure to address line contingency (i.e. A line fault results in blackout)
	• Land acquisition due to requirement of numerous single circuit systems

Table 3 : Multiple Circuit Supporting Towers

Advantages	Disadvantages
Requires low land acquisition and low investment cost	Design complexity (e.g. related to terrain, loading cases will vary)
It is environmental friendly (i.e. Decreased environmental and health impact)	Difficulty for maintenance due to the of modernized technology (i.e. voltage live line maintenance)
Minimized social impact	Takes more time for construction when compared to single circuit lines
Transmission of different voltages in a single tower	

Therefore, it is necessary to give due attention for the property of different categories of transmission lines discussed above so that, knowing these features will enhance the future study on improving a certain transmission line industry to a better level.

2.2 Definition of Span

Span is generally defined as the distance measured horizontally between two points. In transmission line context, it could be defined as the distance between two adjacent tower structures. Its different components are as briefed below [11]:

- *Back Span*: the span length in the span behind the structure in question. For instance; in the figure 6 below, span 1 is back span of structure B;
- *Ahead Span*: the span length in the span ahead of the structure in question. For instance; again in figure 6 below, span 2 is ahead span of structure B;
- *Slack*: the amount of conductor length difference between a straight line made by two adjacent supports and a sagging conductor;

- *Weight Span*: the horizontal distance between the low point of sag in back span and the low point of sag in the ahead span. It is helpful in calculating the vertical load that the conductor imposes on the supporting structure. It is also referred as the vertical span.
- *Wind Span*: the mathematical average of the back span and the fore span which is used in calculating the wind load that the conductor imposes on the supporting structure. It is also referred as the horizontal span.

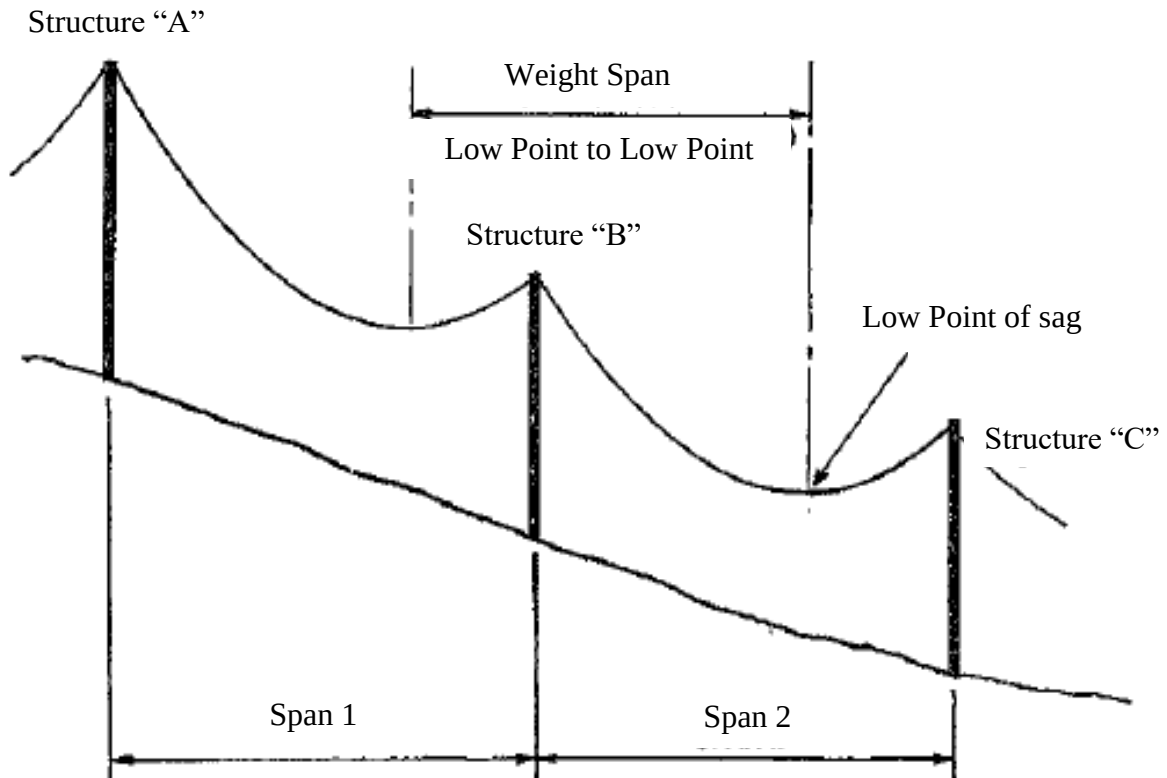


Figure 6 : Profile of a Transmission Line Segment

2.3 Discussion on the criteria of different voltage levels along a certain transmission line system

2.3.1 Clearance of overhead electric lines

The summarized tables below show standards that are set for the clearance spaces associated with high voltage transmission line for the purpose of the protection of persons from risk and property from damage as well as to specify the quality of supply voltage [10].

Table 4 : Overhead Electric Line above the Ground

Description	Voltage Level	Clearance
Minimum requirements for the height above the ground of an overhead electric line	132kV	• 8m above a road or vehicular traffic • 7m above any other point
	$> 132\text{kV} \ \& \ \leq 230\text{kV}$	• 10.5m above a road or vehicular traffic • 8m above any other point
	$> 230\text{kV} \ \& \ \leq 400\text{kV}$	• 12m above a road or vehicular traffic • 10m above any other point
Minimum distance from the track of a small gauge railway/tramway system	132kV	10.5m
	$> 132\text{kV} \ \& \ \leq 230\text{kV}$	10.5m
	$> 230\text{kV} \ \& \ \leq 400\text{kV}$	12m

Table 5 : Overhead Electric Line Clearance from Vegetation

Description	132kV	$> 132\text{kV} \ \& \ \leq 230\text{kV}$	$> 230\text{kV} \ \& \ \leq 400\text{kV}$
Minimum distance of an overhead electric line from vegetation in all direction	13m	15m	19m

Note: The space vertically above the overhead electric line shall be kept clear of vegetation at all times

Table 6 : Overhead Electric Line Clearance from Other Lines

Description	132kV	$> 132\text{kV} \ \& \ \leq 230\text{kV}$	$> 230\text{kV} \ \& \ \leq 400\text{kV}$
Minimum distance of an overhead electric line from part of a communication line	4.6m	6m	9m

2.4 International Code Review

Many developed as well as developing countries in the world have their own code of practice in regards to electric power transmission line engineering. Some of the code of practice used intensively on the transmission line industry all over the world are as tabulated below [6] where of course, all will follow the electrical parameters and design criteria present in the IEC code standards.

Table 7 : International Code Standards for Transmission Line

Basic Standards	Country
ANSI / ASCE – 10 : Design of Latticed Steel Transmission Structures (© 2016 IEEE)	United States of America (USA)
ASCE – 48 : Design of Steel Transmission Pole Structures (© 2016 IEEE)	
IEEE C2 (2002) : National Electrical Safety Code ® (© 2001 IEEE)	
IS 802 (Part 1 / Sec 2), 1992 : Use of Structural Steel in Overhead Line Towers (© BIS 1992)	India
BS 8100 – 3, 1999 : Lattice Towers and Masts (© BSI 03 – 2001)	England
DIN EN 10025 – 2 : Hot Rolled Products of Structural Steel – Part 2	Germany
IEC-60826/Ed4 : Overhead Transmission Lines – Design Criteria (© IEC 2016)	Switzerland
GB 50545 – 2010 : Code for Design of 110kV – 750kV Overhead Transmission Line	China
SANS 10280/NRS 041 – 1, 2008 : Overhead Power Lines for Conditions Prevailing in South Africa	South Africa

In Ethiopia, there aren't any code of practices that will be implemented for the design and construction of different level of voltage transmission lines. Hence, this paper is believed to assist code as well as policy makers in the preparation of Ethiopian code or adoption from other codes which will, through time, help in the design of cost effective, safe and environmental friendly structures that also adheres to the different electrical parameter effects put on standards like IEC.

In order to implement a code for Ethiopia that fits the different factors to be considered (like: terrain, wind speed, weather, etc.) the following codes shall be referenced as tabulated below:

Table 8 : Recommended Code of Practice for Transmission Line

International Codes	Country
IEC-60826/Ed4 : Overhead Transmission Lines – Design Criteria (© IEC 2016)	Switzerland
ANSI / ASCE – 10 : Design of Latticed Steel Transmission Structures (© 2016 IEEE)	United States of America
ASCE – 48 : Design of Steel Transmission Pole Structures (© 2016 IEEE)	United States of America
GB 50545 – 2010 : Code for Design of 110kV – 750kV Overhead Transmission Line	China
IS 802 (Part 1 / Sec 2), 1992 : Use of Structural Steel in Overhead Line Towers (© BIS 1992)	India
DIN EN 10025 – 2 : Hot Rolled Products of Structural Steel – Part 2	Germany

The recommendation for the above tabulated codes in the implementation practice of the new code for Ethiopia depends on the long time exercise of the stakeholder “Ethiopian Electric Power” (EEP) whom have been engaged with numerous transmission line projects from 132kV to 500kV all over Ethiopia for more than 50years. And while doing so, the corporation have been applying the above recommended international codes which are defined standards for design and construction of transmission lines. Besides other codes like the Indian, Chinese or South African codes have also been intensively implemented through negotiation considering the similarities in the design requirements of the respective code standards.

Some of these standards have been put for different foreign contractors to adhere to it on the employer’s requirement section of each contract documents’ specification prepared by EEP, please refer appendix 1 [6].

In addition to this, it should also be noted that, well studied meteorological data of the past trend in Ethiopia should be done to have a complete data regarding wind and temperature information’s, which are considered to be the basic factors / influencers of transmission line tower design process.

3. Chapter Three

Transmission Line Design Requirements

3.1 Tower Design Concepts

Geometry of tower plays a crucial role in understanding the basic design concepts. Tower geometry includes the voltage level, base width, type, height, conductor configuration, type of conductors and number of circuits. The number of cross arms depends on the voltage level and number of circuits. ROW is fixed based on the tower geometry and Electromagnetic fields. The basic parameters to give due attention while designing a tower structure are as follows [3]:

3.2 Wind Loading

This is one of the important factor to be implemented in the tower design process. Calculated loads as per the particular wind zone are applied to the tower structure. Loadings include self-weight, transverse loads, longitudinal loads, compression loads and tension loads. No deflection is observed in tower after applying these loads that are calculated as per standards. The loadings determination is done using various inputs like design wind pressure, angle of deviation, design wind span, pressure due to wind on conductor and ground wire, type of ground wire, insulator strings, etc. All the members of the tower are applied with the corresponding loading combinations [3].

3.3 Height Determination

Various factors that influence the height of the tower are:

1. Minimum permissible ground clearance (h_1)
2. Maximum sag (h_2)
3. Vertical spacing between phase conductors (h_3)
4. Vertical clearance between top conductor and ground wire (h_4)

Hence, the total height of the tower (H) is given by:

- $H = h_1 + h_2 + h_3 + h_4$, see figure 7 below [2]

When Multiple Circuits are considered, circuit to circuit clearance will be added to the height of the tower accordingly [3].

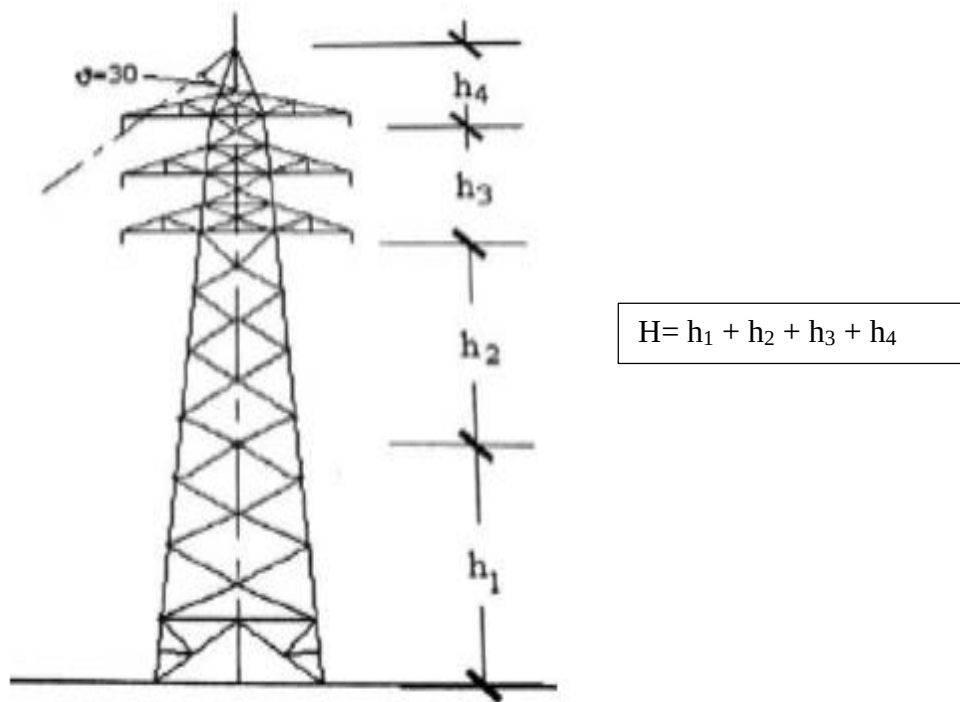


Figure 7 : Height of Tower Determination

3.4 Sag

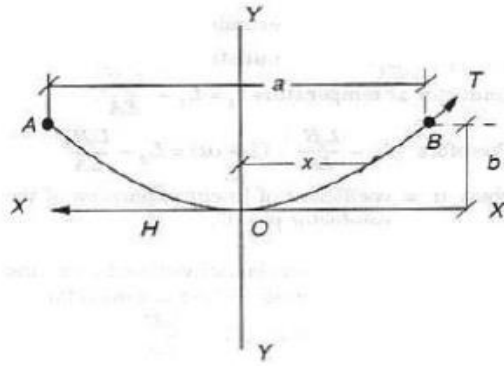
Sag is defined as the relative vertical distance of the straight line made by two adjacent supports to a point along a conductor [11]. The power conductors sags because of its self-weight and the maximum sag is observed under maximum temperature and no wind condition [3]. In order to obtain the maximum sag as well as the tension loads from the conductors on each tower supports, Sag – Tension calculations will be necessary. These calculations can be performed for various wind and temperature combinations and the maximum sag value is used to determine the height of a transmission tower [3].

A certain transmission line conductor is usually subjected to the following forces [12]:

- Horizontal force due to wind pressure;
- Vertical force due to the dead weight of the conductor itself and;
- Vertical force due to the deposit of ice on the conductor (i.e. in areas subjected to snowfall).

Among the different ways to calculate sag and tension, *Catenary method* is the most widely used method.

See figure below describing a transmission line conductor strung between two points or supports A & B at the same elevation [12]:



$$de = \frac{T}{AE} dlx$$

Figure 8 : Transmission Line Conductor Strung Between Supports A & B

The following equations are implemented for calculating *Sag* and *Tension* for supports at the same level in order to know the *height of the transmission line tower* and *conductor load* respectively on the structure [12]:

$$q = \sqrt{w^2 + p^2}$$

$$L = \frac{2H}{q} \sinh \frac{aq}{2H}$$

$$b = \frac{H}{q} \left(\cosh \frac{aq}{2H} - 1 \right)$$

$$\frac{T}{q} = \frac{H}{q} \left(\cosh \frac{aq}{2H} \right)$$

$$\frac{T}{q} = b + \frac{H}{q}$$

$$e = \int_{-a/2}^{+a/2} de = \frac{H^2}{2AqE} \left[\frac{qx}{H} + \frac{1}{2} \sinh \frac{2qx}{H} \right]_{-a/2}^{+a/2}$$

$$\frac{e}{a} = \frac{qa}{AE} \left[\frac{H}{2qa} + \frac{1}{2} \left(\frac{H}{qa} \right)^2 \sinh \frac{qa}{H} \right]$$

Stretch Factor;
which is independent
of the conductor type

w = Weight of conductor per meter length (including the weight of ice deposit (if any));

p = Horizontal force due to the wind pressure acting on the ice – coated conductor per meter length;

q = Resultant force on the conductor per meter length;

a = Span AB;

b = Sag of conductor at its lowest point with reference to the points support;

L = Length of the conductor in the span;

T = Tension at either point of support;

H = Horizontal tension at the lowest point O;

e = Stretch of the conductor in the span;

$\frac{e}{a}$ = Change in the length factor produced when the conductor is subjected to or freed from stress;

E = Young's Modulus of Elasticity of conductor;

Figure below describes a transmission line conductor strung between two supports at different elevation [12]:

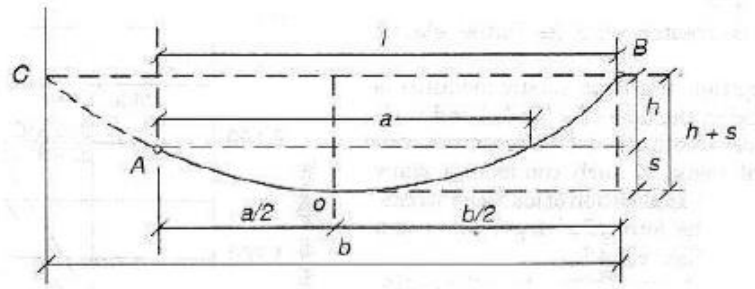


Figure 9 : Transmission Line Conductor Strung Between Two Supports

$$S_A = \frac{a^2 R}{2H} = s;$$

&

$$S_B = \frac{b^2 R}{2H} = h + s;$$

where;

R = Resultant Load;

H = Tension Load;

h = Height of B above that of A;

s = Sag below the level of the shortest support.

Hence, the sag and tensions can be calculated for different terrain cases along a certain transmission line as such.

3.5 Electrical Clearances

The electrical clearances involve selection of minimum air gap clearances, to avoid distracting sources between live and earthed parts of the transmission line [1].

3.6 Tower Modelling and Software

After designing a tower and based on its Electrical Clearance Diagram (ECD) the tower is modelled with suitable software designed for the said analysis and the corresponding calculated loads are applied to the members [3]. Most powerful software include PLS-CADD and PLS-TOWER which are used to calculate sag - tension calculations and modeling steel tower structures respectively. PLS-CADD is the most powerful and comprehensive program available for the structural and geometric design of overhead lines. It integrates in a seamless environment all aspects of transmission line design, including terrain modeling and rendering, route selection, manual or automatic minimum cost spotting, sag-tension, clearance and strength checks, electric and magnetic fields calculations, material list generation, plan & profile drafting, and much more. It will significantly increase the capability and productivity for new transmission line, assessments and refurbishing projects [7].

Meanwhile, the input data obtained from PLS-CADD will be used for design of transmission line structures using PLS-TOWER. This is possible because libraries of standard parts and components such as steel angles, insulators, attached equipment's, cables or guys can be shared between PLS-TOWER and our other pole and frame programs.

PLS-TOWER is one of several MS-WINDOWS programs developed by Power Line Systems for the analysis and design of transmission structures. These programs have many features in common. Therefore, if one is proficient in the use of one of these programs, he/she can quickly master the others.

It is now used by hundreds of organizations in over eighty countries and is probably the most widely used tower program in the world. It deals with the analysis and design of steel latticed towers. See summarized flow of the design process as briefed below:

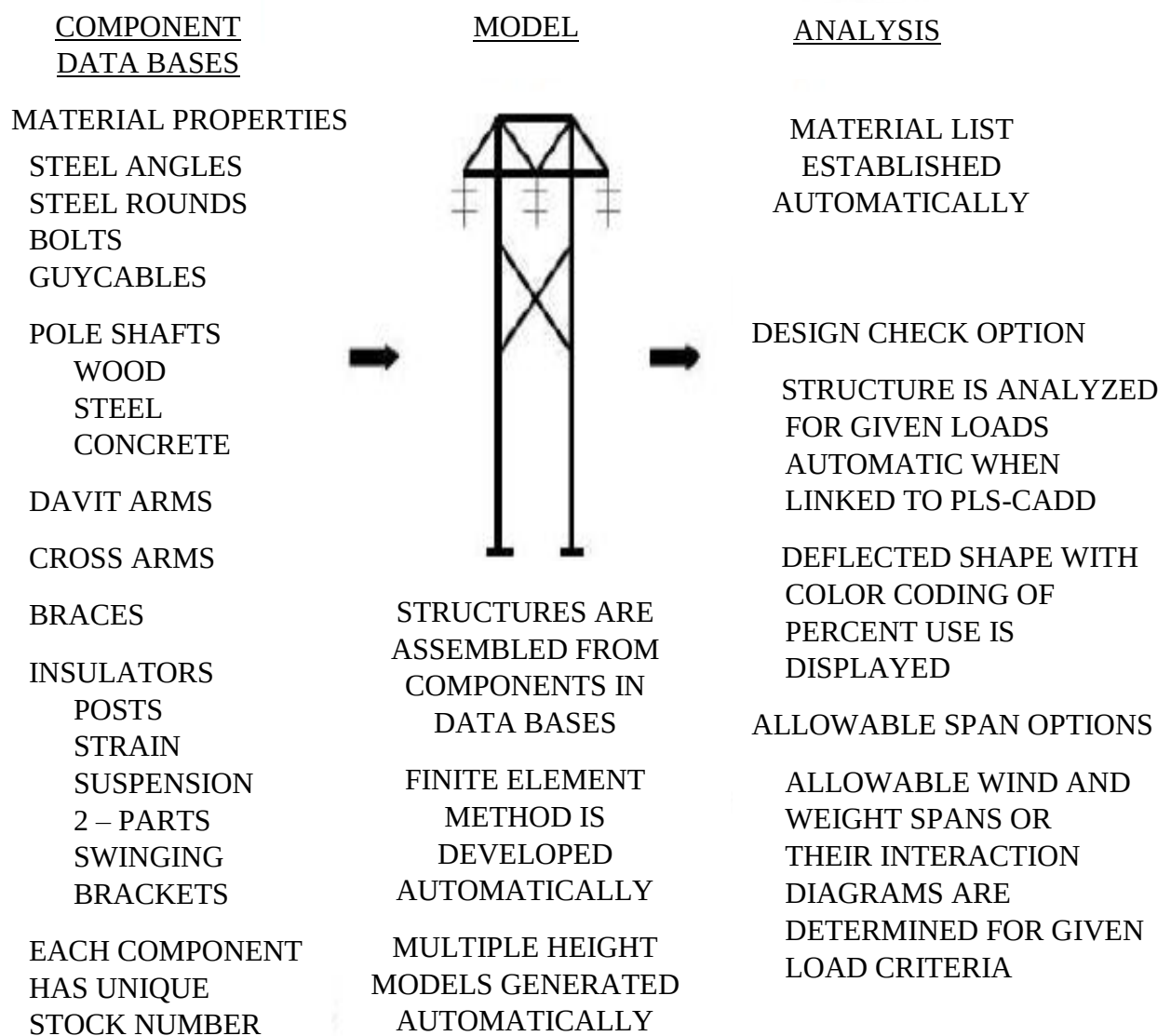


Figure 10: State Grid, PLS – Tower Software Training

For the analysis and design of poles and frames made of concrete, steel or wood, one should use PLS-POLE program. It also supports numerous international standards such as: US NESC Standard ANSI C2 (NESC, 2002), European Standard for Construction Steel (ECCS, 1985), European CENELEC Standard EN-50341-1(CENELEC, 2001) and some of its national adaptations (NNA's of Poland, Portugal, Spain, United Kingdom, etc.), British Standard BS-8100 (BS 8100, 1999), various versions of Electricite de France (RTEEDF) Specifications, several load and strength standards for Australia/ New Zealand, IEC Standard 60826 (IEC 60826, 2003), India Standard IS-802 (IS 802, 1995), and EIA Standards 222 for communication towers (EIA/TIA Rev F -1996) and ANSI/TIA Rev G - 2005) [8].

3.7 Loads, Load factors and Design Requirements

The accurate stress analysis for a transmission tower includes calculation of the total forces in each member of the tower with various combination of loads externally applied plus the self-weight of structure [3].

Loads on a transmission line are the forces that are applied to the wires and to the structures. The loads that are applied to the wires are subsequently transmitted to the structures where these loads should also incorporate appropriate load factors. The resultant forces, stresses and displacements in the component of the transmission line system caused by these applied loads are said to be load effects. Legislated loads, such as those of National Electrical Safety Code (NESC) have their own load factors. Recommended load factors for extreme wind and extreme ice concurrent with wind is as tabulated below [11]:

Table 9 : Load Factors, γ_w to Adjust Relative Reliability from 50year Return Period
Extreme Wind Load Design

Relative Reliability factor (RRF)	Load Return Period, RP (Years)	Probability that the load is exceeded in 50 years = $(1-(1-(1/RP))^{50})$	Wind Load Factor, γ_w
0.5	25	0.87	0.85
1	50	0.64	1.00
2	100	0.39	1.15
4	200	0.22	1.30
8	400	0.12	1.45

Table 10: Load Factors γ_i and Corresponding γ_w , to Adjust Relative Reliability from 50 year Extreme Uniform Ice Thickness and Concurrent Wind Load Design

Relative Reliability factor (RRF)	Load Return Period, RP (Years)	Ice Thickness Factor, γ_i	Concurrent Wind Load Factor, γ_w
0.5	25	0.80	1.00
1	50	1.00	1.00
2	100	1.25	1.00
4	200	1.50	1.00
8	400	1.85	1.00

In consideration of life safety concerns, the load factors for Construction and Maintenance loads are generally 1.5 or greater [11]. For the case of Ethiopia, since there are no well-defined meteorological data of the weather conditions, the factor of safety is somehow high. The applied loads will vary with respect to the employer requirements specification. For instance here in Ethiopia, the design requirements stipulated by Ethiopian Electric Power for the design of tower structures is as follows [6]:

- a. The conditions of ambient temperature for maximum working tensions and sags are a temperature of -5°C with wind loads.
- b. The basic wind pressure on structures shall be taken as 86 kg/m^2 . The factored wind load on the towers shall be calculated in accordance with IEC 60826. - Design Criteria of Overhead Transmission Lines.
- c. The basic wind pressure on conductors and earth wires shall be 52 kg/m^2 and wind load on a single insulator shall be 60 kg/m^2 . The factored wind load on conductors shall be calculated in accordance with IEC 60826 – Design criteria of overhead transmission lines.
- d. Design spans shall be as specified for the appropriate type of tower. The weight of insulator strings shall also be considered. The maximum longitudinal tension to be considered is that caused by maximum permissible span being adjacent to minimum permissible span.
- e. Towers shall be designed to support, at a temperature of 0°C , the said wind loading on structures and wind loads on conductors, earth wires and insulators strings, applied normal and at 45° to structures and spans.
- f. Longitudinal loads shall be considered for earth wires and conductors of suspension and tension towers.

- g. All double circuit suspension towers shall be designed to support, under the most unfavorable conditions, the overturning and torsion moments resulting from the break of one phase conductor or one earth wire.

All double circuit medium angle tension towers shall be designed to support, under the most unfavorable conditions, the overturning and torsion moments resulting from the break of any two phase conductors on the same side and in same span, or any one phase conductor and one earth wire on the same side and in same span.

All double circuit large angle tension towers shall be designed to support, under the most unfavorable conditions, the overturning and torsion moments resulting from the break of any three phase conductors on the same side and in same span, or any two phase conductors and one earth wire on the same side and in same span. Maximum working tension at -5°C and wind load for conductor, earth wire, insulator strings and structures shall be taken for this load condition. The tension due to broken line conductor(s) on suspension towers may be reduced to 70% of the maximum tension to allow for rotation of insulator strings. Ice loading shall not be considered.

Table 11 : Maximum working tensions at -5°C with wind load

	ASTER	ASH	OPGW
Maximum admissible stress at -5°C and wind load	24.8% UTS	40% UTS	20% UTS
Everyday Stress (EDS) (%UTS)	20% UTS	18% UTS	20% UTS

All towers shall be designed for cascade condition. All wires are to be considered as broken in one span at an everyday tension of 20% UTS in still air at 20°C.

The transverse and vertical loads at the conductors and earth wires supports shall be calculated according to the length of the specified spans, the weight and wind. The effects of vertical, transverse and longitudinal loads shall be considered as acting simultaneously and shall be applied normal to one another.

All towers and their related components shall be capable of resisting any combination of the design basic loads multiplied by a factor of safety of 2 (in normal conditions) and of 1.25 (in broken wire conditions).

- h. The capacity of all members and connections shall be determined using the allowable stresses set forth by the Contractor and approved by the Engineer.

- i. All tension members shall be designed on the basis of minimum net sectional area.
- j. All compression members shall be designed on the basis of gross sectional area.

Members are to be properly proportioned to prevent local buckling at loads less than the column carrying capacity.

- k. Tower members on which man can stand (defined as being up to 30° from horizontal) shall be capable of withstanding on ultimate point load at 1.5kN at any point of the member.
- l. Load on dead-end structures are those resulting from the assumption that all conductors and shield wires are dead-ended only on one side of the structure at maximum tensions with maximum deviation angle. The outlines of towers shall be in accordance with the drawings included in the Specifications.
- m. All towers shall be designed to carry line conductors with the associated insulator sets, overhead optical fiber core and galvanized steel shield wires and all fittings under the conditions and within the factors of safety specified. The conductors shall be arranged as shown on the drawings. Conductor stringing procedure shall be provided stating the sequence of conductor erection, and maximum tensions.

Therefore, the load calculation results that follow different international standard requirements in relation to : Wind, Ice, reliability, construction and maintenance factors and others, as discussed earlier, that are obtained by also following the criteria above in parallel, will be used as an input for tower related software such as PLS – Tower so that the design and modelling will be executed to have the desired tower structure that can support the most likely load that is imposed up on it in order to transmit a certain power line from the source to different substations and end users.

4. Chapter Four

Cost – Benefit Analysis and Results

In order to implement a certain technology or proposal to work, it is first recommended to perform a cost – benefit analysis in regard to the different parameters related with the idea in question. In this case, it is opted to know the prospects of implementing Multi – Circuit Tower structures for future transmission line projects in Ethiopia. As stated in different literatures, the cost of towers is about one fourth to half of the whole transmission line cost and hence, performing this analysis is believed to be a feasible way to reflect the merits and demerits of the idea of implementing tower structures that can carry more than two circuits for high voltage transmission lines in Ethiopia.

4.1 Existing Project Overview and Proposed Technology Estimated Cost

The transmission line project chosen for this analysis in Ethiopia is the line from Grand Ethiopian Renaissance Dam Project (GERD) to Holeta substation via Dedessa substation. The line is composed of two twin towers aligned in parallel each carrying double circuits of 500kV power along the line. This project comprises of 4 LOT's (LOT – 3, 4, 5 & 6) [13].

- LOT – 3 for line 1 & LOT – 5 for line 2 takes the section from the Dedessa substation to Holeta substation. It is about 275 Km for line 1 and 273 Km for line 2 of a double circuit 500kV, 3 phase, four bundle ACSR “CONDOR” conductor, one single optical fiber cable shield wire and one galvanized steel shield wire on self-supporting, tapered configuration, vertical formation galvanized steel lattice towers with each leg having separate foundation of pad and chimney concrete type; and
- LOT – 4 for line 1 & LOT – 6 for line 2 takes the section from the GERD to Dedessa substation which is about 344 Km with the same accessories, material and structures as discussed in LOT – 3 & LOT – 5.

The choice of this project for the intended analysis relies on the good opportunity to answer the question: ***“What are the pros and cons, if this transmission line was executed with towers that can support all the four circuits in one?”***

In order to show the merits of implementing such technology i.e. Multi – Circuit supporting towers for future transmission line projects in Ethiopia, the cost wise advantage in comparison with the chosen project above will be analyzed.

In this process the varying parameters are the number of towers, tower weight as well as foundation. Following that, a weight factor say “ W_f ” will be required so that the cost of one of the 500kV 2 circuits supporting twin towers including the foundation will be factored by “ W_f ” to estimate the cost of the proposed tower & foundation carrying 4 circuits of 500kV. In addition, a reduction factor “ R_f ” will also be implemented to consider the reduced number of towers, thereby to the insulators accessories & fittings too, due to the assumption that the maximum single span is instigated on the proposed ideal route using multiple circuit tower transmission line.

The maximum wind span of 550 meters is chosen, for the ideal route alignment, to use it as the span between consecutive towers along the ideal line assuming the terrain as almost suave. This span is the least critical requirement specified for the Suspension and Tension towers while for the dead end tower, the assumption is that the distance from this tower to the substation gantry will not be greater than 250 meters. In other words, the maximum wind span considered above (i.e. 550 meters) will be likely in that, the sum of half of this span and half of 250 meters will not exceed the maximum wind span (i.e. 400 meters) of the dead end tower specified in the employer requirement specification of the existing 500kV double circuit carrying twin towers transmitting power from GERD to Holeta Substation via Dedessa Substation Project. See table 12 below the design spans for support locations [13].

Table 12: Design Spans for Support Locations

500kV Ruling Span: 400m	Suspension Tower Types DL	Tension Tower Types DT30	Tension Tower Types DT60	Tension Tower Types DT60 (Dead – end)
Angle of Deviation (deg.)	$0^0 - 2^0$	$0^0 - 30^0$	$30^0 - 60^0$	$0^0 - 60^0$
Max. Sum of Adjacent Spans (m)	1100	1600 (20 ⁰) 1230 (30 ⁰)	1170	800
Maximum Span (m)	630	650	700	600
Maximum Wind Span (m)	550	800 (20 ⁰) 620 (30 ⁰)	585	400
Maximum Weight Span (m)	1170	1400	850	700
Uplift Weight Span (m)		- 450	- 140	- 100

However, the cost for conductors, OPGW's, Ground wires, Junction & Terminal boxes etc... will be kept same because only the tower number, structure & foundation will be changed. On the other hand, as the comparison is between one of the twin line, the conductors cost will be factored by 2, because the proposed tower is assumed to carry all the 4 circuits. Studies show that based on the basic tower body type, the comparison for 500kV transmission line corridor and the material for two double circuit line and one multiple circuit line is as tabulated below [4]:

Table 13 : Comparison of Corridor and Material for 500kV Power

Description	2 x 500kV Double Circuit Tower	4 Circuit on Common Tower
Width of the transmission line corridor (Meter)	95.0	54.0
Weight of steel (Ton)	2 x 24.2	63.1

Therefore, from the above comparison, the weight of four circuit in one supporting tower will be 2.607 times that of a double circuit carrying tower structure. Hence this value will be used to modify the cost of the suspension, tension, angle as well as transposition towers quoted for the 500kV transmission line project from the Grand Ethiopian Renaissance Dam (GERD) to Holeta substation via Dedessa substation so that the tower and foundation cost will be estimated. Additionally, due to the reduction of the number of towers, the reduction factor “ R_f ” will be obtained by computing the ratio between the existing number of tower along the line and the number of towers which will be needed for the proposed ideal route discussed earlier.

The summarized price schedules tabulated below contains the existing project's (i.e. 500kV GERD – Dedesa – Holeta Transmission line), total investment cost and the proposed technology (i.e. four circuits in one tower) total investment cost as well, for comparison purpose. Refer Appendix 2 for the schedule of prices of each materials in detail and the cost modification due to reduction in the number of towers along the line, changes in the tower structure as well as foundation for the proposed technology.

Table 14 : Total Investment Cost for the 500kV GERD – Dedesa – Holeta Transmission Line (Considering the Existing Twin Towers)

Schedule of Prices

Grand Summary (For Existing Double Circuit Supporting Twin Tower Structures)

Item	Description	Supply (FOB)	Sea Transportation	Local transportation	Insurance	Erection, Test and Commissioning	Grand Total
		Total Price	Total Price	Total price	Total price	Total Price	Total Price
	Currency	USD	USD	USD	USD	USD	USD
1	Dedesa - Holeta 500kV Transmission Line - 1	127,797,286.80	6,804,653.83	1,001,742.23	532,403.01	34,228,660.01	170,364,745.88
						TOTAL (Lot-3) =	170,364,745.88
2	GERD - Dedesa 500kV Transmission Line - 1	157,617,050.00	8,421,606.56	1,285,387.97	682,811.70	41,413,655.50	209,420,511.73
						TOTAL (Lot-4) =	209,420,511.73
3	Dedesa - Holeta 500kV Transmission Line - 2	126,410,582.90	6,763,378.34	997,734.33	530,309.26	32,897,232.73	167,599,237.56
						TOTAL (Lot-5) =	167,599,237.56
4	GERD - Dedesa 500kV Transmission Line - 2	162,442,728.65	8,691,626.07	1,285,273.23	684,678.70	42,617,427.93	215,721,734.57
						TOTAL (Lot-6) =	215,721,734.57
						GRAND TOTAL (Lot3 to Lot-6) =	763,106,229.74

Table 15 : Total Investment Cost for the 500kV GERD – Dedesa – Holeta Line with the Proposed Multi – Circuit Tower (Considering 4 Circuits in One Tower) “A” & “B”

Schedule of Prices
Grand Summary (For Proposed Multi - Circuit Supporting Tower Structure)
Cost modified along line - 1

Item	Description	Supply (FOB)	Sea Transportation	Local Transportation	Insurance	Erection, Test and Commissioning	Grand Total
		Total Price	Total Price	Total price	Total price	Total Price	Total Price
	Currency	USD	USD	USD	USD	USD	USD
1	Dedesa - Holeta 500kV Transmission Line	236,618,434.75	12,978,571.20	1,801,387.04	964,834.86	58,167,759.29	310,530,987.13
TOTAL =							310,530,987.13
2	GERD - Dedesa 500kV Transmission Line	291,935,267.72	16,092,614.06	2,311,618.48	1,237,464.12	69,280,869.58	380,857,833.96
TOTAL =							380,857,833.96
GRAND TOTAL =							691,388,821.10

“A”

Schedule of Prices
Grand Summary (For Proposed Multi - Circuit Supporting Tower Structure)
Cost modified along line - 2

Item	Description	Supply (FOB)	Sea Transportation	Local Transportation	Insurance	Erection, Test and Commissioning	Grand Total
		Total Price	Total Price	Total price	Total price	Total Price	Total Price
	Currency	USD	USD	USD	USD	USD	USD
1	DEDESA - HOLETA 500KV TRANSMISSION LINE	234,586,473.67	12,946,866.06	1,803,817.14	965,884.00	55,052,361.00	305,355,401.87
		TOTAL =					305,355,401.87
2	GERD - DEDESA 500KV TRANSMISSION LINE	295,143,432.72	16,284,079.21	2,279,454.68	1,222,714.53	70,221,164.55	385,150,845.69
		TOTAL =					385,150,845.69
		GRAND TOTAL =					690,506,247.56

Therefore, from the above cost benefit analysis it is seen that the total investment cost of the existing 500kV project with twin towers is **763,106,229.74** which is a higher than **691,388,821.10** cost modified with line – 1 and **690,506,247.56** cost modified with line – 2 if it had been constructed with the proposed Multi – Circuit towers where all the 4 circuits are carried by one tower. In addition to this, it is also very important to take a look at the right of way corridor cost that will be paid for the farm land and house owners as well as clearing of trees treated as compensation cost.

The total amount of money in ETB paid for the compensation cost until 2017 is **271,745,301.96**. [14] This is for a right of way (ROW) clearance requirement of the existing 500kV twin double circuit line aligned in parallel which will take a length of 120meters [13]. Hence, if **271,745,301.96 ETB** is paid for 120 meters ROW clearance, using interpolation, for a ROW clearance of 54 meters the amount of money paid by applying the proposed Multi – Circuit tower will be about **122,285,385.88 ETB**. See table 16 below for the summarized expression of the above stated analysis:

Table 16 : Cost Comparison between Existing and Proposed Tower

Description	Total Investment Cost (USD)	Total ROW Clearance Compensation Cost (ETB)
2 x 500kV towers carrying 2 circuit for GERD – Dedesa – Holeta transmission line (#)	763,106,229.74	271,745,301.96
Proposed 500kV tower carrying 4 circuits in one tower cost modified with line – 1 (*)	691,388,821.10	122,285,385.88
Proposed 500kV tower carrying 4 circuits in one tower cost modified with line – 2 (**)	690,506,247.56	
Ratio 1 ((#) - (*)) / (#)	0.0940	0.55
Ratio 2 ((#) - (**)) / (#)	0.0951	
Benefit	$((0.094+0.0951)/2) * 100$ 9.46%	$0.55 * 100$ 55.00%

Hence, about 9.5% gain in the total investment cost and 55% benefit / gain in the ROW clearance compensation cost has been observed. It will also be vital to discuss some of the disadvantages of implementing Multi – Circuit supporting tower structures.

One of the demerit can be seen in the design process of such structure. For instance, one calculation note for existing suspension tower supporting a double circuit transmission line from Bahirdar to Addis Ababa via Debre markos, in Ethiopia [17], have been adjusted to be a tower structure carrying 4 circuits where the shaded rows show the additional load cases due to additional 2 circuits. Following that, it is seen in the table 17 below that the number of load cases will increase thereby raising the number of load cases to be simulated in determining the governing load.

Table 17 : Design Parameters

No.	Description	Symbol	Value	Unit
1.0	Shield Wire GSW(Fe) 79			
1.1	Stranded overall diameter	dS	0.0115	m
1.2	Converted weight of line	Ws	0.00614	kN/m
1.2a	Weight of shield wire		0.00603	kN/m
1.2b	Weight of vibration damper		0.00011	kN/m
1.3	Minimum ultimate strength	UTSS	97	kN
1.4	Maximum working tension at -5°C	TmaxS	19.4	kN
1.5	Everyday tension	EDTS	19.4	kN
2.0	OPGW (48 fibers)			
2.1	Stranded overall diameter	dO	0.0131	m
2.2	Converted weight of line	WO	0.00534	kN/m
2.2a	Weight of OPGW		0.00514	kN/m
2.2b	Weight of Vibration Damper		0.0002	kN/m
2.3	Minimum ultimate strength	UTSO	78.9	kN
2.4	Maximum working tension at -5°C	TmaxO	15.78	kN
2.5	Everyday tension	EDTO	15.78	kN
3.0	Conductor (ASTER 851)			
3.1	No. of line per phase	NC	2	
3.2	Stranded overall diameter	dC	0.03795	m
3.3a	Converted weight of per sub-line	WC	0.02521	kN/m
3.3b	weight of per sub-conductor		0.02309	kN/m
3.3c	Weight of Spacing Damper for Per Sub-conductor		0.00061	kN/m
3.3d	Weight of Vibration Damper for Per Sub-conductor		0.00015	kN/m
3.4	Weight of Grease for Per Sub-conductor		0.00135	kN/m
3.5	Minimum ultimate strength of conductor	UTSC	273.9	kN
3.6	Maximum working tension at -5°C	TmaxC	67.927	kN
3.7	Everyday tension	EDTC	54.78	kN

No.	Description	Symbol	Value	Unit
4.0	Suspension Insulator (2x23 U 120BS) & string			
4.1	Single insulator			
4.1a	Normianl Diameter		254	mm
4.1b	Normianl Spacing		146	mm
4.1c	Minimum creepage distance		292	mm
4.1d	Approximate Weight per unit		0.0392	kN
4.2	Clamp & hardware			
4.2a	Approximate area of clamp(perpendicular to line)		0.05	m ²
4.2b	Approximate Weight of Clamp		0.5886	kN
4.3	String			
4.3a	Area perpendicular to line	AI	1.4147	m ²
4.3b	Weight per set	WI	2.3936	kN
5.0	Design Spans			
5.1	Maximum wind span (0° line deviation angle)	NHS0	500	m
5.2	Maximum wind span (2° line deviation angle)	NHS2	400	m
5.3	Maximum weight span	NVS	1000	m
6.0	Angle of deviation			
6.1	Maximum (2°)	Amax	0.035	rad
6.2	Minimum (0°)	Amin	0	rad
7.0	Wind load			
7.1	On conductors & Earth wires	WPL	0.51	kN/m ²
7.2	On single insulators	WPI	0.589	kN/m ²
7.3	On towers	WPT	0.844	kN/m ²
8.0	Load Factor			
8.1	Normal Condition	NFAC	2.00	
8.2	Broken Wire Condition	BFAC	1.25	

The above stated parameters will be used as an input as well as design requirements which will be needed for the design of a certain self-supporting transmission tower structure. Subsequent to this, different loads will be computed with regards to the different cases of wind action and the deviation angle for the normal condition, broken wire condition as well as cascade condition. In this example, the deviation angle for a suspension tower structure is from 0° to 2° which means the application of the wind load direction (i.e. for 45° and 90°) will be analyzed in order to attain the governing load. See table 18 for the different load cases.

Table 18 : Load Cases

No.	Description	Hanging	Deviation	Wind
1	Normal Condition	4	0°	90°
2	Normal Condition	4	0°	45°
3	Normal Condition	4	2°	90°
4	Normal Condition	4	2°	45°
5	Left Shield Wire Broken	4	0°	90°
6	Right Shield Wire Broken	4	0°	90°
7	Top - 2 Left Conductor Broken	4	0°	90°
8	Top - 2 Right Conductor Broken	4	0°	90°
9	Left Medium - 2 Conductor Broken	4	0°	90°
10	Right Medium - 2 Conductor Broken	4	0°	90°
11	Left Bottom - 2 Conductor Broken	4	0°	90°
12	Right Bottom - 2 Conductor Broken	4	0°	90°
13	Left Shield Wire Broken	4	0°	90°
14	Right Shield Wire Broken	4	0°	90°
15	Top - 1 Left Conductor Broken	4	0°	90°
16	Top - 1 Right Conductor Broken	4	0°	90°
17	Left Medium - 1 Conductor Broken	4	0°	90°
18	Right Medium - 1 Conductor Broken	4	0°	90°
19	Left Bottom - 1 Conductor Broken	4	0°	90°
20	Right Bottom - 1 Conductor Broken	4	0°	90°
21	Left Shield Wire Broken	4	0°	45°
22	Right Shield Wire Broken	4	0°	45°
23	Top - 2 Left Conductor Broken	4	0°	45°
24	Top - 2 Right Conductor Broken	4	0°	45°
25	Left Medium - 2 Conductor Broken	4	0°	45°
26	Right Medium - 2 Conductor Broken	4	0°	45°
27	Left Bottom - 2 Conductor Broken	4	0°	45°
28	Right Bottom - 2 Conductor Broken	4	0°	45°
29	Left Shield Wire Broken	4	0°	45°
30	Right Shield Wire Broken	4	0°	45°
31	Top - 1 Left Conductor Broken	4	0°	45°
32	Top - 1 Right Conductor Broken	4	0°	45°
33	Left Medium - 1 Conductor Broken	4	0°	45°
34	Right Medium - 1 Conductor Broken	4	0°	45°
35	Left Bottom - 1 Conductor Broken	4	0°	45°
36	Right Bottom - 1 Conductor Broken	4	0°	45°

No.	Description	Hanging	Deviation	Wind
37	Left Shield Wire Broken	4	2°	90°
38	Right Shield Wire Broken	4	2°	90°
39	Top - 2 Left Conductor Broken	4	2°	90°
40	Top - 2 Right Conductor Broken	4	2°	90°
41	Left Medium - 2 Conductor Broken	4	2°	90°
42	Right Medium - 2 Conductor Broken	4	2°	90°
43	Left Bottom - 2 Conductor Broken	4	2°	90°
44	Right Bottom - 2 Conductor Broken	4	2°	90°
45	Left Shield Wire Broken	4	2°	90°
46	Right Shield Wire Broken	4	2°	90°
47	Top - 1 Left Conductor Broken	4	2°	90°
48	Top - 1 Right Conductor Broken	4	2°	90°
49	Left Medium - 1 Conductor Broken	4	2°	90°
50	Right Medium - 1 Conductor Broken	4	2°	90°
51	Left Bottom - 1 Conductor Broken	4	2°	90°
52	Right Bottom - 1 Conductor Broken	4	2°	90°
53	Left Shield Wire Broken	4	2°	45°
54	Right Shield Wire Broken	4	2°	45°
55	Top - 2 Left Conductor Broken	4	2°	45°
56	Top - 2 Right Conductor Broken	4	2°	45°
57	Left Medium - 2 Conductor Broken	4	2°	45°
58	Right Medium - 2 Conductor Broken	4	2°	45°
59	Left Bottom - 2 Conductor Broken	4	2°	45°
60	Right Bottom - 2 Conductor Broken	4	2°	45°
61	Left Shield Wire Broken	4	2°	45°
62	Right Shield Wire Broken	4	2°	45°
63	Top - 1 Left Conductor Broken	4	2°	45°
64	Top - 1 Right Conductor Broken	4	2°	45°
65	Left Medium - 1 Conductor Broken	4	2°	45°
66	Right Medium - 1 Conductor Broken	4	2°	45°
67	Left Bottom - 1 Conductor Broken	4	2°	45°
68	Right Bottom - 1 Conductor Broken	4	2°	45°
69	Cascade	4	0°	—
70	Cascade	4	2°	—

As seen in table 18 above, the load cases for the double circuit transmission line suspension tower structure has been increased by including additional load cases with regard to the broken wire condition and 32 load cases have been included to fulfill the criteria of load case for a 4 – Circuit suspension tower structure. The single line diagram of the assumed 4 – Circuit carrying tower is shown in figure 11 below.

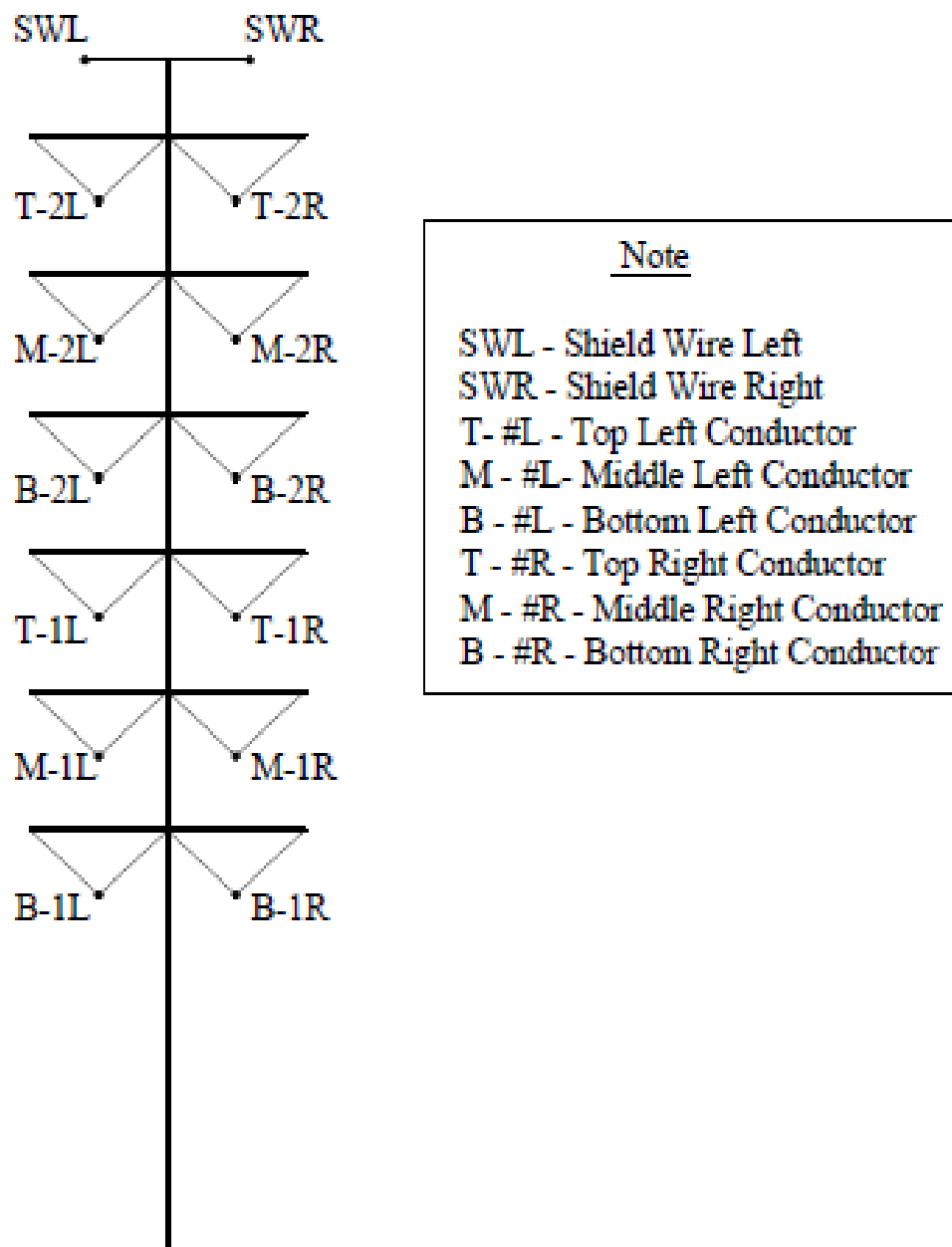


Figure 11 : Single Line Diagram of a 4 – Circuit Supporting Tower

Finally the design load will be computed as shown in table 19, 20 and 21 below so that these loads will be analyzed for the different load cases discussed earlier with an appropriate software to design a 4 - Circuit suspension transmission line tower structure.

