Suri Khola Hydropower (P.) Ltd

Kathmandu

33 kV Double Circuit Transmission Line Project

Design Report

Of

Suri Khola Hydropower Project

Dolakha District, Janakpur Zone

Nepal

October 2014

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SALIENT FEATURES

General

Development region	Central
Zone	Janakpur
District	Dolakha
District headquarter	Charikot
VDC	Chankhu and Suri
Project location (same as before)	
Longitude	86° 15’ 10” to 86° 12’ 50” East
Latitude	27° 45’ 14” to 27° 44’ 10” North
Type of scheme	Run of river (RoR)
Source river	Suri Khola

Hydrology

Catchment area	36.40 km^2 at intake site
Mean annual precipitation	1650 mm
Design discharge	3.075 m^3/s ($Q_{40\%}$)
Compensation flow	0.066 m^3/s
1 in 100 years return period design flood	167.75 m^3/s
1 in 5 years return period operation flood	61.22 m^3/s
1 in 2 years return period diversion flood	34.55 m^3/s

Power and energy

Gross head	282 m
Rated net head	269.71m
Installed capacity	7000 kW
Dry season energy	5.15 GWh
Wet season energy	28.75 GWh
Annual energy	33.90 GWh

Project components

Weir

Type	Concrete lined weir
Crest level	1395 m amsl
Length of weir	20 m including undersluice
Spillway type	Free overflow

Intake

Type	Gated submerged orifice intake with course trash rack
Nos. of opening	2 nos
Opening size	2.5m long X1.0 m

Conneting canal

Type	Box type
Length	18.37 m
Width	1.50 m
Overall depth	1.65 m
L-slope	0.215277778
Overflow spillway length	7.84 m
Overflow spillway capacity	10 m^3/s

Gravel trap

Type	Continuous flushing hopper type
Overall length	8.17 m
Width	3.75 m
Overall depth	2.60 m
Particle size to be trapped	5 mm
Design flow	3.54 m^3/s
Flushing flow	0.41 m^3/s

Settling basin

Type	Double chamber, gravity flushing type
Settling zone length	43.00 m
Inlet transition length	16.20 m
Single basin width	5.00 m
Overall depth	3.77 m
Particle size to be settled	0.15 mm with 90% settling efficiency
Design flow	3.075 m^3/s

Headpond

Type	RCC tank
Storage period	60 s
Effective length	11.45 m
Width	7.50 m
Effective depth	1.91 m
Effective storage	165 m^3

Normal water level	1394.726 m amsl

Penstock

Type	Surface, mild steel circular shaped
Length	3384 m
Internal diameter	1.30 m
Thickness	6-22 mm
Design flow	3.075 m^3/s
No. of anchor blocks	52
No. of support piers	370

Powerhouse

Type	Surface type, RCC structure
Length	27.82 m
Width	16.24 m
Height	12.00 m
Tailrace length	80 m

Turbine

Type	Pelton (2 units)
Rated capacity	3700 kW one unit
Turbine axis level	1113 m amsl
Design flow	1.538 m^3/s for one unit

Generator

Type	3 Phase brushless synchronous (2 units)
Rated capacity	4375 kVA each
Rating	50 Hz, 750 rpm
Governor	Electro-Hydraulic
Overhead crane	Lifting capacity 25 T

Step up transformer

Type	3-Phase, ONAN cooled, Outdoor type
Rating	2 x 4375 kVA, 6.90/33kV, 50 Hz

Transmission line	33 kV Double circuit, 3 phase, 50 Hz, 6.8 km long
Connection with grid	Singati sub-station
Access road	Earthen road, 3.5 km long

Cost and finance

Project cost (with IDC,)	1052.993 Mill NRs
Cost per kW (with IDC)	1534.98 US$/kW
Debt equity ratio	70/30
FIRR	14.20%
NPV	138.541 Mill NRs
BC ratio	1.29
Return on equity	16.70%

1. INTRODUCTION

1.1. BACKGROUND

Potential of hydropower energy in Nepal is huge. The perennial nature of Nepali rivers and the steep gradient of the country's topography provide ideal conditions for the development of some of the world's largest hydroelectric projects in Nepal. Nepal has approximately 40,000 MW of economically feasible hydropower potential. However, the present situation is that Nepal has developed only approximately 650 MW of hydropower. Therefore, bulk of the economically feasible generation has not been realized yet.