Table 19 : Load Computation (Normal Condition)

Normal condition	OPGW/SW	0° line deviation	T(90°)	Wind Load	=	$WPL*\max(dS,dO)*NHS0*NFAC$	=	6.683	kN
			T(45°)	Wind Load	=	$80\%*WPL*\max(dS,dO)*NHS0*NFAC$	=	5.346	kN
		2° line deviation	T(90°)	Wind Load	=	$WPL*\max(dS,dO)*NHS2*NFAC$	=	5.346	kN
				Tension	=	$2*\max(TmaxS,TmaxO)*\sin(Amax/2)*NFAC$	=	1.354	kN
				total	=			6.7	kN
			T(45°)	Wind Load	=	$80\%*WPL*\max(dS,dO)*NHS2*NFAC$	=	4.277	kN
		Tension		=	$2*\max(TmaxS,TmaxO)*\sin(Amax/2)*NFAC$	=	1.354	kN	
		total		=			5.631	kN	
		L	Tension	=	$15\%*\max(EDTS,EDTO)*NFAC$	=	5.82	kN	
			Weight	=	$\max(WS,WO)*NVS*NFAC$	=	12.286	kN	
	Conductor	0° line deviation	T(90°)	Wind Load	=	$(NC*WPL*dC*NHS0+WPI*AI)*NFAC$	=	40.383	kN
			T(45°)	Wind Load	=	$(80\%*NC*WPL*dC*NHS0+WPI*AI)*NFAC$	=	32.64	kN
		2° line deviation	T(90°)	Wind Load	=	$(NC*WPL*dC*NHS2+WPI*AI)*NFAC$	=	32.64	kN
				Tension	=	$2*NC*TmaxC*\sin(Amax/2)*NFAC$	=	9.484	kN
				total	=			42.124	kN
			T(45°)	Wind Load	=	$(80\%*NC*WPL*dC*NHS2+WPI*AI)*NFAC$	=	26.445	kN
		Tension		=	$2*NC*TmaxC*\sin(Amax/2)*NFAC$	=	9.484	kN	
		total		=			35.929	kN	
		L	Tension	=	$15\%*NC*EDTC*NFAC$	=	32.868	kN	
			Weight	=	$(NC*WC*NVS+WI)*NFAC$	=	105.626	kN	

Table 20 : Load Computation (Broken Wire Condition (Broken Wire Phase))

Broken wire condition	Broken wire phase									
	OPGW/SW									
	0° line deviation	T(90°)	Wind Load	=	$75\%*WPL*\max(dS,dO)*NHS0*BFAC$	=	3.132	kN		
		T(45°)	Wind Load	=	$75\%*80\%*WPL*\max(dS,dO)*NHS0*BFAC$	=	2.506	kN		
		L	Tension	=	$\max(T_{\max S},T_{\max O})*BFAC$	=	24.25	kN		
	2° line deviation	T(90°)	Wind Load	=	$75\%*WPL*\max(dS,dO)*NHS2*BFAC$	=	2.506	kN		
			tension	=	$\max(T_{\max S},T_{\max O})*\sin(A_{\max}/2)*BFAC$	=	0.423	kN		
			total	=			2.929	kN		
	2° line deviation	T(45°)	Wind Load	=	$75\%*80\%*WPL*\max(dS,dO)*NHS2*BFAC$	=	2.005	kN		
			Tension	=	$\max(T_{\max S},T_{\max O})*\sin(A_{\max}/2)*BFAC$	=	0.423	kN		
			total	=			2.428	kN		
	2° line deviation	L	Tension	=	$\max(T_{\max S},T_{\max O})*\cos(A_{\max}/2)*BFAC$	=	24.246	kN		
			Weight	=	$75\%*\max(WS,WO)*NVS*BFAC$	=	5.759	kN		
			0° line deviation	T(90°)	Wind Load	=	$(75\%*NC*WPL*dC*NHS0+WPI*AI)*BFAC$	=	19.19	kN
	T(45°)	Wind Load		=	$(75\%*80\%*NC*WPL*dC*NHS0+WPI*AI)*BFAC$	=	15.56	kN		
	L	Tension		=	$70\%*NC*T_{\max C}*BFAC*\cos(A_{\min}/2)$	=	118.873	kN		
	Conductor	0° line deviation	T(90°)	Wind Load	=	$(75\%*NC*WPL*dC*NHS2+WPI*AI)*BFAC$	=	15.56	kN	
				Tension	=	$70\%*NC*T_{\max C}*\sin(A_{\max}/2)*BFAC$	=	2.075	kN	
				total	=			17.635	kN	
		2° line deviation	T(45°)	Wind Load	=	$(75\%*80\%*NC*WPL*dC*NHS2+WPI*AI)*BFAC$	=	12.656	kN	
				Tension	=	$70\%*NC*T_{\max C}*\sin(A_{\max}/2)*BFAC$	=	2.075	kN	
				total	=			14.731	kN	
2° line deviation	L	Tension	=	$70\%*NC*T_{\max C}*\cos(A_{\max}/2)*BFAC$	=	118.854	kN			
		Weight	=	$(NC*WC*NVS*75\%+WI)*BFAC$	=	50.26	kN			

Table 21 : Load Computation (Broken Wire Condition (Intact Phase) and Cascade Condition

Broken wire condition	Intact phase	OPGW/SW	0° line deviation	T(90°)	Wind Load	=	$WPL * \max(dS, dO) * NHS0 * BFAC$	=	4.177	kN
				T(45°)	Wind Load	=	$80\% * WPL * \max(dS, dO) * NHS0 * BFAC$	=	3.341	kN
			2° line deviation	T(90°)	Wind Load	=	$WPL * \max(dS, dO) * NHS2 * BFAC$	=	3.341	kN
					Tension	=	$2 * \max(TmaxS, TmaxO) * \sin(Amax/2) * BFAC$	=	0.846	kN
		V		total	=			4.188	kN	
				Wind Load	=	$80\% * WPL * \max(dS, dO) * NHS2 * BFAC$	=	2.673	kN	
			T(45°)	Tension	=	$2 * \max(TmaxS, TmaxO) * \sin(Amax/2) * BFAC$	=	0.846	kN	
				total	=			3.519	kN	
	Conductor	0° line deviation	T(90°)	Weight	=	$\max(WS, WO) * NVS * BFAC$	=	7.679	kN	
				Wind Load	=	$(NC * WPL * dC * NHS0 + WPI * AI) * BFAC$	=	25.24	kN	
			T(45°)	Wind Load	=	$(80\% * NC * WPL * dC * NHS0 + WPI * AI) * BFAC$	=	20.4	kN	
				Wind Load	=	$(NC * WPL * dC * NHS2 + WPI * AI) * BFAC$	=	20.4	kN	
		2° line deviation	T(90°)	Tension	=	$2 * NC * TmaxC * \sin(Amax/2) * BFAC$	=	5.927	kN	
				total	=			26.327	kN	
				Wind Load	=	$(80\% * NC * WPL * dC * NHS2 + WPI * AI) * BFAC$	=	16.528	kN	
				T(45°)	Tension	=	$2 * NC * TmaxC * \sin(Amax/2) * BFAC$	=	5.927	kN
Cascade	OPGW/SW	0° line deviation	V	total	=			22.456	kN	
				Weight	=	$(NC * WC * NVS + WI) * BFAC$	=	66.016	kN	
			0° line deviation	L	Tension	=	$70\% * \max(EDTS, EDTO) * BFAC$	=	16.975	kN
				V	Weight	=	$75\% * \max(WS, WO) * NVS * BFAC$	=	5.759	kN
	Conductor	0° line deviation	V	Tension	=	$70\% * NC * EDTC * BFAC$	=	95.865	kN	
				Weight	=	$(75\% * NC * WC * NVS + WI) * BFAC$	=	50.26	kN	
			2° line deviation	T	Tension	=	$70\% * \max(EDTS, EDTO) * \sin(Amax/2) * BFAC$	=	0.296	kN
				L	Tension	=	$70\% * \max(EDTS, EDTO) * \cos(Amax/2) * BFAC$	=	16.972	kN
	OPGW/SW	2° line deviation	V	Weight	=	$75\% * \max(WS, WO) * NVS * BFAC$	=	5.759	kN	
			T	Tension	=	$70\% * NC * EDTC * \sin(Amax/2) * BFAC$	=	1.673	kN	
	Conductor	2° line deviation	L	Tension	=	$70\% * NC * EDTC * \cos(Amax/2) * BFAC$	=	95.85	kN	
			V	Weight	=	$(75\% * NC * WC * NVS + WI) * BFAC$	=	50.26	kN	

Thus, from this, it is observed that one of the demerit of implementing such technology is the design complexity.

4.2 Assessment of Different Projects for Comparison of Single and Double circuit Transmission Lines

In order to analyze the pros and cons of Multi – Circuit supporting towers for high voltage lines, different projects constructed in Ethiopia for voltage levels 132kV & 230kV will be assessed by comparing the weight of the tower for single and double circuit transmission lines. Therefore, in order to obtain a reasonable Weight factor “ W_f ”, comparative analysis will be performed between single and double circuit transmission line supporting towers for the stated high voltage power transmission projects that were executed in Ethiopia. The chosen project’s wind and weight span requirements are identical for the 132kV & somehow similar for the 230kV lines.

In the process, maximum tower height (i.e. Basic body +12 meter body extension + 4 or + 3 meter leg extension) of Suspension ($0^0 - 2^0$), Tension ($0^0 - 30^0$) and Angle towers ($30^0 - 60^0$) are assessed for the two voltage levels. Accordingly the following transmission line projects as tabulated below are used for the analysis of the respective high voltages stated earlier.

Table 22 : Projects used for Analysis to Compare the Weight Factor “ W_f ”

Line Voltage level	Single Circuit Power transmission Project	Double Circuit Power Transmission Project
132kV	Butajira - Bue	Butajira – Bue Tap to Yabelo
	Awash - Metehara	Metehara – Melkajilo
230kV	Tekeze – Indaselse – Humera	Bedele - Metu
	Adigala – Milo – Lonis – Hurso	Yirgalem II – Hawassa II

For the stated projects in table 22 above, comparison is done between the weight of single and double circuit towers from the total weights stated in the as built as well as approved drawings for each projects so that the respective Weight factors relating the weight of single circuit towers with the double will be obtained. Refer [Appendix 2]. But for Yirgalem II – Hawassa II double circuit 230kV transmission line, there is only Suspension and Angle towers used, therefore, in order to estimate the weight of the tension tower, interpolation with tower weights of Suspension, Tension & Angle towers for the double circuit 230kV Bedele – Metu project have been performed where the estimated weight is 19953.7Kg.

See below the total weight of single as well as double circuit towers for a maximum height tower of each projects as tabulated below:

4.2.1 132kV Transmission Line Projects

Table 23 : Weight of Single and Double Circuit 132kV Line

Project	Tower Type	Tower Height (m)	Weight (Kg)
132kV S/C Butajira - Bue	Suspension	Maximum Height Tower (Basic Body, +12 Body Extension, +4 Leg Extension)	5109.4
	Tension		5943.3
	Angle		7575.0
132kV D/C Bue - Yabelo	Suspension		6881.2
	Tension		8295.7
	Angle		11236.1
132kV S/C Awash - Metehara	Suspension		6460.1
	Tension		7099.3
	Angle		8424.2
132kV D/C Metehara - Melkajilo	Suspension		8352.7
	Tension		10171.4
	Angle		13121.0

Table 24 : Weight Factor of Single and Double Circuit 132kV Line

Project	Suspension Tower (Weight in Kg)	Tension Tower (Weight in Kg)	Angle Tower (Weight in Kg)
132kV S/C Butajira - Bue (a)	5109.4	5943.3	7575.0
132kV D/C Bue - Yabelo (b)	6881.2	8295.7	11236.1
132kV S/C Awash - Metehara (c)	6460.1	7099.3	8424.2
132kV D/C Metehara - Melkajilo (d)	8352.7	10171.4	13121
Weight Increased (%) for (a) & (b)	34.7	39.6	48.3
Weight increased (%) for (c) & (d)	30.4	43.3	55.8
Weight factor (b) / (a)	1.347	1.396	1.483
Weight factor (d) / (c)	1.304	1.433	1.558
Average Weight factor	1.326	1.415	1.521

4.2.2 230kV Transmission Line Projects

Table 25 : Weight of Single and Double Circuit 230kV Line

Project	Tower Type	Tower Height (m)	Weight (Kg)
230kV S/C Tekeze – Indaselse – Humera	Suspension	Maximum Height Tower (Basic Body, +12 Body Extension, +4 Leg Extension)	8079.8
	Tension		9433.1
	Angle		9955.1
230kV D/C Bedele - Metu	Suspension		11402.6
	Tension		16086.6
	Angle		20480.4
230kV S/C Adigala – Milo – Lonis - Hurso	Suspension		8460.6
	Tension		10378.8
	Angle		12958.2
230kV D/C Yirgalem II – Hawassa II	Suspension		13190.9
	Tension		19953.7
	Angle		26297.5

Table 26 : Weight Factor of Single and Double Circuit 230kV Line

Project	Suspension Tower (Weight in Kg)	Tension Tower (Weight in Kg)	Angle Tower (Weight in Kg)
230kV S/C Tekeze – Indaselse – Humera (a)	8079.8	9433.1	9955.1
230kV D/C Bedele - Metu (b)	11402.6	16086.6	20480.4
230kV S/C Adigala – Milo – Lonis - Hurso (c)	8460.6	10378.8	12958.2
230kV D/C Yirgalem II – Hawassa II (d)	13190.9	19953.7	26297.5
Weight Increased (%) for (a) & (b)	41.1	70.5	105.7
Weight increased (%) for (c) & (d)	55.9	92.3	102.9
Weight factor (b) / (a)	1.411	1.705	2.057
Weight factor (d) / (c)	1.559	1.923	2.029
Average Weight factor	1.485	1.814	2.043

The figurative display of the above comparisons are as shown below:

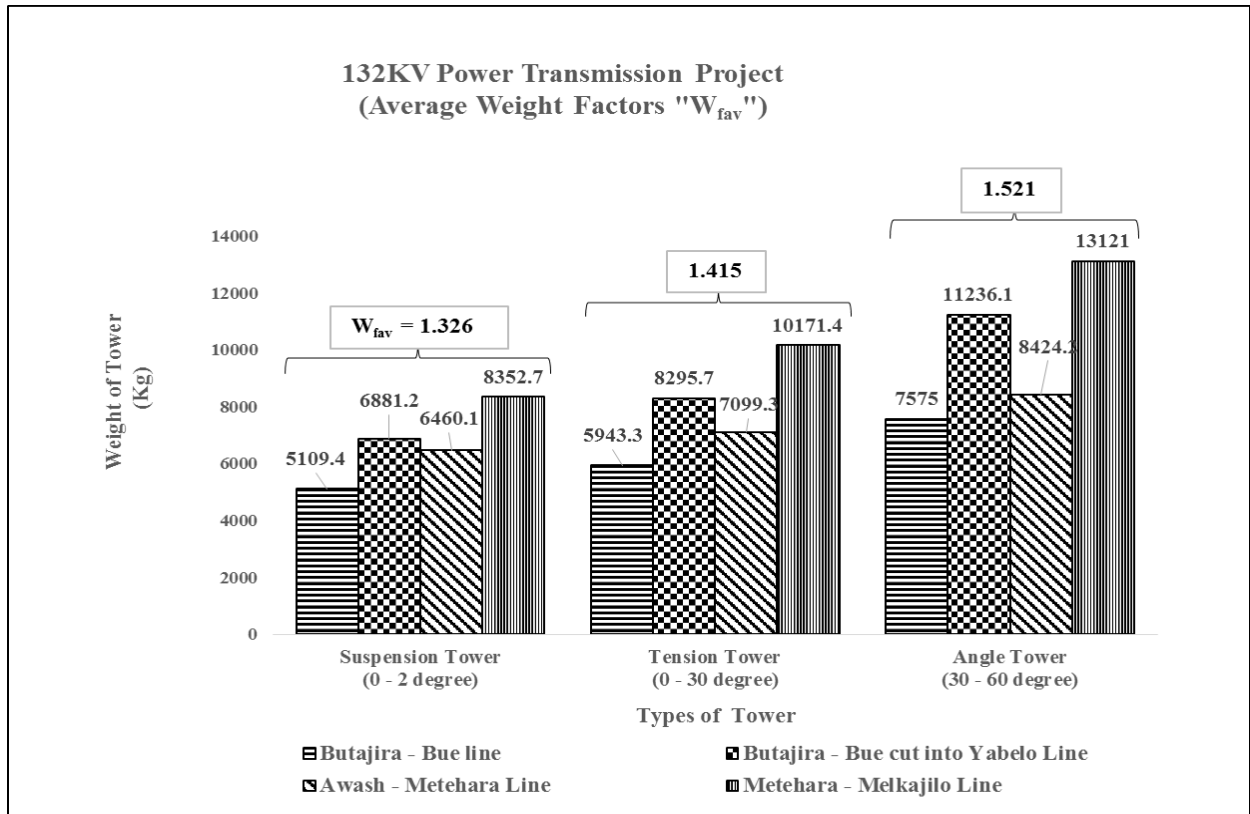


Figure 12: Single and Double Circuit Towers Weight Comparison for 132kV Line

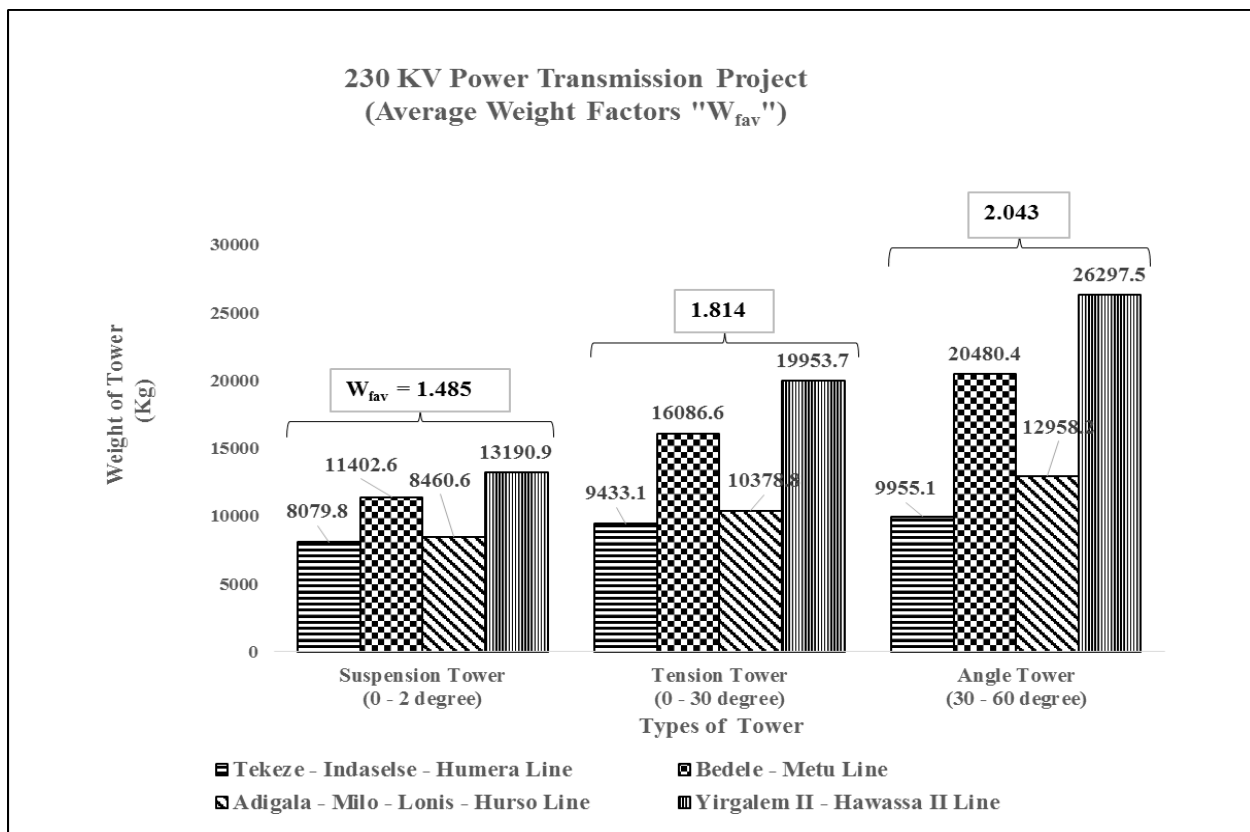


Figure 13 : Single and Double Circuit Towers Weight Comparison for 230kV Line

From the above analysis, considering the eight projects from different regions of Ethiopia, the average value of each weight factors for their respective tower types is obtained. And hence the estimated amount of weight which will be saved per tower by practicing Multi – Circuit supporting tower structures along a high voltage transmission line is as tabulated below:

Table 27 : Percentage of Weight Saved per Tower

Tower Type	132kV		230kV	
	Average Weight factor	Weight Saved per Tower	Average Weight factor	Weight Saved per Tower
Suspension Tower ($0^0 - 2^0$)	1.326	67.4%	1.485	51.5%
Tension Tower ($0^0 - 30^0$)	1.415	58.5%	1.814	18.6%
Angle Tower ($30^0 - 60^0$)	1.521	47.9%	2.043	-4.3%

See the figurative description below that shows the trend of the amount of weight that will be saved by implementing multiple circuit tower structures technology mainly for suspension towers and a little weight increase for the case of highly tensioned towers.

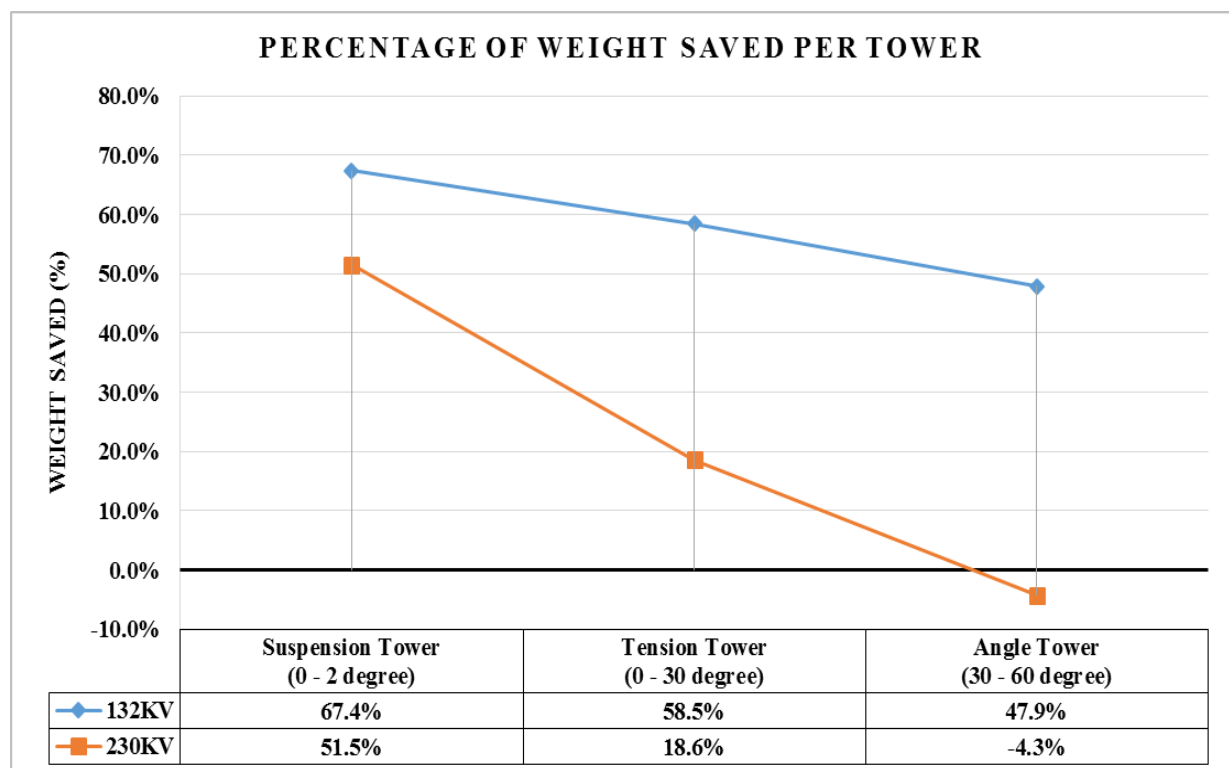


Figure 14 : Percentage of Weight Saved per Tower for Suspension, Tension and Angle Towers Structures

It is known that suspension towers are more in number along a certain transmission line and thus if it is possible to save more than 50% weight per these type of towers for both 132kV and 230kV transmission lines which is from using a double circuit instead of two single circuit lines, there will be no hesitation in mind that the application of Multi – Circuit supporting tower structures will have a positive influence on the investment cost of a certain transmission line. Meanwhile, from the analysis above, it can also be said that *as the voltage level to be transmitted increases, the amount of weight difference between single and double circuit transmission line supporting towers will have a decreasing trend especially for high tension carrying towers*. Therefore it is recommended to apply Double Circuit supporting towers preferably for 132kV lines in regards to investment cost of the tower materials.

But for the case of clearing trees and very important farm lands, which would be good income means for the villager around the line, applying Multi –Circuit structures independent of the voltage levels will be of great use.

The advantage in regards with the investment cost was also seen to have a decreasing trend for towers experiencing high tension forces (such as tension towers ($0^0 - 30^0$) and angle towers ($30^0 - 60^0$) especially for the later type of towers carrying 230kV power. Hence, it can be said that, implementing double circuit towers for suspension ($0^0 - 2^0$) and tension towers ($0^0 - 30^0$) will have virtue with regards to the material cost of the towers along a certain transmission line.

Security is also one of the factors that needs to be given due attention while implementing multiple circuit tower structures for a certain transmission line. This is due to the fact that all phases or circuits are on one tower, therefore, if there is by any means, a theft on the members of the tower structure, failure of the tower will follow thereby causing total black out of the line. Hence antitheft mechanisms like sealing connection bolts should be given due attentions plus educating the villagers or people around the line to be conscious of the hazard should be implemented.

Generally tower structures are very important components of a certain transmission line and studying the pros and cons of these will be of good use as it will help in choosing which type of tower for which project so that the material and construction investment cost as well as right of way (ROW) corridor compensation cost will be dealt in a cost effective and environmental friendly way.

5. Chapter Five

Conclusions and Recommendations

5.1 Conclusions

It is seen that many countries are using a multi circuit supporting steel tower structures or multi voltage multi circuit supporting steel structures for the transmission of high voltages from the source to the demand area in order to attain different advantages. And from analyzed project in Ethiopia, about 9.5% gain in cost of the material, transportation as well as construction was seen. In addition, more than 50% profit was also observed from the analysis with regards to the right of way compensation cost. Besides, while comparing suspension ($0^0 - 2^0$), tension ($0^0 - 30^0$) and angle towers ($30^0 - 60^0$) for 132kV and 230kV projects constructed in Ethiopia, about 67% for 132kV and 52% for 230kV cost advantage have been found for suspension towers. Whereas for the tension and angle towers, decreasing trend in the advantage have been observed. Some disadvantages of implementing Multi – Circuit towers will be the design complexity. And in relation to security, theft of members of the tower structures would result in total black out of the line. The other is during maintenance, as the towers are longer, there will be a difficulty faced to do so. Hence, advanced maintenance equipment's' or devices should also be given due attention to be included in the project cost while planning to execute a certain transmission line with Multi – Circuit towers.

The design requirements followed in Ethiopia (i.e. Ethiopian Electric Power) also have similarities with other countries for the implementation of the desired structure that will maintain every possible load which is imposed up on it (i.e. satisfying the normal conditions, broken wire conditions as well as cascade conditions for the tower design process) where only the meteorological data or factor of safety would be altered compared to other countries design practice. Therefore, if the same requirement is implemented for the proposed tower, which is multi circuit supporting steel structure, compared to the disadvantages, it is expected to land on better perspective adding good value for Ethiopia's power supply system.

5.2 Recommendations

- I. In regards to right of way reduction, implementing Multi – Circuit tower structures for a certain transmission line will provide the advantage to decrease the compensation cost which will be paid for personnel's belongings (like farm land or houses, etc...) along the corridor of the transmission line.
- II. Well organized environmental & meteorological data with zonal classification of Ethiopia will be helpful in assisting the economical and safe design process of a certain tower structure.
- III. Multi – Circuit – Multi – Voltage transmission line towers should also be exercised especially in urban areas because different voltage levels (For instance 230kV with 132kV & 33kV) can be transmitted together using a single tower.
- IV. From the analysis results, it was observed that the difference in the weight of the tower between a single circuit and double circuit transmission line have got a decreasing trend for high tension towers compared with suspension towers. Hence, it is recommended to apply towers that can carry more than one circuits mostly for suspension towers because the amount of tower weight to be saved is high and following the fact that they are more in number along a certain transmission line, the virtue to be gained is humungous.
- V. It is also important to give due attention for the security of a Multi – Circuit tower which could be due to theft of members of the structure or accidental situations that would affect the tower stability like foundation problems. These conditions would be reduced by educating the society about the hazard of a tower failure and proper construction and tower spot selection during check survey.
- VI. Extra high voltage (EHV) transmission line (For instance; greater than or equal to 765kV) should also be exercised which is also suitable for very long transmission line projects, which will result in an extra high power transmission followed by a reduced voltage loss along the line. Another importance of such technology will be reduction of the amount of land to be used by different transmission lines to transmit the same amount of power (For instance, more than 3 x 230kV transmission lines will be needed to transmit 765kV power but applying the EHV technology will bear much advantage in regard to voltage loss as well as land acquisition).

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11. ASCE Manuals and Reports on Engineering Practice No.74, Guidelines for Electrical Transmission Line Structural Loading, Third Edition, Edited by C. Jerry Wong & Michael D. Miller, Published by American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia 20191 © 2010
12. S.S Murthy and A.R Santhakumar, Transmission Line Structures, Published Singapore, McGraw-Hill © 1990
13. Ethiopian Electric Power, GERD – Dedessa – Holeta 500kV Power Transmission Project, Contract (LOT – 3, 4, 5 & 6), Employer’s Requirements, April 2013.

14. Audit Services Corporation, Ethiopian Electric Power, GERD – DEDESSA – HOLETA 500kV Power Transmission Project, China Electric Power Equipment & Technology Ltd (CET), Loan No. 33.20/101/05 Independent Auditor’s Report & Financial Statements, July, 2017.
15. Typical Multi Circuit Tower of 110kV and 220kV Lines
<https://goo.gl/images/WAZ6eU>.
16. National Grid Corporation for Advanced Technology Assessment, Multiple Circuits on Common Tower, State Grid, 2005.
17. Ethiopian Electric Power, Beles – Bahirdar – Debremarkos – Addis Ababa Power Transmission Project, Contract Lot 3B, Load Computation and Load Cases of DS Tower Type, August, 2008.
18. Layout of Multi – Circuit Suspension Towers
<https://goo.gl/images/WAZ6eU>.

Appendix 1

A-1.

Defined standards for design and construction of
transmission line [6]

Manufacturer	DIN ISO 9001
Planning and Design of Overhead Power Lines with rated voltages above 1 kV	IEC 60 826
Quartering wind, angle of 45°	IEC 60 826
Clearances	See B1.5.10
Broken wire conditions	DIN 1054 BS 8004
Coefficient of dynamic wind pressure	IEC 60 826
Wind pressure on conductors, ground wires and on areas of steel angle members	IEC 60 826
Foundation concrete; compressive strength	DIN 1045
Access roads; maximum size, weight and axle loading of vehicles	DIN 1072, SLW 60
Concrete work, concrete class 25	DIN 1045
Towers; quality of steel	DIN 17100 EN 10025
Steel; yield stresses	DIN, BS
Tower materials	Euro Norm, DIN ASTM A123/143
Bolts nuts, with metric thread, min. grade 5.6	DIN 267 DIN 555. ASTM A-394
Spring lock washers	DIN 127 B
Flat washers	DIN 126
Step bolts	DIN 57105, part 1
Earthing bolt M 16	DIN 48088, part 2
Danger plates	DIN 40006
Bolts, locking type; with hot-dip galvanized nuts	DIN 48073 form "S",
Earthing grid	VDE 0141.
Conductor reels	DIN 46 391 BS 1559
Line conductors Type, routine, sample tests	IEC 60889 IEC 61089 IEC 61232 ASTM B415, B232, B416

Conductors and ground wire	DIN 48200, 48201, 48203, 48204
Aluminum clad steel wire	ASTM B 415, B 416
Optical fiber	CCITT ITU-T G652, 655 recommend. IEC 793-1
OPGW	IEC 60794-4-1 IEEE 1138, Annexure A for short circuit tests ITU-T issues for single mode fibers IEC recommendations, IEEE;
OPGW tests	IEC 60793-1, 60794-4-1
Fittings for OHTL	IEC, DIN
Material for fittings	DIN 17200, DIN 1725
Fittings for OHTL Static mechanical behavior Dynamic mechanical behavior of anti-vibration fittings Electrical contact behavior of current carrying fittings, under normal operating conditions Partial discharge characteristics, tests Thermal mechanical tests Impulse over-voltage puncture test	DIN/VDE0212 IEC 60383-2 part 50 part 51 part 52 part 53 IEC 60 575 IEC 1211
Ball and socket connection Clevis Caps for Insulators Hinges (only form "S" to be utilized) Connecting Dimensions for protective fittings Eye links Yokes (only form "S" to be utilized) Connecting Bolts (only form "S" to be utilized) Connecting Dimensions for Eyes and Clevises P.G. Clamps Clevis Straps (only form "S" to be utilized) Compression Dies Earth Clamping Bolts Clamps & joints Turnbuckles Galvanizing	IEC 120 DIN 48062/2 DIN 48066 DIN 48068 DIN 48069 DIN 48070/1 DIN 48073 DIN 48074 DIN 48075 DIN 48078/1 DIN 48083 DIN 48088/2 DIN 48215 DIN 48334 DIN VDE 0210, ASTM A153
Fatigue test, dynamic endurance of the damper	DIN VDE 0212 Part 51 (issue July 1986)
Glass Insulators	IEC 60305
Insulator strings	IEC 60383 IEC 60437 IEC 61109
Type tests	DIN/VDE 0212 p. 53
Insulator-, Conductor-, OPGW fittings and line accessories, type, routine, sample tests	DIN/VDE 0212 p. 50-54
Ball & Socket type insulators Track resistance of the material shall be min. class 1A 3.5	IEC 60587
Resistance of the insulator rod against brittle fracture	IEC 61109
Corrosion protection coating	DIN 55945, 53678, 536230 ISO 4628, 2409

Appendix 2

A-2.

GERD Price Schedule, as built and approved design
drawings for Suspension, Tension & Angle Towers
[Ethiopian Electric Power's Executed & Ongoing
Projects]

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -I

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
	Including complete design, manufacturing, testing, transport, loading, unloading, intermediate storage, erection installation, testing and commissioning.													
1.0	GENERAL WORKS													
	Including all necessary survey activities like tower spotting, survey of crossing objects including pegging of towers, diagonal profiles and all necessary documentation for the OHTL, soil investigations and route clearing & access roads.													
1.1	Check survey, review of tower plotting and preparation of profile drawings and tower schedule.		route km	275									16,000.00	4,400,000.00
1.2	Preliminary sub-soil investigation at support locations by means of soil penetration test (SPT), establishment of ground water level and determination of soil/water aggressiveness		per tower	642									700.00	449,400.00
1.3	Specialist soil investigation		per tower	50									1,400.00	70,000.00
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		lump sum										825,000.00	825,000.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES													5,744,400.00
2.0	FOUNDATIONS													
	All Foundations for Tower Types according to the specification, including all transport, excavation, installation of stubs, all necessary reinforcement, shuttering, concreting & backfilling, compacting, complete tower earthing and their connections to tower, measuring of earth resistance and submitting of records to Employer/Engineer, according to drawings and regulations of the Employer. Soil class definition concerning permissible soil pressure is according to Employer's design and specifications.													
2.1	Type DL Tower, concrete footings, in class 1 (rock) soil		per tower	12	961.5	11538	64.1	769.2	32.05	384.6	32.05	384.6	5,320.30	63,843.60
2.2	Type DL Tower, concrete footings in class 2 (good) soil		per tower	250	1671.6	417900	111.44	27860	55.72	13930	55.72	13930	9,249.52	2,312,380.00
2.3	Type DL Tower, concrete footings in class 3 (poor) soil		per tower	230	2632.65	605509.5	175.51	40367.3	87.755	20183.65	87.755	20183.65	14,567.33	3,350,485.90
2.4	Type DL Tower, concrete footings in class 4 (good submerged) soil		per tower	40	4129.05	165162	275.27	11010.8	137.635	5505.4	137.635	5505.4	22,847.41	913,896.40
2.5	Type DL Tower, concrete footings in class 5 (poor submerged) soil		per tower	22	6895.35	151697.7	459.69	10113.18	229.845	5056.59	229.845	5056.59	38,154.27	839,393.94
2.6	Type DL Tower, raft foundation in class 6 (very poor submerged) soil		per tower	2	7935.3	15870.6	529.02	1058.04	264.51	529.02	264.51	529.02	43,908.66	87,817.32
2.7	Type DT30 Tower, concrete footings, in class 1 (rock) soil		per tower	10	1756.35	17563.5	117.09	1170.9	58.545	585.45	58.545	585.45	9,718.47	97,184.70
2.8	Type DT30 Tower, concrete footings in class 2 (good) soil		per tower	30	3801.6	114048	253.44	7603.2	126.72	3801.6	126.72	3801.6	21,035.52	631,065.60
2.9	Type DT30 Tower, concrete footings in class 3 (poor) soil		per tower	28	5836.65	163426.2	389.11	10895.08	194.555	5447.54	194.555	5447.54	32,296.13	904,291.64
2.11	Type DT30 Tower, concrete footings in class 4 (good submerged) soil		per tower	5	9836.7	49183.5	655.78	3278.9	327.89	1639.45	327.89	1639.45	54,429.74	272,148.70
2.11	Type DT30 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	15628.35	31256.7	1041.89	2083.78	520.945	1041.89	520.945	1041.89	86,476.87	172,953.74
2.12	Type DT30 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	18879.15	18879.15	1258.61	1258.61	629.305	629.305	629.305	629.305	104,464.63	104,464.63
2.13	Type DT60 Tower, concrete footings, in class 1 (rock) soil		per tower	1	3052.65	3052.65	203.51	203.51	101.755	101.755	101.755	101.755	16,891.33	16,891.33
2.14	Type DT60 Tower, concrete footings in class 2 (good) soil		per tower	3	7597.2	22791.6	506.48	1519.44	253.24	759.72	253.24	759.72	42,037.84	126,113.52
2.15	Type DT60 Tower, concrete footings in class 3 (poor) soil		per tower	3	10901.7	32705.1	726.78	2180.34	363.39	1090.17	363.39	1090.17	60,322.74	180,968.22
2.16	Type DT60 Tower, concrete footings in class 4 (good submerged) soil		per tower	1	18598.2	18598.2	1239.88	1239.88	619.94	619.94	619.94	619.94	102,910.04	102,910.04
2.17	Type DT60 Tower, concrete footings in class 5 (poor submerged) soil		per tower	1	27138.9	27138.9	1809.26	1809.26	904.63	904.63	904.63	904.63	150,168.58	150,168.58
2.18	Type DT60 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	25294.5	25294.5	1686.3	1686.3	843.15	843.15	843.15	843.15	139,962.90	139,962.90
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES					1891615.80		126107.72		63053.86		63053.86		10,466,940.76
3.0	TOWER GROUNDING													
	All tower groundings including excavation, laying of counterpoise, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and measuring of ohmic value													
3.1	Basic grounding on two diagonal legs, consisting of three (3) ground rods 1m long and 5m counterpoise.		per tower	1284	50.00	64,200.00	3.00	3,852.00	0.50	642.00	0.25	321.00	40.00	51,360.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	40.00	4,000.00	2.00	200.00	0.40	40.00	0.20	20.00	40.00	4,000.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES					68,200.00		4,052.00		682.00		341.00		55,360.00

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -1

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
4.0	STEEL TOWERS													
	Supply and erection of hot dip galvanised lattice steel towers according to the design including stubs, stub extensions, leg extensions, earthing connections and measuring of earth resistance and submittance of record to Employer/ Engineer, warning and danger plates, number plates, phase plates where necessary, step bolts, all necessary fittings, and all connections to the insulator strings. Securing against vandalism by punching of bolts above 6mts hight of the tower.													
4.1	TypeDL Tower, standard height -6.0m		each	4	55,165.00	220,660.00	3,397.00	13,588.00	274.90	1,099.60	137.45	549.80	4,124.00	16,496.00
4.2	Type DL Tower, standard height -3.0m		each	8	60,908.00	487,264.00	3,751.00	30,008.00	303.53	2,428.24	151.76	1,214.08	4,553.00	36,424.00
4.3	Type DL Tower, standard height		each	172	64,716.00	11,131,152.00	3,986.00	685,592.00	322.50	55,470.00	161.25	27,735.00	4,838.00	832,136.00
4.4	Type DL Tower, standard height +3.0m		each	74	70,171.00	5,192,654.00	4,321.00	319,754.00	349.68	25,876.32	174.84	12,938.16	5,245.00	388,130.00
4.5	Type DL Tower, standard height +6.0m		each	98	75,357.00	7,384,986.00	4,641.00	454,818.00	375.53	36,801.94	187.76	18,400.48	5,633.00	552,034.00
4.6	Type DL Tower, standard height +9.0m		each	45	80,261.00	3,611,745.00	4,943.00	222,435.00	399.97	17,998.65	199.98	8,999.10	5,999.00	269,955.00
4.6	Type DL Tower, standard height +12.0m		each	155	85,475.00	13,248,625.00	5,264.00	815,920.00	425.95	66,022.25	212.97	33,010.35	6,389.00	990,295.00
4.7	Type DL Tower, -2.0m Leg Extension		each	200	1,379.00	275,800.00	85.00	17,000.00	6.87	1,374.00	3.44	688.00	103.00	20,600.00
4.8	Type DL Tower, -1.0m Leg Extension		each	236	1,660.00	391,760.00	102.00	24,072.00	8.27	1,951.72	4.14	977.04	124.00	29,264.00
4.9	TypeDL Tower, +0.0m Leg Extension		each	788	1,967.00	1,549,996.00	121.00	95,348.00	9.80	7,722.40	4.90	3,861.20	147.00	115,836.00
4.10	Type DL Tower, +1.0m Leg Extension		each	400	2,357.00	942,800.00	145.00	58,000.00	11.75	4,700.00	5.87	2,348.00	176.00	70,400.00
4.11	Type DL Tower, +2.0m Leg Extension		each	300	2,661.00	798,300.00	164.00	49,200.00	13.26	3,978.00	6.63	1,989.00	199.00	59,700.00
4.12	TypeDL Tower, +3.0m Leg Extension		each	300	2,986.00	895,800.00	184.00	55,200.00	14.88	4,464.00	7.44	2,232.00	223.00	66,900.00
4.13	Type DT30 Tower, standard height -6.0m		rate only		94,681.00		5,831.00		471.83		235.91		7,077.00	
4.14	Type DT30 Tower, standard height -3.0m		each	3	103,213.00	309,639.00	6,356.00	19,068.00	514.35	1,543.05	257.17	771.51	7,715.00	23,145.00
4.15	Type DT30 Tower, standard height		each	41	109,578.00	4,492,698.00	6,748.00	276,668.00	546.07	22,388.87	273.03	11,194.23	8,191.00	335,831.00
4.16	Type DT30 Tower, standard height +3.0m		each	7	118,734.00	831,138.00	7,312.00	51,184.00	591.69	4,141.83	295.85	2,070.95	8,875.00	62,125.00
4.17	TypeDT30 Tower, standard height +6.0m		each	2	129,258.00	258,516.00	7,960.00	15,920.00	644.14	1,288.28	322.07	644.14	9,662.00	19,324.00
4.17	Type DT30 Tower, standard height +9.0m		each	6	138,451.00	830,706.00	8,526.00	51,156.00	689.95	4,139.70	344.97	2,069.82	10,349.00	62,094.00
4.18	Type DT30 Tower, standard height +12.0m		each	17	147,564.00	2,508,588.00	9,088.00	154,496.00	735.36	12,501.12	367.68	6,250.56	11,030.00	187,510.00
4.19	Type DT30 Tower, -2.0m Leg Extension		each	12	2,310.00	27,720.00	142.00	1,704.00	11.51	138.12	5.75	69.00	173.00	2,076.00
4.20	Type DT30 Tower, -1.0m Leg Extension		each	16	2,922.00	46,752.00	180.00	2,880.00	14.56	232.96	7.28	116.48	218.00	3,488.00
4.21	Type DT30 Tower, +0.0m Leg Extension		each	124	3,398.00	421,352.00	209.00	25,916.00	16.94	2,100.56	8.47	1,050.28	254.00	31,496.00
4.22	Type DT30 Tower, +1.0m Leg Extension		each	80	3,998.00	351,824.00	246.00	21,648.00	19.92	1,752.96	9.96	876.48	299.00	26,312.00
4.23	Type DT30 Tower, +2.0m Leg Extension		each	32	4,523.00	144,736.00	279.00	8,928.00	22.54	721.28	11.27	360.64	338.00	10,816.00
4.24	Type DT30 Tower,+3.0m Leg Extension		each	32	5,036.00	161,152.00	310.00	9,920.00	25.09	802.88	12.55	401.60	376.00	12,032.00
4.25	Type DT60 Tower,standard height -6.0m		each	1	125,947.00	125,947.00	7,756.00	7,756.00	627.64	627.64	313.82	313.82	9,415.00	9,415.00
4.26	Type DT60 Tower,standard height -3.0m		rate only		138,173.00		8,509.00		688.56		344.28		10,328.00	
4.27	Type DT60 Tower,standard height		each	7	146,608.00	1,026,256.00	9,029.00	63,203.00	730.60	5,114.20	365.30	2,557.10	10,959.00	76,713.00
4.28	Type DT60 Tower,standard height +3.0m		rate only		159,675.00		9,834.00		795.71		397.86		11,936.00	
4.28	Type DT60 Tower,standard height +6.0m		each	1	173,763.00	173,763.00	10,701.00	10,701.00	865.92	865.92	432.96	432.96	12,989.00	12,989.00
4.29	Type DT60 Tower,standard height +9.0m		rate only		183,842.00		11,322.00		916.14		458.07		13,742.00	
4.30	Type DT60 Tower,standard height +12.0m		each	1	197,159.00	197,159.00	12,142.00	12,142.00	982.51	982.51	491.25	491.25	14,738.00	14,738.00
4.31	Type DT60 Tower, -2.0m leg Extension		each	4	3,779.00	15,116.00	233.00	932.00	18.83	75.32	9.42	37.68	282.00	1,128.00
4.32	Type DT60 Tower, -1.0m leg Extension		each	4	4,514.00	18,056.00	278.00	1,112.00	22.50	90.00	11.25	45.00	337.00	1,348.00
4.33	Type DT60 Tower, +0.0m leg Extension		each	8	5,224.00	41,792.00	322.00	2,576.00	26.03	208.24	13.02	104.16	390.00	3,120.00
4.34	Type DT60 Tower, +1.0m leg Extension		each	8	6,035.00	48,280.00	372.00	2,976.00	30.08	240.64	15.04	120.32	451.00	3,608.00
4.35	Type DT60 Tower, +2.0m leg Extension		each	8	6,911.00	55,288.00	426.00	3,408.00	34.44	275.52	17.22	137.76	517.00	4,136.00
4.36	Type DT60 Tower, +3.0m leg Extension		each	8	7,741.00	61,928.00	477.00	3,816.00	38.58	308.64	19.29	154.32	579.00	4,632.00
4.37	Transposition tower type DT30,standard height		each	3	109,578.00	328,734.00	6,748.00	20,244.00	546.07	1,638.21	273.03	819.09	8,191.00	24,573.00
4.38	Transposition tower type DT30,+0.0m leg Extension		each	4	3,398.00	13,592.00	209.00	836.00	16.94	67.76	8.47	33.88	254.00	1,016.00
4.39	Transposition tower type DT30,+1.0m leg Extension		each	8	3,998.00	31,984.00	246.00	1,968.00	19.92	159.36	9.96	79.68	299.00	2,392.00
4.40	Anti-theft bolts or Welding of tower bolts & nuts and painting over with Anti-rust and galvanizing paint including Steel Cradle guards up to 6mts of tower height		per tower	642	3,500.00	2,247,000.00	123.00	78,966.00	2.00	1,284.00	1.00	642.00	1,050.00	674,100.00
4.41	Alternative proposal for protecting towers from vandalism		per tower	rate only	9,000.00		315.00		6.00		3.00		2,700.00	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						60,901,258.00		3,691,059.00		293,576.69		146,786.92		5,058,327.00

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -1

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
5.0	TOWER LOAD TESTS													
	Tower type test to ultimate loading including, supply, erection and dismantling. The test shall include minimum 8(eight) Loading cases													
5.1	Tower type DL		per test	1	97,419.00	97,419.00							194,838.00	194,838.00
5.2	Tower type DT30		per test	1	167,708.00	167,708.00							335,416.00	335,416.00
5.3	Tower type DT60		per test	1	228,123.00	228,123.00							456,246.00	456,246.00
5.4	Test Witnessing, as per clause A2.21		lump sum	1									45,000.00	45,000.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES					493,250.00								1,031,500.00
6.0	LINE CONDUCTOR INSULATORS AND FITTINGS													1524750.00
	Supply and installation of Insulators & complete Sets of Fittings including all types of clamps, armor rods, extension links, pilot insulator sets, counterweights and all connections to Tower.													
6.1	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	54	2,599.00	140,346.00	90.97	4,912.38	25.99	1,403.46	13.00	702.00	389.85	21,051.90
6.2	for item 6.1 complete with arc horns at both ends, armour rods, suspension clamp & fittings.		set	54	886.00	47,844.00	31.01	1,674.54	8.86	478.44	4.43	239.22	132.90	7,176.60
6.3	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	3318	2,568.00	8,520,624.00	89.88	298,221.84	25.68	85,206.24	12.84	42,603.12	385.20	1,278,093.60
6.4	for item 6.3 complete with bottom arc horn only, armour rods, suspension clamp and fittings.		set	3318	850.00	2,820,300.00	29.75	98,710.50	8.50	28,203.00	4.25	14,101.50	127.50	423,045.00
6.5	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	1044	3,217.00	3,350,548.00	112.60	117,554.40	32.17	33,585.48	16.09	16,797.96	482.55	503,782.20
6.6	for item 6.5 including all connections to towers, clamps and fittings, armor rods arcing device line end only.		set	1044	968.00	1,010,592.00	33.88	35,370.72	9.68	10,105.92	4.84	5,052.96	145.20	151,588.80
6.7	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	84	3,265.00	274,260.00	114.28	9,599.52	32.65	2,742.60	16.33	1,371.72	489.75	41,139.00
6.8	for item 6.7 including all connections to towers, clamps and fittings, armor rods arcing device both ends.		set	84	936.00	78,624.00	32.76	2,751.84	9.36	786.24	4.68	393.12	140.40	11,793.60
6.9	"I" Jumper string as per the drawing		each	72	732.00	52,704.00	25.62	1,844.64	7.32	527.04	3.66	263.52	109.80	7,905.60
6.10	for item 6.9 complete with armour rods, suspension clamp and fittings.		each	72	718.00	51,696.00	25.13	1,809.36	7.18	516.96	3.59	258.48	107.70	7,754.40
6.11	Aircraft warning spheres		per unit	30	181.00	5,430.00	6.34	190.20	1.81	54.30	0.91	27.30	27.15	814.50
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES					16,360,968.00		572,639.94		163,609.68		81,810.90		2,454,145.20
7.0	GSW & OPGW FITTINGS AND ACCESSORIES													
	Supply and installation of complete Sets of Fittings, including all types of clamps, extension links, armor rods, counterweights and all connections to Tower.													
7.1	Suspension set for OPGW		each	529	103.00	54,487.00	3.61	1,909.69	1.03	544.87	0.52	275.08	15.45	8,173.05
7.2	Tension passing set for OPGW		each	44	252.00	11,088.00	8.82	388.08	2.52	110.88	1.26	55.44	37.80	1,663.20
7.3	Tension double dead end down set for OPGW, to be installed on suspension tower		each	30	226.00	6,780.00	7.91	237.30	2.26	67.80	1.13	33.90	33.90	1,017.00
7.4	Tension double dead end down set for OPGW		each	33	226.00	7,458.00	7.91	261.03	2.26	74.58	1.13	37.29	33.90	1,118.70
7.5	Tension terminal dead end down set for OPGW		each	2	226.00	452.00	7.91	15.82	2.26	4.52	1.13	2.26	33.90	67.80
7.6	Joining Box for OPGW/OPGW, for use within the transmission line, including fixing, splicing and downlead clamps, with feed through sets, suitable for up to 72 SMF/ NZSDF fibres and OPGW, types as per specification		each	63	242.00	15,246.00	8.47	533.61	2.42	152.46	1.21	76.23	36.30	2,286.90
7.7	Terminal Box for OPGW/FOC, for the connection at substation gantry, including fixing, splicing and downlead clamps, for up to 72 SMF/ NZSDF fibres and OPGW/FOC, types as per specification		each	2	242.00	484.00	8.47	16.94	2.42	4.84	1.21	2.42	36.30	72.60
7.8	Suspension set for GSW		each	559	44.00	24,596.00	1.54	860.86	0.44	245.96	0.22	122.98	6.60	3,689.40
7.9	Tension set for GSW complete for one tower		each	83	32.00	2,656.00	1.12	92.96	0.32	26.56	0.16	13.28	4.80	398.40
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES					123,247.00		4,316.29		1,232.47		618.88		18,487.05

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -1

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning		
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price	
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	
					(1)	(2)	(1) x (2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
8.0	CONDUCTOR AND SHIELD WIRE														
	Supply, stringing and installation including all joints, sleeves, jumper loops, spacers and necessary dampers, earthing connections and all downloads														
8.1	3 phase, Quad bundle ACSR Conductor Code Name "CONDOR"454.5, stringing of double circuit on double circuit towers.	route km	275	162,600.00	44,715,000.00	8,130.00	2,235,750.00	1,626.00	447,150.00	813.00	223,575.00	25,000.00	6,875,000.00		
8.2	Single Optical Groundwire (OPGW) with 24 fibres, including all splicing and connections to joint boxes	route km	275	5,565.00	1,530,375.00	278.00	76,450.00	55.65	15,303.75	27.82	7,650.50	750.00	206,250.00		
8.3	Single galvanized steel shieldwire type GSW 79	route km	275	801.00	220,275.00	40.00	11,000.00	8.01	2,202.75	4.00	1,100.00	750.00	206,250.00		
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						46,465,650.00		2,323,200.00		464,656.50		232,325.50		7,287,500.00	
9.0	SPARES														
9.1	Type DL Tower, foundation steelwork for footings in class 3 (poor) soil	per tower	3	5,265.00	15,795.00	184.28	552.84	52.65	157.95	26.33	78.99				
9.2	Type DL Tower, steelwork for grillage footings in class 2 (good) soil	per tower	3	4,005.00	12,015.00	140.18	420.54	40.05	120.15	20.03	60.09				
9.3	Type DT30 Tower, foundation steelwork for footings in class 3 (poor) soil	per tower	3	6,675.00	20,025.00	233.63	700.89	66.75	200.25	33.38	100.14				
9.4	Type DT60 Tower, foundation steelwork for footings in class 3 (poor) soil	per tower	1	11,670.00	11,670.00	408.45	408.45	116.70	116.70	58.35	58.35				
9.5	Ground rods, each to include clamps forwire/tower & wire/rod connection	each	10	12.50	125.00	0.75	7.50	0.13	1.30	0.06	0.60				
9.6	Type DL Tower, standard height -3.0m	each	1	60,908.00	60,908.00	3,751.00	3,751.00	609.08	609.08	304.54	304.54				
9.7	Type DL Tower, standard height	each	3	64,716.00	194,148.00	3,986.00	11,958.00	647.16	1,941.48	323.58	970.74				
9.8	Type DL Tower, standard height +6.0m	each	1	75,357.00	75,357.00	4,641.00	4,641.00	753.57	753.57	376.79	376.79				
9.10	Type DL Tower, standard height +12.0m	each	1	85,475.00	85,475.00	5,264.00	5,264.00	854.75	854.75	427.38	427.38				
9.11	Type DL Tower, +0.0m Leg Extension	each	4	1,967.00	7,868.00	121.00	484.00	19.67	78.68	9.84	39.36				
9.12	Type DL Tower, +1.0m Leg Extension	each	4	2,357.00	9,428.00	145.00	580.00	23.57	94.28	11.79	47.16				
9.13	Type DL Tower, +2.0m Leg Extension	each	8	2,661.00	21,288.00	164.00	1,312.00	26.61	212.88	13.31	106.48				
9.14	Type DL Tower, +3.0m Leg Extension	each	8	2,986.00	23,888.00	184.00	1,472.00	29.86	238.88	14.93	119.44				
9.15	Type DT30 Tower, standard height	each	2	109,578.00	219,156.00	6,748.00	13,496.00	1,095.78	2,191.56	547.89	1,095.78				
9.16	Type DT30 Tower, standard height +6.0m	each	1	129,258.00	129,258.00	7,960.00	7,960.00	1,292.58	1,292.58	646.29	646.29				
9.17	Type DT30 Tower, +0.0m Leg Extension	each	8	3,398.00	27,184.00	209.00	1,672.00	33.98	271.84	16.99	135.92				
9.18	Type DT30 Tower, +1.0m Leg Extension	each	4	3,998.00	15,992.00	246.00	984.00	39.98	159.92	19.99	79.96				
9.19	Type DT60 Tower,standard height	each	1	146,608.00	146,608.00	9,029.00	9,029.00	1,466.08	1,466.08	733.04	733.04				
9.20	Type DT60 Tower, +0.0m leg Extension	each	4	5,224.00	20,896.00	322.00	1,288.00	52.24	208.96	26.12	104.48				
9.21	Suspension string as item 6.1	set	24	2,599.00	62,376.00	90.97	2,183.28	25.99	623.76	13.00	312.00				
9.22	Tension string as item 6.3	set	24	2,568.00	61,632.00	89.88	2,157.12	25.68	616.32	12.84	308.16				
9.23	OPGW suspension set as item 7.1	set	8	103.00	824.00	3.61	28.88	1.03	8.24	0.52	4.16				
9.24	OPGW tension set as item 7.2	set	4	252.00	1,008.00	8.82	35.28	2.52	10.08	1.26	5.04				
9.25	GSW suspension set as item 7.8	set	8	44.00	352.00	1.54	12.32	0.44	3.52	0.22	1.76				
9.26	GSW tension set as item 7.9	set	4	32.00	128.00	1.12	4.48	0.32	1.28	0.16	0.64				
9.27	Flexible sacers for ACSR "CONDOR" 454.5 Conductor.	each	300	80.00	24,000.00	2.80	840.00	0.80	240.00	0.40	120.00				
9.27	Stockbridge type vibration dampers for CONDOR 454.5	each	50	120.00	6,000.00	4.20	210.00	1.20	60.00	0.60	30.00				
9.28	Stockbridge type vibration dampers for OPGW	each	50	30.00	1,500.00	1.05	52.50	0.30	15.00	0.15	7.50				
9.29	Stockbridge type vibration dampers for GWS	each	50	30.00	1,500.00	1.05	52.50	0.30	15.00	0.15	7.50				
9.30	ACSR "CONDOR" 454.5Conductor	km	30	6,775.00	203,250.00	339.00	10,170.00	67.75	2,032.50	33.88	1,016.40				
9.31	OPGW	km	4	5,565.00	22,260.00	278.00	1,112.00	55.65	222.60	27.83	111.32				
9.32	E.H.S shieldwire	km	4	801.00	3,204.00	40.00	160.00	8.01	32.04	4.01	16.04				
9.33	Mid - span tension joint for ACSR "CONDOR" 454.5Conductor	each	60	72.00	4,320.00	2.52	151.20	0.72	43.20	0.36	21.60				
9.34	Reepair sleeve forACSR "CONDOR" 454.5Conductor	each	30	72.00	2,160.00	2.52	75.60	0.72	21.60	0.36	10.80				
9.35	Joint Box intermediate type for OPGW	each	3	300.00	900.00	10.50	31.50	3.00	9.00	1.50	4.50				
9.36	Mid - span tension joint for E.H.S shieldwire	each	30	20.00	600.00	0.70	21.00	0.20	6.00	0.10	3.00				
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						1,493,098.00		83,278.88		14,931.03		7,465.95			
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFFS														
10.1	Office and housing facilities for the engineer and employer's staff as specified under Section-VI " Employers requirements", part A2, item A2.13 and A2.14	LOT	1									440,000.00	440,000.00		
SUB - TOTAL													440,000.00		
11.0	VEHICLES														
11.1	Land cruiser, swing type back door, 5-speed, common rail turbo charged diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.22	each	1									272,000.00	272,000.00		
11.2	Double cabin pick-ups, four door, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section VI-Employers requirements, part A2, item A2.22	each	10									140,000.00	1,400,000.00		
SUB - TOTAL CARRIED TO SUMMARY OF PRICES													1,672,000.00		
TOTAL (to Grand Summary)						127,797,286.80		6,804,653.83		1,001,742.23		532,403.01		34,228,660.00	

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD - BHERSA 30KV TRANSMISSION LINE - 4

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
				(1)	(2)	(1) x (2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
	Including complete design, manufacturing, testing, transport, loading, unloading, intermediate storage, erection installation, testing and commissioning													
1.0	GENERAL WORKS													
	Including all necessary survey activities like tower spotting, survey of crossing alignment, including pegging of towers, diagonal profiles and all necessary documentation for the OHTL, soil investigations and state clearing & access roads.													
1.1	Check survey, review of tower plotting and preparation of profile drawings and tower schedule.		route km	344									16,000.00	5,504,000.00
1.2	Preliminary sub-soil investigation at support locations by means of soil penetration test (SPT), establishment of ground water level and dimensional soil-water aggressiveness		per tower	863									700.00	562,100.00
1.3	Specialist soil investigations		per tower	60									1,400.00	84,000.00
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		lamp run										1,032,000.00	1,032,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES														5,682,100.00
2.0	FOUNDATIONS													
	All Foundations for Tower Types according to the specifications, including all transport, excavation, installation of rebar, all necessary reinforcement, shoring, concreting, backfilling, compaction, complete tower seating and their connection to tower, ensuring of earth concrete and submitting of records to Engineer/Owner, according to drawings and regulations of the													
2.1	Type D8, Tower, concrete footings, in class 1 (rock) soil		per tower	30	961.5	28845	64.1	1923	32.05	961.5	32.05	961.5	5,320.30	159,009.00
2.2	Type D8, Tower, concrete footings in class 2 (good) soil		per tower	280	1674.6	469088	111.44	31203.2	55.75	15609.4	55.75	15609.4	9,349.52	2,589,863.60
2.3	Type D8, Tower, concrete footings in class 3 (poor) soil		per tower	313	2632.65	824019.45	175.51	54934.63	87.755	27467.315	87.755	27467.315	14,567.33	4,509,574.29
2.4	Type D8, Tower, concrete footings in class 4 (good submarginal) soil		per tower	55	4129.05	227097.75	275.27	15139.85	137.635	7569.925	137.635	7569.925	22,887.41	1,256,607.55
2.5	Type D8, Tower, concrete footings in class 5 (poor submarginal) soil		per tower	22	6885.35	151697.7	409.69	10113.18	229.845	5056.59	229.845	5056.59	38,154.27	839,303.94
2.6	Type D8, Tower, soil foundation in class 6 (very poor submarginal) soil		per tower	2	7935.3	15870.6	129.02	1059.04	164.51	529.02	164.51	529.02	45,909.66	87,817.32
2.7	Type D100 Tower, concrete footings, in class 1 (rock) soil		per tower	9	1756.35	15807.15	117.09	1053.81	58.545	526.905	58.545	526.905	9,719.47	87,466.23
2.8	Type D100 Tower, concrete footings in class 2 (good) soil		per tower	34	3893.6	130954.4	253.44	8616.96	126.75	4308.48	126.75	4308.48	21,635.54	715,207.68
2.9	Type D100 Tower, concrete footings in class 3 (good) soil		per tower	31	10064.65	100636.15	389.11	12062.41	194.555	6031.205	194.555	6031.205	32,296.13	1,001,189.03
2.10	Type D100 Tower, concrete footings in class 4 (good submarginal) soil		per tower	5	9636.7	49083.5	455.78	3279.8	327.88	1639.45	327.88	1639.45	54,428.74	272,148.79
2.11	Type D100 Tower, concrete footings in class 5 (poor submarginal) soil		per tower	2	13628.35	31256.7	1041.89	2063.78	520.945	1041.89	520.945	1041.89	86,476.87	172,053.74
2.12	Type D100 Tower, soil foundation in class 6 (very poor submarginal) soil		per tower	1	18879.15	18879.15	1258.61	1258.61	629.305	629.305	629.305	629.305	184,461.63	184,461.63
2.13	Type D100 Tower, concrete footings, in class 1 (rock) soil		per tower	1	3052.65	3052.65	203.51	203.51	101.755	101.755	101.755	101.755	16,891.33	16,891.33
2.14	Type D100 Tower, concrete footings in class 2 (good) soil		per tower	6	7397.2	44383.2	196.48	3638.88	252.24	1513.44	252.24	1513.44	44,617.64	232,227.04
2.15	Type D100 Tower, concrete footings in class 3 (good) soil		per tower	7	10060.7	70311.9	726.78	5087.46	363.39	2543.73	363.39	2543.73	69,322.74	422,259.18
2.16	Type D100 Tower, concrete footings in class 4 (good submarginal) soil		per tower	1	10398.2	10398.4	1239.89	2479.76	635.54	1239.89	635.54	1239.89	102,610.64	102,610.64
2.17	Type D100 Tower, concrete footings in class 5 (poor submarginal) soil		per tower	2	27139.9	54277.8	1809.26	3618.52	904.63	1809.26	904.63	1809.26	139,169.58	300,337.16
2.18	Type D100 Tower, soil foundation in class 6 (very poor submarginal) soil		per tower	1	25294.5	25294.5	1686.3	1686.3	843.15	843.15	843.15	843.15	139,391.46	139,391.46
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						238262.00		158048.00		79428.40		79428.40		13,181,786.49
3.0	TOWER GROUNDING													
	All tower groundings including excavation, laying of counterpoise, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and measuring of these, value													
3.1	Basic grounding on new diagonal legs, consisting of three (3) ground rods 1m long and 5cm counterpoise		per tower	1006	50.00	50300.00	3.00	4,038.00	6.00	12,048.00	4.00	6,424.00	40.00	64,240.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	40.00	4,000.00	2.00	200.00	6.00	600.00	3.00	300.00	40.00	4,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						54,300.00		5,038.00		13,448.00		6,724.00		68,240.00

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD, BHERSA 30KV TRANSMISSION LINE - 4

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(1) x (2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
4.0	STEEL TOWERS													
	Supply and erection of hot dip galvanized lattice steel towers according to the design including rods, end extensions, leg extensions, bearing connections and mounting of earth terminators and substation air arresters at Engineer's design, working and design plans, erection plans, other plans, where necessary, upon bids, all necessary fittings, and all connections to the installation. Erection													
4.1	Type DL Tower, standard height - 6.0m		each	36	55,165.00	1,985,940.00	3,397.00	122,292.00	279.50	9,996.00	127.40	4,548.24	6,124.00	148,464.00
4.2	Type DL Tower, standard height - 3.0m		each	23	69,906.00	1,608,038.00	3,751.00	86,273.00	883.50	6,981.15	151.76	3,490.48	4,503.00	104,719.00
4.3	Type DL Tower, standard height		each	261	64,716.00	16,890,876.00	3,099.00	1,046,346.00	320.50	84,172.50	109.25	42,086.25	6,420.00	1,262,718.00
4.4	Type DL Tower, standard height - 9.0m		each	76	76,171.00	5,332,996.00	4,321.00	328,766.00	149.00	26,575.60	173.84	13,287.84	5,245.00	398,620.00
4.5	Type DL Tower, standard height - 6.0m		each	86	6,480,762.00	556,446,532.00	4,649.00	399,126.00	375.50	32,295.58	187.76	16,147.36	5,420.00	464,438.00
4.6	Type DL Tower, standard height - 9.0m		each	64	89,261.00	5,712,704.00	4,943.00	316,332.00	399.97	25,598.08	199.98	12,798.72	5,995.00	383,696.00
4.6	Type DL Tower, standard height - 12.0m		each	156	86,475.00	13,334,100.00	5,264.00	821,184.00	435.40	66,448.20	219.07	33,223.52	6,380.00	996,684.00
4.7	Type DL Tower, - 2.0m Leg Extension		each	284	1,179.00	335,016.00	85.00	24,140.00	6.67	1,951.08	3.44	976.08	183.00	29,252.00
4.8	Type DL Tower, - 1.0m Leg Extension		each	427	1,699.00	724,803.00	100.00	43,554.00	9.67	3,531.29	4.14	1,767.78	124.00	52,048.00
4.9	Type DL Tower, - 6.0m Leg Extension		each	533	1,987.00	1,068,461.00	122.00	64,373.00	9.80	5,233.60	4.90	2,606.80	147.00	78,204.00
4.10	Type DL Tower, + 1.0m Leg Extension		each	569	3,167.00	1,341,133.00	145.00	82,595.00	11.35	6,485.75	5.87	3,340.63	176.00	100,144.00
4.11	Type DL Tower, + 2.0m Leg Extension		each	426	2,461.00	1,133,186.00	164.00	69,864.00	13.26	5,648.76	4.63	2,024.38	195.00	84,774.00
4.12	Type DL Tower, + 3.0m Leg Extension		each	570	2,996.00	1,702,020.00	184.00	104,880.00	14.68	8,481.60	5.40	4,240.80	223.00	127,110.00
4.13	Type DTBW Tower, standard height - 6.0m		each	6	94,681.00	568,086.00	5,831.00	34,986.00	471.83	2,830.98	239.50	1,437.48	7,497.00	42,462.00
4.14	Type DTBW Tower, standard height - 3.0m		each	3	393,113.00	369,639.00	6,359.00	19,068.00	144.90	1,543.05	202.17	771.51	7,715.00	23,145.00
4.15	Type DTBW Tower, standard height		each	32	395,178.00	12,645,700.00	6,748.00	215,938.00	146.07	17,474.24	273.03	8,736.96	8,181.00	262,112.00
4.16	Type DTBW Tower, standard height - 3.0m		each	7	811,136.00	5,677,952.00	7,312.00	51,184.00	399.48	4,141.83	295.00	2,070.95	8,475.00	62,125.00
4.17	Type DTBW Tower, standard height - 6.0m		each	3	329,128.00	987,774.00	7,893.00	23,889.00	644.14	1,932.42	301.87	946.23	3,860.00	29,386.00
4.17	Type DTBW Tower, standard height - 9.0m		each	2	138,421.00	276,842.00	8,526.00	17,052.00	689.00	1,378.00	344.87	689.94	18,340.00	20,698.00
4.18	Type DTBW Tower, standard height - 12.0m		each	23	147,564.00	3,393,872.00	9,088.00	209,134.00	776.36	16,913.28	367.68	8,456.64	11,430.00	273,690.00
4.19	Type DTBW Tower, standard height - 24.0m		each	rate only	273,136.00		13,708.00		1,113.54		558.00		16,708.00	
4.20	Type DTBW Tower, - 2.0m Leg Extension		each	26	2,110.00	60,860.00	142.00	3,692.00	11.30	299.26	5.76	140.16	173.00	4,498.00
4.21	Type DTBW Tower, - 1.0m Leg Extension		each	40	2,922.00	116,880.00	189.00	7,206.00	14.58	562.40	7.20	291.20	210.00	8,720.00
4.22	Type DTBW Tower, - 6.0m Leg Extension		each	33	3,198.00	105,534.00	209.00	11,493.00	16.56	631.76	8.47	482.03	254.00	13,970.00
4.23	Type DTBW Tower, + 1.0m Leg Extension		each	89	3,598.00	319,822.00	246.00	21,894.00	19.50	1,772.88	9.36	886.44	299.00	26,611.00
4.24	Type DTBW Tower, + 2.0m Leg Extension		each	40	4,143.00	165,720.00	279.00	11,160.00	29.54	901.60	11.87	458.88	338.00	13,520.00
4.25	Type DTBW Tower, + 3.0m Leg Extension		each	54	5,626.00	271,944.00	310.00	16,746.00	35.00	1,554.06	13.10	677.70	376.00	20,384.00
4.26	Type DTBW Tower, standard height - 6.0m		each	rate only	325,847.00		7,756.00		637.66		311.82		9,415.00	
4.27	Type DTBW Tower, standard height - 3.0m		each	rate only	138,173.00		8,509.00		688.50		344.20		18,320.00	
4.28	Type DTBW Tower, standard height		each	13	146,698.00	1,907,074.00	9,029.00	117,377.00	778.60	9,497.80	360.30	4,788.90	10,950.00	142,467.00
4.29	Type DTBW Tower, standard height - 3.0m		each	4	159,475.00	638,700.00	9,624.00	38,336.00	796.71	3,142.84	287.00	1,148.44	11,450.00	47,744.00
4.30	Type DTBW Tower, standard height - 6.0m		each	rate only	173,763.00		19,781.00		885.50		452.96		12,980.00	
4.30	Type DTBW Tower, standard height - 9.0m		each	1	183,842.00	183,842.00	11,322.00	11,322.00	106.14	916.14	458.07	458.07	13,742.00	13,742.00
4.31	Type DTBW Tower, standard height - 12.0m		each	1	193,842.00	193,842.00	12,142.00	12,142.00	102.11	982.11	491.25	491.25	14,738.00	14,738.00
4.32	Type DTBW Tower, - 2.0m Leg Extension		each	7	3,779.00	26,453.00	233.00	1,631.00	18.83	131.81	8.46	65.94	280.00	1,974.00
4.33	Type DTBW Tower, - 1.0m Leg Extension		each	11	4,114.00	45,254.00	278.00	3,058.00	29.58	247.50	11.20	123.75	317.00	3,797.00

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD - DEHESA 30KV TRANSMISSION LINE - 4

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(1) x (2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
4.34	Type DTH0 Tower, +0.0m leg Extension		each	16	5,424.48	86,791.68	329.00	5,152.00	26.45	416.48	13.00	208.32	300.00	6,240.00
4.35	Type DTH0 Tower, +1.0m leg Extension		each	13	6,435.00	83,655.00	379.00	5,080.00	30.00	451.20	13.00	171.00	451.00	6,780.00
4.36	Type DTH0 Tower, +2.0m leg Extension		each	11	6,611.00	72,721.00	436.00	4,698.00	34.40	378.84	12.20	134.20	419.42	5,467.00
4.37	Type DTH0 Tower, +3.0m leg Extension		each	16	7,141.00	114,256.00	477.00	7,632.00	38.30	612.80	13.20	211.20	388.64	9,264.00
4.37	Transmission tower type DTH0, standard height		each	2	109,576.00	219,152.00	6,748.00	13,496.00	546.07	1,092.14	273.83	547.66	8,191.00	16,382.00
4.38	Transmission tower type DTH0 Tower, standard height +3.0m		each	2	118,734.00	237,468.00	7,332.00	14,664.00	581.60	1,163.20	285.85	571.70	8,875.00	17,750.00
4.39	Transmission tower type DTH0 Tower, standard height +6.0m		each	1	129,258.00	129,258.00	7,960.00	7,960.00	644.14	644.14	322.07	322.07	9,662.00	9,662.00
4.40	Transmission tower type DTH0 Tower, standard height +9.0m		each	2	128,451.00	256,902.00	8,526.00	17,052.00	689.93	1,379.86	344.97	689.94	10,340.00	20,680.00
4.41	Transmission tower type DTH0 Tower, standard height +12.0m		each	1	147,564.00	147,564.00	9,088.00	9,088.00	735.36	735.36	367.68	367.68	11,030.00	11,030.00
4.42	Transmission tower type DTH0, 2.0m leg Extension		each	2	2,330.00	4,660.00	140.00	280.00	13.51	27.02	5.75	11.50	173.00	346.00
4.43	Transmission tower type DTH0, 1.0m leg Extension		each	2	2,922.00	5,844.00	180.00	360.00	14.56	29.12	7.28	14.56	218.00	436.00
4.44	Transmission tower type DTH0, +0.0m leg Extension		each	4	3,786.00	15,144.00	209.00	836.00	16.94	67.76	8.47	33.88	254.00	1,036.00
4.45	Transmission tower type DTH0, +1.0m leg Extension		each	6	3,986.00	23,916.00	246.00	1,476.00	19.92	119.52	9.96	59.76	298.00	1,790.00
4.46	Transmission tower type DTH0, +2.0m leg Extension		each	4	4,523.00	18,092.00	279.00	1,116.00	22.54	90.16	11.27	45.08	338.00	1,352.00
4.47	Transmission tower type DTH0, +3.0m leg Extension		each	6	5,036.00	30,216.00	310.00	1,860.00	25.09	150.54	12.55	75.30	376.00	2,236.00
4.48	Welding of tower bolts & nut and painting over with Anti-rust and galvanizing paint including Steel Caddy guards		per tower	803	2,000.00	2,003,000.00	122.00	98,760.00	35.00	28,105.00	18.00	14,454.00	1,000.00	803,000.00
4.49	Alternative proposal for protecting towers from vandalism		per tower	row only	9,000.00		315.00		90.00		45.00		2,700.00	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						74,988,677.00		4,392,194.00		384,696.91		192,758.12		6,191,828.89
6.8	LINE CONDUCTOR INSULATORS AND FITTINGS													
	Supply and installation of insulators & complete line of fittings including all types of clamps, armor rods, extension links, pilot insulator sets, counterweights and all accessories to Towers.													
6.1	V* suspension string with 2x29 insulator units for quad bundle ACSIR "CONDOR" 454.5.		each	66	2,599.00	171,534.00	96.97	6,394.02	25.99	1,715.34	13.89	858.00	389.85	25,736.10
6.2	for item 6.1 complete with arc horns at both ends, armor rods, suspension clamp & fittings.		set	66	886.00	58,476.00	35.03	2,346.66	8.86	584.76	4.43	292.38	132.96	8,771.40
6.3	V* suspension string with 2x29 insulator units for quad bundle ACSIR "CONDOR" 454.5.		each	4146	2,568.00	10,646,928.00	89.88	372,642.48	25.68	106,469.28	12.84	53,234.64	385.28	1,597,639.20
6.4	for item 6.3 complete with insulator arc horns only, armor rods, suspension clamp and fittings.		set	4146	830.00	3,441,000.00	39.75	164,845.50	8.30	34,341.00	4.25	17,603.10	127.56	528,633.00
6.5	Double Tension Insulator set with 2x20 insulator units for quad bundle ACSIR "CONDOR" 454.5.		each	1140	3,217.00	3,667,380.00	112.60	128,364.00	32.17	36,673.80	16.09	18,342.60	482.55	550,107.00
6.6	for item 6.5 including all connections to towers, clamps and fittings, armor rods using device bolt and nut.		set	1140	988.00	1,126,320.00	33.88	38,635.20	9.88	11,263.20	4.84	5,517.60	145.26	165,528.00
6.7	Double Tension Insulator set with 2x20 insulator units for quad bundle ACSIR "CONDOR" 454.5.		each	84	3,265.00	274,260.00	114.28	9,598.32	32.65	2,742.60	16.33	1,371.72	488.75	41,139.00
6.8	for item 6.7 including all connections to towers, clamps and fittings, armor rods using device bolt and nut.		set	84	936.00	78,624.00	32.76	2,750.64	9.36	786.24	4.68	391.12	148.48	11,793.60
6.9	T* jumper string as per the drawing		each	280	732.00	204,960.00	25.62	7,173.60	7.32	2,049.60	3.66	1,024.80	189.80	50,744.00
6.10	for item 6.9 complete with armor rods, suspension clamp and fittings.		each	280	718.00	201,040.00	25.13	7,036.40	7.18	2,010.40	3.59	1,005.20	187.76	50,156.00
6.11	Aircraft warning sphere		per unit	30	181.00	5,430.00	6.34	190.20	1.81	54.30	0.91	27.30	27.15	814.50
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						78,958,212.00		487,775.42		399,362.12		199,887.88		2,998,437.89

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD, BEREHA, 30KV TRANSMISSION LINE - 4

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
				(1)	(2)	(1) x (2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
7.0	GSW & OPGW FITTINGS AND ACCESSORIES													
	Supply and installation of complete Sets of Fittings, including all types of clamps, extension links, armor rods, counterweights and all connections to Towers.													
7.1	Suspension set for OPGW		each	822	102.00	64,066.00	3.61	2,945.42	1.81	640.66	0.00	121.44	15.45	9,609.90
7.2	Tension-pulling set for OPGW		each	87	232.00	16,084.00	8.80	590.94	2.32	168.84	1.26	84.42	37.80	2,532.69
7.3	Tension double dead end down set for OPGW, to be installed on suspension tower		each	91	236.00	20,566.00	7.90	719.81	2.36	205.66	1.13	102.61	51.90	3,084.90
7.4	Tension double dead end down set for OPGW		each	21	236.00	4,746.00	7.90	166.31	2.36	47.46	1.13	23.71	13.30	731.90
7.5	Tension vertical dead end down set for OPGW		each	2	236.00	452.00	7.90	15.82	2.36	4.52	1.13	2.26	10.50	67.80
7.6	Arresting Box for OPGW(OPGW, for use within the transmission line, including fitting, splicing and downlead clamps, with lead through wire, suitable for up to 72 3M6/ NUSSEP fibers and OPGW, types as per specification		each	122	242.00	27,004.00	8.47	945.64	2.42	271.04	1.21	121.12	36.30	4,002.60
7.7	Vertical Box for OPGW(WBC, for the connection at substation gantry, including fitting, splicing and downlead clamps, for up to 72 3M6/ NUSSEP fibers and OPGW(WBC, types as per specification		each	2	242.00	484.00	8.47	16.94	2.42	4.84	1.21	2.42	16.30	72.60
7.8	Suspension set for GSW		each	702	44.00	30,888.00	1.54	1,080.00	0.44	308.88	0.02	124.41	6.80	4,633.20
7.9	Tension set for GSW complete for one tower		each	101	32.00	3,232.00	1.12	113.12	0.32	32.32	0.01	16.14	4.80	484.80
SUB- TOTAL CARRIED TO SUMMARY OF PRICES						108,412.00		5,897.06		1,684.22		840.22		25,263.39
8.0	CONDUCTOR AND SHIELD WIRE													
	Supply, stringing and installation including all joints, clewires, jumper loops, spacers and necessary dampers, earthing connections and all downleads.													
8.1	3 phase, Quad bundle ACSR Conductor Code Name "CONDOR" 45/3, stringing of double circuit on double circuit towers.		route km	344	162,600.00	55,914,480.00	8,130.00	2,796,720.00	1,626.00	559,344.00	81.30	279,672.00	25,000.00	8,600,000.00
8.2	Single Optical Groundwire (OPGW) with 24 Fibers, including all splicing and connections to joint boxes.		route km	344	5,500.00	1,892,000.00	270.00	92,920.00	23.60	21,142.40	27.82	9,370.08	750.00	258,000.00
8.3	Single galvanized steel shieldwire type GSW 70		route km	344	801.00	275,544.00	40.00	13,760.00	8.01	2,755.44	4.80	1,376.00	750.00	258,000.00
SUB- TOTAL CARRIED TO SUMMARY OF PRICES						58,124,000.00		2,906,112.00		781,242.84		299,818.08		8,116,000.00
9.0	SPARES													
9.1	Type DL Tower, foundation one/bank for footings in class 3 (poor) soil		per tower	3	5,265.00	15,795.00	184.20	552.64	52.65	157.95	26.33	78.99		
9.2	Type DL Tower, one/bank for grillage footings in class 2 (good) soil		per tower	3	4,805.00	12,815.00	140.10	420.34	40.05	120.15	20.03	60.09		
9.3	Type DTBW Tower, foundation one/bank for footings in class 3 (poor) soil		per tower	3	6,675.00	20,025.00	233.63	700.89	66.75	200.25	33.38	100.14		
9.4	Type DTBW Tower, foundation one/bank for footings in class 3 (poor) soil		per tower	1	11,670.00	11,670.00	408.45	408.45	116.70	116.70	58.35	58.35		
9.5	Ground rods, each to include clamps for enclosures & terminal connections		each	10	12.30	123.00	0.75	7.50	0.13	1.30	0.06	0.60		
9.6	Type DL Tower, standard height -3.0m		each	1	60,908.00	60,908.00	3,751.00	3,751.00	609.08	609.08	304.54	304.54		
9.7	Type DL Tower, standard height		each	2	64,756.00	129,412.00	3,086.00	7,972.00	647.56	1,294.32	321.08	647.16		
9.8	Type DL Tower, standard height -6.0m		each	2	75,357.00	150,714.00	4,641.00	9,282.00	753.57	1,507.14	376.79	753.58		
9.10	Type DL Tower, standard height -12.0m		each	3	95,475.00	286,425.00	5,264.00	15,792.00	804.75	2,564.25	427.38	1,282.14		
9.11	Type DL Tower, -6.0m Leg Extension		each	4	1,967.00	7,868.00	121.00	484.00	19.67	78.68	9.84	39.36		
9.12	Type DL Tower, -11.0m Leg Extension		each	8	2,357.00	18,856.00	145.00	1,160.00	23.57	188.56	11.79	94.32		
9.13	Type DL Tower, -12.0m Leg Extension		each	12	2,661.00	31,932.00	164.00	1,968.00	26.61	319.32	11.11	133.72		
9.14	Type DL Tower, -13.0m Leg Extension		each	8	2,080.00	16,640.00	104.00	1,472.00	20.80	208.88	14.83	118.64		
9.15	Type DTBW Tower, standard height		each	2	109,578.00	219,156.00	6,748.00	13,496.00	1,095.78	2,191.56	547.89	1,095.78		
9.16	Type DTBW Tower, standard height -6.0m		each	3	129,238.00	387,714.00	7,080.00	21,240.00	1,292.38	3,877.14	646.29	1,938.87		
9.17	Type DTBW Tower, -6.0m Leg Extension		each	8	3,396.00	27,168.00	209.00	1,672.00	33.96	271.68	16.09	130.52		
9.18	Type DTBW Tower, -11.0m Leg Extension		each	12	3,090.00	37,076.00	246.00	2,952.00	30.90	479.76	19.09	230.88		
9.19	Type DTBW Tower, standard height		each	3	146,608.00	439,824.00	9,620.00	27,867.00	1,466.08	4,398.24	733.04	2,199.12		
9.20	Type DTBW Tower, -6.0m Leg Extension		each	12	5,224.00	62,688.00	322.00	3,864.00	52.24	626.88	26.12	313.44		

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD - DERESA 30KV TRANSMISSION LINE - 4

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (2)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
9.21	Suspension string as item 6.1		set	42	2,599.00	109,158.00	96.97	3,824.74	25.99	1,091.58	1.00	546.00		
9.22	Tension string as item 6.1		set	96	2,588.00	248,328.00	89.88	8,628.48	25.88	2,483.28	12.84	1,232.64		
9.23	OPGW suspension set as item 7.1		set	8	103.00	824.00	3.61	28.88	1.03	8.24	0.52	4.16		
9.24	OPGW tension set as item 7.2		set	8	252.00	2,016.00	8.82	70.56	2.52	20.16	1.26	10.08		
9.25	GWW suspension set as item 7.8		set	8	44.00	352.00	1.54	12.32	0.44	3.52	0.22	1.76		
9.26	GWW tension set as item 7.9		set	8	32.00	256.00	1.12	8.96	0.32	2.56	0.16	1.28		
9.27	Flexible wires for ACSB "CONDOR" 454.5 Conductor		each	300	80.00	24,000.00	2.80	840.00	0.80	240.00	0.40	120.00		
9.27	Stockbridge type vibration dampers for CONDOR 454.5		each	30	120.00	3,600.00	4.20	250.00	1.20	60.00	0.60	30.00		
9.28	Stockbridge type vibration dampers for OPGW		each	50	30.00	1,500.00	1.05	52.50	0.30	15.00	0.15	7.50		
9.29	Stockbridge type vibration dampers for GWW		each	30	30.00	1,000.00	1.05	32.30	0.30	15.00	0.15	7.50		
9.30	ACSB "CONDOR" 454.5 Conductor		km	30	6,775.00	203,250.00	109.00	18,170.00	67.75	2,032.50	31.68	1,010.40		
9.31	OPGW		km	4	5,585.00	22,340.00	278.00	1,112.00	55.85	222.00	27.83	111.32		
9.32	E.H.S shieldwire		km	4	801.00	3,204.00	40.00	160.00	8.01	32.04	4.01	16.04		
9.33	Mid -span tension joint for ACSB "CONDOR" 454.5 Conductor		each	60	72.00	4,320.00	2.52	151.20	0.72	43.20	0.36	21.60		
9.34	Rangeup shaver for ACSB "CONDOR" 454.5 Conductor		each	30	72.00	2,160.00	2.52	75.60	0.72	21.60	0.36	10.80		
9.35	Joint Box intermediate type for OPGW		each	3	300.00	900.00	30.50	91.50	3.00	9.00	1.50	4.50		
9.36	Mid - span tension joint for E.H.S shieldwire		each	30	20.00	600.00	0.70	21.00	0.20	6.00	0.10	3.00		
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						2,193,683.00		142,368.46		21,538.88		12,766.42		
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFFS													
10.1	Office and housing facilities for the Engineer and Employer's staff as specified under Section V1 "Employers requirements", part A2, item A2.13 and A2.14		LOT	1									440,000.00	440,000.00
SUB - TOTAL														440,000.00
11.0	VEHICLES AND COMMUNICATION EQUIPMENT													
11.1	Trucks, Load cranes, towing type back door, 5 speed, common rail turbo charged diesel engine, etc. as specified under Section V1 "Employers requirements", part A2, item A2.22		No	3									272,000.00	816,000.00
11.2	Trucks, Double cab/pickups, four door, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section V1 "Employers requirements", part A2, item A2.22		No	10									140,000.00	1,400,000.00
11.3	Basic HF radios to be installed in each selected site for Engineer's and Employer's representative office and camp.		No	4									57,000.00	228,000.00
11.4	Mobile HF radio-telephone equipment to be mounted on each Load Crane and Pick-up vehicles, including its accessories, power supply, etc.		No	13									11,000.00	143,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES														2,216,000.00
N1. (to Grand Summary)						197,687,608.00		8,421,698.56		1,381,387.97		982,811.78		41,413,851.39

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 5 DEHESA - HOLETA 500 KV TRANSMISSION LINE-2

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
				(1)	(2)	(1) x (2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(1) x (5)	(6)	(1) x (6)
	Including complete design, manufacturing, wiring, transport, loading, unloading, intermediate storage, erection insulation, testing and commissioning.													
1.0	GENERAL WORKS													
	Including all necessary survey activities like tower spotting, survey of crossing objects including pegging of towers, diagonal profiles and all necessary documentation for the O&M, soil investigation and route clearing & access roads.													
1.1	Check survey, review of tower plotting and preparation of profile drawings and tower schedule.		route km	273									16,000.00	4,368,000.00
1.2	Preliminary sub-soil investigation at support location by means of soil penetration test (SPT), establishment of ground water level and determination of soil-water aggressiveness.		per tower	630									700.00	440,000.00
1.3	Specialized soil investigation		per tower	60									1,400.00	84,000.00
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		lamp span										825,000.00	825,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES														5,127,000.00
2.0	FOUNDATIONS													
	All Foundations for Tower Types according to the specification, including all transport, excavation, installation of rails, all necessary reinforcement, shoring, concreting, backfilling, compacting, complete tower curing and later connection to tower, ensuring of safety measures and submitting of records to Employer/Engineer, according to drawings and regulations of the Employer. Soil class definition													
2.1	Type DL Tower, concrete footings, in class 1 (rock) soil		per tower	30	961.5	28845	64.1	1923	32.05	961.5	32.05	961.5	5,305.30	159,600.00
2.2	Type DL Tower, concrete footings in class 2 (good) soil		per tower	200	1675.6	335120	111.44	22288	55.72	11144	55.72	11144	9,245.52	1,849,504.00
2.3	Type DL Tower, concrete footings in class 3 (poor) soil		per tower	263	2632.05	692206.95	175.51	46159.13	87.726	23079.565	87.726	23079.565	14,567.33	3,831,207.79
2.4	Type DL Tower, concrete footings in class 4 (poor submerged) soil		per tower	50	4129.05	206452.5	275.27	13763.5	137.635	6881.75	137.635	6881.75	22,847.45	1,142,376.50
2.5	Type DL Tower, concrete footings in class 5 (poor submerged) soil		per tower	18	6095.35	109716.3	409.69	8274.42	229.845	4137.21	229.845	4137.21	38,154.27	686,776.86
2.6	Type DL Tower, soil foundation in class 6 (very poor submerged) soil		per tower	2	7955.3	15910.6	529.02	1058.04	264.51	529.02	264.51	529.02	45,969.66	87,817.32
2.7	Type DT30 Tower, concrete footings, in class 1 (rock) soil		per tower	5	1756.35	8781.75	117.69	585.45	58.545	292.725	58.545	292.725	5,718.47	45,592.35
2.8	Type DT30 Tower, concrete footings in class 2 (good) soil		per tower	24	3801.6	91238.4	253.44	6082.56	126.72	3041.28	126.72	3041.28	20,855.54	504,852.48
2.9	Type DT30 Tower, concrete footings in class 3 (poor) soil		per tower	30	5836.65	175099.5	309.11	11673.3	194.555	5836.65	194.555	5836.65	32,296.13	968,883.90
2.10	Type DT30 Tower, concrete footings in class 4 (good submerged) soil		per tower	3	5836.7	29010.1	655.78	1967.34	327.89	981.67	327.89	981.67	58,429.74	163,289.22
2.11	Type DT30 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	15628.35	31256.7	1041.89	2083.78	520.945	1041.89	520.945	1041.89	36,479.47	172,953.74
2.12	Type DT30 Tower, soil foundation in class 6 (very poor submerged) soil		per tower	1	18879.15	18879.15	1258.61	1258.61	629.305	629.305	629.305	629.305	108,464.63	108,464.63
2.13	Type DT60 Tower, concrete footings, in class 1 (rock) soil		per tower	1	3052.65	3052.65	203.51	203.51	101.755	101.755	101.755	101.755	16,891.33	16,891.33
2.14	Type DT60 Tower, concrete footings in class 2 (good) soil		per tower	3	7597.2	22791.6	566.48	1539.44	252.24	759.72	252.24	759.72	46,857.66	126,113.52
2.15	Type DT60 Tower, concrete footings in class 3 (poor) soil		per tower	3	10091.7	32275.1	726.78	2180.34	363.39	1096.17	363.39	1096.17	69,323.74	180,968.22
2.16	Type DT60 Tower, concrete footings in class 4 (good submerged) soil		per tower	1	10598.2	10598.2	1239.88	1239.88	619.94	619.94	619.94	619.94	109,856.68	109,856.68
2.17	Type DT60 Tower, concrete footings in class 5 (poor submerged) soil		per tower	1	27138.9	27138.9	1809.26	1809.26	904.63	904.63	904.63	904.63	159,168.58	159,168.58
2.18	Type DT60 Tower, soil foundation in class 6 (very poor submerged) soil		per tower	1	25284.5	25284.5	1696.3	1696.3	848.15	848.15	848.15	848.15	159,964.05	159,964.05
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						1886337.96		125755.86		62077.83		62077.83		16,437,736.38
3.0	TOWER GROUNDING													
	All tower grounding, including excavation, laying of counterpoise, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and ensuring of electric value													
3.1	Basic grounding on two diagonal legs, consisting of three (3) ground rods 7m long and 5cm counterpoise		per tower	630	50.00	31,500.00	3.50	1,214.00	0.20	126.00	0.25	159.50	40.00	25,520.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	40.00	4,000.00	2.00	200.00	0.40	40.00	0.20	20.00	40.00	4,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						35,500.00		1,414.00		166.00		179.50		29,520.00

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 5 DEDESA - BOLETA 30 KVS TRANSMISSION LINE-2

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (2)	(4)	(3) x (4)	(5)	(2) x (5)	(6)	(2) x (6)
4.0	STEEL TOWERS													
	Supply and erection of hot dip galvanized lattice steel towers according to the design including rods, rail extension, leg extension, crossbar extension and mounting of earth resistance and substation of current in Engineer's design. Working and longer plates, metal plates, plates plates, where necessary, use bolts, all necessary fittings, and all connections in the erection system. Erection system conditions by contract of													
4.1	Type DS Tower, standard height 6.0m		each	7	55,165.00	386,155.00	3,307.00	23,179.00	275.20	1,824.30	127.45	902.11	8,124.00	28,868.00
4.2	Type DS Tower, standard height 3.0m		each	5	384,580.00	1,922,900.00	3,751.00	18,755.00	360.53	1,817.65	151.76	758.80	8,593.00	31,762.00
4.3	Type DS Tower, standard height		each	184	63,748.00	11,707,744.00	3,586.00	733,424.00	305.20	56,340.00	160.25	29,670.00	4,738.00	890,192.00
4.4	Type DS Tower, standard height 3.0m		each	91	4,389,451.00	399,440,041.00	4,321.00	263,381.00	349.08	21,230.00	174.83	16,013.24	5,245.00	319,042.00
4.5	Type DS Tower, standard height 16.0m		each	91	70,171.00	6,385,461.00	4,321.00	422,331.00	375.53	34,173.23	187.76	17,086.16	5,433.00	512,603.00
4.6	Type DS Tower, standard height 19.0m		each	104	80,261.00	8,347,544.00	4,543.00	216,323.00	389.87	25,090.00	189.50	12,790.72	5,989.00	383,036.00
4.6	Type DS Tower, standard height 12.0m		each	140	65,475.00	9,166,500.00	5,264.00	737,072.00	405.00	61,040.00	212.97	31,519.56	6,369.00	945,572.00
4.7	Type DS Tower, 2.0m Leg Extension		each	115	1,379.00	158,685.00	85.00	9,775.00	6.87	760.05	3.41	391.00	103.00	11,845.00
4.8	Type DS Tower, 1.0m Leg Extension		each	200	1,690.00	338,000.00	100.00	20,400.00	8.27	1,654.00	4.14	828.00	124.00	24,800.00
4.9	Type DS Tower, 10.0m Leg Extension		each	500	1,967.00	983,500.00	121.00	60,500.00	9.80	4,900.00	4.90	2,450.00	147.00	73,500.00
4.10	Type DS Tower, 13.0m Leg Extension		each	505	1,786,285.00	902,163,900.00	145.00	73,225.00	11.75	5,933.75	5.87	2,964.35	176.00	88,880.00
4.11	Type DS Tower, 12.0m Leg Extension		each	400	2,661.00	1,064,400.00	164.00	65,600.00	12.26	5,204.00	6.63	2,652.00	260.00	79,600.00
4.12	Type DS Tower, 13.0m Leg Extension		each	520	2,552,720.00	1,328,414,400.00	164.00	95,680.00	13.76	7,237.60	6.88	3,568.00	272.00	115,560.00
4.13	Type DT30 Tower, standard height 6.0m		each	5	474,401.00	2,372,005.00	5,831.00	29,155.00	477.83	2,393.15	295.50	1,479.55	7,497.00	36,985.00
4.14	Type DT30 Tower, standard height 3.0m		each	0	-	-	-	-	-	-	-	-	-	-
4.15	Type DT30 Tower, standard height		each	39	4,073,542.00	158,867,178.00	6,748.00	263,172.00	548.87	21,296.73	277.63	10,648.17	8,391.00	319,440.00
4.16	Type DT30 Tower, standard height 13.0m		each	3	596,262.00	1,788,786.00	7,312.00	21,936.00	593.00	1,775.07	295.00	8,875.00	26,425.00	80,250.00
4.17	Type DT30 Tower, standard height 16.0m		each	8	1,024,064.00	8,192,512.00	7,060.00	63,680.00	649.14	5,113.12	387.87	3,106.96	9,862.00	77,296.00
4.17	Type DT30 Tower, standard height 19.0m		each	1	1,98,461.00	1,98,461.00	8,536.00	8,536.00	689.95	689.95	344.97	344.97	34,349.00	34,349.00
4.18	Type DT30 Tower, standard height 12.0m		each	9	1,528,075.00	13,752,675.00	9,088.00	81,792.00	770.36	6,918.24	387.48	3,490.12	11,838.00	99,270.00
4.20	Type DT30 Tower, 2.0m Leg Extension		each	10	2,310.00	23,100.00	140.00	1,400.00	11.53	115.10	5.75	57.50	173.00	1,730.00
4.21	Type DT30 Tower, 1.0m Leg Extension		each	10	2,522.00	25,220.00	180.00	1,800.00	14.56	145.60	7.28	72.80	218.00	2,180.00
4.22	Type DT30 Tower, 16.0m Leg Extension		each	60	2,081,880.00	124,912,800.00	200.00	12,540.00	16.04	1,064.40	8.47	508.20	254.00	15,240.00
4.23	Type DT30 Tower, 13.0m Leg Extension		each	100	3,999.00	399,900.00	246.00	24,700.00	19.92	1,992.00	9.96	997.00	299.00	27,900.00
4.24	Type DT30 Tower, 12.0m Leg Extension		each	54	4,543.00	244,242.00	279.00	15,066.00	20.25	1,217.14	13.27	688.58	138.00	18,252.00
4.25	Type DT30 Tower, 13.0m Leg Extension		each	100	5,030.00	503,000.00	310.00	31,000.00	25.00	1,205.00	13.53	753.00	276.00	31,560.00
4.26	Type DT50 Tower, standard height 6.0m		each	rate only	125,847.00		7,756.00		607.00		163.82		8,463.00	
4.27	Type DT50 Tower, standard height 3.0m		each	rate only	138,171.00		8,559.00		689.56		184.28		10,308.00	
4.28	Type DT50 Tower, standard height		each	9	1,46,698.00	1,319,472.00	5,029.00	81,261.00	738.00	6,375.40	361.30	3,287.70	10,938.00	98,631.00
4.29	Type DT50 Tower, standard height 12.0m		each	rate only	159,675.00		9,834.00		799.73		387.88		11,436.00	
4.29	Type DT50 Tower, standard height 16.0m		each	rate only	173,763.00		10,701.00		865.92		452.56		12,289.00	
4.30	Type DT50 Tower, standard height 19.0m		each	rate only	183,842.00		11,322.00		930.14		498.07		13,742.00	
4.31	Type DT50 Tower, standard height 12.0m		each	1	187,159.00	187,159.00	12,142.00	12,142.00	985.12	982.11	489.25	491.25	14,738.00	14,738.00
4.32	Type DT50 Tower, 2.0m leg Extension		each	2	3,779.00	7,358.00	460.00	920.00	18.83	37.66	9.43	18.84	282.00	564.00
4.33	Type DT50 Tower, 1.0m leg Extension		each	2	5,514.00	11,028.00	778.00	1,556.00	20.20	45.00	13.25	22.50	107.00	674.00
4.34	Type DT50 Tower, 10.0m leg Extension		each	4	5,323.00	21,292.00	322.00	1,288.00	26.03	104.12	13.83	52.00	389.00	1,556.00

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 5 DEDESA - HOLETA 30 KVS TRANSMISSION LINE-2

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (2)	(4)	(3) x (4)	(5)	(2) x (5)	(6)	(2) x (6)
4.35	Type DT50 Tower, +1.0m leg Extension		each	12	6,035.00	72,420.00	372.00	4,464.00	30.00	360.00	17.00	180.00	450.00	5,412.00
4.36	Type DT50 Tower, +2.0m leg Extension		each	8	6,511.00	52,088.00	430.00	3,440.00	30.00	270.00	17.20	137.76	367.00	4,136.00
4.37	Type DT50 Tower, +3.0m leg Extension		each	12	7,740.00	92,880.00	477.00	5,724.00	30.00	402.00	19.20	231.48	579.00	6,940.00
4.37	Transmission tower type DT50 standard height		each	non-qty	105,070.00		6,740.00		540.00		270.00		8,030.00	
4.38	Transmission tower type DT50 Tower, standard height +3.0m		each	1	118,734.00	118,734.00	7,312.00	7,312.00	591.60	591.60	295.85	295.85	8,875.00	8,875.00
4.39	Transmission tower type DT50 Tower, standard height +6.0m		each	1	129,230.00	129,230.00	7,900.00	7,900.00	644.14	644.14	322.07	322.07	9,602.00	9,602.00
4.40	Transmission tower type DT50 Tower, standard height +9.0m		each	1	138,451.00	138,451.00	8,526.00	8,526.00	689.95	689.95	344.97	344.97	10,340.00	10,340.00
4.41	Transmission tower type DT50 Tower, standard height +12.0m		each	non-qty	147,566.00		9,080.00		733.36		367.00		11,630.00	
4.42	Transmission tower type DT50, +2.0m leg Extension		each	2	2,310.00	4,620.00	142.00	284.00	11.51	23.02	5.75	11.50	175.00	340.00
4.43	Transmission tower type DT50, +1.0m leg Extension		each	2	2,922.00	5,844.00	180.00	360.00	14.36	28.72	7.28	14.56	210.00	420.00
4.44	Transmission tower type DT50, +6.0m leg Extension		each	2	3,396.00	6,796.00	209.00	418.00	16.94	33.88	8.47	16.94	254.00	508.00
4.45	Transmission tower type DT50, +1.0m leg Extension		each	2	3,098.00	6,196.00	146.00	402.00	19.92	39.84	9.36	19.92	209.00	398.00
4.46	Transmission tower type DT50, +2.0m leg Extension		each	2	4,521.00	9,046.00	279.00	558.00	22.54	45.08	11.27	22.54	338.00	676.00
4.47	Transmission tower type DT50, +3.0m leg Extension		each	2	5,036.00	10,072.00	310.00	620.00	25.09	50.18	12.05	24.10	376.00	752.00
4.48	Welding of tower bolts & nuts and painting over with Anti-rust and galvanizing paint including Steel Cattle guards		per tower	630	3,500.00	2,205,000.00	123.00	78,474.00	2.00	1,276.00	1.89	630.00	1,050.00	669,900.00
4.49	Alternative proposal for protecting towers from vandalism		per tower	non-qty	9,000.00		325.00		6.00		3.00		2,700.00	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						53,907,115.00		3,636,314.00		288,485.25		144,340.20		4,089,415.00
6.0	LINE CONDUCTOR INSULATORS AND FITTINGS													
Supply and installation of Insulators & complete Sets of Fittings including all types of clamps, armor rods, extension links, pilot insulator sets, cross-arms and all connections to Tower.														
6.1	4" suspension string with 2x20 insulator units for quad bundle ACSIR "CONCORD" 404.5		each	66	2,099.00	137,534.00	90.97	6,004.02	25.09	1,715.34	11.00	858.00	389.00	25,790.10
6.2	for item 6.1 complete with arc horns at both ends, armor rods, suspension clamp & fittings.		set	66	896.00	59,476.00	31.61	2,046.66	8.86	584.74	4.43	292.38	132.00	8,771.40
6.3	4" suspension string with 2x20 insulator units for quad bundle ACSIR "CONCORD" 404.5		each	3294	2,099.00	6,919,902.00	89.88	295,864.72	25.08	84,599.92	12.84	42,294.96	385.20	1,268,948.00
6.4	for item 6.3 complete with bottom arc horns only, armor rods, suspension clamp and fittings.		set	3294	850.00	2,799,960.00	29.75	97,996.50	8.50	27,999.00	4.25	13,999.50	127.50	419,985.00
6.5	Double Tension Insulator set with 2x20 insulator units for quad bundle ACSIR "CONCORD" 404.5		each	850	3,217.00	2,738,500.00	112.00	96,030.00	32.17	27,801.00	16.00	13,805.20	402.00	344,027.00
6.6	for item 6.5 including all connections to towers, clamps and fittings, armor rods serving device line end only.		set	850	968.00	823,540.00	33.88	29,069.04	9.68	8,305.44	4.84	4,152.72	145.20	124,581.60
6.7	Double Tension Insulator set with 2x20 insulator units for quad bundle ACSIR "CONCORD" 404.5		each	84	3,265.00	274,260.00	114.28	9,599.52	32.85	2,742.00	16.33	1,371.72	489.75	41,139.00
6.8	for item 6.7 including all connections to towers, clamps and fittings, armor rods serving device both ends.		set	84	936.00	78,624.00	32.76	2,751.84	9.36	786.24	4.68	393.12	140.40	11,793.60
6.9	4" Tension string as per the drawing		each	325	732.00	237,900.00	35.62	11,674.50	7.32	1,847.00	3.66	823.00	109.00	34,765.00
6.10	for item 6.9 complete with armor rods, suspension clamp and fittings.		each	325	718.00	233,350.00	25.11	8,164.25	7.18	1,815.50	3.59	807.75	107.50	34,332.50
6.11	Antirust warning system		per set	30	101.00	3,030.00	6.34	190.20	1.01	30.30	0.00	27.30	27.30	824.50
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						15,764,996.00		551,782.85		157,461.96		78,626.17		2,364,628.40

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 5 DEDESA - HOLETA 30 KVS TRANSMISSION LINE-2