Although granted with tremendous hydropower resources, only about 40% of Nepal's population has access to electricity. Most of the power plants in Nepal are run-of-river type with energy available in excess of the in-country demand during the monsoon season and deficit during the dry season.

Nepal's electricity generation is dominated by hydropower, though in the entire scenario of energy use of the country, the electricity is a tiny fraction, only 1% energy need is fulfilled by electricity. The bulk of the energy need is dominated by fuel wood (68%), agricultural waste (15%), animal dung (8%) and imported fossil fuel (8%). The other fact is that only about 40% of Nepal's population has access to electricity. With this scenario and having immense potential of hydropower development, it is important for Nepal to increase its energy dependency on electricity with hydropower development.

To attract private investors towards the development of small hydropower projects, Government of Nepal has adopted a liberal policy since 1990. Nepal Electricity Authority (NEA) has also announced its policy to purchase power generated by the private developers and two distinct prices for electricity is fixed for both dry and wet seasons. Banks and financial institutions have also shown their interest to invest in hydropower projects as priority sector investment. This scenario has encouraged the private investors to promote small hydropower projects in Nepal.

1.2. SURI KHOLA HYDRO POWER PROJECT

Suri Khola Hydropower Project is located at Chankhu and Suri VDCs of Dolakha district. It has installed capacity of 7 MW with 2 units of pelton turbines. Geographically the project area is located between longitudes 86^{o} 14’ 00”E to 86^{o} 09’ 40”E and latitudes 27^{o} 46’00” N to 27^{o} 43’30” N.

Distance from Kathmandu to Project area is around 175 km. From Kathmandu to Khadichaur (Araniko Highway), the distance is 78 km. Motorable track road goes from Charikot to Singati. Charikot is connected to the Araniko Highway via Khadichaur 55 km long road. From Charikot to Singati, there is track road 35 km long and from Singati to Bhorle is 7 km graveled road. The road is to be constructed with the active participation from local people. From Dolakha, the powerhouse site is about 3 km far. The intake site located at Khalde village is about 3 km upstream from the powerhouse site.

The nearest sub-station from the project site is located at Singati of Dolakha district. The power generated from this project will be synchronized with 33 kV transmission line. The length of the proposed transmission line will be about 7 km from the powerhouse of the Suri Khola Hydropower Project.

1.3. 33 kV TRANSMISSION LINE

The power generated from Sri Khola Hydropower Project shall be connected to the NEA 33 kV substation in Singati, of Dolakha district. The power generated from Suri Khola HP shall be connected to 33 kV bus bar of Singati substation. The magnitude of the electricity to be transmitted is 7 MW from Suri HP to Singati S/S. Project shall construct 33 kV double circuit line from the proposed switchyard of the powerhouse to the existing 30 MVA 33/132 kV substation. The length of the proposed 33 kV transmission line shall be about 7 km.

The proposed route of 33 kV Transmission Line of Suri Khola Small Hydropower Project passes through Gurumphi village of Suri VDC.

The 33 kV transmission line shall be constructed from the switchyard of the powerhouse towards the NEA substation. The line shall be made in steel tubular poles (telescopic) of 13 m heights and placed at an average span of 50-60 m. The minimum clearance to ground shall be maintained above 7 m. The conductor for use in this project shall be 0.10 sq. inch ACSR “Dog” based on power to be transmitted, length, and mechanical strength and voltage regulation. Other necessary materials and accessories like insulators, cross arms, stays, jointing sleeves shall be in accordance with the IEC standard for use on 33 kV transmission line.