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (3)	(4)	(1) x (4)	(5)	(2) x (5)	(6)	(2) x (6)
7.0	GW & OPGW FITTINGS AND ACCESSORIES													
	Supply and installation of complete Sets of Fittings, including all types of clamps, tension links, arrow rods, counterweights and all connections to Towers.													
7.1	Suspension set for OPGW		each	500	100.00	51,809.00	3.60	1,815.83	1.00	518.09	0.50	261.56	15.46	7,771.35
7.2	Tension pinning set for OPGW		each	30	250.00	8,064.00	8.80	262.24	2.50	80.64	1.20	40.32	37.86	1,209.60
7.3	Tension double dead end drives set for OPGW, to be installed on suspension tower		each	57	236.00	12,882.00	7.90	490.87	2.20	128.62	1.10	64.41	33.36	1,932.30
7.4	Tension double dead end drives set for OPGW		each	40	236.00	9,520.00	7.90	363.80	2.20	103.36	1.10	51.38	33.36	1,339.40
7.5	Tension terminal dead end drives set for OPGW		each	2	236.00	452.00	7.90	15.82	4.52	1.13	1.13	2.26	33.36	67.80
7.6	Joining Box for OPGW/OPGW, for use within the transmission line, including fitting, splicing and drive lead clamps, with lead through into, suitable for up to 72 50M ² /N2SF Fibers and OPGW, types as per specification		each	100	240.00	24,000.00	8.40	872.40	2.40	240.20	1.20	124.60	36.76	3,738.00
7.7	Terminal Box for OPGW/OPGW, for the connection at substation gantry, including fitting, splicing and drive lead clamps, for up to 72 50M ² /N2SF Fibers and OPGW/OPGW, types as per specification		each	2	240.00	484.00	8.40	16.54	2.40	4.84	1.20	2.42	36.76	72.60
7.8	Suspension set for GSW		each	100	48.00	24,000.00	1.54	382.40	0.84	246.00	0.20	123.20	6.56	3,696.00
7.9	Tension set for GSW complete for one tower		each	80	30.00	2,560.00	1.10	89.60	0.30	25.60	0.10	12.80	4.00	384.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES					136,253.80		4,789.97		1,362.13		483.38		26,431.95
8.0	CONDUCTOR AND SHIELD WIRE													
	Supply, stringing and installation including all joints, shovers, jumper loops, spacer dampers and necessary spacers, working connections and all drive leads													
8.1	3-phase, Quad bundle ACSSR Conductor Code Name "CONDOR" 454.5, stringing of double circuit on double circuit towers.		route km	275	162,600.00	44,905,000.00	8,130.00	2,235,495.00	1,826.00	448,856.00	813.00	221,949.00	25,000.00	6,825,000.00
8.2	Single Optical Ground wire (OPGW) with 24 fibers, including all splicing and connections to joint boxes.		route km	275	5,000.00	1,375,000.00	270.00	75,894.00	15.00	15,101.00	27.60	7,594.00	750.00	204,750.00
8.5	Single galvanized steel shield wire type GSW 79		route km	275	801.00	218,673.00	40.00	10,520.00	8.01	2,196.73	4.00	1,092.00	750.00	204,750.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES					46,327,738.80		2,396,394.99		461,277.18		238,635.98		2,234,396.00
9.0	SPARES													
9.1	Type DL Tower, foundation overwork for footings in class 3 (good) soil		per tower	3	5,260.00	15,780.00	184.20	552.84	52.80	157.91	26.33	78.99		
9.2	Type DL Tower, overwork for grillage footings in class 2 (good) soil		per tower	3	4,005.00	12,015.00	140.18	420.54	40.05	120.15	20.03	60.09		
9.3	Type DT30 Tower, foundation overwork for footings in class 3 (good) soil		per tower	3	6,675.00	20,025.00	233.63	700.89	66.75	200.25	31.38	100.14		
9.4	Type DT50 Tower, foundation overwork for footings in class 3 (good) soil		per tower	1	11,670.00	11,670.00	408.47	408.45	116.70	116.70	38.35	58.35		
9.5	Ground rods, each to include clamps for wire between & wrenched connection		each	10	12.30	123.00	0.75	7.50	0.33	3.30	0.06	0.60		
9.6	Type DL Tower, standard height 3.0m		each	1	60,908.00	60,908.00	3,751.00	3,751.00	609.00	609.00	304.54	304.54		
9.7	Type DL Tower, standard height		each	3	64,716.00	199,452.00	1,086.00	3,912.00	647.36	1,942.32	323.58	647.36		
9.8	Type DL Tower, standard height 4.0m		each	2	75,357.00	150,714.00	4,441.00	9,282.00	753.57	1,507.14	376.79	753.58		
9.10	Type DL Tower, standard height 12.0m		each	3	85,475.00	256,425.00	5,364.00	15,792.00	854.75	2,564.25	427.38	1,282.14		
9.11	Type DL Tower, 4.0m Lag Extension		each	4	1,907.00	7,668.00	121.00	484.00	190.7	768.00	9.84	39.36		
9.12	Type DL Tower, 12.0m Lag Extension		each	8	2,337.00	18,696.00	140.00	1,120.00	233.7	1,869.60	11.79	94.32		
9.13	Type DL Tower, 2.0m Lag Extension		each	12	2,661.00	31,932.00	164.00	1,968.00	266.1	3,193.2	13.31	159.72		
9.14	Type DL Tower, 12.0m Lag Extension		each	8	2,096.00	16,768.00	184.00	1,472.00	209.86	1,678.88	14.93	119.44		
9.15	Type DL Tower, standard height		each	2	109,578.00	219,156.00	6,748.00	13,496.00	1,095.78	2,191.56	547.00	1,095.78		
9.16	Type DT30 Tower, standard height 4.0m		each	3	129,218.00	387,774.00	7,060.00	2,920.38	1,292.38	3,877.74	646.29	1,938.87		
9.17	Type DT30 Tower, 4.0m Lag Extension		each	8	3,396.00	27,168.00	209.00	1,672.00	33.96	271.68	16.99	135.92		
9.18	Type DT30 Tower, 12.0m Lag Extension		each	12	3,098.00	37,176.00	346.00	2,952.00	30.98	479.76	19.88	238.56		
9.19	Type DT50 Tower, standard height		each	3	146,608.00	439,824.00	9,429.00	27,687.00	1,466.08	4,398.24	733.04	2,199.12		
9.20	Type DT50 Tower, 4.0m Lag Extension		each	12	5,234.00	62,808.00	322.00	3,864.00	52.34	628.08	26.12	313.44		

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 5 DEDESA - HOLETA 500 KV TRANSMISSION LINE-2

No	Description	Code	Unit	Qty.	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(1) x (2)	(4)	(1) x (4)	(5)	(2) x (5)	(6)	(2) x (6)
9.21	Suspension string as item 6.1		set	42	2,599.00	108,158.00	90.97	3,821.74	25.00	1,091.50	11.00	546.00		
9.22	Tension string as item 6.3		set	396	2,588.00	1,025,008.00	80.88	32,030.48	25.00	2,405.28	12.88	1,252.04		
9.23	OPGW suspension set as item 7.1		set	8	103.00	824.00	3.61	28.88	1.03	8.24	0.32	4.35		
9.24	OPGW tension set as item 7.2		set	8	252.00	2,016.00	8.82	70.56	2.32	20.16	1.26	10.08		
9.25	GW suspension set as item 7.8		set	8	44.00	352.00	1.54	12.32	0.44	3.52	0.22	1.76		
9.26	GW tension set as item 7.9		set	8	32.00	256.00	1.12	8.96	0.32	2.56	0.16	1.28		
9.27	Spacedamper for ACSR "CONDOR" 454.5 Conductor.		each	300	80.00	24,000.00	2.807	840.00	0.80	240.00	0.40	120.00		
9.27	Spacer for ACSR "CONDOR" 454.5		each	30	220.00	6,600.00	4.20	126.00	1.20	36.00	0.60	30.00		
9.28	Steelbridge type vibration dampers for OPGW		each	50	30.00	1,500.00	1.05	52.50	0.30	15.00	0.15	7.50		
9.29	Steelbridge type vibration dampers for GWS		each	30	30.00	1,500.00	1.05	32.50	0.30	15.00	0.15	7.50		
9.30	ACSR "CONDOR" 454.5 Conductor		km	30	6,775.00	203,250.00	139.00	41,770.00	67.75	2,032.50	31.88	1,016.40		
9.31	OPGW		km	4	5,560.00	22,240.00	178.00	1,132.00	55.60	222.40	27.83	111.32		
9.32	E.H.S shield wire		km	4	801.00	3,204.00	40.00	160.00	8.01	32.04	4.01	16.04		
9.33	Mid - operation joint for ACSR "CONDOR" 454.5 Conductor		each	100	72.00	4,200.00	2.52	131.20	0.72	43.20	0.36	21.60		
9.34	Repair sleeve for ACSR "CONDOR" 454.5 Conductor		each	30	72.00	2,160.00	2.52	75.00	0.72	21.60	0.36	10.80		
9.35	Joint Box intermediate type for OPGW		each	3	200.00	600.00	35.50	31.50	3.00	9.00	1.50	4.50		
9.36	Mid - operation joint for E.H.S shield wire		each	30	600.00	600.00	0.70	21.00	0.20	6.00	0.10	3.00		
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						3,233,083.00		542,388.46		25,238.00		12,766.04		
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFF													
10.1	Office and housing facilities for the Engineer and Employer's staff as specified under Section VI "Employers requirements", part A2, item A2.13 and A2.14		LOT	1									480,000.00	480,000.00
SUB - TOTAL														480,000.00
11.0	VEHICLES AND COMMUNICATION EQUIPMENT													
11.1	Trucks, Load cranes, towing type back door, 5-speed, common rail turbo charged diesel engine, etc. as specified under Section VI "Employers requirements", part A2, item A2.22		No	1									272,000.00	272,000.00
11.2	Trucks, Double cabin pick-ups, four door, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section VI "Employers requirements", part A2, item A2.22		No	10									140,000.00	1,400,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES														1,672,000.00
P.M. (in Grand Summary)						326,408,382.00		6,793,278.36		897,234.33		336,389.36		32,897,232.73

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD - DERESA 500 KV TRANSMISSION LINE-2

No	Description	Code	Unit	Qty-	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
				(1)	(2)	(1) x (2)	(3)	(3) x (3)	(4)	(4) x (4)	(5)	(5) x (5)	(6)	(6) x (6)
	Including complete design, manufacturing, testing, transport, loading, unloading, intermediate storage, erection, installation, testing and commissioning													
1.0	GENERAL WORKS													
	Including all necessary survey activities like tower spotting, survey of crossing objects including prugging of towers, diagonal profiles and all necessary documentation in the CDRL, soil investigation and route clearing & access roads.													
1.1	Check survey, review of tower plotting and preparation of profile drawings and tower schedule.		route km	364									16,000.00	5,844,000.00
1.2	Preliminary sub-soil investigation at support locations by means of soil penetration test (SPT), establishment of ground water level and dimensional soil-water characteristics		per tower	828									700.00	579,600.00
1.3	Specialist soil investigation		per tower	60									1,400.00	84,000.00
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		lump sum										1,032,000.00	1,032,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES														7,209,600.00
2.0	FOUNDATIONS													
	All Foundations for Tower Types according to the specifications, including all transport, excavation, installation of rails, all necessary reinforcement, churning, concreting, backfilling, compaction, complete tower setting and their connection to tower, ensuring of earth continuity and submitting of records to Engineer/Inspector, according to drawings and regulations of the Engineer. Soil class definition													
2.1	Type DL Tower, concrete footings, in class 1 (rock) soil		per tower	30	561.5	28845	64.1	1923	32.05	961.5	32.05	961.5	5,320.30	159,600.00
2.2	Type DL Tower, concrete footings in class 2 (good) soil		per tower	285	1071.6	47688	111.44	31769.4	55.72	15889.2	55.72	15889.2	9,249.32	2,636,113.00
2.3	Type DL Tower, concrete footings in class 3 (poor) soil		per tower	318	2632.65	837182.7	175.51	55812.18	87.705	27966.09	87.705	27966.09	14,567.33	4,832,410.94
2.4	Type DL Tower, concrete footings in class 4 (good submerged) soil		per tower	55	4129.05	227097.75	275.27	15139.85	137.635	7589.925	137.635	7589.925	1,256,687.05	72,847.41
2.5	Type DL Tower, concrete footings in class 5 (poor submerged) soil		per tower	22	6895.35	151807.7	459.69	10133.18	229.845	5056.39	229.845	5056.39	38,154.27	859,383.94
2.6	Type DL Tower, rail foundation in class 6 (very poor submerged) soil		per tower	2	7935.3	15870.6	529.02	1058.04	264.51	529.02	264.51	529.02	43,968.66	87,917.32
2.7	Type DL30 Tower, concrete footings, in class 1 (rock) soil		per tower	9	1756.35	15807.15	117.09	1053.81	58.545	526.905	58.545	526.905	9,718.47	87,466.23
2.8	Type DL30 Tower, concrete footings in class 2 (good) soil		per tower	40	3893.6	155864	253.44	10137.6	126.72	5068.8	126.72	5068.8	21,635.32	881,420.80
2.9	Type DL30 Tower, concrete footings in class 3 (poor) soil		per tower	35	5836.65	204282.75	389.11	13618.85	194.555	6889.425	194.555	6889.425	32,298.13	1,130,364.55
2.10	Type DL30 Tower, concrete footings in class 4 (good submerged) soil		per tower	5	9836.7	49183.5	655.78	3278.9	327.89	1639.45	327.89	1639.45	18,429.74	272,148.76
2.11	Type DL30 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	15628.35	31256.7	1041.89	2083.78	520.945	1041.89	520.945	1041.89	36,479.87	172,953.74
2.12	Type DL30 Tower, rail foundation in class 6 (very poor submerged) soil		per tower	1	18879.15	18879.15	1258.61	1258.61	629.305	629.305	629.305	629.305	104,464.63	104,464.63
2.13	Type DL50 Tower, concrete footings, in class 1 (rock) soil		per tower	1	3052.65	3052.65	203.51	203.51	101.755	101.755	101.755	101.755	16,891.33	16,891.33
2.14	Type DL50 Tower, concrete footings in class 2 (good) soil		per tower	8	7597.2	60777.6	596.48	4851.84	253.24	2025.92	253.24	2025.92	49,657.84	396,361.72
2.15	Type DL50 Tower, concrete footings in class 3 (poor) soil		per tower	8	10990.7	87923.6	726.78	5814.24	363.39	2907.12	363.39	2907.12	60,322.74	482,581.92
2.16	Type DL50 Tower, concrete footings in class 4 (good submerged) soil		per tower	2	10598.2	21196.6	1258.88	2517.76	619.94	1239.88	619.94	1239.88	109,310.04	218,781.12
2.17	Type DL50 Tower, concrete footings in class 5 (poor submerged) soil		per tower	3	27138.9	81416.7	1889.26	5627.78	994.43	2713.89	994.43	2713.89	150,168.18	450,505.74
2.18	Type DL50 Tower, rail foundation in class 6 (very poor submerged) soil		per tower	1	25294.5	25294.5	1686.3	1686.3	843.15	843.15	843.15	843.15	139,364.00	139,364.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						2522422.85		168641.34		84876.76		84876.76		13,953,745.33
3.0	TOWER GROUNDING													
	All tower groundings including excavation, laying of counterpoise, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and measuring of earth value													
3.1	Basic grounding on two diagonal legs, consisting of three (3) ground rods, 1m long and 5m counterpoise		per tower	625	30.00	41,400.00	3.00	2,460.00	0.50	414.00	0.25	207.00	40.00	33,120.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	40.00	4,000.00	2.00	200.00	0.40	40.00	0.20	20.00	40.00	4,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						45,400.00		2,660.00		454.00		227.00		37,120.00

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD DEHESA 500 KV TRANSMISSION LINE 2

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)=(2)	(4)	(5)=(3)	(6)	(7)=(4)*5	(8)	(9)=(7)*(5)	(10)=(8)
4.0	STEEL TOWERS													
	Supply and erection of two (2) galvanized lattice steel towers according to the design including rods, wire extensions, leg extensions, working extensions and securing of steel extension and attachment of rod end to bracing? Erection, working and design plates, master plates, other plates where necessary, wire bolts, all necessary fittings, and all connections in the erection system. Securing system installation by													
4.1	Type DL Tower, standard height 4.0m		each	36	56,545.00	1,995,940.00	3,307.00	122,252.00	274.00	9,896.40	137.40	4,948.20	8,324.00	148,464.00
4.2	Type DL Tower, standard height 3.0m		each	23	40,888.00	1,400,884.00	3,751.00	86,273.00	303.53	6,983.19	151.70	3,490.48	4,553.00	104,710.00
4.3	Type DL Tower, standard height		each	261	64,716.00	16,890,876.00	3,080.00	1,040,340.00	322.30	84,172.50	161.40	42,086.25	4,838.00	1,262,718.00
4.4	Type DL Tower, standard height 13.0m		each	70	70,173.00	5,112,990.00	4,321.00	328,360.00	349.08	26,275.60	174.84	13,287.84	5,245.00	368,520.00
4.5	Type DL Tower, standard height 6.0m		each	86	76,307.00	6,480,702.00	4,641.00	398,126.00	375.53	32,295.58	187.70	16,147.36	5,653.00	484,438.00
4.6	Type DL Tower, standard height 10.0m		each	60	80,261.00	5,138,980.00	4,554.00	342,887.00	399.07	27,187.95	199.08	13,788.62	5,890.00	42,132.00
4.6	Type DL Tower, standard height 12.0m		each	161	86,475.00	13,764,475.00	5,264.00	847,384.00	425.00	68,577.95	212.07	34,288.17	6,380.00	1,028,620.00
4.7	Type DL Tower, 1.0m Leg Extension		each	284	1,179.00	335,636.00	85.00	24,140.00	6.87	1,953.88	3.44	970.36	103.00	29,252.00
4.8	Type DL Tower, 1.0m Leg Extension		each	427	1,680.00	708,800.00	100.00	43,534.00	8.17	3,531.29	4.10	1,767.78	147.00	52,948.00
4.9	Type DL Tower, 10.0m Leg Extension		each	111	1,046,444.00	1,161,444.00	121.00	14,373.00	9.80	5,213.60	4.40	3,696.80	147.00	78,284.00
4.10	Type DL Tower, 1.0m Leg Extension		each	569	1,341,133.00	1,341,133.00	145.00	82,385.00	11.75	6,685.75	5.80	3,348.63	178.00	100,144.00
4.11	Type DL Tower, 12.0m Leg Extension		each	400	5,133,580.00	5,133,580.00	164.00	65,864.00	13.76	5,648.76	6.63	3,824.34	199.00	84,774.00
4.12	Type DL Tower, 15.0m Leg Extension		each	650	1,821,460.00	1,821,460.00	112.00	72,940.00	9.87	6,458.40	7.46	4,538.40	136,030.00	136,030.00
4.13	Type DTDL Tower, standard height 4.0m		each	6	59,681.00	358,086.00	5,453.00	34,080.00	473.83	2,830.98	235.03	1,415.06	7,877.00	42,082.00
4.14	Type DTDL Tower, standard height 3.0m		each	3	100,213.00	300,639.00	6,506.00	19,888.00	514.30	1,543.05	267.17	771.51	7,715.00	23,145.00
4.15	Type DTDL Tower, standard height		each	32	109,578.00	3,506,496.00	6,748.00	215,936.00	548.07	17,474.24	273.03	8,736.36	8,101.00	262,512.00
4.16	Type DTDL Tower, standard height 15.0m		each	7	118,734.00	831,138.00	7,112.00	51,384.00	595.00	4,141.83	255.80	2,076.95	8,873.00	62,125.00
4.17	Type DTDL Tower, standard height 10.0m		each	3	129,258.00	387,774.00	7,895.00	23,880.00	644.14	1,932.42	322.07	965.21	9,660.00	28,986.00
4.17	Type DTDL Tower, standard height 10.0m		each	7	136,451.00	955,157.00	8,526.00	59,682.00	688.50	4,826.45	344.07	2,414.79	10,345.00	72,443.00
4.18	Type DTDL Tower, standard height 12.0m		each	20	147,564.00	2,951,280.00	9,085.00	174,464.00	735.36	14,390.88	367.68	10,293.84	11,830.00	398,600.00
4.19	Type DTDL Tower, standard height 14.0m		each	rate only	223,536.00		13,768.00		1,113.04		556.00		16,768.00	
4.20	Type DTDL Tower, 2.0m Leg Extension		each	20	60,880.00	1,217,600.00	142.00	2,840.00	11.55	228.20	5.75	140.20	147.00	4,488.00
4.21	Type DTDL Tower, 1.0m Leg Extension		each	40	116,880.00	4,675,200.00	180.00	7,260.00	14.56	582.40	7.20	251.20	218.00	8,720.00
4.22	Type DTDL Tower, 10.0m Leg Extension		each	10	588,880.00	5,888,800.00	209.00	2,140.00	16.94	635.70	8.47	403.83	254.00	1,577.00
4.23	Type DTDL Tower, 1.0m Leg Extension		each	89	355,822.00	31,668,158.00	246.00	21,894.00	19.50	1,772.88	9.06	886.44	295.00	26,611.00
4.24	Type DTDL Tower, 12.0m Leg Extension		each	40	588,880.00	5,888,800.00	209.00	2,140.00	16.94	635.70	8.47	403.83	254.00	1,577.00
4.25	Type DTDL Tower, 15.0m Leg Extension		each	94	471,384.00	44,309,976.00	279.00	26,140.00	22.54	2,093.60	11.47	1,053.80	339.00	13,520.00
4.26	Type DTDL Tower, standard height 4.0m		each	rate only	125,947.00		7,756.00		627.64		313.82		9,415.00	
4.27	Type DTDL Tower, standard height 3.0m		each	rate only	136,173.00		8,509.00		688.36		344.00		10,328.00	
4.28	Type DTDL Tower, standard height		each	13	1,003,904.00	13,050,752.00	9,429.00	127,577.00	739.60	9,607.80	4,748.00	40,850.00	10,850.00	142,887.00
4.29	Type DTDL Tower, standard height 15.0m		each	4	636,780.00	2,547,120.00	9,624.00	39,306.00	795.71	3,182.84	397.89	1,591.44	11,928.00	47,744.00
4.29	Type DTDL Tower, standard height 10.0m		each	2	173,763.00	347,526.00	10,701.00	21,402.00	860.92	1,730.84	432.06	863.92	12,880.00	25,770.00
4.30	Type DTDL Tower, standard height 15.0m		each	1	183,842.00	183,842.00	11,322.00	11,322.00	916.14	916.14	458.07	458.07	13,742.00	13,742.00
4.31	Type DTDL Tower, standard height 12.0m		each	4	187,159.00	748,636.00	12,143.00	48,580.00	980.51	3,938.04	491.21	1,965.00	14,738.00	58,952.00
4.32	Type DTDL Tower, 2.0m Leg Extension		each	7	3,779.00	26,453.00	233.00	1,631.00	18.83	131.81	9.40	65.94	283.00	1,974.00
4.33	Type DTDL Tower, 1.0m Leg Extension		each	11	4,114.00	45,254.00	278.00	3,058.00	22.90	247.50	11.41	125.71	337.00	3,787.00

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GEBO DEHERSA 500 KV TRANSMISSION LINE-2

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)=(2)	(4)	(5)=(3)	(6)	(7)=(6)	(8)	(9)=(8)	(10)=(9)
4.34	Type DTHD Tower, +0.0m long Extension		each	16	5,224.00	83,584.00	322.00	5,152.00	26.00	416.48	13.00	208.32	369.00	6,240.00
4.35	Type DTHD Tower, +1.0m long Extension		each	13	6,035.00	78,455.00	372.00	5,380.00	30.00	453.20	15.00	255.00	453.00	6,760.00
4.36	Type DTHD Tower, +2.0m long Extension		each	11	76,001.00	76,001.00	4,086.00	4,086.00	34.00	378.84	17.00	189.42	513.00	5,687.00
4.37	Type DTHD Tower, +3.0m long Extension		each	36	7,781.00	278,676.00	477.00	17,372.00	30.00	1,388.88	19.00	684.84	979.00	26,864.00
4.37	Transmission tower type DTHD, standard height		each	2	105,578.00	211,156.00	6,748.00	13,496.00	546.07	1,092.14	275.03	546.06	8,191.90	16,982.00
4.38	Transmission tower type DTHD Tower, standard height +3.0m		each	1	116,734.00	116,734.00	7,332.00	7,332.00	591.00	591.00	295.00	295.00	8,873.00	8,873.00
4.39	Transmission tower type DTHD Tower, standard height +6.0m		each	1	126,258.00	126,258.00	7,960.00	7,960.00	644.14	644.14	322.07	322.07	9,662.00	9,662.00
4.40	Transmission tower type DTHD Tower, standard height +9.0m		each	1	128,451.00	128,451.00	8,526.00	8,526.00	689.95	689.95	344.97	344.97	10,349.00	10,349.00
4.41	Transmission tower type DTHD Tower, standard height +12.0m		each	1	147,564.00	147,564.00	9,088.00	9,088.00	735.36	735.36	367.68	367.68	11,838.00	11,838.00
4.42	Transmission tower type DTHD, 2.0m long Extension		each	2	2,330.00	4,660.00	142.00	284.00	11.51	23.02	5.76	11.51	473.00	346.00
4.43	Transmission tower type DTHD, 4.0m long Extension		each	2	2,522.00	5,044.00	160.00	360.00	14.56	29.12	7.28	14.56	218.00	436.00
4.44	Transmission tower type DTHD, 6.0m long Extension		each	4	3,398.00	13,592.00	200.00	800.00	16.94	67.76	8.47	33.88	254.00	1,016.00
4.45	Transmission tower type DTHD, +1.0m long Extension		each	6	3,598.00	21,588.00	246.00	1,476.00	19.92	119.52	9.56	58.76	299.00	1,794.00
4.46	Transmission tower type DTHD, +2.0m long Extension		each	4	4,523.00	18,092.00	279.00	1,116.00	22.34	90.36	11.27	45.08	238.00	1,322.00
4.47	Transmission tower type DTHD, +3.0m long Extension		each	6	5,436.00	32,616.00	310.00	1,860.00	25.09	150.54	12.55	75.30	376.00	2,256.00
4.48	Welding of tower bolts & nut and painting over with Anti-rust and galvanizing paint including Steel Cattle guards		per tower	620	3,000.00	1,800,000.00	122.00	102,640.00	2.00	1,030.00	1.00	620.00	1,030.00	903,000.00
4.49	Alternative proposal for protecting towers from vandalism		per tower	one only	9,000.00		315.00		6.00		3.00		2,760.00	
NEW- TOTAL CARRIED TO SUMMARY OF PRICES						78,138,893.00		4,734,961.00		276,333.83		188,277.29		6,483,246.00
6.0	LINE CONDUCTOR INSULATORS AND FITTINGS													
	Supply and installation of Insulators & complete Set of fittings including all types of clamps, armor rods, extension links, pilot insulator sets, counterweights and all connections to Towers													
6.1	V suspension string with 2x29 insulator units for quad bundle ACSB "CONDOR" 4545.		each	66	2,599.00	171,534.00	90.97	6,004.02	25.99	1,715.34	13.00	858.00	389.85	25,738.18
6.2	Ww Item 6.1 complete with arc horns at both ends, armor rods, suspension clamp & fittings		set	66	886.00	58,476.00	31.01	2,060.66	8.86	584.76	4.43	292.38	132.80	8,771.40
6.3	V suspension string with 2x29 insulator units for quad bundle ACSB "CONDOR" 4545.		each	4296	2,568.00	10,881,088.00	89.88	378,051.28	25.68	108,016.08	12.64	54,065.04	385.20	1,629,151.20
6.4	Ww Item 6.3 complete with bottom arc horn only, armor rods, suspension clamp and fittings		set	4296	850.00	3,653,580.00	29.75	125,128.50	8.50	36,750.00	4.25	17,873.00	127.50	536,287.00
6.5	Double Tension Insulator set with 2x20 insulator units for quad bundle ACSB "CONDOR" 4545.		each	1320	3,217.00	4,246,440.00	112.60	148,632.00	32.17	42,464.40	16.09	21,238.80	482.55	636,966.00
6.6	Ww Item 6.5 including all connections to towers, clamps and fittings, armor rods acting device line end only.		set	1320	980.00	1,293,760.00	32.88	44,321.60	9.80	12,771.60	4.84	6,388.80	245.20	193,564.00
6.7	Double Tension Insulator set with 2x20 insulator units for quad bundle ACSB "CONDOR" 4545.		each	84	3,265.00	274,260.00	114.28	9,589.52	32.65	2,742.80	16.31	1,371.72	489.75	41,139.00
6.8	Ww Item 6.7 including all connections to towers, clamps and fittings, armor rods acting device both ends.		set	84	936.00	78,624.00	32.76	2,751.84	9.36	786.24	4.68	393.12	140.40	11,793.00
6.9	T Jumper string as per the drawing		each	280	732.00	204,960.00	25.62	7,173.60	7.32	2,049.60	3.66	1,024.80	109.80	30,744.00
6.10	Ww Item 6.9 complete with armor rods, suspension clamp and fittings		each	280	718.00	201,040.00	25.13	7,036.40	7.18	2,010.40	3.59	1,005.20	107.70	30,156.00
6.11	Aircraft warning system		per unit	30	5,430.00	162,900.00	6.34	190.20	1.81	54.30	0.91	27.30	27.15	814.50
NEW- TOTAL CARRIED TO SUMMARY OF PRICES						26,894,632.00		739,328.62		288,946.32		186,489.00		5,234,594.00

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GED, DEHESA, 500 KV TRANSMISSION LINE-2

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
				(1)	(2)	(1) x (2)	(3)	(3) x (2)	(4)	(4) x (2)	(5)	(5) x (2)	(6)	(6) x (2)
7.0	GSW & OPGW FITTINGS AND ACCESSORIES													
	Supply and installation of complete line of fittings, including all types of clamps, extension links, armor rods, counterweights and all connections to Towers.													
7.1	Suspension set for OPGW		each	652	103.00	65,096.00	3.01	2,381.52	1.03	656.96	0.36	238.64	15.45	9,764.40
7.2	Tension passing set for OPGW		each	82	259.00	20,864.00	8.80	723.14	2.52	208.64	1.26	103.32	37.80	3,089.00
7.3	Tension double dead end device set for OPGW, to be installed on suspension tower		each	91	236.00	20,566.00	7.91	719.81	2.26	205.66	1.13	102.83	33.00	3,084.90
7.4	Tension double dead end device set for OPGW		each	21	256.00	4,746.00	7.91	166.11	2.26	47.46	1.13	23.75	33.00	712.00
7.5	Tension terminal dead end device set for OPGW		each	2	256.00	452.00	7.91	15.82	2.26	4.52	1.13	2.26	33.00	67.80
7.6	Joining Box for OPGW/OPGW, for use within the transmission line, including fitting, splicing and downlead clamps, with lead through sets, suitable for up to 72 3MM ² NSDSF fibres and OPGW, types as per specification		each	112	242.00	27,094.00	8.47	948.64	2.42	273.94	1.21	133.32	36.30	4,080.00
7.7	Terminal Box for OPGW/OPGW, for the connection at substation gantry, including fitting, splicing and downlead clamps, for up to 72 3MM ² NSDSF fibres and OPGW/OPGW, types as per specification		each	2	242.00	484.00	8.47	16.94	2.42	4.84	1.21	2.42	36.30	72.60
7.8	Suspension set for GSW		each	712	48.00	33,328.00	1.54	1,086.40	0.84	313.28	0.22	159.84	6.00	4,269.20
7.9	Tension set for GSW complete for one tower		each	116	3,712.00	4,305.92	1.12	129.92	0.31	37.12	0.16	18.56	4.00	466.80
	NEW - TOTAL CARRIED TO SUMMARY OF PRICES					474,032.00		4,086.40		5,743.52		873.80		26,322.80
8.0	CONDUCTOR AND SHIELD WIRE													
	Supply, strapping and installation including all joints, shovers, jumper loops, spacers and necessary dampers, marking connections and all downleads													
8.1	3 phase, Quad bundle ACSR Conductor Code Name "CONDOP" 645, strapping of double circuit on double circuit towers.		meter ton	344	162,600.00	55,934,400.00	6,130.00	2,796,720.00	1,626.00	559,344.00	813.00	279,672.00	25,000.00	8,600,000.00
8.2	Single Optical Groundwire (OPGW) with 24 fibres, including all splicing and connections to joint boxes.		meter ton	304	5,500.00	1,672,000.00	278.00	85,022.00	15.00	45,140.00	27.82	8,370.00	750.00	228,000.00
8.3	Single galvanized steel shieldwire type GSW 79		meter ton	344	880.00	275,544.00	40.00	13,760.00	8.01	2,751.44	4.00	1,376.00	750.00	258,000.00
	NEW - TOTAL CARRIED TO SUMMARY OF PRICES					58,336,944.00		2,986,512.00		581,245.44		286,018.00		9,116,000.00
9.0	SPARES													
9.1	Type DL Tower, foundation steelwork for fittings in class 3 (poor) soil		per tower	3	5,280.00	15,792.00	184.28	552.84	895.00	2,685.15	447.53	1,342.59		
9.2	Type DL Tower, steelwork for galling fittings in class 2 (good) soil		per tower	3	4,495.00	13,815.00	148.18	425.54	689.85	2,042.55	348.45	1,045.29		
9.3	Type DTH Tower, foundation steelwork for fittings in class 3 (poor) soil		per tower	3	6,675.00	20,025.00	233.63	700.89	1,134.75	3,404.25	567.38	1,702.14		
9.4	Type DTH Tower, foundation steelwork for fittings in class 3 (poor) soil		per tower	1	11,670.00	11,670.00	405.45	405.45	1,881.90	1,881.90	991.95	991.95		
9.5	Ground rods, each to include clamps for electrodes & terminal connection		each	10	12.00	120.00	0.75	7.50	0.13	1.25	0.06	0.60		
9.6	Type DL Tower, standard height - 30m		each	1	60,908.00	60,908.00	3,751.00	3,751.00	303.53	303.53	151.76	151.76		
9.7	Type DL Tower, standard height		each	2	64,756.00	129,412.00	3,886.00	7,772.00	322.39	645.00	161.29	322.50		
9.8	Type DL Tower, standard height - 60m		each	2	75,357.00	150,714.00	4,541.00	9,082.00	375.53	751.06	187.76	375.52		
9.9	Type DL Tower, standard height - 120m		each	3	85,475.00	256,425.00	5,264.00	15,792.00	435.00	1,277.85	213.59	638.31		
9.11	Type DL Tower, - 60m Lag Extension		each	4	1,947.00	7,788.00	121.00	484.00	9.80	39.20	4.50	19.80		
9.12	Type DL Tower, - 120m Lag Extension		each	8	2,357.00	18,856.00	145.00	1,160.00	11.75	94.00	5.49	43.96		
9.13	Type DL Tower, - 120m Lag Extension		each	12	2,461.00	29,532.00	164.00	1,968.00	13.26	159.12	6.63	79.56		
9.14	Type DL Tower, - 120m Lag Extension		each	8	2,086.00	16,688.00	184.00	1,472.00	14.88	119.04	7.44	59.52		
9.15	Type DTH Tower, standard height		each	2	105,578.00	211,156.00	6,748.00	13,496.00	546.07	1,092.14	275.03	546.06		
9.16	Type DTH Tower, standard height - 60m		each	3	125,258.00	375,774.00	7,800.00	23,400.00	644.14	1,932.42	323.07	969.21		
9.17	Type DTH Tower, - 60m Lag Extension		each	8	3,398.00	27,184.00	209.00	1,672.00	16.94	135.52	8.47	67.76		
9.18	Type DTH Tower, - 120m Lag Extension		each	12	3,098.00	37,176.00	246.00	2,952.00	19.92	239.04	9.96	119.52		
9.19	Type DTH Tower, standard height		each	3	146,608.00	439,824.00	9,029.00	27,087.00	730.60	2,191.80	365.30	1,095.90		
9.20	Type DTH Tower, - 60m Lag Extension		each	12	5,234.00	62,808.00	322.00	3,864.00	26.01	312.36	13.61	163.34		

SCHEDULE OF PRICES

SUPPLY AND ERECTION

LOT 4 GERD, DERESA 500 KV TRANSMISSION LINE-2

No	Description	Code	Unit	Qty	Supply (FOB)		Sea Transportation		Local transportation		Insurance		Erection, Test and Commissioning	
					Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total price	Unit Price	Total price	Unit Price	Total Price
					USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
					(1)	(2)	(3)	(2)	(4)	(3) x (4)	(5)	(3) x (5)	(6)	(3) x (6)
9.21	Suspension string as item 6.1		set	42	2,599.00	108,158.00	90.97	3,820.74	25.99	1,091.58	13.60	568.00		
9.22	Tension string as item 6.3		set	96	2,588.00	248,328.00	80.88	8,628.48	25.88	2,483.28	12.84	1,232.84		
9.23	OPGW suspension set as item 7.1		set	8	181.00	824.00	3.61	28.88	1.83	8.24	0.52	4.25		
9.24	OPGW tension set as item 7.2		set	8	252.00	2,016.00	8.82	70.56	2.32	20.16	1.26	10.08		
9.25	GSW suspension set as item 7.8		set	8	44.00	352.00	1.54	12.32	0.44	3.52	0.22	1.76		
9.26	GSW tension set as item 7.9		set	8	32.00	256.00	1.12	9.06	0.32	2.56	0.16	1.28		
9.27	Flexible spacers for ACSB "CONDOR" 454.5 Conductor		each	300	80.00	24,000.00	2.80	840.00	13.80	4,140.00	6.40	2,400.00		
9.27	Stockedge type vibration dampers for CONDOR 454.5		each	50	120.00	6,000.00	4.20	210.00	20.80	1,020.00	10.20	510.00		
9.28	Stockedge type vibration dampers for OPGW		each	50	30.00	1,500.00	1.05	52.50	5.10	255.00	2.55	127.50		
9.29	Stockedge type vibration dampers for GSW		each	50	30.00	1,500.00	1.05	52.50	5.10	255.00	2.55	127.50		
9.30	ACSB "CONDOR" 454.5 Conductor		ton	30	6,775.00	203,250.00	339.00	10,170.00	68.90	2,046.00	34.00	1,020.00		
9.31	OPGW		ton	4	5,565.00	22,260.00	278.00	1,112.00	51.85	232.80	27.46	111.28		
9.32	E.H.S shieldwire		ton	4	680.00	2,720.00	40.00	160.00	8.91	32.84	4.40	16.00		
9.33	Mdl - open tension joint for ACSB "CONDOR" 454.5 Conductor		each	60	72.00	4,320.00	2.52	151.20	12.24	734.40	6.12	367.20		
9.34	Recepter sleeve for ACSB "CONDOR" 454.5 Conductor		each	30	72.00	2,160.00	2.52	75.60	12.24	367.20	6.12	183.60		
9.35	Joint Box intermediate type for OPGW		each	3	300.00	900.00	10.50	31.50	51.90	155.00	25.50	76.50		
9.36	Mdl - open tension joint for E.H.S. shieldwire		each	30	20.00	600.00	0.70	21.00	3.40	102.00	1.70	51.00		
SUB - TOTAL CARRIED TO SUMMARY OF PRICES						2,033,883.00		142,868.46		32,263.74		86,233.89		
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFFS													
10.1	Office and housing facilities for the Engineer and Employer's staff as specified under Section-VI "Employers requirements", part A2, item A2.13 and A2.14		LOFT	1									440,000.00	440,000.00
SUB - TOTAL														440,000.00
11.0	VEHICLES AND COMMUNICATION EQUIPMENT													
11.1	Toyota, Land cruiser, entry type back door, 5-speed, common rail turbo charged diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.22		No	3									272,000.00	816,000.00
11.2	Toyota, Double cabler pickup-ups, four door, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.23		No	30									140,000.00	4,200,000.00
11.3	Basic HF radio to be installed in each selected site for Engineer's and Employer's representative office and camp.		No	4									57,000.00	228,000.00
11.4	Mobile HF radio telephone equipment to be mounted on each Land Cruiser and Pick-up vehicles, including its accessories, power supply, etc.		No	12									11,000.00	132,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES														2,216,000.00
TOTAL (for Grand Summary)						162,642,738.00		8,899,626.67		1,380,273.23		684,678.79		42,847,507.93

Schedule of Prices

Grand Summary (For Existing Double Circuit Supporting Twin Tower Strucutres)

Item	Description	Supply (FOB)	Sea Transportation	Local transportation	Insurance	Erection, Test and Commissioning	Grand Total
		Total Price	Total Price	Total price	Total price	Total Price	Total Price
	Currency	USD	USD	USD	USD	USD	USD
1	Dedesa - Holeta 500kV Transmission Line - 1	127,797,286.80	6,804,653.83	1,001,742.23	532,403.01	34,228,660.01	170,364,745.88
TOTAL (Lot-3) =							170,364,745.88
2	GERD - Dedesa 500kV Transmission Line - 1	157,617,050.00	8,421,606.56	1,285,387.97	682,811.70	41,413,655.50	209,420,511.73
TOTAL (Lot-4) =							209,420,511.73
3	Dedesa - Holeta 500kV Transmission Line - 2	126,410,582.90	6,763,378.34	997,734.33	530,309.26	32,897,232.73	167,599,237.56
TOTAL (Lot-5) =							167,599,237.56
4	GERD - Dedesa 500kV Transmission Line - 2	162,442,728.65	8,691,626.07	1,285,273.23	684,678.70	42,617,427.93	215,721,734.57
TOTAL (Lot-6) =							215,721,734.57
GRAND TOTAL (Lot3 to Lot-6) =							763,106,229.74

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -1

Tower & Foundation	Modified Price by "W ₁ = 2.607"	
Conductor	Modified Price by "2.000"	
Number of Tower	Modified Quantity by "R ₀ = 1.281437126"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by 1.28143	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning			
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price	
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	
	Including complete design, manufacturing, testing, transport, loading, unloading, intermediate storage, erection installation, testing and commissioning.																				
1.0	GENERAL WORKS																				
	Including all necessary survey activities like tower spotting, survey of crossing objects including pegging of towers, diagonal profiles and all necessary documentation for the OHTL, soil investigations and route clearing & access roads.																				
1.1	Check survey, review of tower plotting and preparation of profile drawings and tower schedule.		route km	275														16,000.00	16,000.00	4,400,000.00	
1.2	Preliminary sub-soil investigation at support locations by means of soil penetration test (SPT), establishment of ground water level and determination of soil water aggressiveness		per tower	642	501													700.00	700.00	350,700.00	
1.3	Specialist soil investigation		per tower	50														1,400.00	1,400.00	70,000.00	
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		per tower lump sum															825,000.00	825,000.00	825,000.00	
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES																			5,645,700.00	
2.0	FOUNDATIONS																				
	All Foundations for Tower Types according to the specification, including all transport, excavation, installation of stubs, all necessary reinforcement, shuttering, concreting, backfilling, compacting, complete tower earthing and their connections to tower, measuring of earth resistance and submitting of records to Employer/Engineer, according to drawings and regulations of the Employer. Soil class definition concerning permissible soil pressure is according to Employer's design and specifications.																				
2.1	Type DL Tower, concrete footings, in class 1 (rock) soil		per tower	12	9	961.5	2506.6305	23473.0617	64.1	167.1087	1564.887078	32.05	83.55435	782.4435391	32.05	83.55435	782.4435391	5,320.30	13,870.02	129,885.63	
2.2	Type DL Tower, concrete footings in class 2 (good) soil		per tower	250	195	1671.6	4357.8612	850190.2106	111.44	290.52408	56679.34737	55.72	145.26204	28339.67369	55.72	145.26204	28339.67369	9,249.52	24,113.50	4,704,385.83	
2.3	Type DL Tower, concrete footings in class 3 (poor) soil		per tower	230	179	2632.65	6863.31855	1231869.465	175.51	457.55457	82124.63998	87.755	228.77285	41062.31549	87.755	228.77285	41062.31549	14,567.33	37,977.03	6,816,344.37	
2.4	Type DL Tower, concrete footings in class 4 (good submerged) soil		per tower	40	31	4120.05	10764.43355	339011.2839	275.27	717.62889	22400.75226	137.835	358.814445	11200.37613	137.835	358.814445	11200.37613	22,847.41	59,563.20	1,859,262.44	
2.5	Type DL Tower, concrete footings in class 5 (poor submerged) soil		per tower	22	17	6895.35	17976.17745	308619.0464	459.69	1198.41183	20574.6031	229.845	599.205915	10287.30155	229.845	599.205915	10287.30155	38,154.27	99,468.18	1,907,692.06	
2.6	Type DL Tower, raft foundation in class 6 (very poor submerged) soil		per tower	2	2	7935.3	20687.3271	32287.69743	529.02	1379.15514	2152.513162	264.51	689.57757	1076.256581	264.51	689.57757	1076.256581	43,908.66	114,469.88	178,658.59	
2.7	Type DT30 Tower, concrete footings, in class 1 (rock) soil		per tower	10	8	1756.35	4578.80445	35731.79173	117.09	305.25363	2382.119449	58.45	152.62815	1191.059724	58.45	152.62815	1191.059724	9,718.47	25,336.05	197,715.91	
2.8	Type DT30 Tower, concrete footings in class 2 (good) soil		per tower	30	23	3801.6	9910.7712	232023.1349	253.44	660.71888	15468.21299	126.72	330.35904	7734.106496	126.72	330.35904	7734.106496	21,035.52	54,939.60	1,263,861.68	
2.9	Type DT30 Tower, concrete footings in class 3 (poor) soil		per tower	28	22	5836.65	15126.14655	332479.9124	389.11	1014.49977	22165.32749	194.555	507.204895	11082.66575	194.555	507.204895	11082.66575	32,296.13	84,196.01	1,839,722.18	
2.10	Type DT30 Tower, concrete footings in class 4 (good submerged) soil		per tower	5	4	9836.7	25644.2769	100060.6131	655.78	1709.61846	6670.707541	327.89	854.80923	3335.353771	327.89	854.80923	3335.353771	54,429.74	141,898.33	553,668.73	
2.11	Type DT30 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	2	15628.35	40743.10845	63589.71131	1041.89	2716.20723	4239.314087	520.945	1358.103615	2119.657044	520.945	1358.103615	2119.657044	86,476.87	225,445.20	351,863.07	
2.12	Type DT30 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	18879.15	49217.94405	38408.39558	1258.61	3281.19627	2560.559706	629.305	1640.598135	1280.279853	629.305	1640.598135	1280.279853	104,464.63	272,339.29	212,526.46	
2.13	Type DT60 Tower, concrete footings, in class 1 (rock) soil		per tower	1	1	3052.65	7856.59585	6210.416718	203.51	530.50567	4102.77812	101.755	265.275285	207.0138906	101.755	265.275285	207.0138906	16,891.33	44,935.70	126,364.31	
2.14	Type DT60 Tower, concrete footings in class 2 (good) soil		per tower	3	2	7597.2	19885.9004	46368.01915	506.48	1320.30338	3891.201277	253.24	640.19668	1545.600638	253.24	640.19668	1545.600638	42,037.84	109,502.65	236,569.71	
2.15	Type DT60 Tower, concrete footings in class 3 (poor) soil		per tower	3	2	10901.7	28420.7319	66536.38635	726.78	1894.71546	4435.75909	363.39	947.35773	2217.879545	363.39	947.35773	2217.879545	60,322.74	157,261.38	368,168.00	
2.16	Type DT60 Tower, concrete footings in class 4 (good submerged) soil		per tower	1	1	18598.2	48485.5074	37836.82119	1239.88	3232.36716	2522.454746	619.94	1616.18358	1261.227373	619.94	1616.18358	1261.227373	102,910.04	268,286.47	209,363.74	
2.17	Type DT60 Tower, concrete footings in class 5 (poor submerged) soil		per tower	1	1	27138.9	70751.1123	55212.3166	1809.26	4716.74082	3680.821106	904.63	2358.37041	1840.410553	904.63	2358.37041	1840.410553	150,168.58	391,489.49	305,508.15	
2.18	Type DT60 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	25294.5	65942.7615	51460.00546	1686.3	4396.1841	3430.667031	843.15	2198.09205	1715.335515	843.15	2198.09205	1715.335515	139,962.90	364,883.28	284,745.36	
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							3848368.59			25657.91			128278.95			128278.95			21,294,306.22	
3.0	TOWER GROUNDING																				
	All tower groundings including excavation, laying of counter-sink, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and measuring of ohmic value																				
3.1	Basic grounding on two diagonal legs, consisting of three (3) ground rods 1m long and 5m counterpoise		per tower	1284	1002	50.00		50.00	50,100.00	3.00		3,006.00	0.50	0.50	501.00	0.25	0.25	250.50	40.00	40.00	40,080.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	78	40.00		40.00		2.00		156.07	0.40	0.40	31.21	0.20	0.20	15.61	40.00	40.00	3,121.50
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							53,221.50			3,162.07			532.21			266.11			43,201.50	
4.0	STEEL TOWERS																				
	Supply and erection of hot dip galvanized lattice steel towers according to the design including stubs, sub extensions, leg extensions, earthing connections and measuring of earth resistance and submission of record to Employer/Engineer, warning and danger plates, number plates, phase plates where necessary, step bolts, all necessary fittings, and all connections to the insulator strings. Securing against vandalism by punching of bolts above 61m height of the tower.																				
4.1	Type DL Tower, standard height -6.0m		each	4	3	55,165.00	143,815.16	448,918.33	3,397.00	8,855.98	27,643.90	274.90	716.66	2,237.06	137.45	358.33	1,118.53	4,124.00	10,791.27	33,560.83	
4.2	Type DL Tower, standard height -3.0m		each	8	6	60,908.00	158,787.16	491,306.73	3,751.00	9,738.88	61,049.31	303.53	791.30	4,940.10	151.76	395.64	2,469.97	4,553.00	11,869.67	74,102.25	
4.3	Type DL Tower, standard height		each	172	134	64,716.00	168,714.61	22,645,600.53	3,986.00	10,391.50	1,394,792.07	322.50	840.76	112,850.09	161.25	420.38	56,425.04	4,838.00	12,612.67	1,692,926.25	
4.4	Type DL Tower, standard height +3.0m		each	74	58	70,171.00	182,935.80	10,564,114.85	4,321.00	11,264.85	650,518.59	349.68	911.62	52,643.68	174.84	455.81	26,321.84	5,245.00	13,673.72	789,625.09	
4.5	Type DL Tower, standard height +6.0m		each	98	76	75,357.00	196,455.70	15,024,270.88	4,641.00	12,099.09	925,297.47	375.53	979.91	74,871.14	187.76	489.49	37,434.57	5,633.00	14,685.23	1,123,077.06	
4.6	Type DL Tower, standard height +9.0m		each	45	35	80,261.00	209,240.43	7,347,858.92	4,943.00	12,886.40	452,529.46	399.97	1,042.72	36,617.08	199.90	521.35	18,308.08	5,999.00	15,659.39	549,205.79	
4.6	Type DL Tower, standard height +12.0m		each	155	121	85,475.00	222,833.31	26,953,460.82	5,264.00	13,723.25	1,659,935.86	425.95	1,110.45	134,317.95	212.97	555.21	67,157.40	6,389.00	16,656.12	2,014,690.30	
4.7	Type DL Tower, -2.0m Leg Extension		each	200	156	1,379.00	3,595.05	561,097.06	85.00	221.60	34,585.39	6.87	17.91	2,795.31	3.44	8.97	1,399.69	103.00	266.52	41,909.35	
4.8	Type DL Tower, -1.0m Leg Extension		each	236	184	1,660.00	4,327.62	797,010.09	102.00	265.91	48,972.91	8.27	21.56	3,970.65	4.14	10.79	1,587.72	124.00	323.27	59,535.69	
4.9	Type DL Tower, +0.0m Leg Extension		each	788	615	1,967.00	5,127.97	3,153,365.46	121.00	315.43	193,979.27	9.80	25.55	15,710.72	4.90	12.77	7,855.36	147.00	383.23	235,660.76	
4.10	Type DL Tower, +1.0m Leg Extension		each	400	312	2,357.00	6,144.70	1,918,064.92	145.00	378.02	117,997.21	11.75	30.63	9,561.84	5.87	15.30	4,776.85	176.00	458.83	143,224.19	
4.11	Type DL Tower, +2.0m Leg Extension		each	300	234	2,661.00	6,937.23	1,624,089.12													

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -1

Towers & Foundation	Modified Price by "W" = 2.607"	
Conductor	Modified Price by "2.000"	
Number of Tower	Modified Quantity by "R ₀ " = 1.281437126"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by 1.28143	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
4.32	Type DT60 Tower, -1.0m leg Extension		each	4	3	4,514.00	11,768.00	36,733.75	278.00	724.75	2,262.29	22.50	58.66	183.10	11.25	29.33	91.55	337.00	878.56	2,742.42
4.33	Type DT60 Tower, +0.0m leg Extension		each	8	6	5,224.00	13,618.97	85,023.09	322.00	839.45	5,240.70	26.03	67.86	423.65	13.02	33.94	211.91	390.00	1,016.73	6,347.44
4.34	Type DT60 Tower, +1.0m leg Extension		each	8	6	6,035.00	15,733.25	98,222.50	372.00	969.80	6,054.48	30.08	78.42	489.57	15.04	39.21	244.78	451.00	1,175.76	7,340.24
4.35	Type DT60 Tower, +2.0m leg Extension		each	8	6	6,911.00	18,016.98	112,479.82	426.00	1,119.59	6,933.35	34.44	89.79	560.53	17.22	44.89	280.26	517.00	1,347.82	8,414.42
4.36	Type DT60 Tower, +3.0m leg Extension		each	8	6	7,741.00	20,180.79	125,988.46	477.00	1,243.54	7,763.40	38.58	100.58	627.91	19.29	50.29	313.95	579.00	1,509.45	9,423.50
4.37	Transposition tower type DT30,standard height		each	3	2	109,578.00	285,669.85	668,787.82	6,748.00	17,592.04	41,185.09	546.07	1,423.60	3,332.83	273.03	711.79	1,666.39	8,191.00	21,353.94	49,992.16
4.38	Transposition tower type DT30,+0.0m leg Extension		each	4	3	3,398.00	8,858.59	27,652.03	209.00	544.86	1,700.79	16.94	44.16	137.85	8.47	22.08	68.93	254.00	662.18	2,066.99
4.39	Transposition tower type DT30,+1.0m leg Extension		each	8	6	3,998.00	10,422.79	65,069.36	246.00	641.32	4,003.77	19.92	51.93	324.21	9.96	25.97	162.10	299.00	779.49	4,866.37
4.40	Anti-theft bolts or Welding of tower bolts & nuts and painting over with Anti-rust and galvanizing paint including Steel Cradle guards up to 6mts of tower height		per tower	642	501	3,500.00	9,124.50	4,571,374.50	123.00	320.66	160,651.16	2.00	5.21	2,612.21	1.00	2.61	1,306.11	1,050.00	2,737.35	1,371,412.35
4.41	Alternative proposal for protecting towers from vandalism		per tower	rate only	rate only	9,000.00	23,463.00		315.00	821.21		6.00	15.64		3.00	7.82		2,700.00	7,038.90	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES								123,899,625.18			7,509,218.06			597,262.57			298,628.39			10,290,835.36

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -1

Tower & Foundation	Modified Price by "W ₁ = 2.687"	
Conductor	Modified Price by "2.800"	
Number of Tower	Modified Quantity by "R ₁ = 1.281437126"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by 1.28143	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
5.0	TOWER LOAD TESTS																			
	Tower type test to ultimate loading including, supply, erection and dismantling. The test shall include minimum 8(eight) Loading cases																			
5.1	Tower type DL		per test	1		97,419.00	253,971.33	253,971.33										194,838.00	507,942.67	507,942.67
5.2	Tower type DT30		per test	1		167,708.00	437,214.76	437,214.76										335,416.00	874,429.51	874,429.51
5.3	Tower type DT60		per test	1		228,123.00	594,716.66	594,716.66										456,246.00	1,189,433.32	1,189,433.32
5.4	Test Witnessing, as per clause A2.21		lump sum	1														45,000.00	117,315.00	117,315.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							1,285,902.75												2,689,120.50
6.0	LINE CONDUCTOR INSULATORS AND FITTINGS																			
	Supply and installation of Insulators & complete Sets of Fittings including all types of clamps, armor rods, extension links, pilot insulator sets, counterweights and all connections to Tower.																			
6.1	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	54	42	2,599.00	2,599.00	109,522.35	90.97	90.97	3,833.49	25.99	25.99	1,095.22	13.00	13.00	547.82	389.85	389.85	16,428.35
6.2	for item 6.1 complete with arc horns at both ends, armour rods, suspension clamp & fittings.		set	54	42	886.00	886.00	37,336.21	31.01	31.01	1,306.77	8.86	8.86	373.36	4.43	4.43	186.68	132.90	132.90	5,600.43
6.3	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	3318	2589	2,568.00	2,568.00	6,649,272.00	89.88	89.88	232,724.52	25.68	25.68	66,492.72	12.84	12.84	33,246.36	385.20	385.20	997,390.80
6.4	for item 6.3 complete with bottom arc horn only, armour rods, suspension clamp and fittings.		set	3318	2589	850.00	850.00	2,200,888.32	29.75	29.75	77,031.09	8.50	8.50	22,008.88	4.25	4.25	11,004.44	127.50	127.50	330,133.25
6.5	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	1044	815	3,217.00	3,217.00	2,620,922.97	112.60	112.60	91,736.38	32.17	32.17	26,209.23	16.09	16.09	13,108.69	482.55	482.55	393,138.45
6.6	for item 6.5 including all connections to towers, clamps and fittings, armor rods arcing device line end only.		set	1044	815	968.00	968.00	788,639.55	33.88	33.88	27,602.38	9.68	9.68	7,886.40	4.84	4.84	3,943.20	145.20	145.20	118,295.93
6.7	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	84	66	3,265.00	3,265.00	214,025.33	114.28	114.28	7,491.21	32.65	32.65	2,140.25	16.33	16.33	1,070.45	489.75	489.75	32,103.80
6.8	for item 6.7 including all connections to towers, clamps and fittings, armor rods arcing device both ends.		set	84	66	936.00	936.00	61,356.11	32.76	32.76	2,147.46	9.36	9.36	613.56	4.68	4.68	306.78	140.40	140.40	9,203.42
6.9	"T" Jumper string as per the drawing		each	72	56	732.00	732.00	41,128.82	25.62	25.62	1,439.51	7.32	7.32	411.29	3.66	3.66	205.64	109.80	109.80	6,169.32
6.10	for item 6.9 complete with armour rods, suspension clamp and fittings.		each	72	56	718.00	718.00	40,342.21	25.13	25.13	1,411.98	7.18	7.18	403.42	3.59	3.59	201.71	107.70	107.70	6,051.33
6.11	Aircraft warning signals		per unit	30	23	181.00	181.00	4,237.43	6.34	6.34	148.43	1.81	1.81	42.37	0.91	0.91	21.30	27.15	27.15	635.61
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							12,767,671.29			446,873.22			127,676.71			63,843.09			1,915,150.69
7.0	GSW & OPGW FITTINGS AND ACCESSORIES																			
	Supply and installation of complete Sets of Fittings, including all types of clamps, extension links, armor rods, counterweights and all connections to Tower.																			
7.1	Suspension set for OPGW		each	529	413	103.00	103.00	42,520.23	3.61	3.61	1,490.27	1.03	1.03	425.20	0.52	0.52	214.67	15.45	15.45	6,378.03
7.2	Tension passing set for OPGW		each	44	34	252.00	252.00	8,952.79	8.82	8.82	302.85	2.52	2.52	86.53	1.26	1.26	43.26	37.80	37.80	1,297.92
7.3	Tension double dead end down set for OPGW, to be installed on suspension tower		each	30	23	226.00	226.00	5,290.93	7.91	7.91	185.18	2.26	2.26	52.91	1.13	1.13	26.45	33.90	33.90	793.64
7.4	Tension double dead end down set for OPGW		each	33	26	226.00	226.00	5,820.03	7.91	7.91	203.70	2.26	2.26	58.20	1.13	1.13	29.10	33.90	33.90	873.00
7.5	Tension terminal dead end down set for OPGW		each	2	2	226.00	226.00	352.73	7.91	7.91	12.35	2.26	2.26	3.53	1.13	1.13	1.76	33.90	33.90	52.91
7.6	Joining Box for OPGW/OPGW, for use within the transmission line, including fixing, splicing and download clamps, with feed through sets, suitable for up to 72 SMF/ NZSDF fibres and OPGW, types as per specification		each	63	63	242.00	242.00	15,246.00	8.47	8.47	533.61	2.42	2.42	152.46	1.21	1.21	76.23	36.30	36.30	2,286.90
7.7	Terminal Box for OPGW/FOC, for the connection at substation gantry, including fixing, splicing and download clamps, for up to 72 SMF/ NZSDF fibres and OPGW/FOC, types as per specification		each	2	2	242.00	242.00	484.00	8.47	8.47	16.94	2.42	2.42	4.84	1.21	1.21	2.42	36.30	36.30	72.60
7.8	Suspension set for GSW		each	559	436	44.00	44.00	19,194.07	1.54	1.54	671.79	0.44	0.44	191.94	0.22	0.22	95.97	6.60	6.60	2,879.11
7.9	Tension set for GSW complete for one tower		each	83	65	32.00	32.00	2,072.67	1.12	1.12	72.54	0.32	0.32	20.73	0.16	0.16	10.36	4.80	4.80	310.90
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							99,633.45			3,489.23			996.33			500.23			14,945.02

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-3 DEDESA - HOLETA 500 KV TRANSMISSION LINE -1

Tower & Foundation	Modified Price by "W ₁ = 2.687"	
Conductor	Modified Price by "2.800"	
Number of Tower	Modified Quantity by "R ₁ = 1.281437126"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by 1.28143	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
8.0	CONDUCTOR AND SHIELD WIRE																			
	Supply, stringing and installation including all joints, sleeves, jumper loops, spacers and necessary dampers, earthing connections and all downloads																			
8.1	3 phase, Quad bundle ACSR Conductor Code Name "CONDOR"454.5, stringing of double circuit no double circuit towers		route km	275		162,600.00	325,200.00	89,430,000.00	8,130.00	16,260.00	4,471,500.00	1,626.00	3,252.00	894,300.00	813.00	1,626.00	447,150.00	25,000.00	50,000.00	13,750,000.00
8.2	Single Optical Conduidbwe (OPGW) with 24 fibres, including all splicing and connections to joint boxes		route km	275		5,565.00	5,565.00	1,530,375.00	278.00		76,450.00	55.65		15,303.75	27.82	27.82	7,650.50	750.00	750.00	206,250.00
8.3	Single galvanized steel shieldwire type GSW 79		route km	275		801.00	801.00	220,275.00	40.00		11,000.00	8.01		2,202.75	4.00	4.00	1,100.00	750.00	750.00	206,250.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							91,180,650.00			4,558,950.00			911,886.50			455,900.50			14,162,500.00
9.0	SPARES																			
9.1	Type DL Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	3		5,265.00	13,725.86	41,177.57	184.28	480.43	1,441.25	52.65	137.26	411.78	26.33	68.64	205.93			
9.2	Type DL Tower, steelwork for grillage footings in class 2 (good) soil		per tower	3		4,005.00	10,441.04	31,323.11	140.18	363.45	1,096.35	40.05	104.41	313.23	20.03	52.22	156.65			
9.3	Type DT30 Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	3		6,675.00	17,401.73	52,205.18	233.63	609.07	1,827.22	66.75	174.02	522.05	33.38	87.02	261.06			
9.4	Type DT60 Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	1		11,670.00	30,423.69	40,423.69	408.45	1,064.83	1,064.83	116.70	304.24	304.24	58.35	152.12	152.12			
9.5	Ground rods, each to include clamps for wire/tower & wire/rod connection		each	10		12.50	32.59	325.88	0.75	1.96	19.55	0.13	0.34	3.39	0.06	0.16	1.56			
9.6	Type DL Tower, standard height -3.0m		each	1		60,908.00	158,787.16	158,787.16	3,751.00	9,728.86	9,728.86	609.08	1,587.87	304.54	793.94	793.94				
9.7	Type DL Tower, standard height		each	3		64,716.00	168,714.61	506,143.84	3,986.00	10,391.50	31,174.51	647.16	1,687.15	5,061.44	323.38	843.57	2,530.72			
9.8	Type DL Tower, standard height +6.0m		each	1		75,357.00	196,455.70	196,455.70	4,641.00	12,099.09	12,099.09	753.57	1,964.56	1,964.56	376.79	982.29	982.29			
9.10	Type DL Tower, standard height +12.0m		each	1		85,475.00	222,833.33	222,833.33	5,264.00	13,723.25	13,723.25	854.75	2,228.33	2,228.33	427.38	1,114.18	1,114.18			
9.11	Type DL Tower, +0.0m Leg Extension		each	4		1,967.00	5,127.97	20,511.88	121.00	315.45	1,261.79	19.67	51.28	205.12	9.84	25.65	102.61			
9.12	Type DL Tower, +1.0m Leg Extension		each	4		2,357.00	6,144.70	24,578.80	145.00	378.02	1,512.06	23.57	61.45	245.79	11.79	30.74	122.95			
9.13	Type DL Tower, +2.0m Leg Extension		each	8		2,661.00	6,937.23	55,497.82	164.00	427.53	3,420.38	26.61	68.57	354.88	13.31	34.70	277.59			
9.14	Type DL Tower, +3.0m Leg Extension		each	8		2,986.00	7,784.50	62,276.02	184.00	479.69	3,837.50	29.86	77.85	622.76	14.93	38.92	311.38			
9.15	Type DT30 Tower, standard height		each	2		109,578.00	285,669.85	571,339.69	6,748.00	17,592.04	35,184.07	1,095.78	2,856.70	5,713.40	547.89	1,428.35	2,856.70			
9.16	Type DT30 Tower, standard height +6.0m		each	1		129,258.00	336,975.61	336,975.61	7,960.00	20,751.72	20,751.72	1,292.58	3,369.76	3,369.76	646.29	1,684.88	1,684.88			
9.17	Type DT30 Tower, +0.0m Leg Extension		each	8		3,398.00	8,838.59	70,988.69	209.00	544.86	4,358.90	33.98	88.59	708.69	16.99	44.29	354.34			
9.18	Type DT30 Tower, +1.0m Leg Extension		each	4		3,998.00	10,422.79	41,691.14	246.00	641.32	2,565.29	39.98	104.23	416.91	19.99	52.11	208.46			
9.19	Type DT60 Tower, standard height		each	1		146,608.00	382,207.06	382,207.06	9,029.00	23,538.60	23,538.60	1,466.08	3,822.07	3,822.07	733.04	1,911.04	1,911.04			
9.20	Type DT60 Tower, +0.0m leg Extension		each	4		5,224.00	13,618.97	54,475.87	322.00	839.45	3,357.82	52.24	136.19	544.76	26.12	68.09	272.38			
9.21	Suspension string as item 6.1		set	24		2,599.00	2,599.00	62,376.00	90.97	90.97	2,183.28	25.99	25.99	623.76	13.00	31.20	312.00			
9.22	Tension string as item 6.3		set	24		2,568.00	2,568.00	61,632.00	89.88	89.88	2,157.12	25.68	25.68	616.32	12.84	30.84	308.16			
9.23	OPGW suspension set as item 7.1		set	8		103.00	103.00	824.00	3.61	3.61	28.88	1.03	1.03	8.24	0.52	0.52	4.16			
9.24	OPGW tension set as item 7.2		set	4		252.00	252.00	1,008.00	8.82	8.82	35.28	2.52	2.52	10.08	1.26	1.26	5.04			
9.25	GSW suspension set as item 7.8		set	8		44.00	44.00	352.00	1.54	1.54	12.32	0.44	0.44	3.52	0.22	0.22	1.76			
9.26	GSW tension set as item 7.9		set	4		32.00	32.00	128.00	1.12	1.12	4.48	0.32	0.32	1.28	0.16	0.16	0.64			
9.27	Flexible spacers for ACSR "CONDOR" 454.5 Conductor		each	300		80.00	196.00	48,000.00	2.80	2.80	1,680.00	0.80	1.96	480.00	0.40	0.80	240.00			
9.27	Stockbridge type vibration dampers for OPGW 454.5		each	50		120.00	120.00	6,000.00	4.20	4.20	210.00	1.20	1.20	60.00	0.60	0.60	30.00			
9.28	Stockbridge type vibration dampers for OPGW		each	50		30.00	30.00	1,500.00	1.05	1.05	52.50	0.30	0.30	15.00	0.15	0.15	7.50			
9.29	Stockbridge type vibration dampers for GWS		each	50		30.00	30.00	1,500.00	1.05	1.05	52.50	0.30	0.30	15.00	0.15	0.15	7.50			
9.30	ACSR "CONDOR" 454.5 Conductor		km	30		6,775.00	13,550.00	406,500.00	339.00	678.00	20,340.00	67.75	135.50	4,065.00	33.88	67.76	2,032.80			
9.31	OPGW		km	4		5,565.00	5,565.00	22,260.00	278.00	278.00	1,112.00	55.65	222.60	27.83	27.83	27.83	111.32			
9.32	E.H.S shieldwire		km	4		801.00	801.00	3,204.00	40.00	40.00	160.00	8.01	8.01	32.04	4.01	4.01	16.04			
9.33	Mid - span tension joint for ACSR "CONDOR" 454.5 Conductor		each	60		72.00	72.00	4,320.00	2.52	2.52	151.20	0.72	0.72	43.20	0.36	0.36	21.60			
9.34	Repair sleeve for ACSR "CONDOR" 454.5 Conductor		each	30		72.00	72.00	2,160.00	2.52	2.52	75.60	0.72	0.72	21.60	0.36	0.36	10.80			
9.35	Joint Box intermediate type for OPGW		each	3		300.00	300.00	900.00	10.50	10.50	31.50	3.00	3.00	9.00	1.50	1.50	4.50			
9.36	Mid - span tension joint for E.H.S shieldwire		each	30		20.00	20.00	600.00	0.70	0.70	21.00	0.20	0.20	6.00	0.10	0.10	3.00			
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							3,483,361.99			200,320.70			34,833.75			17,417.68			
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFFS																			
10.1	Office and housing facilities for the engineer and employer's staff as specified under Section-VI "Employers requirements", part A2, item A2.13 and A2.14		LOT	1														440,000.00	440,000.00	440,000.00
	SUB - TOTAL																			440,000.00
11.0	VEHICLES																			
11.1	Land cruiser, swing type back door, 5-speed, common rail turbo charged diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.22		each	1														272,000.00	272,000.00	272,000.00
11.2	Double cabin pick-ups, four door, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section VI-Employers requirements, part A2, item A2.22		each	10														140,000.00	140,000.00	1,400,000.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES																			1,672,000.00
	TOTAL (to Grand Summary)							236,618,434.75			12,978,571.20			1,801,387.04			964,834.86			58,167,759.29

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-4 GERD - DEDESA 500 KV TRANSMISSION LINE -1

Tower and Foundation	Modified Price by "W" = 2.467"	
Conductor	Modified Price by "L" = 2.466"	
Number of Tower	Modified Quantity by "B" = 1.200/81754"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by "1.200"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
	Including complete design, manufacturing, testing, transport, loading, unloading, intermediate storage, erection installation, testing and commissioning.																			
1.8	GENERAL WORKS																			
	Including all necessary survey activities like tower spotting, survey of crossing objects including pegging of towers, diagonal profiles and all necessary documentation for the OHTL, soil investigations and route clearing & access roads.																			
1.1	Check survey, review of tower spotting and preparation of profile drawings and tower schedule.		route km	344														16,000.00	16,000.00	5,504,000.00
1.2	Preliminary sub-soil investigation at support locations by means of soil penetration test (SPT), establishment of ground water level and determination of soil/water aggressiveness.		per tower	803	627													700.00	700.00	436,900.00
1.3	Specialist soil investigation		per tower	60														1,400.00	1,400.00	84,000.00
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		lump sum															1,032,000.00	1,032,000.00	1,032,000.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES																			7,058,900.00
2.8	FOUNDATIONS																			
	All Foundations for Tower Types according to the specification, including all transport, excavation, installation of stubs, all necessary reinforcement, shuttering, concreting, backfilling, compaction, complete tower earthing and their connections to tower, measuring of earth resistance and submitting of records to Employer/Engineer, according to drawings and regulations of the Employer. Soil class definition concerning permissible soil pressure is according to Employer's design and specifications.																			
2.1	Type DE Tower, concrete footings, in class 1 (rock) soil		per tower	30	23	961.5	2506.6305	58716.96105	64.1	167.1087	3914.46407	32.05	83.55435	1957.232035	32.05	83.55435	1957.232035	5,320.30	13,678.02	324,900.52
2.2	Type DE Tower, concrete footings in class 2 (good) soil		per tower	280	219	1671.6	4357.8612	92,7759.7914	111.44	290.52408	63517.31843	55.72	145.26204	31758.65971	55.72	145.26204	31758.65971	9,249.52	24,113.50	5,271,537.51
2.3	Type DE Tower, concrete footings in class 3 (poor) soil		per tower	313	244	2632.65	6863.91835	167,376.251	175.54	457.55455	114825.0834	87.755	228.77285	55912.54168	87.755	228.77285	55912.54168	14,267.43	37,407.40	9,280,481.92
2.4	Type DE Tower, concrete footings in class 4 (good submerged) soil		per tower	35	43	4129.05	10764.43335	462,280.8022	275.27	717.62089	30818.72015	137.635	358.814445	15489.36007	137.635	358.814445	15489.36007	22,847.41	58,563.40	2,257,853.77
2.5	Type DE Tower, concrete footings in class 5 (poor submerged) soil		per tower	22	17	6895.35	17976.17745	308796.2538	459.69	1186.41103	20586.41692	229.845	599.205915	10293.20846	229.845	599.205915	10293.20846	38,154.27	99,468.18	1,708,672.60
2.6	Type DE Tower, raft foundation in class 6 (very poor submerged) soil		per tower	2	2	7393.5	20687.2271	42,866.26865	529.02	1379.15314	2152.748123	264.51	685.57759	1076.874562	264.51	685.57759	1076.874562	43,508.66	114,465.38	178,761.18
2.7	Type D730 Tower, concrete footings, in class 1 (rock) soil		per tower	9	7	1726.35	4571.80445	32177.87796	117.89	607.25361	2145.13854	58.545	152.62015	1072.565262	58.545	152.62015	1072.565262	9,718.47	25,336.07	179,048.50
2.8	Type D730 Tower, concrete footings in class 2 (good) soil		per tower	34	27	3801.6	9910.7712	263110.6108	253.44	660.71808	17540.70739	126.72	330.35004	8770.353695	126.72	330.35004	8770.353695	21,035.52	54,670.60	1,455,878.71
2.9	Type D730 Tower, concrete footings in class 3 (poor) soil		per tower	31	24	5836.65	15216.14055	368114.1238	389.11	1014.40977	24554.27485	194.555	507.304885	12277.13743	194.555	507.304885	12277.13743	32,296.11	84,136.01	2,038,004.81
2.10	Type D730 Tower, concrete footings in class 4 (good submerged) soil		per tower	5	4	9826.7	26442.7209	100118.8674	655.78	1709.61046	6674.537825	327.89	814.80932	3337.268913	327.89	814.80932	3337.268913	5,429.74	141,808.83	555,986.64
2.11	Type D730 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	2	15628.35	40741.10845	63626.22417	1041.89	2716.20723	4241.748278	529.945	1358.103815	2120.874139	529.945	1358.103815	2120.874139	86,476.87	225,445.20	352,065.11
2.12	Type D730 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	18879.15	49217.34405	38430.44948	1258.61	3281.19627	2562.029965	629.305	1640.598135	1281.014983	629.305	1640.598135	1281.014983	104,464.63	272,339.29	212,648.49
2.13	Type D160 Tower, concrete footings, in class 1 (rock) soil		per tower	1	1	3652.65	958.25935	6214.985795	203.51	530.5697	414.265137	101.755	265.275285	207.1327568	101.755	265.275285	207.1327568	16,891.34	44,033.78	34,384.04
2.14	Type D160 Tower, concrete footings in class 2 (good) soil		per tower	6	5	7597.2	19801.5004	92759.26683	506.48	1320.39336	6185.955456	253.24	660.19668	3092.976238	253.24	660.19668	3092.976238	42,017.84	105,292.62	513,434.05
2.15	Type D160 Tower, concrete footings in class 3 (poor) soil		per tower	7	5	16901.7	28420.7319	155340.7128	726.78	1884.71546	10356.04752	363.39	947.35773	5178.023759	363.39	947.35773	5178.023759	60,322.74	157,261.38	859,551.94
2.16	Type D160 Tower, concrete footings in class 4 (good submerged) soil		per tower	2	2	18598.2	46485.5074	75717.08177	1239.88	3232.36716	5047.806251	619.94	1616.18328	2521.903126	619.94	1616.18328	2521.903126	102,510.04	268,295.47	418,967.92
2.17	Type D160 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	2	27138.9	70751.1123	114688.0384	1869.26	4716.74087	7964.865228	984.63	2518.73341	3682.534844	984.63	2518.73341	3682.534844	150,168.59	391,489.49	611,367.15
2.18	Type D160 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	25294.5	65842.7615	51489.55352	1686.3	4396.1841	3432.636901	843.15	2198.09205	1716.318451	843.15	2198.09205	1716.318451	139,962.90	364,883.28	284,908.86
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							4850851.52			321336.77			161668.38			161668.38			20836951.72
3.0	TOWER GROUNDING																			
	All tower groundings including excavation, laying of counterpoise, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and measuring of ohmic value.																			
3.1	Basic grounding on two diagonal legs, consisting of three (3) ground rods 1m long and 5cm counterpoise.		per tower	1606	1254	50.00	50.00	62,700.00	3.00	3.00	3,762.00	8.00	8.00	10,032.00	4.00	4.00	5,016.00	40.00	40.00	50,160.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	78	40.00	40.00		2.00	2.00	156.18	6.00	6.00	468.49	3.00	3.00	234.25	40.00	40.00	3,122.29
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							65,823.29			3,918.18			10,500.49			5,250.25			53,283.29

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-4 GERD - DEDESA 500 KV TRANSMISSION LINE -1

Tower and Foundation	Modified Price by "W ₁ = 2.487"	
Conductor	Modified Price by "W ₂ = 2.487"	
Number of Tower	Modified Quantity by "W ₂ = 1.20701754"	
	Modified Price by "1.800"	

No	Description	Code	Unit	Qty.	Qty Modified by 1.2007	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
4.0	STEEL TOWERS																			
Supply and erection of hot dip galvanized lattice steel towers according to the design including studs, sub extensions, leg extensions, earthing connections and measuring of earth resistance and substantance of record to Employer/ Engineer, warning and danger plates, number plates, phase plates where necessary, stay bolts, all necessary fittings, and all connections to the insulator strings. Securing against vandalism by purchasing of bolts for leg extensions and first tower section.																				
4.1	TypeDL Tower, standard height -6.0m		each	36	28	55,165.00	143,015.16	4,042,584.91	3,397.00	8,055.98	248,937.93	274.90	716.66	20,145.14	137.45	358.33	10,072.57	4,124.00	10,751.27	302,213.73
4.2	Type DL Tower, standard height -3.0m		each	23	18	60,948.00	158,787.16	2,651,643.31	3,751.00	8,778.06	175,517.56	303.53	791.30	395.64	7,106.23	151.76	395.64	11,809.49	213,106.38	
4.3	Type DL Tower, standard height		each	261	204	64,716.00	168,714.61	34,383,113.47	3,986.00	10,391.50	2,117,731.17	322.50	840.76	174,341.77	161.25	420.38	86,679.89	4,808.00	12,612.87	2,279,762.22
4.4	Type DL Tower, standard height +3.0m		each	76	50	70,171.00	182,935.00	10,855,861.27	4,321.00	11,264.85	668,483.80	349.68	911.62	57,048.73	174.84	455.81	24,007.53	174.84	313.72	811,431.96
4.5	Type DL Tower, standard height +6.0m		each	86	67	75,357.00	196,455.70	13,192,134.75	4,641.00	12,029.00	812,465.98	375.53	979.01	65,740.97	187.76	489.49	32,809.61	5,633.00	14,695.23	986,123.32
4.6	Type DL Tower, standard height +9.0m		each	64	50	80,261.00	209,240.43	10,456,208.74	4,923.00	12,048.40	643,967.00	399.97	1,042.72	52,107.52	199.08	521.35	28,053.11	5,999.00	15,639.39	781,541.17
4.7	Type DL Tower, standard height +12.0m		each	156	122	85,475.00	222,813.31	27,142,930.50	5,264.00	13,721.33	1,671,804.40	425.95	1,110.45	135,262.14	212.97	555.21	67,629.48	6,399.00	16,656.12	2,028,852.68
4.8	Type DL Tower, -2.0m Leg Extension		each	284	222	1,379.00	3,559.05	797,215.31	85.00	221.60	481,139.45	6.87	17.91	3,971.62	3.44	8.97	1,988.70	10.03	20.82	59,545.45
4.9	Type DL Tower, -1.0m Leg Extension		each	427	333	1,660.00	4,332.63	1,442,467.93	102.00	265.91	86,656.64	8.27	21.26	7,188.30	4.14	10.79	3,598.59	12.44	32.32	107,780.69
4.10	Type DL Tower, +0.0m Leg Extension		each	532	415	1,987.00	5,127.97	2,130,144.27	121.00	315.45	131,835.82	9.80	25.55	10,612.82	4.90	12.77	5,306.41	14.70	38.03	159,192.28
4.11	Type DL Tower, +1.0m Leg Extension		each	569	444	2,357.00	6,144.70	2,730,014.01	145.00	378.02	167,947.40	11.75	30.63	13,609.53	5.87	15.30	6,798.97	17.60	45.83	203,853.40
4.12	Type DL Tower, +3.0m Leg Extension		each	426	333	2,661.00	6,937.23	2,307,530.77	184.00	422.55	142,715.35	13.26	34.52	11,498.03	6.63	17.28	6,749.32	19.90	51.79	172,566.19
4.13	TypeDL Tower, +5.0m Leg Extension		each	570	445	2,586.00	6,784.50	3,464,636.58	184.00	479.69	213,494.02	14.88	38.79	17,265.17	7.44	19.40	8,632.58	22.03	56.38	258,745.46
4.14	Type DL30 Tower, standard height -6.0m		each	6	5	94,861.00	246,833.37	1,156,397.42	5,831.00	15,201.42	71,217.60	471.83	1,230.06	5,762.75	235.91	615.02	2,881.31	7,077.00	18,449.74	86,435.76
4.15	Type DL30 Tower, standard height -3.0m		each	3	2	103,213.00	269,076.29	630,302.00	6,356.00	16,570.99	38,014.87	514.35	1,340.91	3,141.04	257.17	670.44	1,570.49	2,715.00	20,113.01	47,114.03
4.16	Type DL30 Tower, standard height		each	32	25	109,578.00	285,668.85	7,137,932.37	7,549.00	19,592.04	498,558.91	546.07	1,422.60	35,570.81	273.03	711.29	17,784.98	8,391.00	21,353.94	535,555.91
4.17	Type DL30 Tower, standard height +3.0m		each	7	5	118,734.00	309,539.54	1,091,866.79	7,312.00	19,062.30	104,190.29	591.69	1,542.54	8,431.12	295.85	771.28	4,215.63	8,995.00	23,137.13	126,461.82
4.18	Type DL30 Tower, standard height +6.0m		each	3	2	128,258.00	336,975.61	789,553.82	7,960.00	20,751.72	48,610.19	644.14	1,679.27	3,933.64	322.07	839.64	1,966.82	5,662.00	25,188.83	59,003.98
4.19	Type DL30 Tower, standard height +9.0m		each	2	2	136,451.00	364,041.76	562,662.47	8,256.00	21,265.28	34,711.10	689.95	1,769.20	2,808.93	344.97	899.34	1,494.44	10,349.00	26,929.48	42,132.91
4.20	Type DL30 Tower, standard height +12.0m		each	23	18	147,564.00	384,095.35	6,908,778.70	9,088.00	23,039.42	425,489.83	735.36	1,917.00	34,428.72	307.68	956.41	17,214.36	11,030.00	28,525.21	516,412.06
4.21	Type DL30 Tower, standard height +24.0m		each	rate only	rate only	223,536.00	582,758.35		13,768.00	35,893.18		1,113.94	2,904.04		556.98	1,452.05	16,708.00	43,557.76		8,164.14
4.22	Type DL30 Tower, -2.0m Leg Extension		each	26	20	2,110.00	5,022.17	122,258.30	142.00	370.19	7,515.45	11.51	30.01	609.17	5.75	14.99	804.32	17.73	45.81	17,750.46
4.23	Type DL30 Tower, -1.0m Leg Extension		each	40	31	2,522.00	7,017.65	237,921.75	180.00	469.26	14,066.74	14.56	37.96	1,185.54	7.28	19.08	7,218.00	26.81	68.31	279,946.46
4.24	Type DL30 Tower, +0.0m Leg Extension		each	55	43	3,988.00	8,068.50	380,433.80	209.00	544.86	23,399.25	16.94	44.16	1,896.57	8.47	22.08	948.29	25.40	66.18	28,437.37
4.25	Type DL30 Tower, +1.0m Leg Extension		each	89	69	3,998.00	10,422.79	724,112.24	246.00	641.32	44,567.49	19.62	51.93	3,668.88	9.96	25.97	1,804.44	29.09	77.49	54,169.42
4.26	Type DL30 Tower, +3.0m Leg Extension		each	40	31	4,522.00	12,791.46	568,281.55	279.00	722.32	22,717.33	22.54	58.75	2,135.38	11.27	29.38	917.65	38.00	97.51	27,521.35
4.27	Type DL30 Tower, +5.0m Leg Extension		each	54	42	5,036.00	13,128.85	553,569.95	308.00	808.17	34,975.99	25.09	65.41	2,797.96	12.55	32.72	1,379.53	37.60	98.23	41,330.88
4.28	Type DL30 Tower, standard height -6.0m		each	rate only	rate only	125,947.00	328,343.83		7,756.00	20,219.89		627.64	1,636.26		313.82	818.13	8,415.00	24,544.96		5,164.14
4.29	Type DL30 Tower, standard height -3.0m		each	rate only	rate only	138,173.00	360,317.01		8,299.00	21,328.46		688.56	1,795.80		344.30	892.54	10,349.00	26,929.48		42,132.91
4.30	Type DL30 Tower, standard height		each	13	10	146,668.00	382,207.66	3,879,663.41	9,029.00	23,538.60	238,932.94	739.60	1,904.67	19,333.75	7.28	19.08	9,666.87	10,659.00	26,570.11	290,006.22
4.31	Type DL30 Tower, standard height +3.0m		each	4	3	159,675.00	416,272.73	1,300,139.47	9,834.00	25,637.24	80,072.47	795.71	2,074.42	6,479.00	387.86	1,037.22	2,339.54	13,936.00	31,117.15	97,187.82
4.32	Type DL30 Tower, standard height +6.0m		each	rate only	rate only	173,763.00	454,090.14		10,701.00	27,897.51		865.82	2,257.45		452.96	1,128.73	12,889.00	33,862.32		59,003.98
4.33	Type DL30 Tower, standard height +9.0m		each	1	1	183,842.00	479,270.09	374,229.28	11,322.00	29,516.45	23,047.89	916.14	2,388.30	1,864.90	658.07	1,394.19	932.45	13,742.00	34,825.39	27,975.25
4.34	Type DL30 Tower, standard height +12.0m		each	1	1	197,159.00	513,993.51	401,337.40	12,142.00	31,654.19	24,716.29	982.51	2,561.40	2,000.99	491.25	1,280.69	990.99	14,738.00	38,421.87	30,000.71
4.35	Type DL30 Tower, -2.0m Leg Extension		each	7	5	3,779.00	9,853.85	51,847.89	233.00	607.43	3,320.07	18.83	49.09	268.31	9.42	24.50	134.23	282.00	735.17	4,018.28
4.36	Type DL30 Tower, -1.0m Leg Extension		each	11	9	4,554.00	12,760.00	101,075.92	278.00	724.75	6,224.87	22.50	58.66	503.81	11.25	29.31	251.91	337.00	878.56	7,545.98
4.37	Type DL30 Tower, +0.0m Leg Extension		each	16	12	5,224.00	13,618.97	170,143.82	322.00	839.45	10,487.43	26.03	67.88	847.79	13.02	33.84	424.06	390.00	1,016.75	12,702.16
4.38	Type DL30 Tower, +1.0m Leg Extension		each	15	12	6,035.00	15,733.25	184,272.94	372.00	969.80	11,358.66	30.08	78.42	918.46	15.04	39.21	459.23	451.00	1,175.76	13,770.85
4.39	Type DL30 Tower, +3.0m Leg Extension		each	11	9	6,911.00	18,016.98	154,748.56	426.00	1,110.58	9,538.83	34.44	89.79	717.17	17.22	44.80	385.58	517.00	1,347.86	11,576.47
4.40	Type DL30 Tower, +5.0m Leg Extension		each	16	12	7,481.00	20,188.79	252,121.81	477.00	1,243.64	15,535.72	38.38	98.08	1,256.54	19.20	49.20	628.27	679.00	1,699.46	18,857.82
4.41	Transmission tower type DL30 standard height		each	2	2	109,578.00	285,668.85	446,114.55	6,748.00	17,502.40	27,472.49	548.07	1,423.60	2,223.16	273.03	711.29	1,111.56	8,191.00	21,533.94	33,347.24
4.42	Transmission tower type DL30 Tower, standard height +3.0m		each	1	1	118,734.00	309,539.54	241,695.26	7,312.00	19,062.30	14,864.23	591.69	1,542.54	1,204.45	295.85	771.28	662.23	8,675.00	23,137.13	18,866.97
4.43	Transmission tower type DL30 Tower, standard height +6.0m		each	1	1	129,258.00	336,975.61	263,117.94	7,960.00	20,751.72	16,203.40	644.14	1,679.27	1,311.21	322.07	839.64	856.61	9,666.87	25,188.83	19,665.99
4.44	Transmission tower type DL30 Tower, standard height +9.0m		each	1	1	138,651.00	360,941.76	281,831.24	8,526.00	22,227.20	17,355.55	689.95	1,798.70	1,464.46	344.97	899.34	702.22	10,349.00	26,	

SCHEDULE OF PRICES SUPPLY AND ERECTION

LOT-4 GERD - DEDESA 500 KV TRANSMISSION LINE -1

Tower and Foundation	Modified Price by "W _t = 2.607"	
Conductor	Modified Price by "2.000"	
Number of Tower	Modified Quantity by "R _t = 1.289701754"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by 120877	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning							
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price					
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD					
7.8	GSW & OPGW FITTINGS AND ACCESSORIES																								
Supply and installation of complete Sets of Fittings, including all types of clamps, extension links, armor rods, counterweights and all connections on Tower																									
7.1	Suspension set for OPGW		each	622	486			103.00			50,024.14	3.61	3.61	1,753.27	1.03		1.03	500.24	0.52	252.55	15.45	7,503.62			
7.2	Tension bearing set for OPGW		each	67	52			252.00			13,183.40	8.62	8.62	461.42	2.52	2.52	131.83	1.26	1.26	65.92	37.80	1,977.51			
7.3	Tension double dead and down set for OPGW, to be installed on suspension tower		each	31	25			226.00			16,058.30	7.91	7.91	492.04	2.26	2.26	160.58	1.13	1.13	60.29	33.90	2,408.76			
7.4	Tension double dead end down set for OPGW		each	21	16			226.00			3,705.78	7.91	7.91	129.70	2.26	2.26	37.06	1.13	1.13	18.53	33.90	555.87			
7.5	Tension terminal dead end down set for OPGW		each	2	2			226.00			352.93	7.91	7.91	12.35	2.26	2.26	3.53	1.13	1.13	1.76	33.90	52.94			
7.6	Joining Box for OPGW/OPGW, for use within the transmission line, including fixing, splicing and download clamps, with feed through eyes, suitable for up to 72 SM7/ NZSD/ fibers and OPGW, types as per specification		each	112	112			242.00			27,104.00	8.47	8.47	948.64	2.42	2.42	271.04	1.21	1.21	135.52	36.30	4,065.00			
7.7	Terminal Box for OPGW/FOC, for the connection at suspension gully, including fixing, splicing and download clamps, for up to 72 SM7/ NZSD/ fibers and OPGW/FOC, types as per specification		each	2	2			242.00			484.00	8.47	8.47	16.94	2.42	2.42	4.84	1.21	1.21	2.42	36.30	72.60			
7.8	Suspension set for GSW		each	702	548			44.00			24,118.03	1.54	1.54	844.13	0.44	0.44	241.18	0.22	0.22	120.59	6.60	3,617.70			
7.9	Tension set for GSW complete for one tower		each	101	79			32.00			2,523.62	1.12	1.12	88.31	0.32	0.32	25.24	0.16	0.16	12.82	4.80	2,768.54			
SUB - TOTAL CARRIED TO SUMMARY OF PRICES											137,554.27			4,816.83			1,375.34			698.28		20,833.14			
8.0	CONDUCTOR AND SHIELD WIRE																								
Supply, stringing and installation including all joints, jumpers, loops, spacers and necessary dampers, earthing connections and all downloads																									
8.1	1. Light, Quad bundle ACSR Conductor Code Name "CONDOR" 45.4, stringing of double circuit on double circuit towers		route km	344				162,600.00		25,200.00	111,868.800	8,130.00		16,260.00	5,590,440.00	1,638.00	3,276.00	1,118,688.00	813.00	1,626.30	529,344.00	25,000.00	50,000.00	17,300,000.00	
8.2	1. Single Optical Groundwire (OPGW) with 24 fibers, including all splicing and connections to joint boxes.		route km	344				5,905.00		5,905.00	1,914,360.00	278.00			55,632.00	55.65	55.65	19,143.60	27.82	27.82	9,570.08	750.00	750.00	258,000.00	
8.3	Single galvanized steel shieldwire type GSW 70		route km	344				801.00			275,544.00	40.00			40,000.00	13,760.00	8.01	8.01	2,755.44	4.00	4.00	1,376.00	750.00	750.00	258,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES											114,658,794.00			5,782,832.00			1,140,587.00			579,296.00			17,716,880.00		
9.0	SPARES																								
9.1	Type D1 Tower, foundation steelwork for footings in class 1 (poor) soil		per tower	3				5,265.00		13,725.86	41,177.57	184.28		480.42		52.65	137.26	411.78	26.31	68.64	205.93				
9.2	Type D1 Tower, steelwork for grillage footings in class 2 (good) soil		per tower	3				4,005.00		10,444.04	31,323.11	140.18		365.45		1,096.35	40.05	104.41	313.23	20.03	52.22	156.65			
9.3	Type D3/D30 Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	3				6,675.00		15,401.73	52,205.18	233.63		609.07		1,827.22	66.75	174.06	522.65	33.38	87.92	261.06			
9.4	Type D3/D30 Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	1				11,676.00		30,423.09	39,423.09	498.45		1,064.81		1,064.81	116.70	304.24	304.24	26.35	152.12				
9.5	Ground rods, each to include clamps for/over/under & wire/nut connection		each	10				12.50		32.50	325.88	0.75		1.96		19.55	0.13	0.34	3.39	0.06	0.16	1.56			
9.6	Type D1 Tower, standard height -3.0m		each	1				60,900.00		158,787.16	158,787.16	3,751.00		9,770.86		9,770.86	1,587.87	1,587.87	304.54	793.94	793.94				
9.7	Type D1 Tower, standard height		each	2				64,714.00		168,714.61	337,429.22	3,986.00		10,201.50		20,383.00	647.16	1,687.35	3,374.29	333.58	843.57	1,687.15			
9.8	Type D1 Tower, standard height +6.0m		each	2				75,357.00		196,475.00	392,914.00	4,641.00		12,099.09		24,198.17	753.57	1,964.56	3,929.11	376.79	982.29	1,964.58			
9.10	Type D1 Tower, standard height +12.0m		each	3				85,475.00		223,833.33	668,499.58	5,264.00		13,723.25		41,169.74	854.75	2,228.33	6,685.00	427.38	1,114.18	3,342.54			
9.11	Type D1 Tower, +0.0m Leg Extension		each	4				1,967.00		5,127.97	20,511.88	121.00		315.45		1,261.79	19.67	61.38	205.12	9.84	25.65	102.61			
9.12	Type D1 Tower, +1.0m Leg Extension		each	8				2,357.00		6,144.70	49,157.59	145.00		378.02		3,024.12	23.57	64.45	491.58	11.79	30.74	245.89			
9.13	Type D1 Tower, +2.0m Leg Extension		each	12				2,661.00		6,937.23	83,246.72	184.00		427.55		5,130.58	26.61	63.97	832.47	13.31	34.70	416.39			
9.14	Type D1 Tower, +3.0m Leg Extension		each	8				2,986.00		7,984.50	62,276.02	184.00		479.69		3,837.59	29.86	77.65	622.76	14.93	38.32	311.38			
9.15	Type D3/D30 Tower, standard height		each	2				109,578.00		253,660.65	571,339.69	6,748.00		17,592.04		35,114.07	1,095.78	2,859.70	5,713.48	547.80	1,409.36	2,859.70			
9.16	Type D3/D30 Tower, standard height +6.0m		each	3				129,528.00		336,975.61	1,010,926.82	7,960.00		20,751.72		62,255.16	1,292.58	3,369.76	10,109.27	646.29	1,684.88	5,054.63			
9.17	Type D3/D30 Tower, +0.0m Leg Extension		each	3				3,398.00		8,858.59	70,868.69	209.00		544.86		4,358.90	33.98	88.59	708.69	16.50	44.29	354.34			
9.18	Type D3/D30 Tower, +1.0m Leg Extension		each	12				3,998.00		10,422.79	125,073.42	246.00		641.32		7,695.86	39.98	104.28	1,429.73	19.90	52.11	425.37			
9.19	Type D3/D30 Tower, standard height		each	3				146,608.00		382,207.06	1,146,621.17	9,029.00		23,526.00		70,615.81	1,466.08	3,622.07	11,466.31	733.04	1,911.04	5,733.11			
9.20	Type D3/D30 Tower, +0.0m Leg Extension		each	12				5,224.00		13,618.97	163,427.62	322.00		839.45		10,073.45	52.24	136.18	1,634.38	26.12	68.09	817.14			
9.21	Dispersion string as item 6.1		set	42				2,999.00		2,999.00	109,158.00	98.97		89.48		3,820.74	25.99	25.99	1,091.58	13.00	13.00	546.00			
9.22	Tension string as item 6.3		set	96				2,560.00		2,560.00	246,528.00	89.88		88.48		8,626.48	55.88	25.88	2,465.28	12.84	12.84	1,322.64			
9.23	OPGW suspension set as item 7.1		set	8				103.00		103.00	8,240.36	3.61		3.61		28.88	1.03	1.03	8.24	0.52	0.52	4.16			
9.24	OPGW tension set as item 7.2		set	8				252.00		252.00	2,016.00	8.62		8.62		70.56	2.52	2.52	20.16	1.26	1.26	10.08			
9.25	GSW suspension set as item 7.8		set	44				44.00		44.00	352.00	1.54		1.54		13.2	0.44	0.44	3.52	0.22	0.22	1.76			
9.26	GSW tension set as item 7.9		set	8				32.00		32.00	256.00	1.12		1.12		8.96	0.32	0.32	2.56	0.16	0.16	1.28			
9.27	Flexible spacers for ACSR "CONDOR" 45.4's Conductor.		each	300				80.00		160.00	48,000.00	2.10		5.60		1,680.00	0.80	1.60	480.00	0.40	0.80	240.00			
9.27	Stockbridge type vibration dampers for CONDOR 45.4's		each	50				120.00		120.00	6,000.00	4.20		4.20		210.00	1.20	1.20	60.00	0.60	0.60	30.00			
9.28	Stockbridge type vibration dampers for OPGW		each	50				30.00		30.00	1,500.00	1.05		1.05		52.50	0.30	0.30	15.00	0.15	0.15	7.50			
9.29	Stockbridge type vibration dampers for GWS		each	50				30.00		30.00	1,500.00	1.05		1.05		52.50	0.30	0.30	15.00	0.15	0.15	7.50			
9.30	ACSR "CONDOR" 45.4's Conductor		km	30				6,775.00		14,000.00	496,500.00	139.00		20,240.00		67,750.00	1,400.00	4,065.00	33,885.00	472.50	2,012.80				
9.31	OPGW		km	4				2,565.00		2,565.00	22,620.00	278.00		278.00		55.65	222.60	2,783.81	27.83	111.32					
9.32	F.H.S shieldwire		km	4				801.00		801.00	3,204.00	40.00		40.00		1,604.00	8.01	8.01	32.04	4.01	4.01	16.04			
9.33	Mid -span tension joint for ACSR "CONDOR" 45.4's Conductor		each	60				72.00		72.00	4,320.00	2.52		2.52		151.20	0.72	0.72	43.20	0.36	0.36	21.60			
9.34	Bearing sleeves for ACSR "CONDOR" 45.4's Conductor		each	70				72.00		72.00	2,160.00	2.52		2.52		151.20	0.72	0.72	21.60	0.36	0.36	10.80			
9.35	Joint pins intermediate type for OPGW		each	3				30.00		30.00	90.00	10.00		10.00		31.50	3.00	3.00	9.00	1.50	1.50	4.50			
9.36	Mid -span tension joint for F.H.S shieldwire		each	30				20.00		20.00	600.00	0.70		0.70		21.00	0.20	0.20	6.00	0.10	0.10	3.00			
SUB - TOTAL CARRIED TO SUMMARY OF PRICES											5,872,616.79			341,272.47			58,726.40			29,364.87					
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFFS																								
10.1	Office and housing facilities for the Engineer and Employer's staff as specified under Section-VI "Employers requirements", part A2, item A2.13 and A2.14		LOT	1																		440,000.00	440,000.00	440,000.00	
SUB - TOTAL																								440,000.00	
11.0	VEHICLES AND COMMUNICATION EQUIPMENT																								
11.1	Toyota, Land cruiser, swing type back door, 5-speed, common rail turbo charged diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.22		No	3																		272,000.00	272,000.00	816,000.00	
11.2	Toyota, Double cabin pick-up, four doors, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.																								

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-5 DEDESA - HOLETA 500 KV TRANSMISSION LINE-2

Tower and Foundation	Modified Price by "W ₁ = 2.607"	
	Conductor	
	Number of Tower	
	Modified Quantity by "R ₁ = 1.281124498"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by "1.28112"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning			
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price	
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	
	Including complete design, manufacturing, testing, transport, loading, unloading, intermediate storage, erection installation, testing and commissioning.																				
1.0	GENERAL WORKS																				
	Including all necessary survey activities like tower spotting, survey of crossing objects including pegging of towers, diagonal profiles and all necessary documentation for the OHTL, soil investigations and route clearing & access roads.																				
1.1	Check survey, review of tower plotting and preparation of profile drawings and tower schedule.		route km	273														16,000.00	16,000.00	4,368,000.00	
1.2	Preliminary sub-soil investigation at support locations by means of soil penetration test (SPT), establishment of ground water level and determination of soil/water aggressiveness		per tower	638	498													700.00	700.00	348,600.00	
1.3	Specialist soil investigation		per tower	60														1,400.00	1,400.00	84,000.00	
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		lump sum															819,000.00	819,000.00	819,000.00	
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES																			5,619,600.00	
2.0	FOUNDATIONS																				
	All Foundations for Tower Types according to the specification, including all transport, excavation, installation of subs, all necessary reinforcement, shuttering, concreting, backfilling, compacting, complete tower earthing and their connections to tower, measuring of earth resistance and submitting of records to Employer/Engineer, according to drawings and regulations of the Employer. Soil class definition concerning permissible soil pressure is according to Employer's design and specifications.																				
2.1	Type DL Tower, concrete footings in class 1 (rock) soil		per tower	30	23	961.5	2506.6305	58697.58569	64.1	167.1087	3913.172379	32.05	83.55435	1956.58619	32.05	83.55435	1956.58619	5,320.30	13,870.02	324,793.31	
2.2	Type DL Tower, concrete footings in class 2 (good) soil		per tower	200	156	1671.6	4357.8612	680318.1434	111.44	290.52408	43534.5429	55.72	145.26204	22677.27145	55.72	145.26204	22677.27145	9,249.52	24,113.50	3,764,427.06	
2.3	Type DL Tower, concrete footings in class 3 (poor) soil		per tower	263	205	2632.65	6863.31855	1408959.692	175.51	457.55457	93930.64616	87.755	228.777285	46965.32308	87.755	228.777285	46965.32308	14,567.33	37,977.03	7,796,243.63	
2.4	Type DL Tower, concrete footings in class 4 (good submerged) soil		per tower	50	39	4129.05	10764.43335	420116.5994	275.27	177.62889	28007.77329	137.635	358.814445	14003.88665	137.635	358.814445	14003.88665	22,847.41	59,563.20	2,324,645.18	
2.5	Type DL Tower, concrete footings in class 5 (poor submerged) soil		per tower	18	14	6895.35	17976.17745	252568.1108	459.69	1198.41183	16837.87405	229.845	599.209915	8418.937025	229.845	599.209915	8418.937025	38,154.27	99,498.19	1,397,543.55	
2.6	Type DL Tower, raft foundation in class 6 (very poor submerged) soil		per tower	2	2	7935.3	20407.3271	32295.57648	529.02	1379.15514	21533.98432	264.51	689.57757	1076.519216	264.51	689.57757	1076.519216	43,908.66	114,469.80	178,702.19	
2.7	Type DT30 Tower, concrete footings in class 1 (rock) soil		per tower	5	4	1756.35	4578.80845	17870.25561	117.09	305.25363	1191.350374	58.545	152.626815	595.6751871	58.545	152.626815	595.6751871	9,718.47	25,136.05	98,882.00	
2.8	Type DT30 Tower, concrete footings in class 2 (good) soil		per tower	24	19	3801.6	9910.7712	185663.8517	253.44	660.1808	12377.59011	126.72	330.35904	6188.795057	126.72	330.35904	6188.795057	21,035.52	54,839.60	1,027,339.98	
2.9	Type DT30 Tower, concrete footings in class 3 (poor) soil		per tower	30	23	5836.65	15216.14655	356315.4067	389.11	1014.40977	23754.36044	194.555	507.204885	11877.18022	194.555	507.204885	11877.18022	32,296.13	84,196.01	1,971,611.92	
2.10	Type DT30 Tower, concrete footings in class 4 (good submerged) soil		per tower	3	2	9836.7	25644.2769	60051.01832	655.78	1709.61846	4003.401221	327.89	854.80923	2001.700611	327.89	854.80923	2001.700611	54,429.74	141,898.33	332,282.30	
2.11	Type DT30 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	2	15628.35	40743.18045	63605.23887	1041.89	2716.20723	4240.348591	520.945	1358.103615	2120.74296	520.945	1358.103615	2120.74296	86,476.87	225,445.20	351,948.93	
2.12	Type DT30 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	18879.15	49217.94405	38417.76824	1258.61	3281.19627	2561.184549	629.305	1640.598135	1280.592275	629.305	1640.598135	1280.592275	104,464.63	272,339.29	212,578.32	
2.13	Type DT60 Tower, concrete footings in class 1 (rock) soil		per tower	1	1	3052.65	7958.25855	6211.932222	203.51	530.55057	414.1288148	101.755	265.275285	207.0644074	101.755	265.275285	207.0644074	16,891.33	44,035.70	34,372.69	
2.14	Type DT60 Tower, concrete footings in class 2 (good) soil		per tower	3	2	7597.2	19805.9004	46379.33417	506.48	1320.39336	3091.955611	253.24	660.19668	1545.97886	253.24	660.19668	1545.97886	42,037.84	109,592.65	256,632.32	
2.15	Type DT60 Tower, concrete footings in class 3 (poor) soil		per tower	3	2	10901.7	28420.7319	66552.62298	726.78	1894.71546	3466.841532	363.39	947.35773	2218.420766	363.39	947.35773	2218.420766	60,322.74	157,261.38	368,257.85	
2.16	Type DT60 Tower, concrete footings in class 4 (good submerged) soil		per tower	1	1	18598.2	48485.5074	37846.05437	1239.88	3232.36716	2523.070291	619.94	1616.18358	1261.535146	619.94	1616.18358	1261.535146	102,910.04	268,286.47	209,414.83	
2.17	Type DT60 Tower, concrete footings in class 5 (poor submerged) soil		per tower	1	1	27138.9	70751.1123	55225.78985	1809.26	4716.74082	3681.719323	904.63	2358.37041	1840.859662	904.63	2358.37041	1840.859662	150,168.58	391,489.49	305,582.70	
2.18	Type DT60 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	25294.5	65942.7615	51472.56305	1686.3	4396.1841	3431.504203	843.15	2198.09026	1715.752102	843.15	2198.09026	1715.752102	139,962.90	364,883.28	284,814.85	
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							3838567.53			255904.50			127952.25			127952.25			21,240,073.69	
3.0	TOWER GROUNDING																				
	All tower groundings including excavation, laying of counterpoise, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and measuring of ohmic value																				
3.1	Basic grounding on two diagonal legs, consisting of three (3) ground rods 1m long and 5m counterpoise.		per tower	638	498	50.00		50.00	24,900.00	3.00	3.00	1,494.00	0.50	0.50	249.00	0.25	0.25	124.50	40.00	40.00	19,920.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	78	40.00		40.00	3,122.26	2.00	2.00	156.11	0.40	0.40	31.22	0.20	0.20	15.61	40.00	40.00	3,122.26
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							28,022.26			1,650.11			280.22			140.11			23,042.26	
4.0	STEEL TOWERS																				
	Supply and erection of hot dip galvanized lattice steel towers according to the design including subs, sub extensions, leg extensions, earthing connections and measuring of earth resistance and substantance of record to Employer/Engineer, warning and danger plates, number plates, phase plates where necessary, step bolts, all necessary fittings, and all connections to the insulator strings. Securing against vandalism by punching of bolts for leg extensions and first tower section.																				
4.1	Type DL Tower, standard height -6.0m		each	7	5	55,165.00	143,815.16	785,798.79	3,397.00	8,955.98	48,388.63	274.90	716.66	3,915.82	137.45	358.33	1,957.91	4,124.00	10,751.27	58,744.39	
4.2	Type DL Tower, standard height -3.0m		each	5	4	60,908.00	158,707.16	619,717.90	3,751.00	9,770.86	51,165.13	303.53	791.30	3,088.31	151.76	395.64	1,544.11	4,553.00	11,869.67	46,325.20	
4.3	Type DL Tower, standard height +3.0m		each	184	144	64,716.00	168,714.61	24,231,437.82	3,986.00	10,391.50	1,492,467.26	322.50	840.76	120,752.81	161.25	420.30	60,376.40	4,838.00	12,612.87	1,811,479.33	
4.4	Type DL Tower, standard height +6.0m		each	61	48	70,171.00	182,935.80	8,710,381.88	4,321.00	11,264.85	536,369.16	349.68	911.62	43,406.06	174.84	455.81	21,703.03	5,245.00	13,673.72	651,066.01	
4.5	Type DL Tower, standard height +9.0m		each	91	71	75,357.00	196,455.70	13,954,513.11	4,641.00	12,099.09	659,414.46	375.53	979.01	43,409.67	187.76	489.49	34,769.16	5,633.00	14,685.23	1,043,111.75	
4.6	Type DL Tower, standard height +12.0m		each	64	50	80,261.00	209,240.43	10,452,838.38	4,943.00	12,886.40	643,754.50	399.97	1,042.72	52,090.33	199.98	521.35	26,044.51	5,999.00	15,639.39	781,283.28	
4.7	Type DL Tower, standard height +15.0m		each	148	116	85,475.00	222,833.33	25,742,488.07	5,246.00	13,722.25	1,585,357.79	425.95	1,110.46	128,283.27	212.97	555.21	64,100.13	6,989.00	16,656.12	1,924,173.76	
4.8	Type DL Tower, -2.0m Leg Extension		each	115	90	1,279.00	3,295.65	322,709.54	85.00	221.60	18,991.45	8.87	16.07	1,607.70	3.44	8.97	805.02	103.00	268.52	243,037.66	
4.9	Type DL Tower, -1.0m Leg Extension		each	200	156	1,660.00	4,327.62	675,597.10	102.00	265.91	41,512.59	8.27	21.56	3,365.78	4.14	10.79	1,684.92	124.00	323.27	50,466.29	
4.10	Type DL Tower, +0.0m Leg Extension		each	500	390	1,967.00	5,127.97	2,001,354.67	121.00	315.45	123,113.33	9.80	25.55	1,991.16	4.90	12.97	1,495.58	147.00	383.23	149,567.43	
4.11	Type DL Tower, +1.0m Leg Extension		each	505	394	2,357.00	6,144.70	2,422,147.89	145.00	378.02	149,007.82	11.75	30.63	12,074.77	5.87	15.30	6,032.25	176.00	458.83	180,864.67	
4.12	Type DL Tower, +2.0m Leg Extension		each	400	312	2,661.00	6,937.23	2,165,980.59	164.00	427.55	133,491.48	13.26	34.57	10,793.27	6.63.4						

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-5 DEDESA - HOLETA 500 KV TRANSMISSION LINE-2