Two 6.9/33 kV, 4375 kVA outdoor power transformer shall be connected to the 33 kV transmission line outside the powerhouse. The 6.9 kV bus bar shall be supported inside the control panel with the required isolating material.

1.4. EXISTING TRANSMISSION LINE IN THE VICINITY

Singati Substation is to be connected to Lamosanghu substation with 132kV transmission line of 40 km. The substation will evacuate power from different hydroelectric projects to be developed

by different IPPs in the Tamakoshi – Singati basin. Till date 33 kV transmission line from Siprin Hydropower project has been connected to the substation. And this power is transmitted to Upper Tamakoshi hydro power project.

1.5. SCOPE OF WORK

The main scopes of the study are to select the route of 33 kV transmission line from Suri Khola powerhouse to Singati substation, Singati, and its drawings with Pole Location; Detail survey and electrical design of 33 kV transmission line from Suri Khola powerhouse to Singati substation, Singati; bill of quantity; technical specifications of the equipments required for the construction of the transmission line.

2. GENERAL SCOPE AND METHODOLOGY OF THE STUDY

The detailed survey and design of 33 kV Double Circuit Transmission Line of Suri Khola Hydropower Project has been carried out by CEPAD Hydro Consultants (P.) Ltd. First of all, collection and review of existing data and literature related to the site and electricity transmission was done then after detail survey was performed on the final route for the Transmission Line. The detail of the work such as calculation, design of electro mechanical components and drawings are attached in the Annexes at the end.

2.1. TRANSMISSION LINE ROUTE SELECTION

Team of engineers and local residents, were actively involved in the selection of the appropriate route for the transmission line and its design. Different routes for the transmission line were proposed and the appropriate route was selected. The selection of the final route for the transmission was selected based on walkover survey, direct field observation, appropriate length and discussions with local key informants. Technically feasible and socially acceptable route was selected for the detail topographical survey.

2.2. TOPOGRAPHIC SURVEY

Topographic survey of transmission line corridor was done using Total Station and other machines as per the requirement of site. The topographical map with the pole locations is in 1:10,000 scales with contour interval of 20 m. with the help of software GIS. Pole Locations, profile, layout of the Route and the Topographical map of the route can be found in Annex – A.

2.3. TRANSMISSION LINE DESIGN

The proposed 33 kV double circuit transmission line will be 6.8 km. long, with steel telescopic poles with height of 13 m, having average ruling span 60-70 m. The ground clearance of the designed transmission line will be greater than 7 m. First of all, route survey was carried out by walking through the proposed project alignment. Latter on the detail survey was carried out by using Total Station and detail topographical map for the proposed route is prepared. The plan of the transmission line will be prepared in the scale 1:15,000 and that of L – section shall be prepared in suitable scale. The location of the pole can be found plotted in the map and the coordinates can be found in Annex – B. From the detail survey report, the quantity of poles, length of conductors, insulators and stay out etc. is also quantified. The location of the stay shall be fixed by receiving the deviation angle of the proposed alignment. The telescopic tubular poles (13 m) are proposed for the ease of transportation. The conductors for the transmission line after

the detail electrical analysis is ACSR "Dog". The hardware and structure shall be based on the latest standards and practices adopted by different agencies.

By the help of survey data, sag of the conductor between the poles was determined and hence the length of the conductor. The calculated length of the conductor was 6.99 km. For 3 – Phase double circuit line the length of conductor required will be around 42 km. The list of particulars needed for the construction is attached in Annex – B.

Every pole is to be grounded by using 2.5 m. long GI spike earthing rod (of 16 mm. diameter). One spike earthing rod is to be driven into the ground near each telescopic pole. Preventive measures should be taken to avoid rusting/corrosion of the joints as it increases resistance of the path of grounding.