Tower and Foundation	Modified Price by "W ₁ = 2.607"	
Conductor	Modified Price by "2.000"	
Number of Tower	Modified Quantity by "R ₁ = 1.281124498"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by "1.28112"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
4.29	Type DT60 Tower, standard height +6.0m		each	rate only	rate only	173,763.00	453,000.14		10,701.00	27,897.51		865.92	2,257.45		432.96	1,128.79		12,989.00	33,862.32	
4.30	Type DT60 Tower, standard height +9.0m		each	rate only	rate only	183,842.00	479,276.09		11,322.00	29,516.45		916.14	2,388.38		458.07	1,194.19		13,742.00	35,825.39	
4.31	Type DT60 Tower, standard height +12.0m		each	1	1	197,159.00	513,993.51	401,204.97	12,142.00	31,654.19	24,708.13	982.51	2,561.40	1,999.34	491.25	1,280.69	999.66	14,738.00	38,421.97	29,990.81
4.32	Type DT60 Tower, -2.0m leg Extension		each	2	2	3,779.00	9,851.85	15,380.01	233.00	607.43	948.28	18.83	49.09	76.64	9.42	24.56	38.34	282.00	735.17	1,147.70
4.33	Type DT60 Tower, -1.0m leg Extension		each	2	2	4,514.00	11,768.00	18,371.36	278.00	724.75	1,131.42	22.50	58.66	91.57	11.25	29.33	45.79	337.00	878.56	1,371.54
4.34	Type DT60 Tower, +0.0m leg Extension		each	4	3	5,224.00	13,618.97	42,521.92	322.00	839.45	2,620.99	36.03	97.86	211.88	13.02	33.94	105.98	390.00	1,016.53	3,174.49
4.35	Type DT60 Tower, +1.0m leg Extension		each	12	9	6,035.00	15,733.25	147,369.71	372.00	969.80	9,083.93	30.08	78.42	734.53	15.04	39.21	367.26	451.00	1,175.76	11,013.05
4.36	Type DT60 Tower, +2.0m leg Extension		each	8	6	6,911.00	18,016.98	112,507.27	426.00	1,110.58	6,935.04	34.44	89.79	560.66	17.22	44.89	280.33	517.00	1,347.82	8,416.47
4.37	Type DT60 Tower, +3.0m leg Extension		each	12	9	7,741.00	20,180.79	189,028.81	477.00	1,243.54	11,647.95	38.58	100.58	942.09	19.29	50.29	471.05	579.00	1,509.45	14,138.70
4.37	Transposition tower type DT30, standard height		each	rate only	rate only	109,578.00	285,669.85		6,748.00	17,592.04		546.07	1,423.69		273.03	711.79		8,191.00	21,353.94	
4.38	Transposition tower type DT30 Tower, standard height +3.0m		each	1	1	118,734.00	309,539.54	241,615.50	7,312.00	19,062.38	14,879.42	591.69	1,542.54	1,204.05	295.85	771.38	602.03	8,875.00	23,137.13	18,060.01
4.39	Transposition tower type DT30 Tower, standard height +6.0m		each	1	1	129,258.00	336,975.61	263,031.12	7,960.00	20,751.72	16,198.05	644.14	1,679.27	1,310.78	322.07	839.64	655.39	9,662.00	25,188.83	19,661.50
4.40	Transposition tower type DT30 Tower, standard height +9.0m		each	1	1	138,451.00	360,941.76	281,738.24	8,526.00	22,227.28	17,349.82	689.95	1,798.70	1,404.00	344.97	899.34	701.99	10,349.00	26,979.84	21,059.50
4.41	Transposition tower type DT30 Tower, standard height +12.0m		each	rate only	rate only	147,564.00	384,699.35		9,088.00	23,692.42		735.36	1,917.08		367.68	958.54		11,030.00	28,755.21	
4.42	Transposition tower type DT30, -2.0m leg Extension		each	2	2	2,310.00	6,022.17	9,401.38	142.00	370.19	577.92	11.51	30.01	46.84	5.75	14.99	23.40	173.00	451.01	704.09
4.43	Transposition tower type DT30, -1.0m leg Extension		each	2	2	2,922.00	7,617.65	11,892.14	180.00	469.26	732.58	14.56	37.96	59.26	7.28	18.98	29.63	218.00	568.33	887.23
4.44	Transposition tower type DT30, +0.0m leg Extension		each	2	2	3,398.00	8,858.59	13,829.39	209.00	544.86	850.60	16.94	44.16	68.94	8.47	22.00	34.47	254.00	662.18	1,033.74
4.45	Transposition tower type DT30, +1.0m leg Extension		each	2	2	3,998.00	10,422.79	16,271.31	246.00	641.32	1,001.19	19.92	51.93	81.07	9.96	25.97	40.54	299.00	779.49	1,216.89
4.46	Transposition tower type DT30, +2.0m leg Extension		each	2	2	4,523.00	11,791.46	18,407.99	279.00	727.35	1,135.49	22.54	58.76	91.73	11.27	29.38	45.87	338.00	881.17	1,375.61
4.47	Transposition tower type DT30, +3.0m leg Extension		each	2	2	5,036.00	13,128.85	20,495.83	310.00	808.17	1,261.66	25.09	65.41	102.11	12.55	32.72	51.08	376.00	980.23	1,530.27
4.48	Welding of tower bolts & nuts and painting over with Anti-rust and galvanizing paint including Steel Cradle guards		per tower	638	498	3,500.00	9,124.50	4,544,001.00	123.00	320.66	159,689.18	2.00	5.21	2,596.57	1.00	2.61	1,298.29	1,050.00	2,737.35	1,363,200.30
4.49	Alternative proposal for protecting towers from vandalism		per tower	rate only	rate only	9,000.00	23,463.00		315.00	821.21		6.00	15.64		3.00	7.82		2,700.00	7,038.90	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES								121,906,888.20			7,387,438.62			587,454.57			293,722.35			10,135,615.02

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-5 DEDESA - HOLETA 500 KV TRANSMISSION LINE-2

Tower and Foundation	Modified Price by "W ₁ = 2.607"	
Conductor	Modified Price by "2.000"	
Number of Tower	Modified Quantity by "R ₁ = 1.281124498"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by "1.28112"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
6.0	LINE CONDUCTOR INSULATORS AND FITTINGS																			
	Supply and installation of Insulators & complete Sets of Fittings including all types of clamps, armor rods, extension links, pilot insulator sets, counterweights and all connections to Tower.																			
6.1	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	66	52	2,599.00	2,599.00	133,893.31	90.97	90.97	4,686.52	25.99	25.99	1,338.93	13.00	13.00	669.72	389.85	389.85	20,084.00
6.2	for item 6.1 complete with arc horns at both ends, armour rods, suspension clamp & fittings.		set	66	52	886.00	886.00	45,644.28	31.01	31.01	1,597.55	8.86	8.86	456.44	4.43	4.43	228.22	132.90	132.90	6,846.64
6.3	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	3294	2571	2,568.00	2,568.00	6,602,786.86	89.88	89.88	231,097.54	25.68	25.68	66,027.87	12.84	12.84	33,013.93	385.20	385.20	990,418.03
6.4	for item 6.3 complete with bottom arc horn only, armour rods, suspension clamp and fittings.		set	3294	2571	850.00	850.00	2,185,501.88	29.75	29.75	76,492.57	8.50	8.50	21,855.02	4.25	4.25	10,927.51	127.50	127.50	327,825.28
6.5	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	858	670	3,217.00	3,217.00	2,154,502.55	112.60	112.60	75,410.94	32.17	32.17	21,545.03	16.09	16.09	10,775.86	482.55	482.55	323,175.38
6.6	for item 6.5 including all connections to towers, clamps and fittings, armor rods arcing device line end only.		set	858	670	968.00	968.00	648,292.97	33.88	33.88	22,690.25	9.68	9.68	6,482.93	4.84	4.84	3,241.46	145.20	145.20	97,243.94
6.7	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	84	66	3,265.00	3,265.00	214,077.55	114.28	114.28	7,493.04	32.65	32.65	2,140.78	16.33	16.33	1,070.72	489.75	489.75	32,111.63
6.8	for item 6.7 including all connections to towers, clamps and fittings, armor rods arcing device both ends.		set	84	66	936.00	936.00	61,371.08	32.76	32.76	2,147.99	9.36	9.36	613.71	4.68	4.68	306.86	140.40	140.40	9,205.66
6.9	"I" Jumper string as per the drawing		each	225	176	732.00	732.00	128,558.93	25.62	25.62	4,499.56	7.32	7.32	1,285.59	3.66	3.66	642.79	109.80	109.80	19,283.84
6.10	for item 6.9 complete with armor rods, suspension clamp and fittings.		each	225	176	718.00	718.00	126,100.16	25.13	25.13	4,413.51	7.18	7.18	1,261.00	3.59	3.59	630.50	107.70	107.70	18,915.02
6.11	Aircraft warning spheres		per unit	30	23	181.00	181.00	4,238.46	6.34	6.34	148.46	1.81	1.81	42.38	0.91	0.91	21.31	27.15	27.15	635.77
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							12,304,968.04			430,677.93			123,049.68			61,528.89			1,845,745.21
7.0	GSW & OPGW FITTINGS AND ACCESSORIES																			
	Supply and installation of complete Sets of Fittings, including all types of clamps, extension links, armor rods, counterweights and all connections to Tower.																			
7.1	Suspension set for OPGW		each	503	393	103.00	103.00	40,440.25	3.61	3.61	1,417.37	1.03	1.03	404.40	0.52	0.52	204.16	15.45	15.45	6,066.04
7.2	Tension passing set for OPGW		each	32	25	252.00	252.00	6,294.47	8.82	8.82	220.31	2.52	2.52	62.94	1.26	1.26	31.47	37.80	37.80	944.17
7.3	Tension double dead end down set for OPGW, to be installed on suspension tower		each	57	44	226.00	226.00	10,055.23	7.91	7.91	351.93	2.26	2.26	100.55	1.13	1.13	50.28	33.90	33.90	1,508.28
7.4	Tension double dead end down set for OPGW		each	46	36	226.00	226.00	8,114.75	7.91	7.91	284.02	2.26	2.26	81.15	1.13	1.13	40.57	33.90	33.90	1,217.21
7.5	Tension terminal dead end down set for OPGW		each	2	2	226.00	226.00	352.82	7.91	7.91	12.35	2.26	2.26	3.53	1.13	1.13	1.76	33.90	33.90	52.92
7.6	Joining Box for OPGW/OPGW, for use within the transmission line, including fixing, splicing and down lead clamps, with feed through sets, suitable for up to 72 SMF/ NZSDF fibers and OPGW, types as per specification		each	103	103	242.00	242.00	24,926.00	8.47	8.47	872.41	2.42	2.42	249.26	1.21	1.21	124.63	36.30	36.30	3,738.90
7.7	Terminal Box for OPGW/FOC, for the connection at substation gantry, including fixing, splicing and down lead clamps, for up to 72 SMF/ NZSDF fibers and OPGW/FOC, types as per specification		each	2	2	242.00	242.00	484.00	8.47	8.47	16.94	2.42	2.42	4.84	1.21	1.21	2.42	36.30	36.30	72.60
7.8	Suspension set for GSW		each	560	437	44.00	44.00	19,233.10	1.54	1.54	673.16	0.44	0.44	192.33	0.22	0.22	96.17	6.60	6.60	2,884.97
7.9	Tension set for GSW complete for one tower		each	80	62	32.00	32.00	1,998.24	1.12	1.12	69.94	0.32	0.32	19.98	0.16	0.16	9.99	4.80	4.80	299.74
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							111,898.86			3,918.42			1,118.99			561.46			16,784.83
8.0	CONDUCTOR AND SHIELD WIRE																			
	Supply, stringing and installation including all joints, sleeves, jumper loops, spacer dampers and necessary spacers, earthing connections and all down leads																			
8.1	3 phase, Quad bundle ACSR Conductor Code Name "CONDOR" 454.5, stringing of double circuit on double circuit towers		route km	273		162,600.00	325,200.00	88,779,600.00	8,130.00	16,260.00	4,438,980.00	1,626.00	3,252.00	887,796.00	813.00	1,626.00	443,898.00	25,000.00	50,000.00	13,650,000.00
8.3	Single Optical Ground wire (OPGW) with 24 fibers, including all splicing and connections to joint boxes.		route km	273		5,565.00	5,565.00	1,519,245.00	278.00	278.00	75,894.00	55.65	55.65	15,192.45	27.82	27.82	7,594.86	750.00	750.00	204,750.00
8.5	Single galvanized steel shieldwire type GSW 79		route km	273		801.00	801.00	218,673.00	40.00	40.00	10,920.00	8.01	8.01	2,186.73	4.00	4.00	1,092.00	750.00	750.00	204,750.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							90,517,518.00			4,525,794.00			905,175.18			452,584.86			14,659,500.00
9.0	SPARES																			
9.1	Type DL Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	3		5,265.00	13,725.86	41,177.57	184.28	480.42	1,441.25	52.65	137.26	411.78	26.33		68.64	205.93		
9.2	Type DL Tower, steelwork for grillage footings in class 2 (good) soil		per tower	3		4,005.00	10,441.04	31,323.11	140.18	365.45	1,096.35	40.05	104.41	313.23	20.03		52.22	156.65		
9.3	Type DT30 Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	3		6,675.00	17,401.73	52,205.18	233.63	609.07	1,827.22	66.75	174.02	522.05	33.38		87.02	261.06		
9.4	Type DT60 Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	1		11,670.00	30,423.69	30,423.69	408.45	1,064.83	1,064.83	116.70	304.24	304.24	58.35		152.12	152.12		
9.5	Ground rods, each to include clamps for wire/tower & wire/rod connection		each	10		12.50	32.58	325.88	0.75	1.96	19.55	0.13	0.34	3.39	0.06		0.16	1.56		
9.6	Type DL Tower, standard height -3.0m		each	1		69,980.00	158,787.16	158,787.16	3,751.00	9,778.86	609.08	1,587.87	304.54	793.94	793.94					
9.7	Type DL Tower, standard height		each	2		64,716.00	168,714.61	337,429.22	3,986.00	10,391.50	20,783.00	647.16	1,687.15	3,374.29	323.58		843.57	1,687.15		
9.8	Type DL Tower, standard height +6.0m		each	2		75,357.00	196,455.70	392,911.40	4,641.00	12,099.09	24,198.17	753.57	1,964.56	3,929.11	376.79		982.29	1,964.58		
9.10	Type DL Tower, standard height +12.0m		each	3		85,475.00	222,833.33	668,499.98	5,264.00	13,723.25	41,169.74	854.75	2,228.33	6,685.00	427.38		1,114.18	3,342.54		
9.11	Type DL Tower, +0.0m Leg Extension		each	4		1,967.00	5,127.97	20,511.88	121.00	315.45	1,261.79	19.67	51.28	205.12	9.84		25.65	102.61		
9.12	Type DL Tower, +1.0m Leg Extension		each	8		2,557.00	6,144.70	49,157.59	145.00	378.02	3,024.12	23.57	61.45	491.58	11.79		30.74	245.89		
9.13	Type DL Tower, +2.0m Leg Extension		each	12		2,661.00	6,937.23	83,246.72	164.00	427.55	5,130.58	26.61	69.37	832.47	13.31		34.70	416.39		
9.14	Type DL Tower, +3.0m Leg Extension		each	8		2,986.00	7,784.50	62,276.02	184.00	479.69	3,837.50	29.86	77.85	622.76	14.93		38.92	311.38		
9.15	Type DT30 Tower, standard height		each	2		109,578.00	285,669.85	571,339.69	6,748.00	17,592.04	35,184.07	1,095.78	2,856.70	5,713.40	547.89		1,428.35	2,856.70		
9.16	Type DT30 Tower, standard height +6.0m		each	3		129,258.00	336,975.61	1,010,926.82	7,960.00	20,751.72	62,255.16	1,292.58	3,369.76	10,109.27	646.29		1,684.88	5,054.63		
9.17	Type DT30 Tower, +0.0m Leg Extension		each	8		3,398.00	8,858.59	70,868.69	209.00	544.86	4,358.90	33.98	88.59	708.69	16.99		44.29	354.34		
9.18	Type DT30 Tower, +1.0m Leg Extension		each	12		3,998.00	10,422.79	125,073.49	246.00	641.32	7,695.86	39.98	104.23	1,250.73	19.99		52.11	625.37		
9.19	Type DT60 Tower, standard height		each	3		146,608.00	382,207.06	1,146,621.17	9,020.00	23,536.60	70,615.81	1,466.09	3,822.07	111						

SCHEDULE OF PRICES
SUPPLY AND ERECTION

LOT-5 DEDESA - HOLETA 500 KV TRANSMISSION LINE-2

Tower and Foundation	Modified Price by "W _t = 2.607"	
Conductor	Modified Price by "2.000"	
Number of Tower	Modified Quantity by "R _t = 1.281124498"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by "1.28112"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
9.35	Joint Box intermediate type for OPGW		each	3		USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
9.36	Mid - span tension joint for E.H.S shield wire		each	30		300.00	300.00	900.00	10.50	10.50	31.50	3.00	3.00	9.00	1.50	1.50	4.50			
						20.00	20.00	600.00	0.70	0.70	21.00	0.20	0.20	6.00	0.10	0.10	3.00			
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							5,878,618.79			341,482.47			58,786.24			29,394.07			
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFFS																			
10.1	Office and housing facilities for the Engineer and Employer's staff as specified under Section-VI " Employers requirements", part A2, item A2.13 and A2.14		LOT	1														440,000.00	440,000.00	440,000.00
	SUB - TOTAL																			440,000.00
11.0	VEHICLES AND COMMUNICATION EQUIPMENT																			
11.1	Toyota, Land cruiser, swing type back door, 5-speed, common rail turbo charged diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.22		No	1														272,000.00	272,000.00	272,000.00
11.2	Toyota, Double cabin pick-ups, four door, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section VI-Employers requirements, part A2, item A2.22		No	10														140,000.00	140,000.00	1,400,000.00
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES																			1,672,000.00
Grand Summary)								234,586,473.67			12,946,866.06			1,883,817.14			965,884.00			55,852,361.00

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-6 GERD - DEDESA 500 KV TRANSMISSION LINE-2

Tower and Foundation		Modified Price by "W ₁ = 2.687"	
Conductor		Modified Price by "2.000"	
Number of Tower		Modified Quantity by "R ₁ = 1.320574163"	
		Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by "1.32057"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning			
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price	
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	
	Including complete design, manufacturing, testing, transport, loading, unloading, intermediate storage, erection installation, testing and commissioning.																				
1.0	GENERAL WORKS																				
	Including all necessary survey activities like tower spotting, survey of crossing objects including pegging of towers diagonal profiles and all necessary documentation for the OHTL, soil investigations and route clearing & access roads.																				
1.1	Check survey, review of tower plotting and preparation of profile drawings and tower schedule.		route km	344														16,000.00	16,000.00	5,504,000.00	
1.2	Preliminary sub-soil investigation at support locations by means of soil penetration test (SPT), establishment of ground water level and determination of soil/water aggressiveness		per tower	828	627													700.00	700.00	438,900.00	
1.3	Specialist soil investigation		per tower	60														1,400.00	1,400.00	84,000.00	
1.4	Clearing the right-of-way & construction of all required access and maintenance roads		lump sum															1,032,000.00	1,032,000.00	1,032,000.00	
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES																			7,658,900.00	
2.0	FOUNDATIONS																				
	All Foundations for Tower Types according to the specification, including all transport, excavation, installation of subs, all necessary reinforcement, shuttering, concreting, backfilling, compacting, complete tower earthing and their connections to tower, measuring of earth resistance and submitting of records to Employer/Engineer, according to drawings and regulations of the Employer. Soil class definition concerning permissible soil pressure is according to Employer's design and specifications.																				
2.1	Type DL Tower, concrete footings in class 1 (rock) soil		per tower	30	23	961.5	2506.6305	56944.10591	64.1	167.1087	3796.273727	32.05	83.55435	1898.136864	32.05	83.55435	1898.136864	5,320.30	13,870.02	315,090.72	
2.2	Type DL Tower, concrete footings in class 2 (good) soil		per tower	285	216	1671.5	4337.8612	940492.762	111.44	290.5308	62699.51747	55.72	145.26204	31349.75873	55.72	145.26204	31349.75873	9,249.52	24,113.50	5,304,059.95	
2.3	Type DL Tower, concrete footings in class 3 (poor) soil		per tower	318	241	2632.65	6663.31855	1652716.947	175.51	457.55457	110181.1298	87.755	228.777285	55090.5649	87.755	228.777285	55090.5649	14,567.33	37,977.03	9,145,033.77	
2.4	Type DL Tower, concrete footings in class 4 (poor submerged) soil		per tower	55	42	4129.05	10764.43335	448233.0483	275.27	717.62889	29888.20322	137.635	358.814445	14944.10161	137.635	358.814445	14944.10161	22,847.41	59,363.20	2,480,720.87	
2.5	Type DL Tower, concrete footings in class 5 (poor submerged) soil		per tower	22	17	6895.35	17976.17745	299472.6953	459.69	1198.41183	19964.84635	229.845	599.205915	9982.423176	229.845	599.205915	9982.423176	38,154.27	99,468.18	1,657,082.25	
2.6	Type DL Tower, raft foundation in class 6 (very poor submerged) soil		per tower	2	2	7935.3	20687.5271	31330.86968	529.02	1379.15514	20887.20465	264.51	689.572757	1044.360233	264.51	689.572757	1044.360233	43,908.66	114,469.88	173,363.80	
2.7	Type DT30 Tower, concrete footings in class 1 (rock) soil		per tower	9	7	1736.35	4578.80445	31205.54771	117.09	305.25363	2080.369847	58.545	152.626815	1040.184924	58.545	152.626815	1040.184924	9,718.47	25,136.05	172,670.70	
2.8	Type DT30 Tower, concrete footings in class 2 (good) soil		per tower	40	30	3801.6	9910.7712	300195.8232	253.44	660.71808	20013.05488	126.72	330.35904	10006.52744	126.72	330.35904	10006.52744	21,035.52	54,839.60	1,661,083.56	
2.9	Type DT30 Tower, concrete footings in class 3 (poor) soil		per tower	35	27	5836.65	15216.14655	403283.0144	389.11	1014.40977	26885.5343	194.555	507.204885	13442.76715	194.555	507.204885	13442.76715	32,296.13	84,196.01	2,231,499.35	
2.10	Type DT30 Tower, concrete footings in class 4 (good submerged) soil		per tower	5	4	9836.7	25644.2769	97095.17882	655.78	1709.61846	6473.011921	327.89	854.80923	3236.505961	327.89	854.80923	3236.505961	54,429.74	141,898.33	537,259.99	
2.11	Type DT30 Tower, concrete footings in class 5 (poor submerged) soil		per tower	2	2	15628.35	40743.10845	61705.14249	1041.89	2716.20723	4113.676166	520.945	1358.103615	2056.838083	520.945	1358.103615	2056.838083	86,476.87	225,445.20	341,435.12	
2.12	Type DT30 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	18879.15	49217.94405	37270.1098	1258.61	3281.19627	2484.673986	629.305	1640.598135	1242.336993	629.305	1640.598135	1242.336993	104,464.63	272,139.29	386,227.94	
2.13	Type DT60 Tower, concrete footings in class 1 (rock) soil		per tower	1	1	3052.65	7958.25855	6026.362451	203.51	530.55057	401.7574968	101.755	265.275285	200.8787484	101.755	265.275285	200.8787484	16,891.33	44,035.70	333,485.87	
2.14	Type DT60 Tower, concrete footings in class 2 (good) soil		per tower	8	6	7597.2	19805.9004	119983.5705	506.48	1320.39336	7998.904701	253.24	660.19668	3999.45235	253.24	660.19668	3999.45235	42,037.84	109,502.65	663,909.55	
2.15	Type DT60 Tower, concrete footings in class 3 (poor) soil		per tower	8	6	10901.7	28420.7319	172171.97	726.78	1894.71546	11478.13133	363.39	947.35773	5739.065667	363.39	947.35773	5739.065667	60,322.74	157,261.38	952,684.90	
2.16	Type DT60 Tower, concrete footings in class 4 (good submerged) soil		per tower	3	2	18598.2	48485.5974	110146.4244	1259.88	3232.36716	7343.09496	619.94	1616.18358	3671.54748	619.94	1616.18358	3671.54748	102,910.04	268,286.47	699,476.88	
2.17	Type DT60 Tower, concrete footings in class 5 (poor submerged) soil		per tower	3	2	27138.9	70751.1123	168728.0703	1889.26	4716.10882	10715.20469	904.63	2358.37041	5357.602343	904.63	2358.37041	5357.602343	150,168.58	391,489.46	889,361.99	
2.18	Type DT60 Tower, raft foundation in class 6 (very poor submerged) soil		per tower	1	1	25294.5	65942.7615	49934.91721	1686.3	4396.1841	3328.994481	843.15	2198.09205	1664.49724	843.15	2198.09205	1664.49724	139,962.90	364,883.28	276,306.54	
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES							4979626.50			311935.10		165967.55			165967.55				27550613.28	
3.0	TOWER GROUNDING																				
	All tower groundings including excavation, laying of counterpoise, connection to towers including all clamps or other connections, corrosion protection, backfilling, compaction and measuring of ohmic value.																				
3.1	Basic grounding on two diagonal legs, consisting of three (3) ground rods 1m long and 5m counterpoise.		per tower	828	627		50.00	50.00		31,350.00	3.00		3.00	1,881.00	0.50		313.50	0.25	156.75	40.00	25,080.00
3.2	Special grounding, in lengths of 20m of counterpoise		per tower	100	76		40.00	40.00		3,028.99	2.00		2.00	151.45	0.40		30.29	0.20	15.14	40.00	3,028.99
	SUB - TOTAL CARRIED TO SUMMARY OF PRICES									34,378.99		2,032.45		343.79		171.89					28,108.99
4.0	STEEL TOWERS																				
	Supply and erection of hot dip galvanised lattice steel towers according to the design including subs, sub extensions, leg extensions, earthing connections and measuring of earth resistance and substance of record to Employer/Engineer, warning and danger plates, number plates, phase plates where necessary, step bolts, all necessary fittings, and all connections to the insulator strings. Securing against vandalism by punching of bolts for leg extensions and first tower section.																				
4.1	Type DL Tower, standard height -6.0m		each	36	27	55,165.00	143,815.16	3,920,526.18	3,397.00	8,855.98	241,421.69	274.90	716.66	19,536.89	137.45	358.33	9,768.45	4,124.00	10,751.27	293,088.91	
4.2	Type DL Tower, standard height -3.0m		each	23	17	60,908.00	158,787.16	2,765,542.97	3,751.00	9,778.86	170,315.09	303.53	791.30	13,781.86	151.76	395.64	6,890.70	4,553.00	11,869.67	266,730.10	
4.3	Type DL Tower, standard height		each	261	198	64,716.00	168,714.63	33,344,975.97	3,986.00	10,391.50	2,053,790.01	322.50	840.76	166,168.41	161.25	420.38	8,308.20	4,838.00	12,612.67	2,492,783.76	
4.4	Type DL Tower, standard height +3.0m		each	76	58	70,171.00	182,935.80	10,528,087.68	4,321.00	11,244.85	648,300.11	349.68	911.62	52,464.15	174.84	455.81	26,232.07	5,245.00	13,673.72	786,932.21	
4.5	Type DL Tower, standard height +6.0m		each	86	65	75,357.00	196,455.70	12,793,821.50	4,641.00	12,099.09	787,931.12	375.53	979.01	63,736.04	187.76	489.49	31,677.17	5,633.00	14,685.21	956,449.06	
4.6	Type DL Tower, standard height +9.0m		each	69	52	80,261.00	209,240.43	10,932,812.31	4,943.00	12,886.40	673,314.45	399.97	1,042.72	54,482.21	199.98	521.35	27,240.43	5,999.00	15,839.99	817,158.28	
4.6	Type DL Tower, standard height +12.0m		each	161	122	85,475.00	222,833.33	27,167,096.20	5,264.00	13,723.25	1,673,092.65	425.95	1,110.45	67,689.69	212.97	555.21	67,689.69	6,389.00	16,656.12	2,030,659.00	
4.7	Type DL Tower, -2.0m Leg Extension		each	284	215	1,379.00	3,595.05	773,144.80	85.00	221.60	47,655.77	6.87	17.91	3,851.71	3.44	8.97	1,528.66	103.00	268.52	57,747.58	
4.8	Type DL Tower, -1.0m Leg Extension		each	427	323	1,660.00	4,327.62	1,399,310.84	102.00	265.91	85,981.75	8.27	21.56	6,971.27	4.14	10.79	3,489.85	124.00	323.27	104,526.83	
4.9	Type DL Tower, +0.0m Leg Extension		each	532	403	1,967.00	5,127.87	2,065,828.32	121.00	315.45	127,079.42	9.80	25.39	10,292.38	4.90	12.77	5,146.19	147.00	383.23	154,385.75	
4.10	Type DL Tower, +1.0m Leg Extension		each	569	431	2,357.00	6,144.70	2,647,586.05	145.00	378.02	162,876.53	11.75	30.63	13,198.62	5.87	15.30	6,593.69	176.00	458.83	197,698.41	
4.11	Type DL Tower, +2.0m Leg Extension		each	426	323	2,661.00	6,937.23	2,237,858.94	164.00	427.55	137,921.41	13.26	34.5								

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-6 GERD - DEDESA 500 KV TRANSMISSION LINE-2

Tower and Foundation	Modified Price by "W ₁ = 2.607"	
Conductor	Modified Price by "2.000"	
Number of Tower	Modified Quantity by "R ₁ = 1.320574163"	
	Modified Price by "1.000"	

No	Description	Code	Unit	Qty.	Qty Modified by "1.32057"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning			
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price	
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD		
4.31	Type DT60 Tower, standard height +12.0m		each	4	3	197,159.00	513,993.51	1,556,878.90	12,142.00	31,654.19	95,880.09	982.51	2,561.40	7,758.45	491.25	1,280.69	3,879.19	14,738.00	38,419.97	116,379.58	
4.32	Type DT60 Tower, -2.0m leg Extension		each	7	5	3,779.00	9,851.83	52,221.96	233.00	607.43	3,219.82	18.83	49.09	260.21	9.42	24.56	130.17	282.00	735.17	3,896.95	
4.33	Type DT60 Tower, -1.0m leg Extension		each	11	8	4,514.00	11,768.00	98,024.01	278.00	724.75	6,036.92	22.50	58.66	488.60	11.25	29.33	244.30	337.00	878.56	7,318.14	
4.34	Type DT60 Tower, +0.0m leg Extension		each	16	12	5,224.00	13,618.97	165,006.63	322.00	839.45	10,170.78	26.03	67.86	822.19	13.02	33.94	411.25	390.00	1,016.73	12,318.64	
4.35	Type DT60 Tower, +1.0m leg Extension		each	15	11	6,035.00	15,733.25	178,709.14	372.00	969.80	11,015.71	30.08	78.42	890.73	15.04	39.21	445.37	451.00	1,175.76	13,355.07	
4.36	Type DT60 Tower, +2.0m leg Extension		each	11	8	6,911.00	18,016.98	150,076.20	426.00	1,110.58	9,250.83	34.44	89.79	747.88	17.22	44.89	373.94	517.00	1,347.82	11,226.94	
4.37	Type DT60 Tower, +3.0m leg Extension		each	36	27	7,741.00	20,180.79	550,145.80	477.00	1,243.54	33,899.95	38.58	100.58	2,741.85	19.29	50.29	1,370.92	579.00	1,509.45	41,149.00	
4.37	Transposition tower type DT30, standard height		each	2	2	109,578.00	285,669.85	432,644.91	6,748.00	17,592.04	26,643.01	546.07	1,423.60	2,156.04	273.03	711.79	1,078.00	8,191.00	21,353.94	32,340.38	
4.38	Transposition tower type DT30 Tower, standard height +3.0m		each	1	1	118,734.00	309,539.54	234,397.69	7,312.00	19,062.38	14,434.92	591.69	1,542.54	1,168.08	295.85	771.28	584.05	8,875.00	23,137.13	17,520.50	
4.39	Transposition tower type DT30 Tower, standard height +6.0m		each	1	1	129,258.00	336,975.61	255,173.56	7,960.00	20,751.72	15,714.16	644.14	1,679.27	1,271.62	322.07	839.64	635.81	9,662.00	25,188.83	19,074.15	
4.40	Transposition tower type DT30 Tower, standard height +9.0m		each	1	1	138,451.00	360,941.76	273,321.84	8,526.00	22,227.28	16,831.53	689.95	1,798.70	1,362.06	344.97	899.34	681.02	10,349.00	26,979.84	20,430.39	
4.41	Transposition tower type DT30 Tower, standard height +12.0m		each	1	1	147,564.00	384,099.35	291,312.19	9,088.00	23,692.42	17,941.00	735.36	1,917.08	1,451.70	367.68	958.54	725.85	11,030.00	28,755.21	21,774.78	
4.42	Transposition tower type DT30, -2.0m leg Extension		each	2	2	2,310.00	6,022.47	9,120.53	142.00	370.19	560.66	11.51	30.01	45.44	5.75	14.99	22.70	173.00	451.01	683.05	
4.43	Transposition tower type DT30, -1.0m leg Extension		each	2	2	2,922.00	7,617.65	11,536.88	180.00	469.26	710.69	14.56	37.96	57.49	7.28	18.98	28.74	218.00	568.33	860.73	
4.44	Transposition tower type DT30, +0.0m leg Extension		each	4	3	3,398.00	8,858.59	26,832.53	209.00	544.86	1,650.38	16.94	44.16	133.77	8.47	22.08	66.88	254.00	662.18	2,005.73	
4.45	Transposition tower type DT30, +1.0m leg Extension		each	5	5	3,998.00	10,422.79	47,355.70	246.00	641.32	2,913.83	19.92	51.93	235.95	9.96	25.97	117.97	299.00	779.49	3,541.61	
4.46	Transposition tower type DT30, +2.0m leg Extension		each	4	4	4,523.00	11,791.46	35,716.16	279.00	727.35	2,203.14	22.54	58.76	177.99	11.27	29.38	88.99	338.00	881.17	2,669.04	
4.47	Transposition tower type DT30, +3.0m leg Extension		each	6	5	5,036.00	13,128.85	59,650.65	310.00	808.17	3,671.90	25.09	65.41	297.19	12.55	32.72	148.65	376.00	980.23	4,453.66	
4.48	Welding of tower bolts & nuts and painting over with Anti-rust and galvanizing paint including Steel Cradle guards		per tower	828	627	3,500.00	9,124.50	5,721,061.50	123.00	320.66	201,054.45	2.00	5.21	3,269.18	1.00	2.61	1,634.59	1,050.00	2,737.35	1,716,318.45	
4.49	Alternative proposal for protecting towers from vandalism		per tower	rate only	rate only	9,000.00	9,124.50		315.00	821.21		6.00	15.64		3.00	7.82		2,700.00	7,038.90		
SUB - TOTAL CARRIED TO SUMMARY OF PRICES								154,237,755.82			9,347,365.61			743,374.42			371,685.78			12,817,398.67	
6.0 LINE CONDUCTOR INSULATORS AND FITTINGS																					
Supply and installation of Insulators & complete Sets of Fittings including all types of clamps, armor rods, extension links, pilot insulator sets, counterweights and all connections to Tower.																					
6.1	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	66	50	2,599.00	2,599.00	129,893.50	90.97	90.97	4,546.52	25.99	25.99	1,298.93	13.00	13.00	649.72	389.85	389.85	19,484.02	
6.2	for item 6.1 complete with arc horns at both ends, armour rods, suspension clamp & fittings.		set	66	50	886.00	886.00	44,280.74	31.01	31.01	1,549.83	8.86	8.86	442.81	4.43	4.43	221.40	132.90	132.90	6,642.11	
6.3	V" suspension string with 2x29 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	4206	3185	2,568.00	2,568.00	8,179,024.17	89.88	89.88	286,265.85	25.68	25.68	81,790.24	12.84	12.84	40,895.12	385.20	385.20	1,226,853.63	
6.4	for item 6.3 complete with bottom arc horn only, armour rods, suspension clamp and fittings.		set	4206	3185	850.00	850.00	2,707,231.52	29.75	29.75	94,753.10	8.50	8.50	27,072.32	4.25	4.25	13,536.16	127.50	127.50	406,084.73	
6.5	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	1320	1000	3,217.00	3,217.00	3,215,601.30	112.60	112.60	112,551.04	32.17	32.17	32,156.01	16.09	16.09	16,083.00	482.55	482.55	482,340.20	
6.6	for item 6.5 including all connections to towers, clamps and fittings, armor rods arcing device line end only		set	1320	1000	968.00	968.00	967,579.13	33.88	33.88	33,865.27	9.68	9.68	9,675.79	4.84	4.84	4,837.90	145.20	145.20	145,136.87	
6.7	Double Tension Insulator set with 2x30 insulator units for quad bundle ACSR "CONDOR" 454.5.		each	84	64	3,265.00	3,265.00	207,682.39	114.28	114.28	7,269.20	32.65	32.65	2,076.82	16.33	16.33	1,038.73	489.75	489.75	31,152.36	
6.8	for item 6.7 including all connections to towers, clamps and fittings, armor rods arcing device both ends.		set	84	64	936.00	936.00	59,537.74	32.76	32.76	2,083.82	9.36	9.36	595.38	4.68	4.68	297.69	140.40	140.40	8,930.66	
6.9	T" Jumper string as per the drawing		each	280	212	732.00	732.00	155,205.22	25.62	25.62	5,432.18	7.32	7.32	1,552.05	3.66	3.66	776.03	109.80	109.80	23,280.78	
6.10	for item 6.9 complete with armour rods, suspension clamp and fittings.		each	280	212	718.00	718.00	152,236.81	25.13	25.13	5,328.29	7.18	7.18	1,522.37	3.59	3.59	761.18	107.70	107.70	22,835.52	
6.11	Aircraft warning spheres		per unit	30	23	181.00	181.00	4,111.85	6.34	6.34	144.03	1.81	1.81	41.12	0.91	0.91	20.67	27.15	27.15	616.78	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES								15,822,384.37			553,789.13			158,223.84			79,117.60			2,373,357.66	
7.0 GSW & OPGW FITTINGS AND ACCESSORIES																					
Supply and installation of complete Sets of Fittings, including all types of clamps, extension links, armor rods, counterweights and all connections to Tower.																					
7.1	Suspension set for OPGW		each	632	479	103.00	103.00	49,293.71	3.61	3.61	1,727.67	1.03	1.03	492.94	0.52	0.52	248.86	15.45	15.45	7,394.06	
7.2	Tension passing set for OPGW		each	82	62	252.00	252.00	15,647.74	8.82	8.82	547.67	2.52	2.52	156.48	1.26	1.26	78.24	37.80	37.80	2,347.16	
7.3	Tension double dead end down set for OPGW, to be installed on suspension tower		each	91	69	226.00	226.00	15,573.53	7.91	7.91	545.07	2.26	2.26	155.74	1.13	1.13	77.87	33.90	33.90	2,336.03	
7.4	Tension double dead end down set for OPGW		each	21	16	226.00	226.00	3,593.89	7.91	7.91	125.79	2.26	2.26	35.94	1.13	1.13	17.97	33.90	33.90	539.08	
7.5	Tension terminal dead end set for OPGW		each	2	2	226.00	226.00	342.28	7.91	7.91	11.98	2.26	2.26	3.42	1.13	1.13	1.71	33.90	33.90	51.34	
7.6	Joining Box for OPGW/OPGW, for use within the transmission line, including fixing, splicing and download clamps, with feed through sets, suitable for up to 72 SMF/ NZSDF fibres and OPGW, types as per specification		each	112	112		242.00	242.00	27,104.00	8.47	8.47	948.64	2.42	2.42	271.04	1.21	1.21	135.52	36.30	36.30	4,065.60
7.7	Terminal Box for OPGW/FOC, for the connection at substation gantry, including fixing, splicing and download clamps, for up to 72 SMF/ NZSDF fibres and OPGW/FOC, types as per specification		each	2	2		242.00	484.00		8.47	8.47	16.94	2.42	2.42	4.84	1.21	1.21	2.42	36.30	36.30	72.60
7.8	Suspension set for GSW		each	712	539	44.00	44.00	23,723.01	1.54	1.54	830.31	0.44	0.44	237.23	0.22	0.22	118.62	6.60	6.60	3,558.45	
7.9	Tension set for GSW complete for one tower		each	116	88	32.00	32.00	2,810.90	1.12	1.12	98.38	0.32	0.32	28.11	0.16	0.16	14.05	4.80	4.80	421.63	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES								138,573.06			4,852.45			1,385.73			695.26			20,785.96	
8.0 CONDUCTOR AND SHIELD WIRE																					
Supply, stringing and installation including all joints, sleeves, jumper loops, spacers and necessary dampers, earthing connections and all downloads																					
8.1	3 phase, Quad bundle ACSR Conductor Code Name "CONDOR" 454.5, stringing of double circuit on double circuit towers.		route km	344		162,600.00	325,200.00	111,868,800.00	8,130.00	16,260.00	5,593,440.00	1,626.00	3,252.00	1,118,688.00	813.00	1,626.00	559,344.00	25,000.00	50,000.00	17,200,000.00	
8.2	Single Optical Groundwire (OPGW) with 24 fibres, including all splicing and connections to joint boxes.		route km	344		5,565.00	5,565.00	1,914,360.00	278.00	278.00	95,632.00	55.65	55.65	19,143.60	27.82	27.82	9,570.08	750.00	750.00	258,000.00	
8.3	Single galvanized steel shieldwire type GSW 79		route km	344		801.00	801.00	275,544.00	40.00	40.00	13,760.00	8.01	8.01	2,755.44	4.00	4.00	1,376.00	750.00	750.00	258,000.00	
SUB - TOTAL CARRIED TO SUMMARY OF PRICES								114,058,704.00			5,702,832.00			1,140,587.04			576,298.88			17,716,000.00	
9.0 SPARES																					
9.1	Type DL Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	3		5,265.00	13,725.86	41,177.57	184.28	480.42	1,441.25	895.05	2,333.40	7,000.19	447.53	1,166.71	3,500.13				
9.2	Type DL Tower, steelwork for grillage footings in class 2 (good) soil		per tower	3		4,005.00	10,440.04	31,323.11	140.18	365.45	1,096.35	680.85	1,724.98	5,324.93	340.43	887.50	2,662.50				
9.3	Type DT30 Tower, foundation steelwork for footings in class 3 (poor) soil		per tower	3		17,475.00	44,655.73	133,215.02	612.07	1,562.17	4,727.22	1,112.22	2,829.22	8,874.88	561.48	1					

**SCHEDULE OF PRICES
SUPPLY AND ERECTION**

LOT-6 GERD - DEDESA 500 KV TRANSMISSION LINE-2

Tower and Foundation		Modified Price by "W₁ = 2.607"	
Conductor		Modified Price by "2.000"	
Number of Tower		Modified Quantity by "R₁ = 1.320574163"	
		Modified Price by "1.000"	

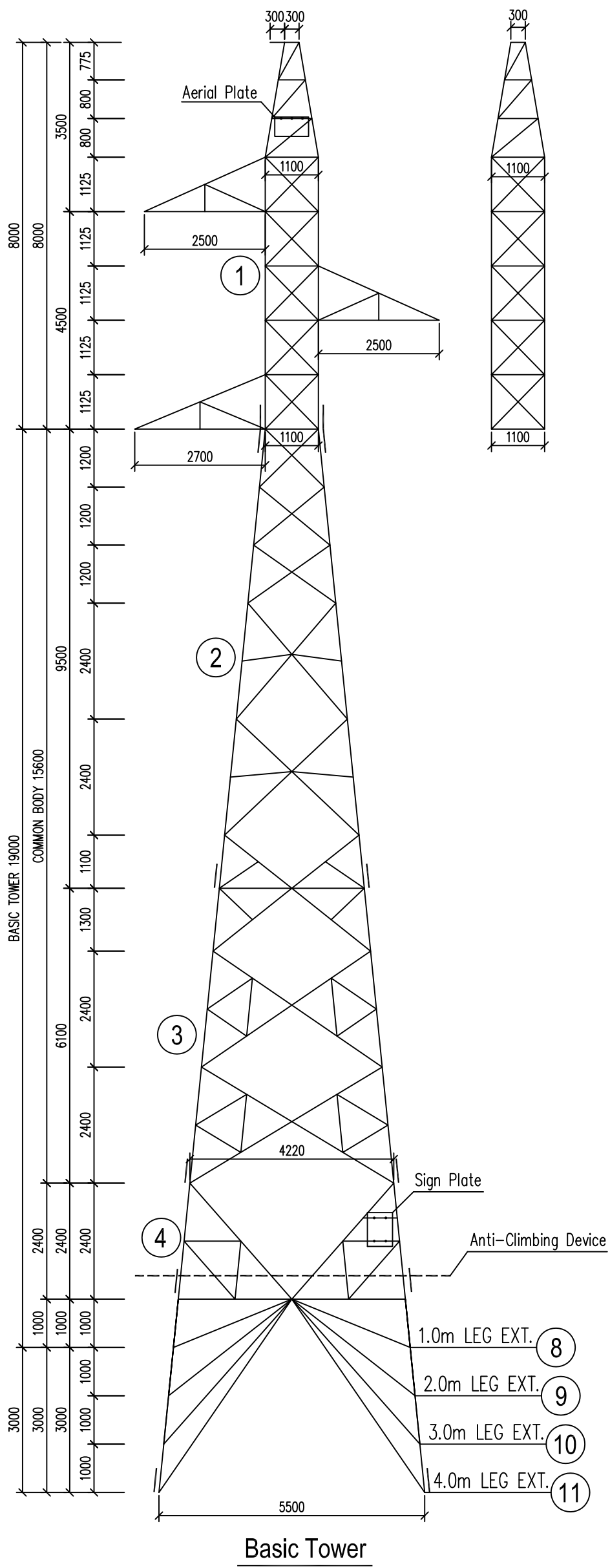
No	Description	Code	Unit	Qty.	Qty Modified by "1.32057"	Supply (FOB)			Sea Transportation			Local transportation			Insurance			Erection, Test and Commissioning		
						Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total Price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total price	Unit Price	Modified Price	Total Price
						USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
9.16	Type DT30 Tower, standard height +6.0m		each	3		129,258.00	336,975.61	1,010,926.82	7,960.00	20,751.72	62,255.16	644.14	1,679.27	5,037.82	322.07	839.64	2,518.91			
9.17	Type DT30 Tower, +0.0m Leg Extension		each	8		3,398.00	8,858.59	70,868.69	209.00	544.86	4,358.90	16.94	44.16	353.30	8.47	22.08	176.65			
9.18	Type DT30 Tower, +1.0m Leg Extension		each	12		3,998.00	10,422.79	125,073.43	246.00	641.32	7,695.86	19.92	51.93	623.18	9.96	25.97	311.59			
9.19	Type DT60 Tower standard height		each	3		146,608.00	382,207.06	1,146,621.17	9,029.00	23,538.60	70,613.81	730.60	1,904.67	5,714.00	365.30	952.34	2,857.01			
9.20	Type DT60 Tower, +0.0m leg Extension		each	12		5,224.00	13,618.97	163,427.62	322.00	839.45	10,073.45	26.03	67.86	814.32	13.02	33.94	407.32			
9.21	Suspension string as item 6.1		set	42		2,599.00	2,599.00	109,158.00	90.97	90.97	3,820.74	25.99	25.99	1,091.58	13.00	13.00	546.00			
9.22	Tension string as item 6.3		set	96		2,568.00	2,568.00	246,528.00	89.88	89.88	8,628.48	25.68	25.68	2,465.28	12.84	12.84	1,232.64			
9.23	OPGW suspension set as item 7.1		set	8		103.00	103.00	824.00	3.61	3.61	28.88	1.03	1.03	8.24	0.52	0.52	4.16			
9.24	OPGW tension set as item 7.2		set	8		252.00	252.00	2,016.00	8.82	8.82	70.56	2.52	2.52	20.16	1.26	1.26	10.08			
9.25	G5W suspension set as item 7.8		set	8		44.00	44.00	352.00	1.54	1.54	12.32	0.44	0.44	3.52	0.22	0.22	1.76			
9.26	G5W tension set as item 7.9		set	8		32.00	32.00	256.00	1.12	1.12	8.96	0.32	0.32	2.56	0.16	0.16	1.28			
9.27	Flexible spacers for ACSR "CONDOR" 454.5 Conductor.		each	300		80.00	160.00	48,000.00	2.80	5.60	1,680.00	13.60	27.20	8,160.00	6.80	13.60	4,080.00			
9.27	Stockbridge type vibration dampers for CONDOR 454.5		each	50		120.00	120.00	6,000.00	4.20	4.20	210.00	20.40	20.40	1,020.00	10.20	10.20	510.00			
9.28	Stockbridge type vibration dampers for OPGW		each	50		30.00	30.00	1,500.00	1.05	1.05	52.50	5.10	5.10	255.00	2.55	2.55	127.50			
9.29	Stockbridge type vibration dampers for GWS		each	50		30.00	30.00	1,500.00	1.05	1.05	52.50	5.10	5.10	255.00	2.55	2.55	127.50			
9.30	ACSR "CONDOR" 454.5 Conductor		km	30		6,775.00	13,550.00	406,500.00	339.00	678.00	20,340.00	68.00	136.00	4,080.00	34.00	68.00	2,040.00			
9.31	OPGW		km	4		5,565.00	5,565.00	22,260.00	278.00	278.00	1,112.00	55.65	55.65	222.60	27.82	27.82	111.28			
9.32	E.H.S shieldwire		km	4		801.00	801.00	3,204.00	40.00	40.00	160.00	8.01	8.01	32.04	4.00	4.00	16.00			
9.33	Mid - span tension joint for ACSR "CONDOR" 454.5 Conductor		each	60		72.00	72.00	4,320.00	2.52	2.52	151.20	12.24	12.24	734.40	6.12	6.12	367.20			
9.34	Repair sleeve for ACSR "CONDOR" 454.5 Conductor		each	30		72.00	72.00	2,160.00	2.52	2.52	75.60	12.24	12.24	367.20	6.12	6.12	183.60			
9.35	Joint Box intermediate type for OPGW		each	3		300.00	300.00	900.00	10.50	10.50	31.50	51.00	51.00	153.00	25.50	25.50	76.50			
9.36	Mid - span tension joint for E.H.S shieldwire		each	30		20.00	20.00	600.00	0.70	0.70	21.00	3.40	3.40	102.00	1.70	1.70	51.00			
SUB - TOTAL CARRIED TO SUMMARY OF PRICES								5,872,618.79			344,272.47			69,572.31			34,786.37			
10.0	OFFICE AND HOUSING FACILITIES FOR THE ENGINEER AND EMPLOYER STAFFS																			
10.1	Office and housing facilities for the Engineer and Employer's staff as specified under Section-VI "Employers requirements", part A2, item A2.13 and A2.14		LOT	1														440,000.00	440,000.00	440,000.00
SUB - TOTAL																				440,000.00
11.0	VEHICLES AND COMMUNICATION EQUIPMENT																			
11.1	Toyota, Land cruiser, swing type back door, 5-speed, common rail turbo charged diesel engine, etc. as specified under Section-VI "Employers requirements", part A2, item A2.22		No	3														272,000.00	272,000.00	816,000.00
11.2	Toyota, Double cabin pick-ups, four door, 5 seat capacity, air conditioned, 5-speed, diesel engine, etc. as specified under Section VI-Employers requirements, part A2, item A2.22		No	10														140,000.00	140,000.00	1,400,000.00
11.3	Base HF radio to be installed in each selected site for Engineer's and Employer's representative office and camp.		No	4														57,000.00	57,000.00	228,000.00
11.4	Mobile HF radio telephone equipment to be mounted on each Land Cruiser and Pick-up vehicles, including its accessories, power supply, etc.		No	13														11,000.00	11,000.00	143,000.00
SUB - TOTAL CARRIED TO SUMMARY OF PRICES																				
Grand Summary)								295,143,432.72			16,284,079.21			2,279,454.68			1,222,714.53			70,221,164.55

Grand Summary (For Proposed Multi - Circuit Supporting Tower Structure)
Cost modified along line - 1

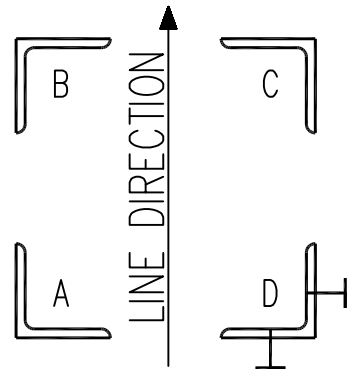
Item	Description	Supply (FOB)	Sea Transportation	Local Transportation	Insurance	Erection, Test and Commissioning	Grand Total
		Total Price	Total Price	Total price	Total price	Total Price	Total Price
	Currency	USD	USD	USD	USD	USD	USD
1	Dedesa - Holeta 500kV Transmission Line	236,618,434.75	12,978,571.20	1,801,387.04	964,834.86	58,167,759.29	310,530,987.13
TOTAL =							310,530,987.13
2	GERD - Dedesa 500kV Transmission Line	291,935,267.72	16,092,614.06	2,311,618.48	1,237,464.12	69,280,869.58	380,857,833.96
TOTAL =							380,857,833.96
GRAND TOTAL =							691,388,821.10

Grand Summary (For Proposed Multi - Circuit Supporting Tower Structure)
Cost modified along line - 2

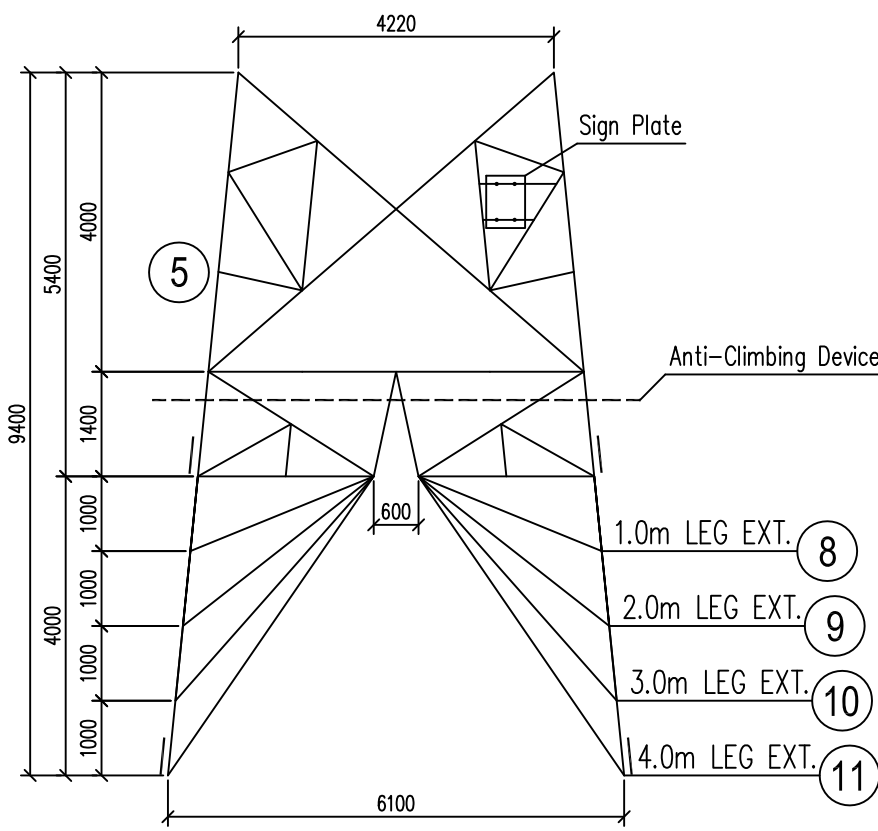
Item	Description	Supply (FOB)	Sea Transportation	Local Transportation	Insurance	Erection, Test and Commissioning	Grand Total
		Total Price	Total Price	Total price	Total price	Total Price	Total Price
	Currency	USD	USD	USD	USD	USD	USD
1	DEDESA - HOLETA 500KV TRANSMISSION LINE	234,586,473.67	12,946,866.06	1,803,817.14	965,884.00	55,052,361.00	305,355,401.87
TOTAL =							305,355,401.87
2	GERD - DEDESA 500KV TRANSMISSION LINE	295,143,432.72	16,284,079.21	2,279,454.68	1,222,714.53	70,221,164.55	385,150,845.69
TOTAL =							385,150,845.69
GRAND TOTAL =							690,506,247.56



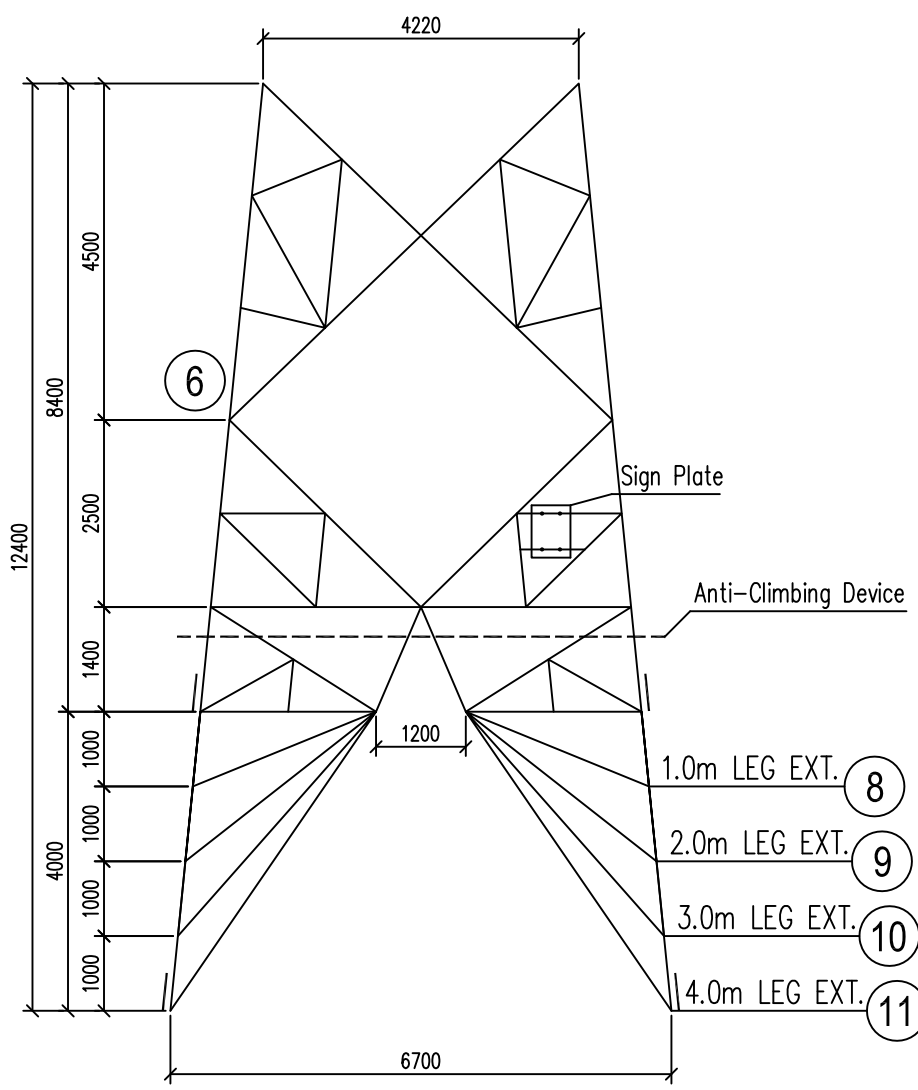
Basic Tower



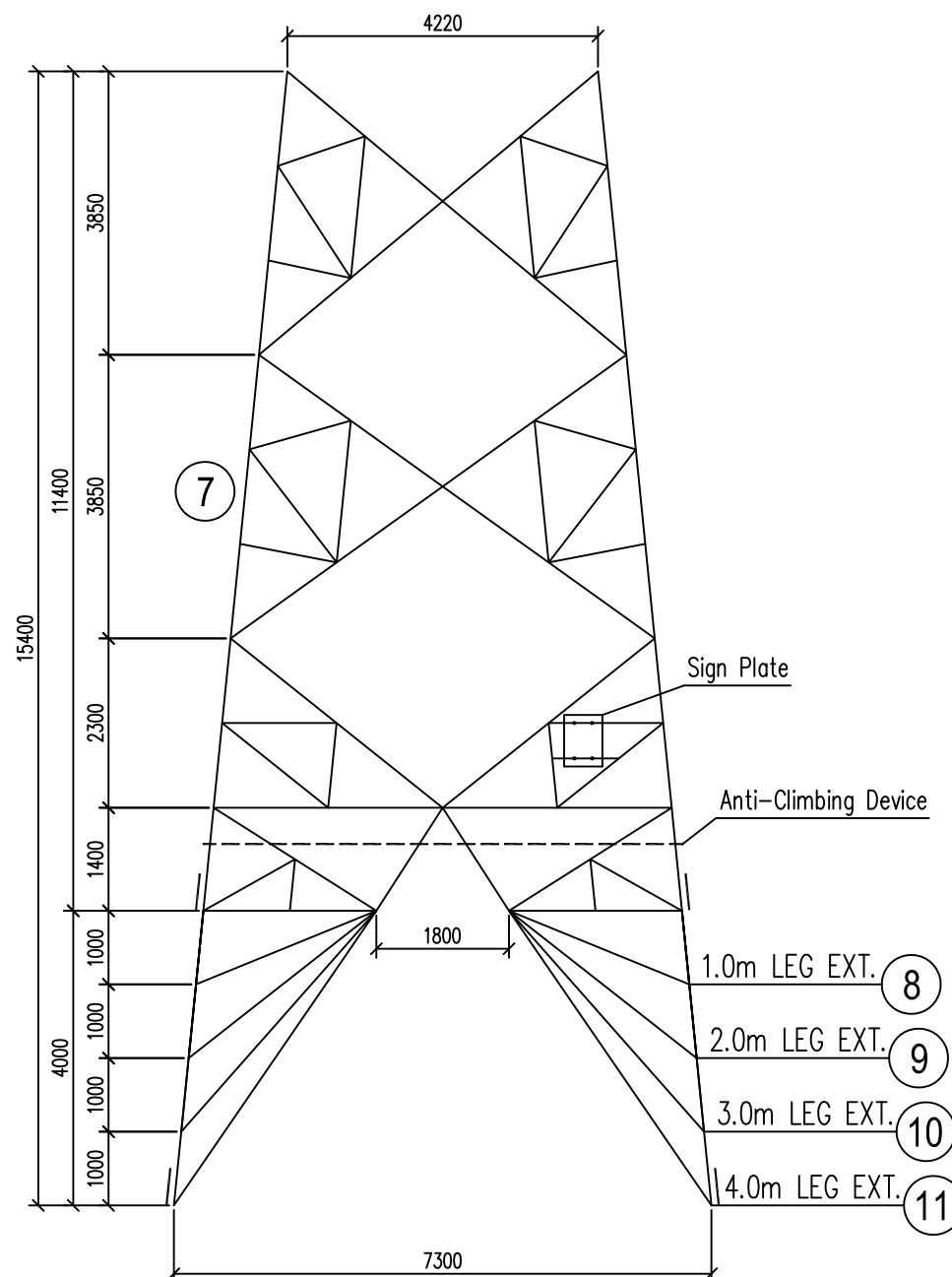
STEP BOLT ARRANGEMENT



+3.0m BODY EXT.



+6.0m BODY EXT.



+9.0m BODY EXT.

NOTES:

	Part No.	Combination
Basic Tower	1	~ 3 + 4
+3.0m Body Ext.	1	~ 3 + 5
+6.0m Body Ext.	1	~ 3 + 6
+9.0m Body Ext.	1	~ 3 + 7

Notes:

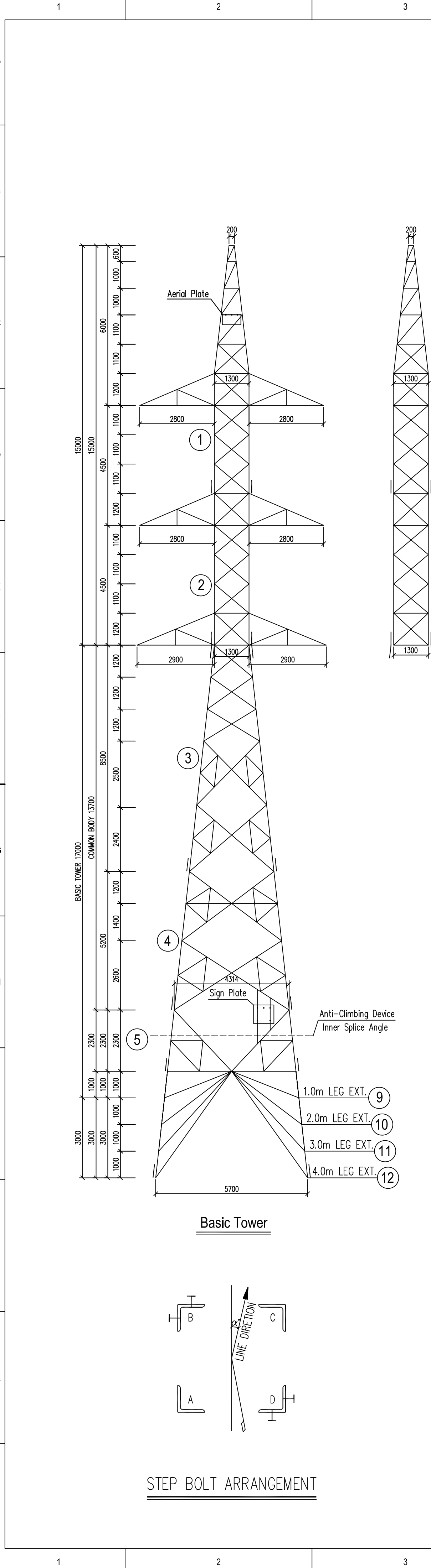
- All dimensions are in mm.
- Structural steel
 - The yield strength of mild steel marked "Q235" shall be 235 N/sq.mm and conform to GB/T 700 Q235;
 - The yield strength of high tensile steel marked "Q345" shall be 345 N/sq.mm and conform to GB/T 1591 Q345;
- Bolts
 - All bolts shall be of grade 5.6 conforming to ISO 898;
 - All bolts shall be with one flat washer conforming to DIN 126 or BS 4320 and one spring lock washer conforming to DIN 127, except for indicated otherwise.
- Galvanizing accords to BS 729.
- The Contractor shall supply the net quantities plus 5% of all permanent bolts and nuts for installation of the works at the site.

LIST OF MATERIAL

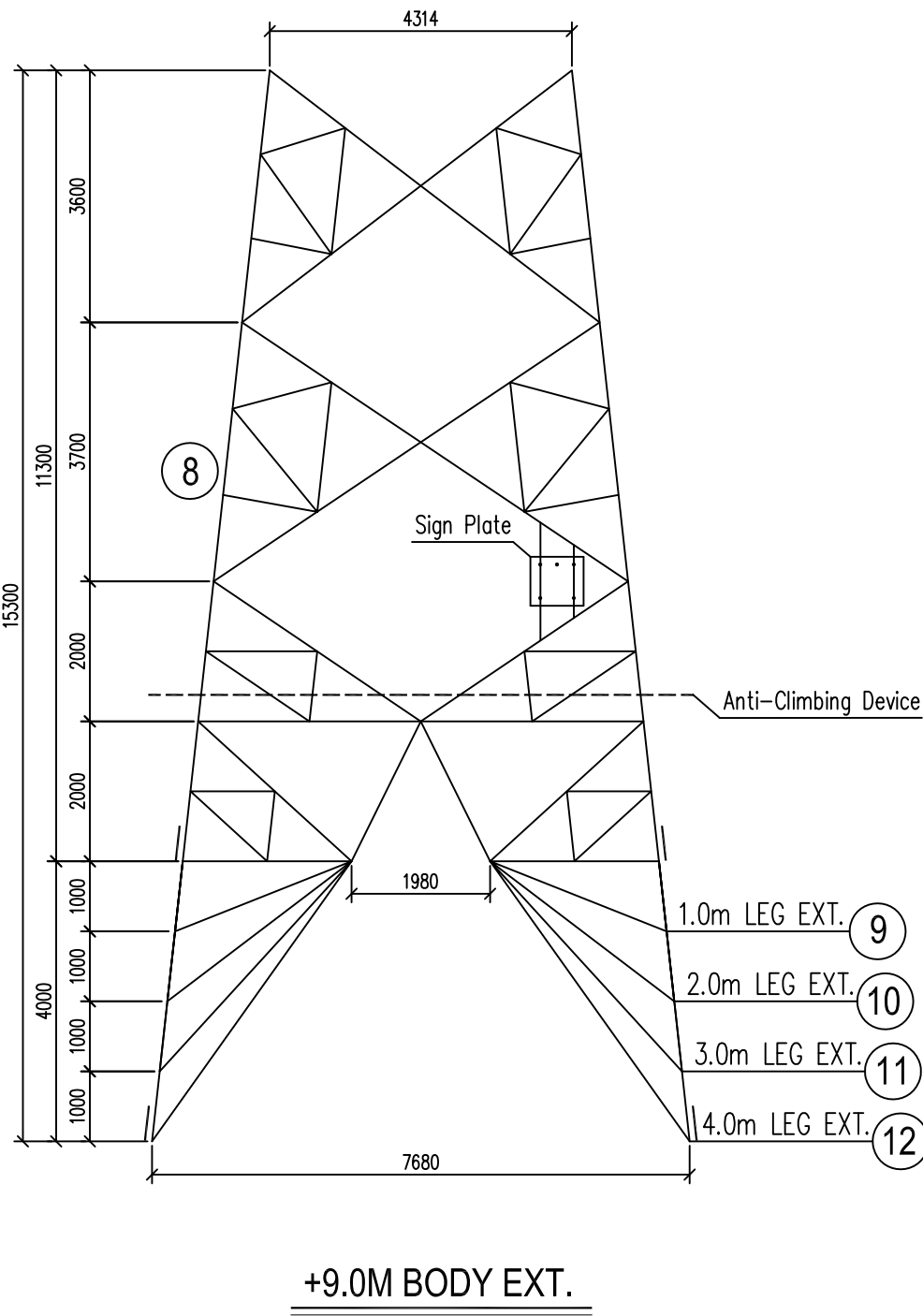
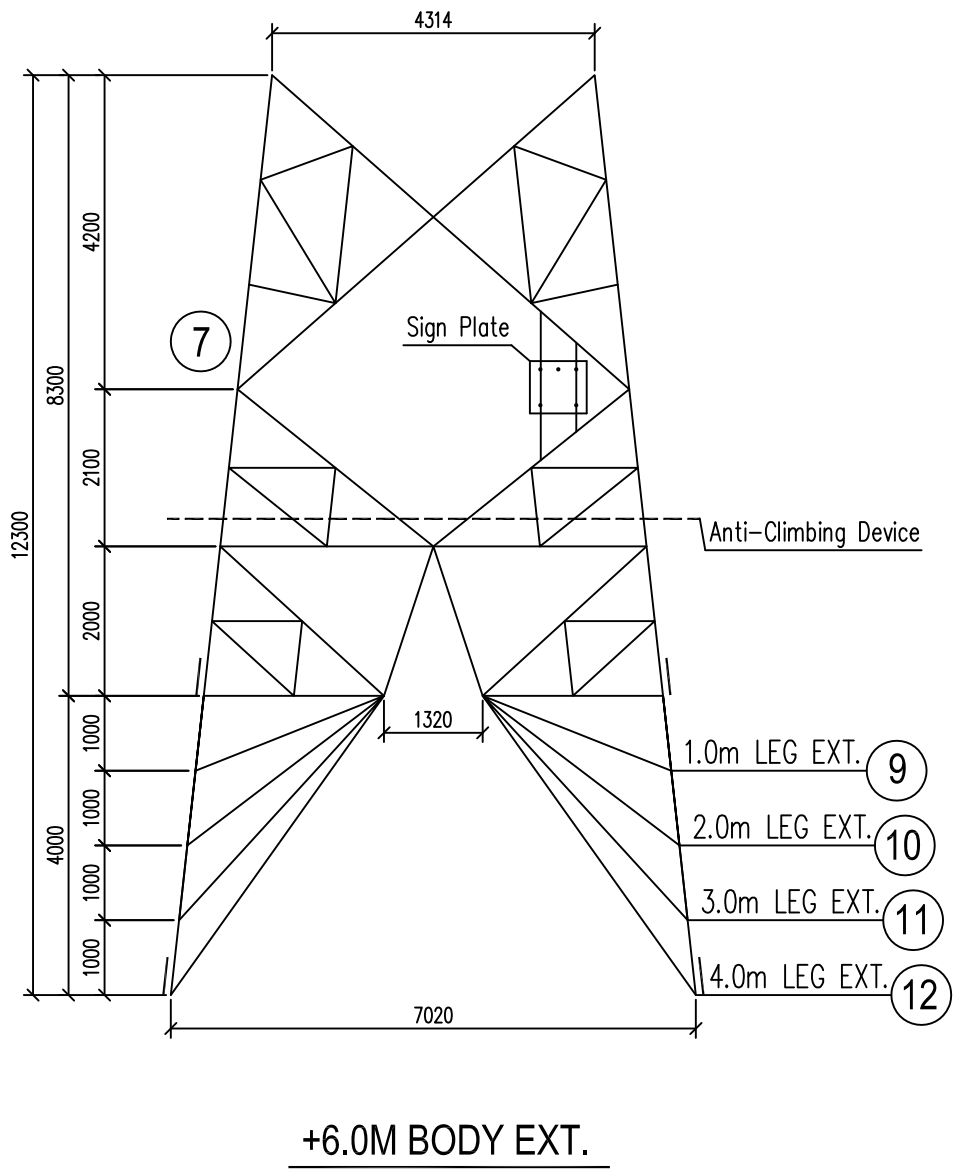
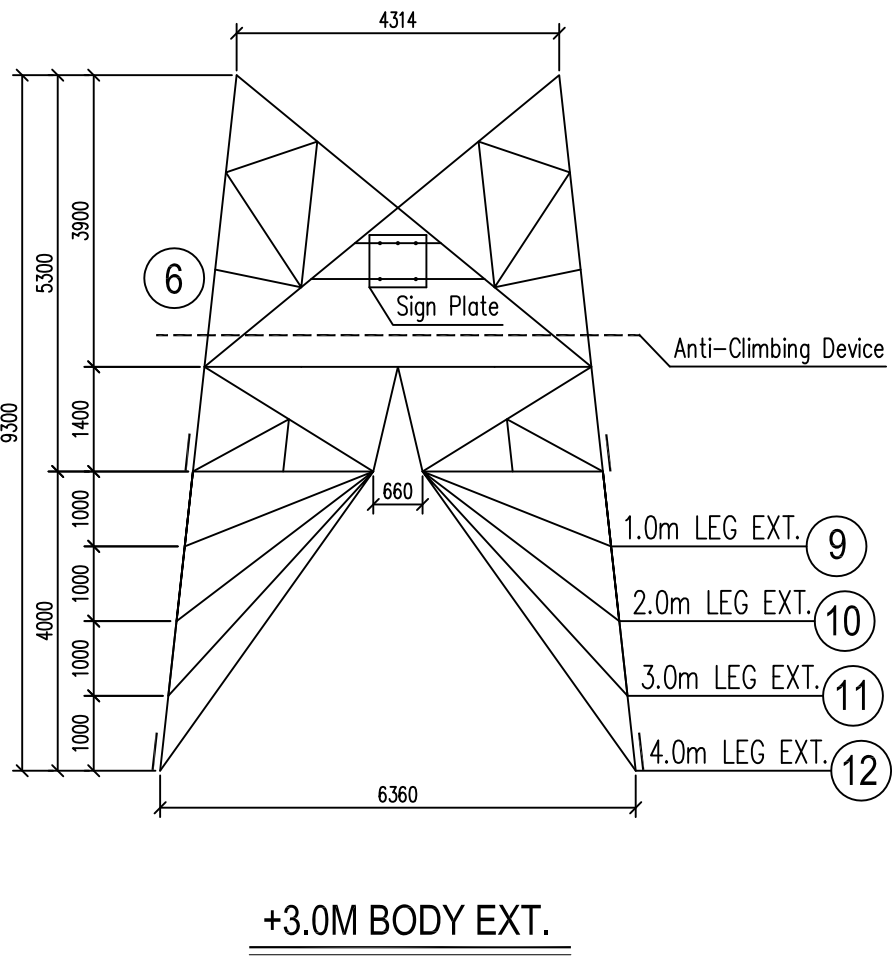
NAME	GRADE	SIZE	NO.											Basic Height +3.0m Body Ext.	Basic Height +6.0m Body Ext.	Basic Height +9.0m Body Ext.
			1	2	3	4	5	6	7	8	9	10	11			
ANGLE STEEL	H	L100X8	9.6			26.0	26.0	26.0	52.1	6.5	6.5	6.5	6.5	35.6	35.6	61.7
		L90X8			41.2	78.9	180.1	281.3	382.2	7.5	16.0	24.4	32.8	41.2	41.2	41.2
		L90X6												78.9	180.1	281.3
		L80X8		15.8										15.8	15.8	15.8
		L80X7	12.4											12.4	12.4	12.4
		L75X6		233.6										233.6	233.6	233.6
		L70X5	223.2						67.0							67.0
		L63X6						52.6	444.4	397.4				223.2	223.2	223.2
														52.6	444.4	397.4
		SUM	245.2	249.4	211.1	104.9	258.7	751.7	898.7	14.0	22.5	30.9	39.3	810.6	964.4	1457.4
PLATE	H	L70X6	35.8											35.8	35.8	35.8
		L63X6	116.6											116.6	116.6	116.6
		L56X5				107.6	205.4		206.2		27.2	33.4	41.2	107.6	205.4	206.2
		L56X4											12.5			
		L50X5		205.2	272.0				92.1	19.2				477.2	477.2	569.3
		L50X4	37.0	31.1				32.8	157.2	140.6	4.9	9.9		68.1	100.9	225.3
		L45X5		202.2	94.6		105.2	196.8	204.8	130.4				402.0	493.6	501.6
		L45X4		22.8			44.6	193.5	124.2	106.0	6.8	6.7	2.9	21.4	21.4	147.0
		L45X3											5.4			128.8
		L40X5	262.9	21.5	37.2			94.2	104.8	116.2				321.6	415.8	426.4
STEEL PIPE	H	L40X4	75.2	17.7	161.9	70.2	90.6	154.2	328.6	6.0	14.6	35.5	44.1	325.0	345.4	409.0
		SUM	527.5	500.5	565.7	327.6	813.3	745.2	1120.1	36.9	53.4	81.7	115.2	1921.3	2407.0	2338.9
		-6	6.3					43.8	52.7	55.8				6.3	50.1	59.0
		-8	79.7	40.6										120.3	120.3	120.3
		-10	14.8											14.8	14.8	14.8
		-12	3.1											3.1	3.1	3.1
		SUM	103.9	40.6										144.5	188.3	197.2
		-4					1.0	2.4	1.3	1.3			2.9	1.0	2.4	1.3
		-6	55.8	6.0	25.9	47.7	68.4	57.7	64.3	7.4	7.6	9.0	10.4	135.4	156.1	145.4
		-8	1.0											1.0	1.0	1.0
BOLT	H	-12	0.5											0.5	0.5	0.5
		SUM	57.3	6.0	25.9	48.7	70.8	59.0	65.6	7.4	7.6	9.0	10.4	137.9	160.0	146.2
		Ø28X5	0.1											0.1	0.1	0.1
		SUM	0.1											0.1	0.1	0.1
		Ø2.5											26.0			
		Round steel														
		SUM											26.0			
		M12X30	2.9	0.5	3.9	2.4	4.8	6.7	12.0	1.7	1.7	2.4	3.0	9.7	12.1	14.0
		M12X35	24.9	3.4	3.9		3.6	3.4	4.7			0.3	0.9	32.2	35.8	35.6
		M12X40	0.8			0.6	0.6	0.8	0.6					1.4	1.4	1.6
WASHER	H	M16X35		2.1		1.5	5.9	6.1	7.2			0.3	0.5	1.1	3.6	8.0
		M16X40	19.2	17.7	24.2	22.8	48.7	44.7	52.6	3.7	4.0	4.0	3.4	1.1	83.9	109.8
		M16X45		9.0	3.6	1.2	1.8	3.0	4.8					13.8	14.4	15.6
		M16X50	6.3											6.3	6.3	6.3
		M16X55	1.8											1.8	1.8	1.8
		M16X65	0.6											0.6	0.6	0.6
		SUM	56.5	32.7	35.6	28.5	65.4	64.7	81.9	5.4	6.0	7.0	7.8	153.3	190.2	189.5
		M20X60	4.0											4.0	4.0	4.0
		SUM	4.0											4.0	4.0	4.0
		M18X210	10.7	12.1	7.8	2.9	6.8	11.6	15.5	1.0	2.4	3.9	5.3	33.5	37.4	42.2
SUMP	H	M18X210	10.7	12.1	7.8	2.9	6.8	11.6	15.5	1.0	2.4	3.9	5.3	33.5	37.4	42.2
		SUM	10.7	12.1	7.8	2.9	6.8	11.6	15.5	1.0	2.4	3.9	5.3	33.5	37.4	42.2
		-2.5(Ø13.5)	0.2	0.1										0.3	0.3	0.3
		-3A(Ø17.5)		0.4	0.2				0.2			0.1	0.1	0.6	0.7	0.8
		SUM	0.2	0.5	0.2				0.2			0.1	0.1	0.9	1.0	1.1
		SUM	1005.4	841.8	846.3	512.6	1258.9	1685.0	2237.8	64.7	91.9	132.6	178.1	3206.1	3952.4	4376.5
		SUM (kg)														
SUMP	H	M18X210	10.7	12.1	7.8	2.9	6.8	11.6	15.5	1.0	2.4	3.9	5.3	33.5	37.4	42.2
		SUM	10.7	12.1	7.8	2.9	6.8	11.6	15.5	1.0	2.4	3.9	5.3	33.5	37.4	42.2
		-2.5(Ø13.5)	0.2	0.1										0.3	0.3	0.3
		-3A(Ø17.5)		0.4	0.2				0.2			0.1	0.1	0.6	0.7	0.8
		SUM	0.2	0.5	0.2				0.2			0.1	0.1	0.9	1.0	1.1
		SUM	1005.4	841.8	846.3	512.6	1258.9	1685.0	2237.8	64.7	91.9	132.6	178.1	3206.1	3952.4	4376.5
		SUM (kg)														

REV.	DATE	BY	DESCRIPTION

					AS BUILT				
EMPLOYER :  ETHIOPIAN ELECTRIC POWER ADDIS ABABA, ETHIOPIA					CONTRACTOR:  NANJING DAJI STEEL TOWER MANUFACTURING Co.,Ltd				
PROJECT: BUTAJIRA-BUEE & YABELLO POWER TRANSMISSION PROJECT					CONTRACT NO.		Co/33.20/39/08		
					PROJECT NO.		BBY2		
BY	NAME	DATE	SCALE	1:100	TITLE:				
DESIGNED	Fan Huiping	12/10/2016	UNIT	mm	Tower Design				
CHECKED	Feng Zhongxiao	14/10/2016	PLOT	A1	- Detail Tower Assembly Drawing - Tower Type "L"				
APPROVED	Yang Shaofeng	16/10/2016	SHEET	2/17	- Outline and Material List				
DOC. NO.					2210-BBY2-AB-ST-DS			REV.	0



STEP BOLT ARRANGEMENT



LIST OF MATERIAL

NAME	GRADE	SIZE	NO.												Basic Height +3.0M Body Ext.	Basic Height +6.0M Body Ext.	Basic Height +9.0M Body Ext.
			1	2	3	4	5	6	7	8	9	10	11	12			
H	H	L140X10					199.2	460.2	721.2	982.0	19.4	41.1	62.9	84.6	199.2	460.2	721.2
		L125X10			614.8	402.0									1016.8	1016.8	1016.8
		L125X8					32.9	32.9	39.1	39.1	8.2	8.2	8.2	8.2	32.9	32.9	39.1
		L110X10		419.2											419.2	419.2	419.2
		L110X8													57.4	57.4	57.4
		L100X8	6.4	12.8	27.0										46.2	46.2	46.2
		L90X8		27.2											27.2	27.2	27.2
		L75X6	109.6												109.6	109.6	109.6
		L70X6	74.4	150.8											225.2	225.2	225.2
		L70X5								91.0							91.0
Q235	Q235	L63X6	177.4	137.0											314.4	314.4	314.4
		L63X5						52.4	453.8	394.2					52.4	453.8	394.2
		小 计	367.8	747.0	641.8	459.4	232.1	545.5	1214.1	1506.3	27.6	49.3	71.1	92.8	2448.1	2761.5	3430.1
		L70X6		1.5	3.1										4.6	4.6	4.6
		L63X6	1.4	2.8											4.2	4.2	4.2
		L56X5					106.0	204.6	93.8	392.8	20.8	26.0	32.4	39.2	243.5	342.1	231.3
		L56X4	11.6	23.5											35.1	35.1	35.1
		L50X5													795.6	947.3	891.6
		L50X4	17.0	34.4							8.0				51.4	116.4	120.9
		L45X5		44.0			97.3	82.5	66.4	66.5					223.8	207.7	207.8
H	H	L45X4					27.4	69.0	143.8	53.2		6.9	7.7	18.9	27.4	69.0	143.8
		L45X3												5.4			
		L40X5	223.8	82.3	10.2	13.2		50.8							329.5	380.3	329.5
		L40X4	113.5	44.2	121.9	137.2	58.1	185.6	249.2	405.4	6.1	15.0	32.4	26.6	474.9	602.4	666.0
		小 计	368.8	407.5	559.9	510.1	343.7	862.8	859.1	1230.2	40.5	53.6	83.9	96.1	2190.0	2709.1	2708.4
		-6						61.8	63.7	67.8					61.8	63.7	67.8
		-8	71.7	125.6	88.2	55.8		29.3	34.8	34.8	7.3	7.3	7.3	7.3	370.6	370.6	376.1
		-10	14.9	20.4											35.3	35.3	35.3
		-12	16.4	32.7											49.1	49.1	49.1
		小 计	103.0	178.7	88.2	55.8									455.0	516.8	524.2
Q235	Q235	-4						4.2	4.5	4.2	3.6			2.9	4.2	4.5	4.2
		-6	37.2	72.9	10.0	40.5	48.5	99.1	77.5	78.3	16.4	16.0	18.2	19.8	209.1	259.7	238.1
		-8	0.8	1.2	0.6			0.6							2.6	3.2	2.6
		-10	1.0	2.0	3.2	0.8			1.1	1.9					7.0	7.0	8.1
		-12	0.6	1.0											1.6	1.6	1.6
		-16		0.6											0.6	0.6	0.6
		小 计	39.6	77.7	13.8	41.3	52.7	104.2	82.8	83.8	16.4	16.0	18.2	19.8	225.1	276.6	256.2
		小 计	0.5	0.6											1.1	1.1	1.1
		小 计	0.5	0.6											1.1	1.1	1.1
		小 计												26.0			
BOLT	BOLT	M12X30	1.9	2.4	1.9	3.6	1.7	6.5	7.9	10.6	0.7	0.8	1.2	1.2	11.5	16.3	17.7
		M12X35	13.2	7.1	2.4	2.3	0.5	5.4	4.4	5.4		0.3	0.5	0.5	25.5	30.4	29.4
		M12X40	2.2	1.2	1.1	0.6									5.1	5.1	5.1
		M12X45	1.5												1.5	1.5	1.5
		M16X35					1.3	2.4	5.9	6.9	0.5		0.8	1.3	1.3	2.4	5.9
		M16X40	2.8	15.3	8.5	7.9	15.8	30.6	27.7	29.4	4.0	4.0	4.2	4.2	50.3	65.1	62.2
		M16X45		11.4	4.2	6.0	11.4	12.0	13.1	1.8	1.8	1.8	1.8	1.8	21.6	27.0	28.7
		M16X50		7.2	7.6	5.0	1.3	1.3	1.3	1.9					21.1	21.1	21.7
		M16X55		1.7											1.7	1.7	1.7
		小 计	21.6	46.3	25.7	19.4	26.6	57.6	59.2	67.3	7.0	6.9	8.5	8.5	139.6	170.6	172.2
WASHER	WASHER	M20X45	25.9	8.1	2.0			8.1	10.2	10.2					36.0	44.1	46.2
		M20X50	1.1	29.3				30.4	2.1	2.1					30.4	30.4	32.5
		M20X55	6.7	13.4					3.3	3.3					20.1	20.1	23.4
		M20X60			14.0	37.2	23.3	23.3	23.3	23.3	5.8	5.8	5.8		74.5	74.5	74.5
		M20X65	2.3												2.3	2.3	2.3
		M20X70	2.9	5.7											8.6	8.6	8.6
		小 计	38.9	56.5	16.0	37.2	23.3	31.4	38.9	38.9	5.8	5.8	5.8		171.9	180.0	187.5
		小 计	60.5	102.8	41.7	56.6	49.9	89.0	98.1	106.2	12.8	12.7	14.3	2.4	311.5	350.6	367.8
		M16X210	19.4	15.5	20.3	12.6	4.8	12.6	20.3	28.1	0.5	1.9	3.4	4.8	72.6	80.4	88.1
		M20X230	1.7	1.7	3.4	1.7	1.7	1.7	3.4	3.4	0.8				10.2	10.2	11.9
		小 计	21.1	17.2	23.7	14.3	6.5	14.3	23.7	31.5	1.3	1.9	3.4	4.8	82.8	90.6	100.0
SUM	SUM	-2.5(ø13.5)	0.2	0.1	0.1										0.4	0.4	0.4
		-3A(ø17.5)	0.1												0.1	0.1	0.1
		小 计	0.2	0.2	0.1										0.5	0.5	0.5
		小 计	961.5	1531.7	1369.2	1137.5	714.2	1706.9	2376.3	3060.6	105.9	140.8	198.3	235.2	641.1	5714.1	6706.8
		小 计															
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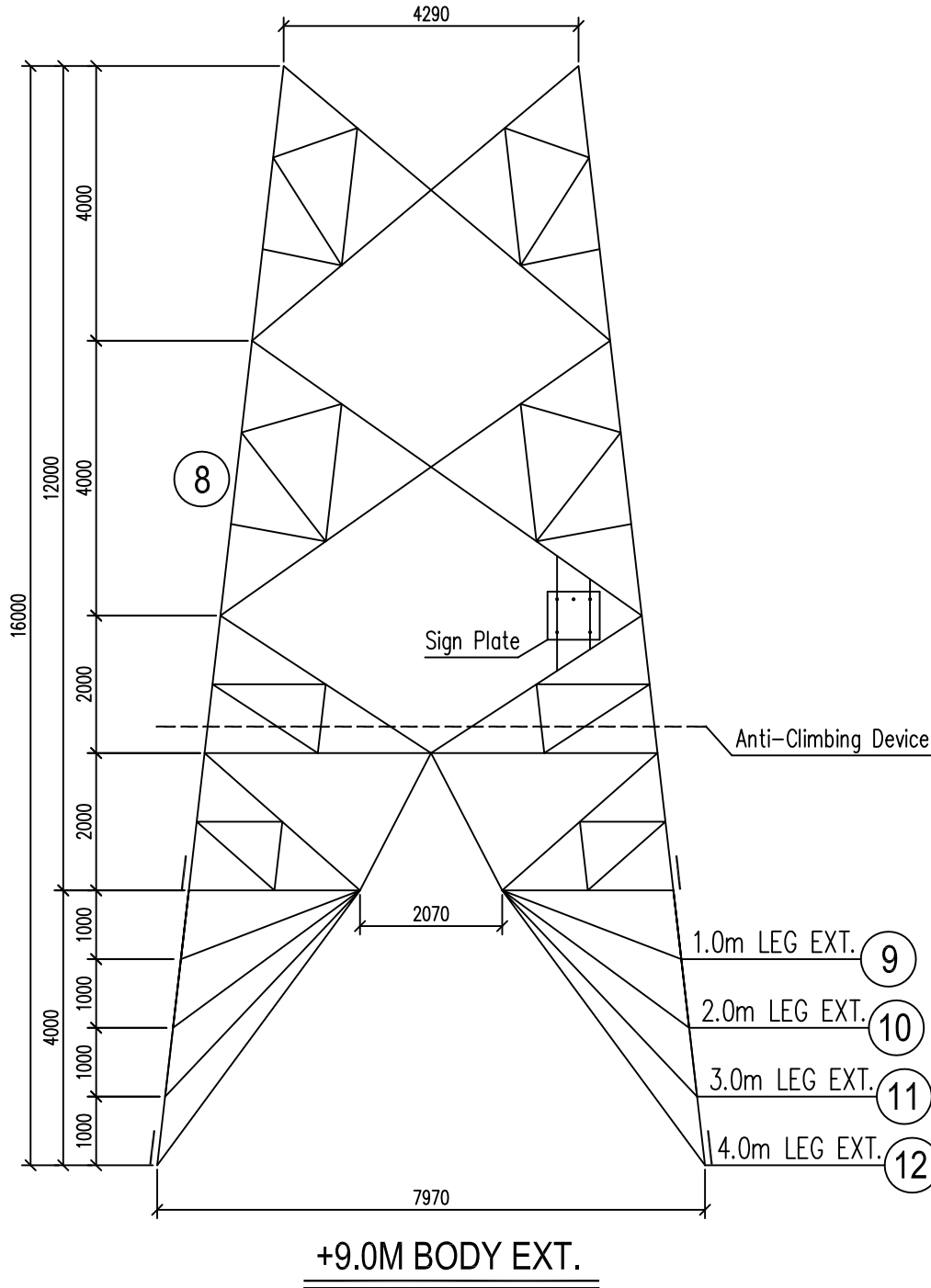
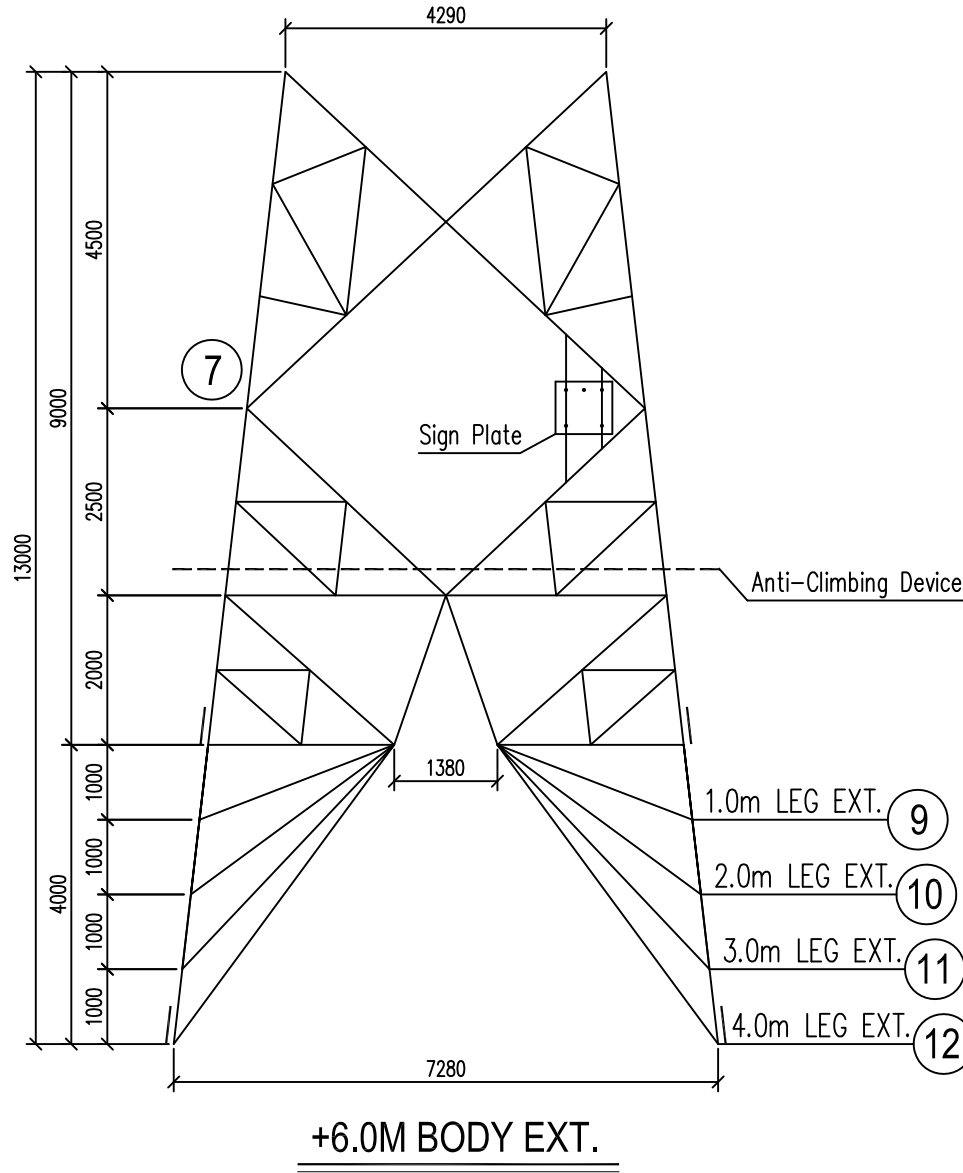
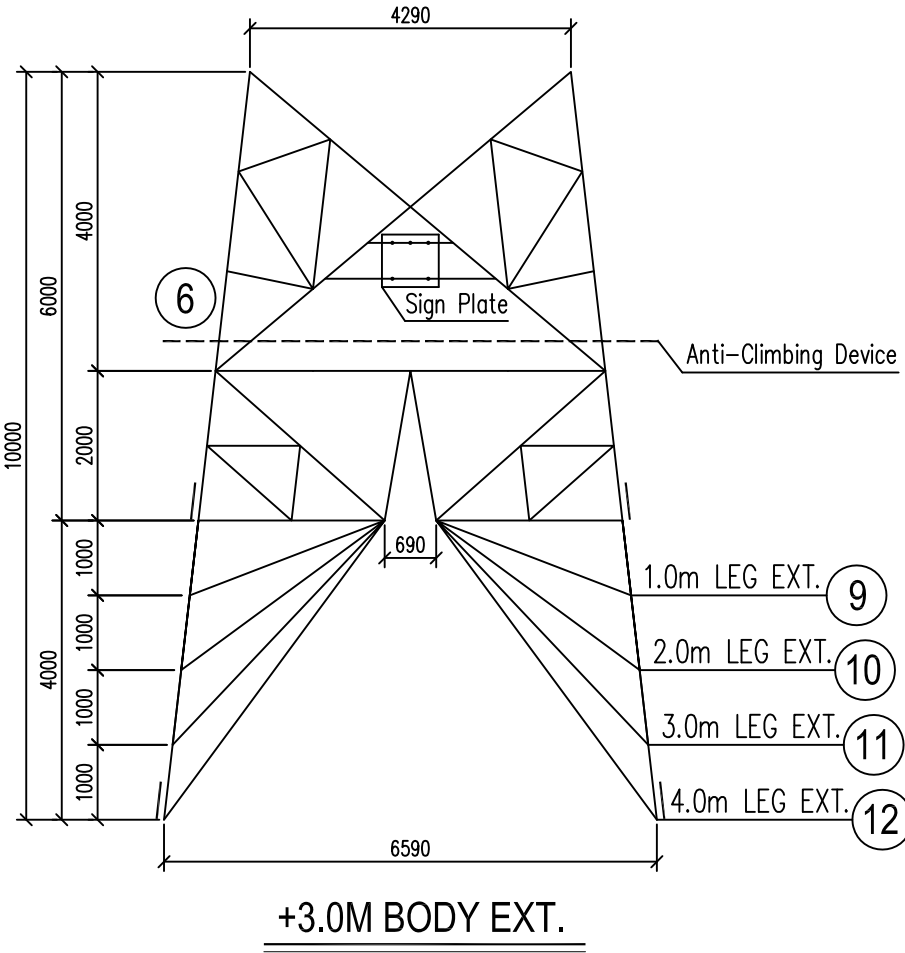
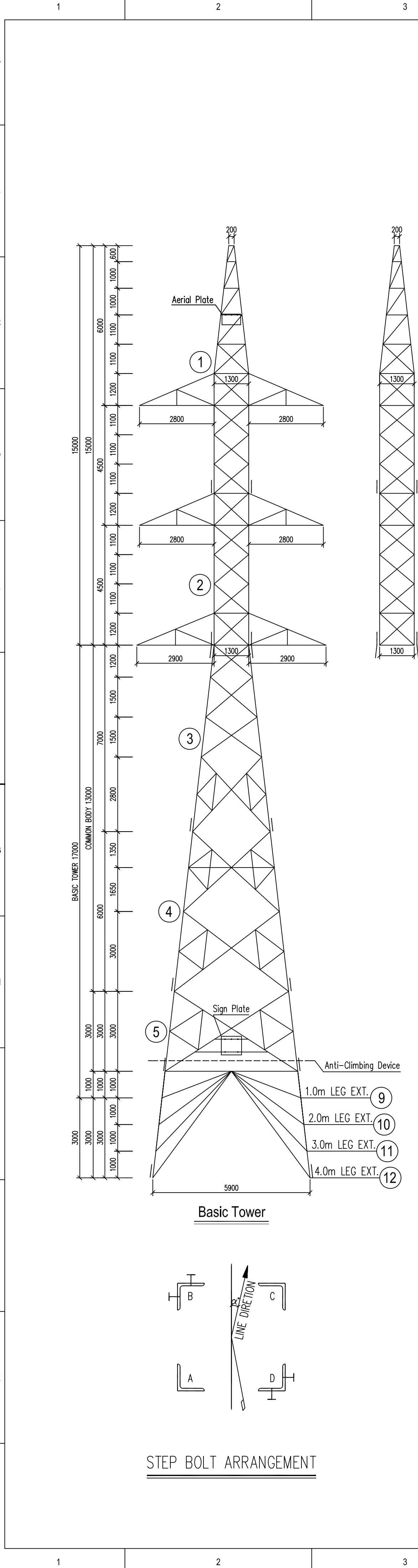
NOTES:
1.WEIGHT ASSEMBLY TABLE:

	Part No.	Combination
Basic Tower	1	~ 4 + 5
+3.0M Body Ext.	1	~ 4 + 6
+6.0M Body Ext.	1	~ 4 + 7
+9.0M Body Ext.	1	~ 4 + 8

- Notes:
- All dimensions are in mm.
 - Structural steel
 - The yield strength of mild steel marked "Q235" shall be 235 N/sq.mm and conform to GB/T 700 Q235;
 - The yield strength of high tensile steel marked "Q345" shall be 345 N/sq.mm and conform to GB/T 1591 Q345;
 - Bolts
 - All bolts shall be of grade 5.6 conforming to ISO 888;
 - All bolts shall be with one flat washer conforming to DN 126 or BS 4320 and one spring lock washer conforming to DN 127, except for indicated otherwise.
 - Galvanizing accords to EN-ISO 1461;
 - The Contractor shall supply the net quantities plus 5% of all permanent bolts and nuts for installation of the works at the site.

EMPLOYER :  ETHIOPIAN ELECTRIC POWER ADDIS ABABA, ETHIOPIA					CONTRACTOR:  NANJING DAJI STEEL TOWER MANUFACTURING Co.,Ltd				
PROJECT: BUTAJIRA-BUEE & YABELLO POWER TRANSMISSION PROJECT					CONTRACT NO. Co/33.20/39/08		PROJECT NO. BBY2		
BY	NAME	DATE	SCALE	1:100	TITLE: Tower Design - Detail Tower Assembly Drawing - Tower Type "MD" - Outline and Material List				
DESIGNED	Zhang Jianzhao	12/10/2016	UNIT	mm					
CHECKED	Feng Zhongxiao	14/10/2016	PLOT	A1					
APPROVED	Yang Shaofeng	16/10/2016	SHEET	2/17	DOC. NO.	2250-BBY2-AB-ST-DS	REV. 0		

REV.	DATE	BY	DESCRIPTION



- Notes:
- All dimensions are in mm.
 - Structural steel
 - The yield strength of mild steel marked "Q235" shall be 235 N/sq.mm and conform to GB/T 700 Q235;
 - The yield strength of high tensile steel marked "Q345" shall be 345 N/sq.mm and conform to GB/T 1591 Q345;
 - Bolts
 - All bolts shall be of grade 5.6 conforming to ISO 898;
 - All bolts shall be with one flat washer conforming to DIN 126 or BS 4320 and one spring lock washer conforming to DIN 127, except for indicated otherwise.
 - Galvanizing accords to EN-ISO 1461.
 - The Contractor shall supply the net quantities plus 5% of all permenat bolts and nuts for installation of the works at the site.