2.4. COST ESTIMATION

The cost estimation for civil works shall be based on the unit rates developed from prevailing labor rate, construction equipment rate and material rate taking into account the local situation and bill of quantities derived from design drawings. The rates for locally available labor shall be obtained from District rates of Dolakha District. The rate of construction equipment shall be taken from regularly updated cost data, quotation from the supplier/ manufactures. The rates of construction materials shall be derived accordingly as their source of supply. While calculating the construction materials rate, sufficient attention shall be given to the mode of transportation and their corresponding cost shall be included. From labor cost, material cost and equipment cost, the direct cost per unit of construction activity shall be calculated. All other indirect costs such as office overhead, contractor's financing cost, insurance, bond, profit and risk margin shall also be included in the total cost of the activities. Detail cost estimation and Bill of Quantity are attached in **Annex – C**.

3. TECHNICAL SPECIFICATION

3.1. SPECIFICATION OF INSULATORS AND HARDWARES

This specification covers the design, manufacturing/ fabrication, procurement, supply and delivery to the site of the following goods.

a. Porcelain Insulators
b. Stay Set
c. Miscellaneous

3.1.1. PORCELAIN INSULATORS

a. Scope

This specification covers the fabrication and supply of pin insulators, suspension insulators, and stay insulators as herein specified for use on overhead power line construction. The qualified manufacturer should be a holder of ISO Certificate.

All insulators furnished under this specification shall be fabricated and tested in accordance with the National Standard referenced for each type of the following insulator.

b. 33 kV Pin Insulator

The pin insulator made up of brown glaze high quality porcelain shall be manufactured and tested in accordance with ISO or the latest version hereof as detailed in drawings.

The pin insulators shall have the following rating and features.

System Voltage	33 kV
Highest System Voltage	36 kV
Rated Voltage	33 kV
Creepage Distance (minimum)	580 mm
Wet Power Frequency Withstand Voltage for 1 minute	75 kV
Impulse Withstand Voltage	170 kV
Puncture Power Frequency Voltage (minimum)	180 kV
Visible Discharge Voltage (effective)	27 kV
G.I. Pin Head	Large

c. Disc Insulator

The disc insulator made up of brown glaze high quality porcelain shall be manufactured and tested in accordance with ISO or the latest version hereof as detailed in drawings.

The disc insulator shall be ball and socket type of size 16 mm. B. the disc insulator shall be supplied in a string of three (3) pieces of 11 kV disc insulators for 33 kV voltage system with tension clamp as detailed in related drawing. Each 11 kV disc insulator shall have the following rating and features:

System Voltage	11 kV
Highest System Voltage	12 kV
Rated Voltage	11 kV
Porcelain Diameter	255 mm
Spacing	145 mm
Creepage Distance (minimum)	320 mm
Power Frequency Puncture withstand Voltage	1.3 × Actual dry Flashover Voltage
Wet Power Frequency Withstand Voltage	35 kV
Impulse Withstand Voltage	75 kV
Visible Discharge Voltage (effective)	9 kV
Electro-Mechanical Strength	45 kN
Applied Standard	IS:731:1971

d. Stay Insulator

The Stay insulators shall be made of brown glaze high class porcelain as shown in the related drawing. The stay insulator shall be manufactured and tested in accordance with ISO as detailed in drawings. The stay insulator shall have following ratings and features:

Rated Voltage	33 kV
Highest System Voltage	36 kV
Creepage Distance (minimum)	57 mm
Minimum Failing Load	>80kN
Power Frequency Withstand Voltage, kV for 1 minute:	
Dry	27 kV
Wet	13 KV
IS Designation	C

e. 33 kV Insulators Pin

1. General

This specification covers the fabrication and supply of bolt type, cross arm insulator pins.

2. Description

The insulator pin to be supplied shall conform to the shape and dimensions shown in the drawing contained in this specification. The insulator pin shall be furnished with a spring steel split lock washer and nut assembled on the insulator pin.

The insulator pin shall have following rating and features:

Head Type	Small S165P
Total Length (mm)	450
Stalk Length (mm)	300
Shank Length (mm)	150
Minimum Failing Load (kN)	10
Applicable Standard	IS-2486 (Pt. I &II)

3. Materials

The insulator pins specified herein shall be fabricated from hot rolled steel. The pins shall be a single piece obtained preferably by the process of forging it shall not be made by joining, welding, shrink-fitting or any other process from more than one piece of material. It shall be of good finish free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided.

4. Galvanization

All ferrous pins, nuts and washers expect those made of stainless steel shall be hot dip galvanized. The threads of nuts shall be cut after galvanizing and shall be oiled and greased. The galvanization shall confirm to IS 2629-1985.

f. Tension Clamp.

The tension clamp shall be of ball and socket type to be used for disc insulators. The details of the clamp shall be as described herein document. The fabrication/manufacturing of the tension clamp shall confirm to the latest version of ISO or equivalent standards. The galvanizing of the ferrous metal should be hot dip galvanized and shall be conformed to the specification IS 2629-1985.

The Tension Clamp shall have following features:

Steel Classification	Mild Steel & Forged Steel
Tension Clamp	Hot dip Galvanized type
Cotter Pin & U-bolts	Galvanized Stainless Steel
Galvanizing Standard	IS:2629

3.1.2. STAY SET

a. General

This specification covers the supply of the stay set assembled with the following accessories for use to guy overhead 33 kV line at angle points and dead end points. All the accessories shall be galvanized as per the relevant standards.

b. Stay Rods

Stay rods shall be made of mild steel of ultimate tensile strength of 4200 kg/sq. cm. as per IS 432 Part 1. Length and section of the rod shall be as mentioned in the rating and features. One end of stay rod shall be square headed 50×50×15 mm. and other end is threaded as shown in drawing.

c. Turn Buckle

The stay turnbuckle shall be bow type with ratchet nut adjuster as shown in figure. The turnbuckle shall be made of steel of 4200 kgf/sq. cm. as per IS 432 Part 1. Bow type part of the turnbuckle shall be made of the 18 mm. steel rod. A thimble made of 18 SWG G.I., steel shall be coupled with bow. The thimble shall be suitable for 7/10 SWG stay wire.

d. Stay Plate

The stay plate shall be square type galvanized M.S. plate of 6 mm. thick. The plate shall have suitable square shape hole of 40 mm. × 40 mm. at the center. The dimension of the plate shall be of 400 mm. × 400 mm. for 33 kV line. Stay plate rod assembled with stay rod has been shown in the drawing.

e. Galvanizing

All the stay set assembly must include rod, plate, turnbuckle, nut and bolts, washers, thimble, etc. and they should be hot dip zinc galvanized conforming to IS 2629-1985.

f. Stay Wire

The stay wire shall be zinc coated steel wire strand type generally used for guying the Stay Set used on poles for the construction of overhead power line.

a. Description of strands

The steel strand shall be fabricated in accordance with ASTM specification A-475 or and equivalent national or international standard, subject to the provision of paragraph 4 contained herein.

The steel strand shall have the following features:

Size	7/10 SWG
Quality of individual wire	Class B with high strength
Quoting on the wire	Zinc
Individual wire diameter after quoting	12.70 mm.
No. of strand	7 wires
Nominal diameter of the strand	4.19 mm.
Laying of the strand	Left hand lay
Minimum breaking strength	18800 lbs

b. Packaging

The steel wire strand shall be furnished in 60 m. reels. Each reels shall have a weather resistance tag securely attached the length, nominal diameter, number of individual wires, grade of the strand, and the class of zinc coating.

g. Other Accessories

The Stay Set shall also include all other accessories such as nut, bolts, washers, thimble, etc. that are necessary to assemble and fit the complete Stay Set.

h. Rating of Stay Set

Length of stay rod	8 ft
Diameter of rod	18 mm.
Ultimate tensile strength of stay rod and turn buckle	4200 kg/sqm.
Length of threaded portion	300 mm.
Thimble shape	Suitable for 7/10 SW Steel Wire
Thimble section	18 SWG min
Stay plate section	400×400×6 mm.
Elbow	18 mm. dia. M.S. rod
Galvanization	Confirm to IS - 2629 – 1985
Applicable standard for steel	IS – 432

3.1.3. MISCELLANEOUS

a. Full Tension Sleeve

The sleeve shall be dual tension (2 pieces) for use with ACSR conductor. The steel sleeve shall be heavily plated for resistance to corrosion and compatibility with aluminum and shall be abrasive lined for maximum holding strength.

The aluminum outer sleeve for 100 sq. mm ACSR conductor shall have a filler hole to permit centering over the steel sleeve and permit inhibitor application.

b. Aluminum Binding Wire

The aluminum binding wire shall be used for binding or securing 100 sq. mm. ACSR conductor to pin insulators fixed on the cross arms. The aluminum binding wire should

be of required strength and conforming to latest ISO standards. However the diameter of the aluminum wire should not be less than 3.25 mm.

c. PG Clamp

PG Clamps shall be used for application in the non-tension connection at jumper supports in 33 kV line structures. PG Clamps should be suitably designed for tightening and holding of 100 sq. mm. conductor in place. It must be corrosion resistant and conform to latest ISO standards.

3.1.4. INSPECTION

The materials to be procured shall be subjected to routine test before final shipment to delivery site. Following tests may be carried out:

i. Dimension Test
ii. Temperature Cycle Test
iii. Mechanical Failing Load Test
iv. Porosity Test
v. Power Frequency Test
vi. Galvanizing Test
vii. Bend Test/Load Test
viii. Hardness

3.1.5. BIDDING DOCUMENTATION

a. The bidder shall provide with the bid two (2) clear copies of the specification governing manufacturing and testing of the insulators, stay set, stay wire, tension sleeve, aluminum binding wire and PG clamp along with relevant drawings, catalogues.

b. Type test certificate, if applicable shall be included in the bid and shall bear a date that is not earlier than five years from the last date of bid submission. The type test certificate shall have been issued by a reputed independent laboratory.

Sample Size and Acceptance Number

Lot Size	For Dimensions and Temperature Cycle Test					For Mechanical, Electro-Mechanical and Porosity Test		For Galvanizing and Puncture Test	
	1st sample size	2nd sample test	Acceptance Number	1st rejection number	2nd rejection number	1st sample size	2nd sample size	1st sample size	2nd sample size
Up to 1000	8	8	0	2	2	5	5	3	3

DATA SHEET

The Bidders/Manufacturers/Suppliers are required to furnish the following required information in the Data Sheet. Separate sheets can be used if additional space is required. The information furnished shall be supported by the catalogue and test reports. Any deviation from the requirements shall be clearly mentioned giving the reasons thereof.

INSULATORS AND HARDWARES

1. 33 kV Pin Insulator

S. No.	Particulars	Offered
1	System Voltage	
2	Highest System Voltage	
3	Rated Voltage	
4	Creepage Distance (min.)	
5	Wet Power Frequency Withstand Voltage for 1 minute	
6	Impulse Withstand Voltage	
7	Puncture Power Frequency Voltage (min.)	
8	Visible Discharge Voltage (effective)	
9	G.I. Pin Head	

2. 33 kV Disc Insulator (3 nos. of 11 kV Disc Insulator)

S. No.	Particulars	Offered
1	Highest System Voltage	
2	Rated Voltage	
3	Porcelain Diameter	
4	Spacing	
5	Creepage Distance (min.)	
6	Power Frequency Puncture Withstand Voltage	
7	Wet Power Frequency Puncture Withstand Voltage	
8	Impulse Withstand Voltage	
9	Puncture Power Frequency Voltage (min.)	
10	Voltage Discharge Voltage	
11	Electro-Mechanical Strength	

3. 33 kV Stay Set (Including Stay wire & Stay Insulator)

S. No.	Particulars	Offered
1	Length of Stay Rod	
2	Diameter of Rod	
3	Ultimate tensile strength of stay rod and turn buckle	
4	Length of threaded portion	
5	Thimble shape	

6	Stay plate dimension	
	Stay Wire	
1	Quality of individual wire	
2	Quoting on the wire	
3	Individual wire diameter after quoting	
4	No. of strand	
5	Nominal diameter of the strand	
6	Laying of the strand	
7	Minimum breaking strength	
	Stay Insulator	
1	Rated Voltage (kV)	
2	Highest System Voltage (kV)	
3	Creepage Distance (min. mm.)	
4	Minimum Failing Load	
5	Power Frequency Withstand Voltage, kV for 1 minute, kV:	
	Dry Wet	
6	IS Designation	

3.2. SPECIFICATION OF ACSR "Dog" CONDUCTOR

3.2.1. SCOPE

The specification covers the design, manufacturing/fabrication, and supply and site delivery of Aluminum Conductor Steel Reinforced (ACSR) commonly used on overhead power/distribution line construction

3.2.2. DESCRIPTION

1.1. All conductors should be of ACSR construction and shall be manufactured in strict conformity to BS215 Part 2. The ACSR conductor shall be fabricated in accordance with British Standards Institution Specification BS215 Part 2 1956 or IS 398:1961.

The steel core and the first layer of aluminum shall be greased. The grease shall be of neutral type and at temperature of 100°C and the grease neither flow nor extrude from the conductor. The grease shall retain its properties as resistance to oxidation and chemical stability at all service temperatures. The steel strands of ACSR conductor shall be performed so that they remain inert and do not move relative to each other when the conductor is out. The outermost layer of all conductors shall be stranded with right hand lay.

The correct tension must be maintained on the stranding machine when spinning the cable to avoid the possibility of bird caging due to stringing. Any condition not complying may be rejected at the discretion of the Engineer.

The purity of the aluminum shall be the highest commercially available and not less than 99.5%, the copper content not exceeding 0.48%. The contractor shall submit the certificates of analysis giving the percentage and the nature of any impurities in the metal from which the wires are made. Aluminum wire shall be made to BS2627 and steel wires to BS4565.

Precaution shall be taken during the manufacturing, storage and erection of steel core aluminum conductors to prevent the possibility of contamination by copper or other materials, which may adversely affect the aluminum. The manufacture of steel core aluminum shall be carried out in a portion of factory specially set aside for such purposes. Machinery previously used in manufacture of copper or copper-bearing conductors shall not be for the manufacture of these aluminum or steel wires. The size and the composition of the entire conductor shall be as stated in general specification.

The conductor shall be supplied on drums of approved construction. The drums shall be securely battened to protect the conductor. Drum battens shall not be removed until the drum is properly mounted on the drum station on line and battens shall be immediately refitted to the drum if any surplus conductor is left therein. Each drum shall be marked

with the manufacturer's name, direction of rolling, any mark, code name, the length, size stranding, net weight, gross weight, approximate measurement and production date of the conductor and manufacturing batch number incised. The minimum length of the conductor shall be at least 1 km. per drum and maximum 2 km. per drum. However EMPLOYER may ask supplier to supply conductor of 1 km. length per coil and coiled without drum if required. The supplier shall quote the individual weight of the conductor and weight of the wooden drum on which it is rolled.

It is made clear to the contractor that the guaranteed weight of the conductor ACSR "DOG" is 394 kg. per km. For any reduction in the actual weight of the conductor from guaranteed weight, the deduction on the contract cost will be made by the Employer for the reduced weight as per the rate quoted on the price schedule. However, no extra cost shall be paid to the contractor for the increased weight of the conductor (hence the length of the conductor).

3.2.3. GENERAL SPECIFICATION

The following listed specification is those, which govern the fabrication. Testing and supply of the materials to be made under this tender are contained in IFB.

	Description	DOG
1	Conductor Size	118.7 mm²
2	Number/Diameter of wire	
	Aluminum	6/4.72
	Steel	7/1.57
3	