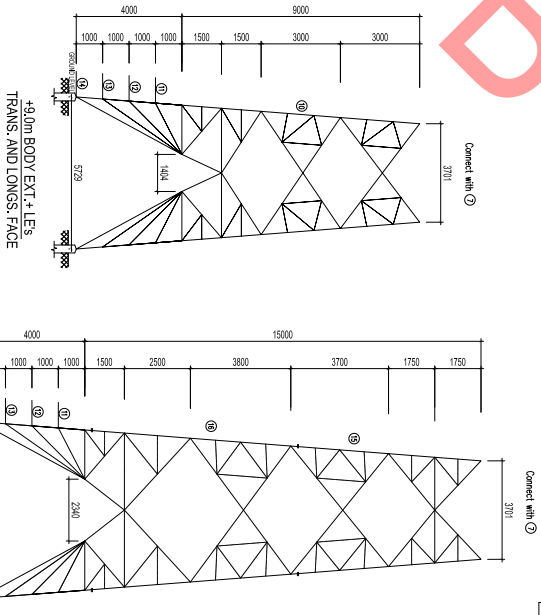
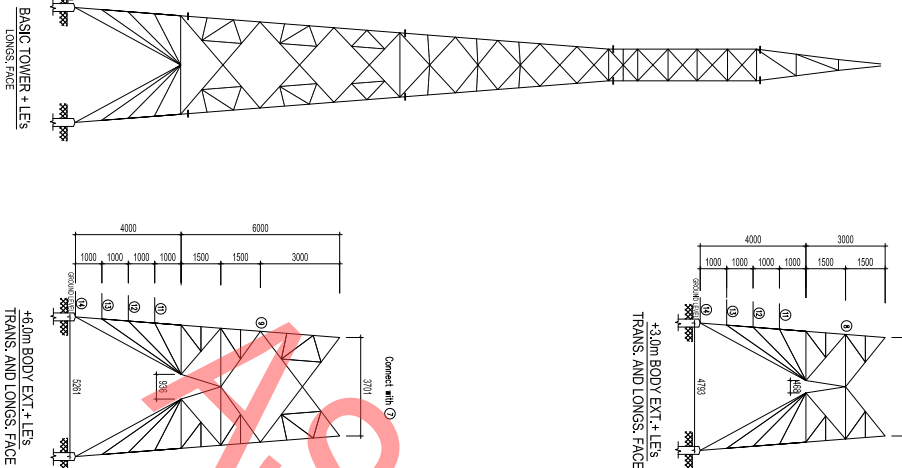
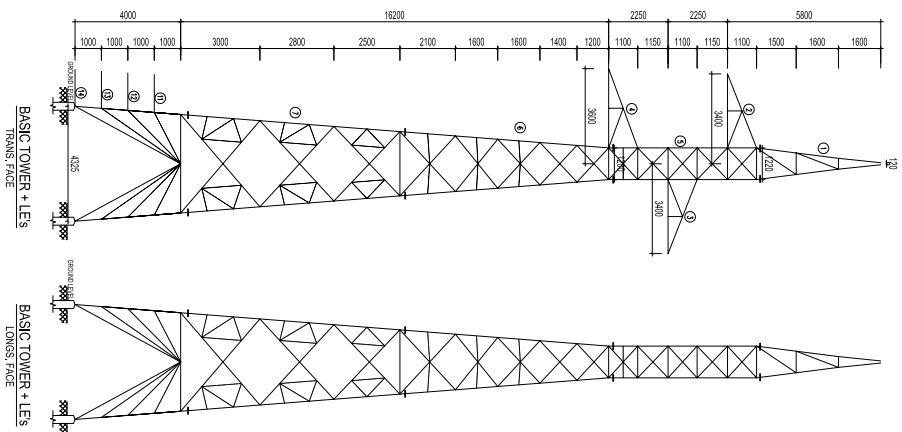
NOTES:
1.WEIGHT ASSEMBLY TABLE:

	Part No.	Combination
Basic Tower	1	~ 4 + 5
+3.0M Body Ext.	1	~ 4 + 6
+6.0M Body Ext.	1	~ 4 + 7
+9.0M Body Ext.	1	~ 4 + 8

LIST OF MATERIAL

NAME	GRADE	SIZE	NO.												Basic Height +3.0M Body Ext.	Basic Height +6.0M Body Ext.	Basic Height +9.0M Body Ext.
			1	2	3	4	5	6	7	8	9	10	11	12			
ANGLE STEEL	H	L160X14			886.6	825.0	411.8	825.0	1238.2	1650.0	30.7	65.1	99.6	134.0	2123.4	2536.6	2949.8
		L160X12		738.8											738.8	738.8	738.8
		L140X12					124.6	64.3	64.3	128.6	16.1	16.1	16.1	16.1	188.9	188.9	188.9
		L140X10				53.7									53.7	53.7	53.7
		L125X10													42.1	42.1	42.1
		L100X8		195.0											195.0	195.0	195.0
		L90X6			18.4										18.4	18.4	18.4
		L70X5		13.2	11.9										25.1	25.1	180.9
		L63X6		64.8	131.2										196.0	196.0	196.0
		L63X5		9.9	169.8	10.6		310.0	335.5	242.6	24.2	30.0	37.2	44.8	190.3	500.3	526.8
PLATE	H	SUM	480.3	1244.2	969.3	949.6	476.1	1199.3	1793.8	2571.1	71.0	111.2	152.9	194.9	4119.5	4842.7	5437.2
		L63X5			2.9										2.9	2.9	2.9
		L56X5			102.4	331.2	300.8	183.4	136.3	284.2		11.1	22.2	22.2	917.8	870.2	870.7
		L56X4					58.6	148.7	320.1	299.2					250.2	405.1	421.6
		L50X4		11.0	31.9				106.5	68.0					50.3	50.3	156.8
		L45X5		67.8	26.9	54.4	11.4	16.6	71.3	113.6	8.9				177.1	231.8	274.1
		L45X4				31.5	132.2	96.3		130.7		3.2	13.4	27.4	260.0	250.0	163.7
		L45X3												5.4			294.4
		L40X5		184.8	93.2	9.9	39.6								327.5	327.5	327.5
		L40X4		120.6	58.0		29.4	5.8	188.9	262.1	8.9	20.7	37.0	33.7	213.8	396.9	470.1
STEEL PIPE	H	SUM	400.8	346.1	429.9	572.0	450.8	785.9	938.6	1180.2	23.5	37.7	62.4	69.3	2199.6	2534.7	2687.4
		φ6			25.7			19.3	94.4	71.6	76.7	6.4	7.6	11.0	45.0	120.1	97.3
		φ8		109.6	162.8										272.4	272.4	272.4
		φ10		8.7											172.7	172.7	172.7
		φ12		20.4	40.4		128.6	66.5	66.5	133.0	16.6	16.6	16.6	16.6	255.9	255.9	322.4
		SUM	138.7	228.9	164.0	128.6	85.8	160.9	138.1	209.7	23.0	24.2	26.2	27.6	746.0	821.1	796.3
		φ4			4.6										4.6	4.6	4.6
		φ6					6.5	5.6	4.0	3.4					6.5	5.6	4.0
		φ8		50.8	83.3	27.3	59.2	43.7	78.2	88.8	9.2	9.4	10.6	10.8	264.3	298.8	309.4
		φ10		2.9	0.3										3.2	3.2	3.2
ROUND STEEL	H	Q235		1.3	2.7			0.8	1.1						4.8	5.1	4.0
		φ14		0.9	3.6	1.0				1.6	3.2				5.2	5.2	6.8
		φ18			0.7										0.7	0.7	0.7
		SUM	55.9	90.6	36.1	60.3	51.0	84.9	94.4	98.2	9.2	9.4	10.6	10.8	293.9	327.8	337.3
		φ34X5		0.5	0.6										1.1	1.1	1.1
		SUM													1.1	1.1	1.1
		φ2.5												26.0			
		SUM												26.0			
		M12X30		1.8	2.5		2.6	1.2	7.5	7.9	6.7	0.7	1.1	1.1	8.1	14.4	14.8
		M12X35		11.5	4.1	2.6	1.3	2.3	4.4	3.1			0.3	0.3	19.5	21.8	23.9
BOLT	5.6	M12X40		1.9	0.9	0.1			0.6	1.1			0.1	0.3	2.9	3.5	4.0
		M12X45		0.7	0.3										1.0	1.0	1.0
		M16X35					3.7	1.6	3.2	3.7	5.9				6.4	8.0	8.5
		M16X40		7.4	16.4	2.3	11.9	18.0	29.4	26.0	32.8	3.4	3.1	3.1	56.0	67.4	64.0
		M16X45		2.4	12.0	12.5	3.6	2.4	6.6	3.6	3.6		0.6	0.6	32.9	37.1	34.1
		M16X50		2.2	4.4	7.6	10.1	7.1	2.5	11.3	12.6				31.4	26.8	35.6
		M16X55			1.7					1.3					1.7	1.7	3.0
		M12X45		0.7	1.3										2.0	2.0	2.0
		SUM	28.6	43.6	26.2	33.2	30.3	52.1	59.3	67.1	4.1	3.9	4.8	5.2	161.9	183.7	190.9
		M20X45		25.4	29.5			12.2	12.2	14.2	2.0	2.5	3.0	3.0	54.9	67.1	67.1
WASHER	5.6	M20X50		10.7	18.1	10.7		4.3	4.3	6.4		0.5	1.1	1.1	39.5	43.8	43.8
		M20X55						12.3	3.3	6.7	2.2	2.2	2.2	2.2	27.3	39.6	30.6
		M20X65				24.3									24.3	24.3	24.3
		M20X70					50.5	30.3	30.3	60.6	7.6	7.6	7.6	7.6	80.8	80.8	111.1
		M20X65		10.0	15.5										25.5	25.5	25.5
		SUM	46.1	88.2	37.2	50.5	30.3	59.1	50.1	87.9	11.8	12.8	13.9	13.9	252.3	281.1	272.1
		M16X210		74.7	131.8	63.4	83.7	60.6	111.2	109.4	15.0	16.7	18.7	19.1	2.4	414.2	464.8
		M16X230		9.7	15.5	15.5	14.5	6.8	14.5	23.3	31.0	0.5	1.9	3.4	62.0	69.7	78.5
		SUM	11.4	17.2	17.2	16.2	8.5	16.2	25.0	34.4	1.3	2.7	4.2	5.6	70.5	78.2	87.0
		φ2.5		0.1	0.1										0.3	0.3	0.3
STEP BOLT	Q235	φ17.5													0.1	0.1	0.1
		SUM	0.1	0.2	0.1										0.1	0.1	0.1
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7
		SUM	1162.4	2059.6	1680.0	1810.4	1132.8	2358.4	3099.3	4248.6	143.9	201.9	275.1	327.4	7845.2	9070.8	9817.7

					AS BUILT	
EMPLOYER :					CONTRACTOR:	
 ETHIOPIAN ELECTRIC POWER ADDIS ABABA, ETHIOPIA					 NANJING DAJI STEEL TOWER MANUFACTURING Co.,Ltd	
PROJECT: BUTAJIRA-BUEE & YABELLO POWER TRANSMISSION PROJECT					CONTRACT NO.	Co/33.20/39/08
					PROJECT NO.	BBY2
BY	NAME	DATE	SCALE	1:100	TITLE:	
DESIGNED	Zhang Jianzhao	12/10/2016	UNIT	mm	Tower Design	
CHECKED	Feng Zhongxiao	14/10/2016	PLOT	A1	- Detail Tower Assembly Drawing - Tower Type "ND"	
					- Outline and Material List	
APPROVED	Yang Shaofeng	16/10/2016	SHEET	2/19	DOC. NO.	2260-BBY2-AB-ST-DS
					REV.	0



Boat Diameter of Boat Spacing (mm)	Boat Spacing between Boats (mm)	End Distance (mm)	Edge Distance (mm)
M6	50	80	25
M6	75	80	75
M20	75	60	100
M20	100	60	100
M20	125	80	120

Note: The Boat Weight Distance of boat holes from the face, 724 or 180 (circle the smaller one)

Note: The Max Weight Distance of bolt holes among the force. 12d or 18d (choose the smaller one).

Roll No.	Question No.	Answer in brief (approx)	Score in answer (approx)	Notes
440	20			
445	23			
450	24/28			
455	28/32			
460	29/32			
465	30/30			
470	35/40			
475	38/40			
480				
485				
490				
495				
500				
505				
510				
515				
520				
525				
530				
535				
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545				
550				
555				
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625				
630				
635				
640				
645				
650				
655				
660				
665				
670				
675				
680				
685				
690				
695				
700				
705				
710				
715				
720				
725				
730				
735				
740				
745				
750				
755				
760				
765				
770				
775				
780				
785				
790				
795				
800				
805				
810				
815				
820				
825				
830				
835				
840				
845				
850				
855				
860				
865				
870				
875				
880				
885				
890				
895				
900				
905				
910				
915				
920				
925				
930				
935				
940				
945				
950				
955				
960				
965				
970				
975				
980				
985				
990				

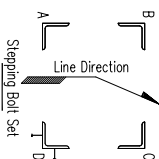
Table 2: Directrix of Angle

The number in bracket used when the edge distance of bolt is not enough, when connecting structure and angle steel, the directrix can be used to fit the bolt hole.

- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHER SPECIFIED.
 2. Q235 AND Q420 STEEL SHALL BE CLASS "B" AS PER GB/T 1591.
 3. STEEL WITHOUT INDICATION SHALL BE CLASS "B" AS PER GB/T 700.
 4. BOLTS AND NUTS SHALL BE IN ACCORDANCE WITH ISO 8881 AND ISO 888-2.
 5. WIRE BOLT: GRADE 6.8
 6. NUT BOLT: GRADE 6.8
 7. WIRE BOLT: GRADE 8.8
 8. NUT BOLT: GRADE 8.8
 9. THE SUPPORT STEEL WITH INCLUDING ANGLES PLATES BOLTS, NUTS AND BOLTS SHALL BE HOT-DIP GALVANIZED AS PER GB/T 13912.

one bolt + w/aster string	w/aster string	washer-core nut	one bolt - flat washer-string			two bolts		
			Specification	Symbol	flat height	Specification	Symbol	flat height
W6x40	7	8-14	W6x55	7	8-14	W6x55	7	8-14
W6x45	14	15-19	W6x60	14	15-19	W6x60	14	15-19
W6x50	19	20-24	W6x65	19	20-24	W6x65	19	20-24
W6x55	24	25-29	W6x70	24	25-29	W6x70	24	25-29
W6x60	29	30-34	W6x75	29	30-34	W6x75	29	30-34
W6x65	34	35-39	W6x80	34	35-39	W6x80	34	35-39
W6x70	39	40-44	W6x85	39	40-44	W6x85	39	40-44
W6x75	9	10-14	W6x90	9	10-14	W6x90	9	10-14
W6x80	14	15-19	W6x95	14	15-19	W6x95	14	15-19
W6x85	19	20-24	W6x100	19	20-24	W6x100	19	20-24
W6x90	24	25-29	W6x105	24	25-29	W6x105	24	25-29
W6x95	29	30-34	W6x110	29	30-34	W6x110	29	30-34
W6x100	34	35-39	W6x115	34	35-39	W6x115	34	35-39
W6x105	39	40-44	W6x120	39	40-44	W6x120	39	40-44
W6x110	44	45-49	W6x125	44	45-49	W6x125	44	45-49
W6x115	49	50-54	W6x130	49	50-54	W6x130	49	50-54
W6x120	54	55-59	W6x135	54	55-59	W6x135	54	55-59
W6x125	59	60-64	W6x140	59	60-64	W6x140	59	60-64
W6x130	64	65-69	W6x145	64	65-69	W6x145	64	65-69
W6x135	69	70-74	W6x150	69	70-74	W6x150	69	70-74
W6x140	74	75-79	W6x155	74	75-79	W6x155	74	75-79
W6x145	79	80-84	W6x160	79	80-84	W6x160	79	80-84
W6x150	84	85-89	W6x165	84	85-89	W6x165	84	85-89
W6x155	89	90-94	W6x170	89	90-94	W6x170	89	90-94
W6x160	94	95-99	W6x175	94	95-99	W6x175	94	95-99
W6x165	99	100-104	W6x180	99	100-104	W6x180	99	100-104
W6x170	104	105-109	W6x185	104	105-109	W6x185	104	105-109
W6x175	109	110-114	W6x190	109	110-114	W6x190	109	110-114
W6x180	114	115-119	W6x195	114	115-119	W6x195	114	115-119
W6x185	119	120-124	W6x200	119	120-124	W6x200	119	120-124
W6x190	124	125-129	W6x205	124	125-129	W6x205	124	125-129
W6x195	129	130-134	W6x210	129	130-134	W6x210	129	130-134
W6x200	134	135-139	W6x215	134	135-139	W6x215	134	135-139
W6x205	139	140-144	W6x220	139	140-144	W6x220	139	140-144
W6x210	144	145-149	W6x225	144	145-149	W6x225	144	145-149
W6x215	149	150-154	W6x230	149	150-154	W6x230	149	150-154
W6x220	154	155-159	W6x235	154	155-159	W6x235	154	155-159
W6x225	159	160-164	W6x240	159	160-164	W6x240	159	160-164
W6x230	164	165-169	W6x245	164	165-169	W6x245	164	165-169
W6x235	169	170-174	W6x250	169	170-174	W6x250	169	170-174
W6x240	174	175-179	W6x255	174	175-179	W6x255	174	175-179
W6x245	179	180-184	W6x260	179	180-184	W6x260	179	180-184
W6x250	184	185-189	W6x265	184	185-189	W6x265	184	

Table 3: Bolt



 ETHIOPIAN ELECTRIC POWER ADDIS ABABA, ETHIOPIA		 SHIMOBIRO CORPORATION LTD.	
CONTRACTOR:			
PROJECT: ETHIO-ADDIS ABABA POWER SUPPLY PROJECT			
CONTRACT NO. 3320807		PROJECT NO. LOT5	
BY		TITLE:	
NAME	DATE	SCALE	WA
JUNG ALONG	10/09/2015	mm	mm
DESIGNED	CHECKED	DATE	BY
JUNG ALONG	10/09/2015	12/07	AT
APPROVED	SHEET	DOC. NO.	REV.
04/01/16	121	2226-BEPC-04-05-025	A
DESCRIPTION			
FOR APPROVAL			
REV.	DATE	BY	DESCRIPTION
0	15/09/2015	JUNG ALONG	FOR APPROVAL
1	15/09/2015	JUNG ALONG	FOR APPROVAL

SECTION NO.																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
MATERIAL	210.4	176.0	176.2	191.2	950.3	1314.0	1940.1	1249.4	1914.2	2613.8	108.3	139.8	196.6	252.9	1736.9	2605.3	1168.8	137.0
BOLT	14.7	13.9	13.9	13.9	150.3	100.0	146.2	123.2	136.1	125.2	13.2	14.1	17.4	21.2	72.2	189.5	77.2	53.7
TOTAL(KG)	225.1	189.9	190.1	205.1	1100.6	1414.0	2086.3	1372.6	2052.3	2739.0	121.5	153.9	214.0	274.1	1809.1	2794.8	1246.0	57.6

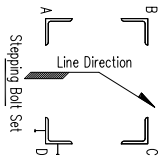


Table1: Spacing between Bolts, Edge Distance									
Diameter of Bolt	Bolt spacing(mm)	Spacing between Bolts (mm)		End Distance (mm)	Edge Distance(mm)		Edge Distance of rolling Edge Distance of Clamping	Edge Distance of rolling Edge Distance of Clamping	Edge Distance of rolling Edge Distance of Clamping
		Single Row	Double Rows		Distance (mm)	Distance (mm)			
M16	φ17.5	50	80	25	≥21	≥23	≥21	≥23	≥23
M20	φ21.5	60	100	30	≥26	≥28	≥26	≥28	≥28
M24	φ25.5	80	120	40	≥31	≥33	≥31	≥33	≥33

Note: The Max Weight Distance of bolt holes among the force 12d or 18d (choose the smaller one)

Table 2 : Directrix of angle				
Width of legs (mm)	Directrix (mm)	Directrix of first end (mm)	Directrix of second end (mm)	Notes
440	20			The number in bracket used when the edge distance of bolt is not enough, when connecting structure and angle steel, the directrix can be used to fix the bolt hole.
445	23			
450	25(28)			
456	28(32)			
463	30(36)			
470	33(40)			
475	36(40)			
480	40			
490	45			
490	50			
490	55	45	75	
490	60	50	85	
490	65	55	90	
490	70	60	105	
490	75	65	120	
490	80	70	135	
490	85	75		
490	90	80		
490	95	85		
490	100	90		
490	105	95		
490	110	100		
490	115	105		
490	120	110		
490	125	115		
490	130	120		
490	135	125		
490	140	130		
490	145	135		
490	150	140		
490	155	145		
490	160	150		
490	165	155		
490	170	160		
490	175	165		
490	180	170		
490	185	175		
490	190	180		
490	195	185		
490	200	190		
490	205	195		
490	210	200		
490	215	205		
490	220	210		
490	225	215		
490	230	220		
490	235	225		
490	240	230		
490	245	235		
490	250	240		
490	255	245		
490	260	250		
490	265	255		
490	270	260		
490	275	265		
490	280	270		
490	285	275		
490	290	280		
490	295	285		
490	300	290		
490	305	295		
490	310	300		
490	315	305		
490	320	310		
490	325	315		
490	330	320		
490	335	325		
490	340	330		
490	345	335		
490	350	340		
490	355	345		
490	360	350		
490	365	355		
490	370	360		
490	375	365		
490	380	370		
490	385	375		
490	390	380		
490	395	385		
490	400	390		
490	405	395		
490	410	400		
490	415	405		
490	420	410		
490	425	415		
490	430	420		
490	435	425		
490	440	430		
490	445	435		
490	450	440		
490	455	445		
490	460	450		
490	465	455		
490	470	460		
490	475	465		
490	480	470		
490	485	475		
490	490	480		
490	495	485		
490	500	490		
490	505	495		
490	510	500		
490	515	505		
490	520	510		
490	525	515		
490	530	520		
490	535	525		
490	540	530		
490	545	535		
490	550	540		
490	555	545		
490	560	550		
490	565	555		
490	570	560		
490	575	565		
490	580	570		
490	585	575		
490	590	580		
490	595	585		
490	600	590		
490	605	595		
490	610	600		
490	615	605		
490	620	610		
490	625	615		
490	630	620		
490	635	625		
490	640	630		
490	645	635		
490	650	640		
490	655	645		
490	660	650		
490	665	655		
490	670	660		
490	675	665		
490	680	670		
490	685	675		
490	690	680		
490	695	685		
490	700	690		
490	705	695		
490	710	700		
490	715	705		
490	720	710		
490	725	715		
490	730	720		
490	735	725		
490	740	730		
490	745	735		
490	750	740		
490	755	745		
490	760	750		
490	765	755		
490	770	760		
490	775	765		
490	780	770		
490	785	775		
490	790	780		
490	795	785		
490	800	790		
490	805	795		
490	810	800		
490	815	805		
490	820	810		
490	825	815		
490	830	820		
490	835	825		
490	840	830		
490	845	835		
490	850	840		
490	855	845		
490	860	850		
490	865	855		
490	870	860		
490	875	865		
490	880	870		
490	885	875		
490	890	880		
490	895	885		
490	900	890		
490	905	895		
490	910	900		
490	915	905		
490	920	910		
490	925	915		
490	930	920		
490	935	925		
490	940	930		
490	945	935		
490	950	940		
490	955	945		
490	960	950		
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490	970	960		
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490	980	970		
490	985	975		
490	990	980		
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490	1005	995		
490	1010	1000		
490	1015	1005		
490	1020	1010		
490	1025	1015		
490	1030	1020		
490	1035	1025		
490	1040	1030		
490	1045	1035		
490	1050	1040		
490	1055	1045		
490	1060	1050		
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490	1070	1060		
490	1075	1065		
490	1080	1070		
490	1085	1075		
490	1090	1080		
490	1095	1085		
490	1100	1090		
490	1105	1095		
490	1110	1100		
490	1115	1105		
490	1120	1110		
490	1125	1115		
490	1130	1120		
490	1135	1125		
490	1140	1130		
490	1145	1135		
490	1150	1140		
490	1155	1145		
490	1160	1150		
490	1165	1155		
490	1170	1160		
490	1175	1165		
490	1180	1170		
490	1185	1175		
490	1190	1180		
490	1195	1185		
490	1200	1190		
490	1205	1195		
490	1210	1200		
490	1215	1205		
490	1220	1210		
490	1225	1215		
490	1230	1220		
490	1235	1225		
490	1240	1230		
490	1245	1235		
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490	1255	1245		
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490	1265	1255		
490	1270	1260		
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490	1290	1280		
490	1295	1285		
490	1300	1290		
490	1305	1295		
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490	1345	1335		
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490	1385	1375		
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490	1405	1395		
490	1410	1400		
490	1415	1405		
490	1420	1410		
490	1425	1415		
490	1430	1420		
490	1435	1425		
490	1440	1430		
490	1445	1435		
490	1450	1440		
490	1455	1445		
490	1460	1450		
490	1465	1455		
490	1470	1460		
490	1475	1465		
490	1480	1470		
490	1485	1475		
490	1490	1480		
490	1495	1485		
490	1500	1490		
490	1505	1495		
490	1510	1500		
490	1515	1505		
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490	1530	1520		
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490	1545	1535		
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490	1555	1545		
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490	1565	1555		
490	1570	1560		
490	1575	1565		
490	1580	1570		
490	1585	1575		
490	1590	1580		
490	1595	1585		
490	1600	1590		
490	1605	1595		
490	1610	1600		
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490	1670	1660		
490	1675	1665		
490	1680	1670		
490	1685	1675		
490	1690	1680		
490	1695	1685		
490	1700	1690		
490	1705	1695		
490	1710	1700		
490	1715	1705		
490	1720	1710		
490	1725	1715		
490	1730	1720		
490	1735	1725		
490	1740	1730		
490	1745	1735		
490	1750	1740		
490	1755	1745		
490	1760	1750		
490	1765	1755		
490	1770	1760		
490	1775	1765		
490	1780	1770		
490	1785	1775		
490	1790	1780		
490	1795	1785		
490	1800	1790		
490	1805	1795		
490	1810	1800		
490	1815	1805		
490	1820	1810		
490	1825	1815		
490	1830	1820		
490	1835	1825		
490	1840	1830		
490	1845	1835		
490	1850	1840		
490	1855	1845		
490	1860	1850		
490	1865	1855		
490	1870			

SECTION NO.																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
MATERIAL	102.7	214.9	226.9	231.7	493.3	729.1	1329.0	1837.9	1200.1	1814.1	1320.8	1530.8	2388.9	93.9	119.4	171.2	226.0	1055.9	89.0
BOLT	10.8	17.5	17.5	17.5	71.1	101.4	95.5	147.4	99.9	123.2	142.3	60.5	167.8	12.2	13.6	16.4	19.7	64.2	2.6
TOTAL(KG)	113.5	232.4	244.4	249.2	564.4	830.5	1424.5	1984.9	1299.9	1937.3	2463.2	1591.3	2556.7	106.1	133.0	187.6	245.7	1120.1	91.6
																			57.4

Table 3. Bolt

one bolt + flat weather spring washer one nut	one bolt + flat weather spring washer two nuts
Specification Symbol	Specification Symbol
Thickness [mm]	Thickness [mm]
M16x40	M16x25
M16x45	M16x30
M16x50	M16x35
M16x55	M16x40
M16x60	M16x45
M16x65	M16x50
M16x70	M16x55
M16x75	M16x60
M16x80	M16x65
M16x85	M16x70
M16x90	M16x75
M16x95	M16x80
M16x100	M16x85
M16x105	M16x90
M16x110	M16x95
M16x115	M16x100
M16x120	M16x105
M16x125	M16x110
M16x130	M16x115
M16x135	M16x120
M16x140	M16x125
M16x145	M16x130
M16x150	M16x135
M16x155	M16x140
M16x160	M16x145
M16x165	M16x150
M16x170	M16x155
M16x175	M16x160
M16x180	M16x165
M16x185	M16x170
M16x190	M16x175
M16x195	M16x180
M16x200	M16x185
M16x205	M16x190
M16x210	M16x195
M16x215	M16x200
M16x220	M16x205
M16x225	M16x210
M16x230	M16x215
M16x235	M16x220
M16x240	M16x225
M16x245	M16x230
M16x250	M16x235
M16x255	M16x240
M16x260	M16x245
M16x265	M16x250
M16x270	M16x255
M16x275	M16x260
M16x280	M16x265
M16x285	M16x270
M16x290	M16x275
M16x295	M16x280
M16x300	M16x285
M16x305	M16x290
M16x310	M16x295
M16x315	M16x300
M16x320	M16x305
M16x325	M16x310
M16x330	M16x315
M16x335	M16x320
M16x340	M16x325
M16x345	M16x330
M16x350	M16x335
M16x355	M16x340
M16x360	M16x345
M16x365	M16x350
M16x370	M16x355
M16x375	M16x360
M16x380	M16x365
M16x385	M16x370
M16x390	M16x375
M16x395	M16x380
M16x400	M16x385
M16x405	M16x390
M16x410	M16x395
M16x415	M16x400
M16x420	M16x405
M16x425	M16x410
M16x430	M16x415
M16x435	M16x420
M16x440	M16x425
M16x445	M16x430
M16x450	M16x435
M16x455	M16x440
M16x460	M16x445
M16x465	M16x450
M16x470	M16x455
M16x475	M16x460
M16x480	M16x465
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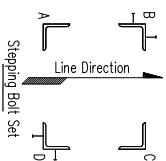


Table1: Spacing between Bolts, Edge Distance					
Bolt spacing(mm)	Single Row	Double Rows	Distance (mm)	Edge Distance(mm)	Spacing between Bolts (mm)
M16	50	80	25	27	23
M20	60	100	30	26	28
M24	75.5	120	40	21	23

Note: The Max Weight Distance of Bolt holes among the force 12d or 18d (choose the smaller one)

Table2: Directs of Angles

|--|

	SECTION NO.																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
MATERIAL	193.0	243.0	239.2	277.2	656.5	958.6	1348.1	2302.5	1456.7	2169.3	2950.1	1879.8	3032.1	123.4	158.5	222.7	289.2	128.0	94.2	53.8
BOLT	18.9	19.1	19.1	19.1	83.9	113.5	86.4	161.5	128.0	144.4	171.9	70.5	196.3	14.1	14.0	18.1	20.9	80.7	3.2	3.9
TOTAL(KG)	211.9	262.1	258.3	296.3	740.4	1072.1	1434.5	2463.7	1584.7	2313.7	3122.0	1950.3	3228.4	137.5	172.5	240.8	310.1	208.7	97.4	57.7

Table1: Spacing between Bolts, Edge Distance

Diameter of Bolt	Bolt spacing(mm)	Spacing between Bolts (mm)		End Distance (mm)	Edge Distance(mm)	
		Single Row	Double Rows		Edge Distance of rolling	Edge Distance of Chamfering
M16	φ17.5	50	80	25	≥21 20(L40Angel)	≥23
M20	φ21.5	60	100	30	≥26	≥28
M24	φ25.5	80	120	40	≥31	≥33

Note: The Max Weight Distance of bolt holes among the force. $12d$ or $18d$ (choose the smaller one)

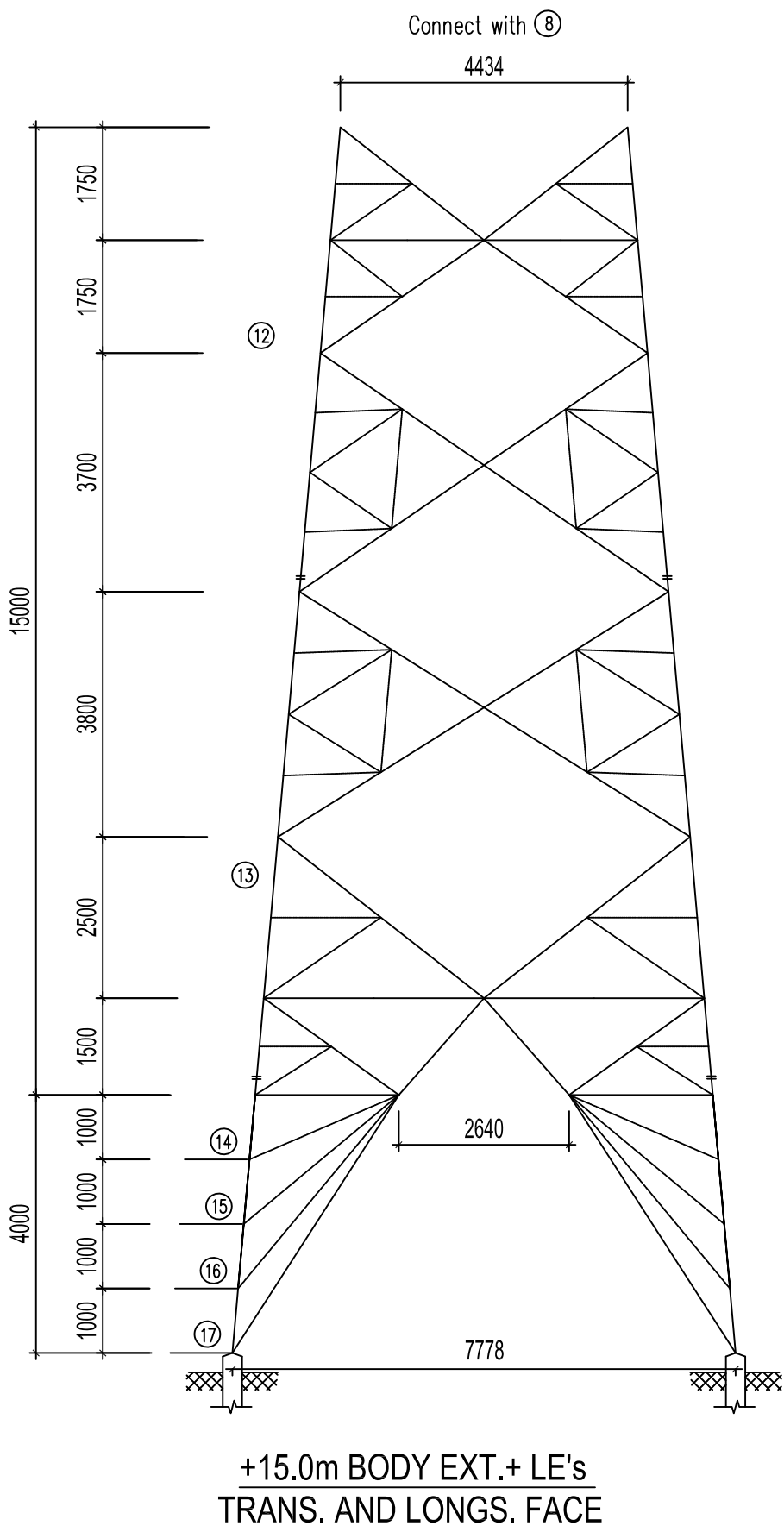
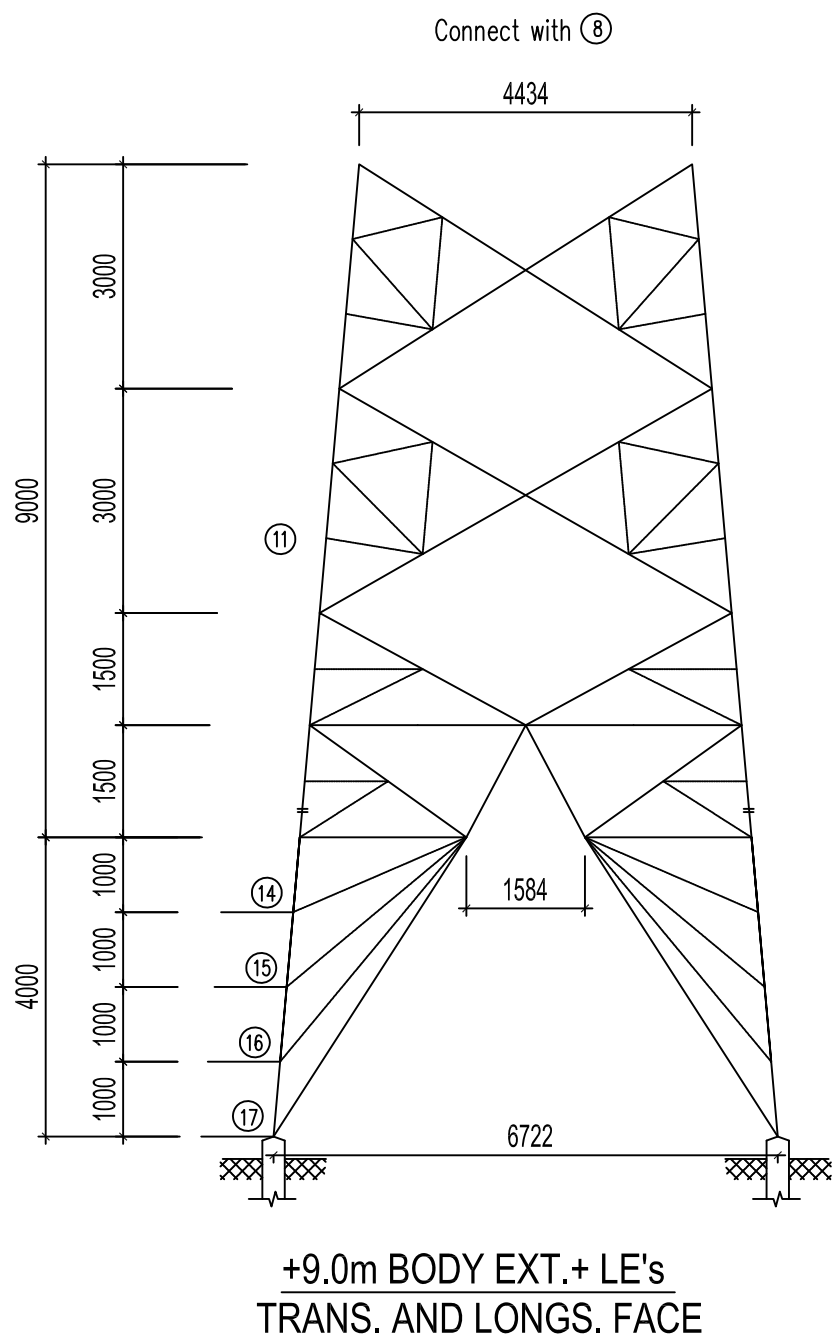
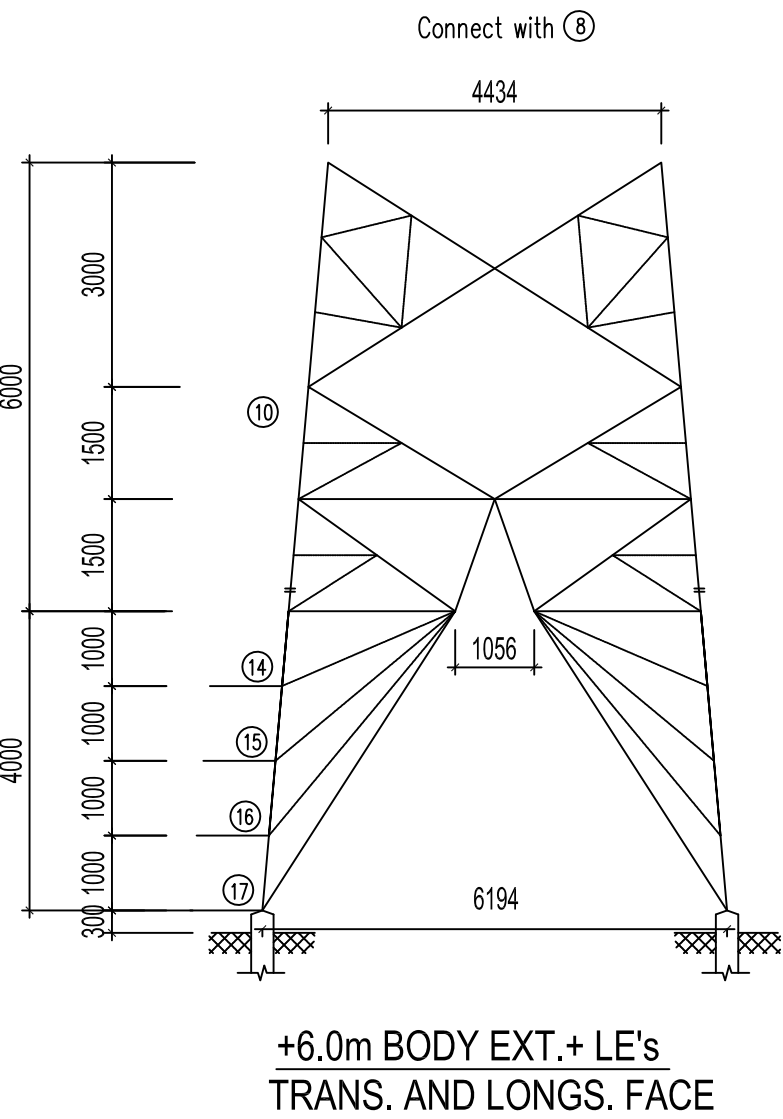
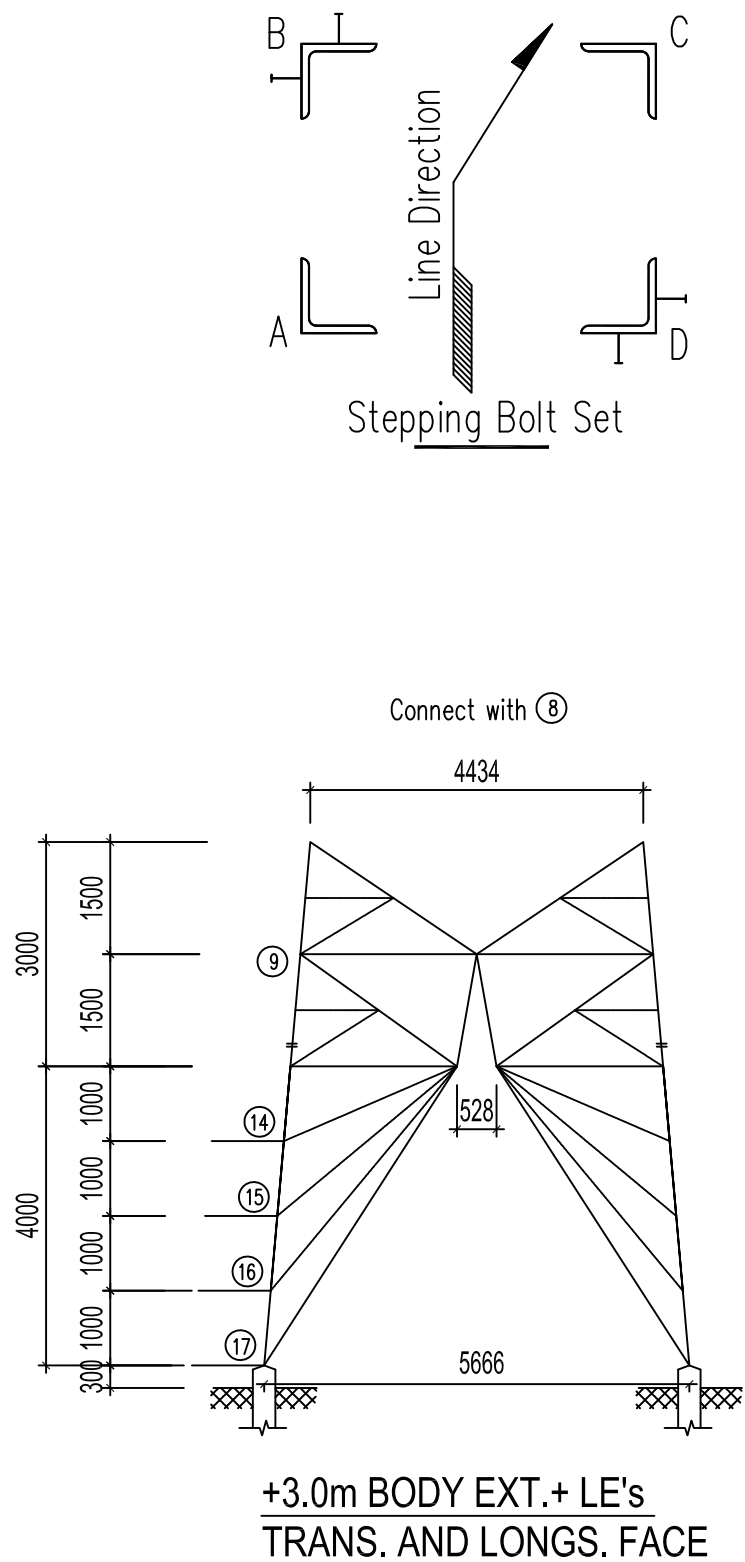
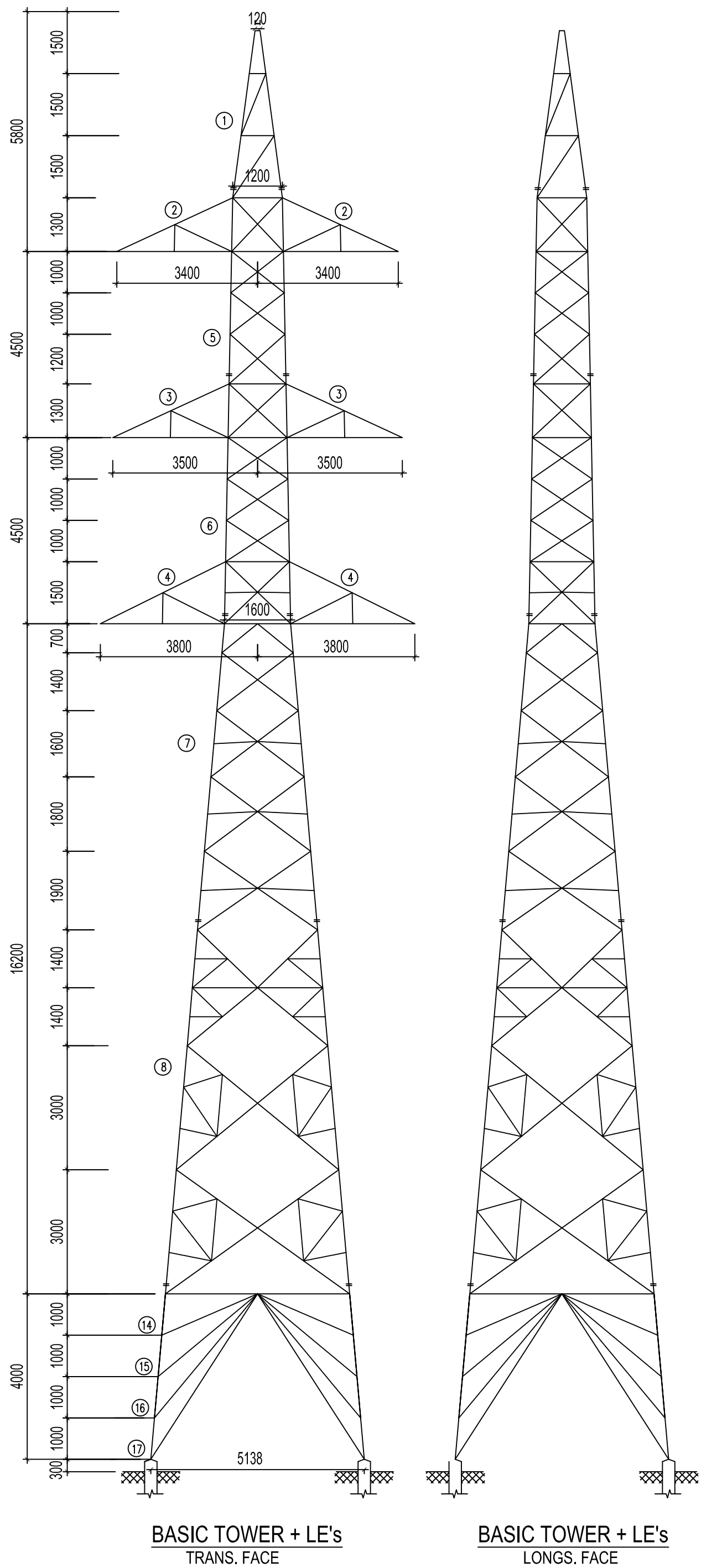
Table2 : Directrix of Angle

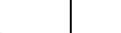
Width of legs (mm)	Directrix(mm)	Directrix of first row(mm)	Directrix of second row(mm)	Notes
£40	20			The number in bracket used when the edge distance of bolt is not enough,when connecting structure and angle steel, the directrix can be used to fix the bolt hole.
£45	23			
£50	25(28)			
£56	28(32)			
£63	30(36)			
£70	35(40)			
£75	38(40)			
£80	40			
£90	45			
£100	50			
£110	55	45	75	
£125	60	50	85	
£140	70	55	90	
£160	80	60	105	
£180	90	65	120	
£200	100	75	135	

NOTES:

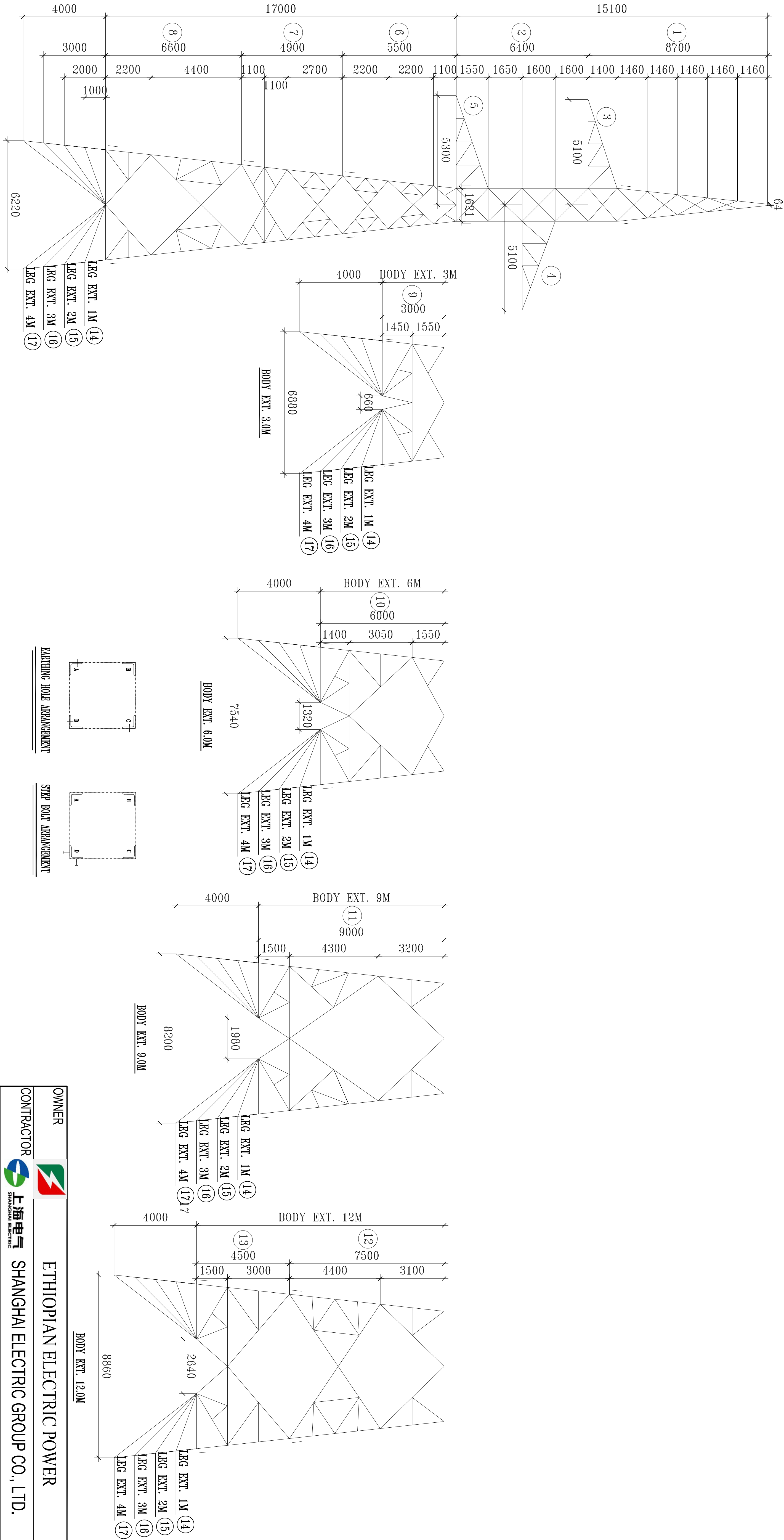
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. Q345 AND Q420 STEEL SHALL BE CLASS "B" AS PER GB/T 1591.
3. STEEL WITHOUT INDICATION SHALL BE Q235 CLASS "B" AS PER GB/T 700.
4. BOLTS AND NUTS SHALL BE IN ACCORDANCE WITH ISO 898.1 AND ISO 898.2:
 - M16 BOLT : GRADE 6.8
 - M20 BOLT : GRADE 6.8
 - M24 BOLT : GRADE 8.8
5. THE SUPPORT STEEL WORK INCLUDING ANGLES, PLATES, BOLTS, NUTS, AND WASHERS SHALL BE HOT-DIP GALVANIZED AS PER GB/T 13912.

one bolt + flat washer+spring washer+one nut					one bolt +flat washer+spring washer+two nuts				
Specification	Symbol	Nut-hole Length	Thickness	Unit Weight(kg)	Specification	Symbol	Nut-hole Length	Thickness	Unit Weight(kg)
M16X40		7	8-14	0.1478	M16X55		7	8-14	0.2039
M16X45		14	15-19	0.1548	M16X60		14	15-19	0.2119
M16X50		19	20-24	0.1618	M16X65		19	20-24	0.2199
M16X55		24	25-29	0.1698	M16X70		24	25-29	0.2279
M16X60		29	30-34	0.1778	M16X75		29	30-34	0.2359
M16X65		34	35-39	0.1858	M16X80		34	35-39	0.2439
M16X70		39	40-44	0.1938	M16X85		39	40-44	0.2519
M20X45		9	10-14	0.2738	M20X65		9	10-14	0.3812
M20X50		14	15-19	0.2848	M20X70		14	15-19	0.3937
M20X55		19	20-24	0.2958	M20X75		19	20-24	0.4062
M20X60		24	25-29	0.3068	M20X80		24	25-29	0.4187
M20X65		29	30-34	0.3193	M20X85		29	30-34	0.4307
M20X70		34	35-39	0.3318	M20X90		34	35-39	0.4427
M20X75		39	40-44	0.3443	M20X95		39	40-44	0.4552
M20X80		44	45-49	0.3568	M20X100		44	45-49	0.4667
M20X85		49	50-54	0.3688	M20X105		49	50-54	0.4802
M20X90		54	55-59	0.3808	M20X110		54	55-59	0.4927
M20X95		59	60-64	0.3933	M20X115		59	60-64	0.5052
M20X100		64	65-69	0.4058	M20X120		64	65-69	0.5177
M24X55		13	14-18	0.4706	M24X75		13	14-18	0.6545
M24X60		18	19-23	0.4886	M24X80		18	19-23	0.6725
M24X65		23	24-28	0.5066	M24X85		23	24-28	0.6905
M24X70		28	29-33	0.5246	M24X90		28	29-33	0.7085
M24X75		33	34-38	0.5426	M24X95		33	34-38	0.7260
M24X80		38	39-43	0.5606	M24X100		38	39-43	0.7435
M24X85		43	44-48	0.5786	M24X105		43	44-48	0.7615
M24X90		48	49-53	0.5966	M24X110		48	49-53	0.7795
M24X95		53	54-58	0.6141	M24X115		53	54-58	0.7975
M24X100		58	59-63	0.6316	M24X120		58	59-63	0.8155
M24X105		63	64-68	0.6316	M24X125		63	64-68	0.8330
M24X110		68	69-73	0.6576	M24X130		68	69-73	0.8505
M24X115		73	74-78	0.6856	M24X135		73	74-78	0.8685
M24X120		78	79-83	0.7036	M24X140		78	79-83	0.8865
					M16X250		200		0.4612



EMPLOYER :					CONTRACTOR:				
		ETHIOPIAN ELECTRIC POWER ADDIS ABABA, ETHIOPIA					SINOHYDRO CORPORATION LTD.		
PROJECT: ETHIO-DJIBOUTI RAILWAYS POWER SUPPLY PROJECT					CONTRACT NO.		33.20/38/07		
					PROJECT NO.		LOT-5		
BY	NAME	DATE	SCALE	N/A	TITLE: DETAIL TOWER ASSEMBLY DRAWING - TOWER TYPE "MD(0°-30°)" - GENERAL LAYOUT				
DESIGNED	JING XULONG	10/05/2015	UNIT	mm					
CHECKED	QIAN JINQIAO	13/05/2015	PLOT	A1					
APPROVED	ZHOU LEI	15/05/2015	SHEET	1/2					
					DOC. NO.	2250-EDRPS-DD-ST-DS			REV. 0

SECTION NO.																	ANTI-CLIMBING DEVICES
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
MATERIAL	513.7	1785.3	334.6	327.5	340.0	1324.3	1232.3	1938.8	1452.1	2182.3	3052.1	2023.9	2031.6	117.0	196.0	270.4	
BOLT	21.2	199.3	22.2	22.2	22.2	125.7	84.8	94.8	87.4	102.0	121.8	62.7	105.6	17.3	21.1	26.1	
TOTAL (KG)	534.9	1984.6	356.8	349.7	362.2	1450	1317.1	2033.6	1539.5	2284.3	3173.9	2086.6	2137.2	134.3	217.1	296.5	96.0



0				SEP. 10, 2016		AS-BUILT DRAWING	
0				AUG. 29, 2015		FOR CONSTRUCTION	
0				APR. 30, 2015		FIRST ISSUE FOR APPROVAL	
REV.		DATE		NOTES			
☐ APPROVED				☐ APPROVED AS CORRECTED			
☐ REVISED AND RESUBMIT				☐ NOT APPROVED			
DATE:				SIGNATURE:			

TRANSMISSION LINE					
ADIGALA-MILO-LONIS-HURSO 230KV TRANSMISSION LINE					
		BY	DATE	TOWER TYPE C OUTLINE	
DESIGNED		马海	SEP. 05,2016		
DRAWN		马海	SEP. 07,2016		
CHECKED		薛其	SEP. 09,2016		
APPROVED		马海	SEP. 10,2016		
SCALE		1:200	DRW NO.	EDRP-L0T3-TL-AMLH-230-T06-Z-DW-001	

OWNER
CONTRACTOR
PROJECT

ETHIOPIAN ELECTRIC POWER
SHANGHAI ELECTRIC GROUP CO., LTD.
ETHIOPIA - DJIBOUTI RAILWAYS POWER SUPPLY

CONTRACT EDRP ,LOT3 :

MATERIAL LIST

[illegible]

TOWER HEIGHT	BODY NUMBER COMBINATION
$\pm 0.0\text{M}$	$(1 \sim 8) + (10) + \text{ANTI-CLIMBING DEVICES}$
$+3.0\text{M}$	$(1 \sim 8) + (9) + (11) + \text{ANTI-CLIMBING DEVICES}$
$+6.0\text{M}$	$(1 \sim 8) + (9) + (12) + \text{ANTI-CLIMBING DEVICES}$
$+9.0\text{M}$	$(1 \sim 8) + (9) + (13) + \text{ANTI-CLIMBING DEVICES}$
$+12.0\text{M}$	$(1 \sim 8) + (9) + (14) + (15) + \text{ANTI-CLIMBING DEVICES}$

Contract- GDYW-2 "Supply and Construction of 400 kV Genale Dawa III-YirgalemI-Wolayita Soodo II Transmission Line"									
OWNER:									
ETHIOPIAN ELECTRIC POWER									
DESIGNER:									
CHINA ENERGY ENGINEERING GROUP XIJIANG ELECTRIC POWER DESIGN INSTITUTE CO.,LTD									
CONTRACTOR:									
MOHIO International Cooperation Ltd. & CHINA ENERGY ENGINEERING GROUP XIJIANG ELECTRIC POWER DESIGN INSTITUTE CO.,LTD									
DESIGNER:  北方国际 NORTH ENERGY ENGINEERING GROUP XIJIANG ELECTRIC POWER DESIGN INSTITUTE CO.,LTD									
YIRGALEM II -HAWASA II 230KV D/C TRANSMISSION LINE									
DOC. STATUS: FILE FOR APPROVAL									
DESIGN:  TITLE									
CHECKED:  INTERMEDIATE FILE									
REVIEWED:  WORKING DRAWING									
APPROVED:  AS BUILD									
DATE: Jul.1,2017									
SCALE: 1:20									
DRAWING No. GDYW-YH-IL-230-10-S-DW-027-A									
CD TOWER MATERIAL LIST									

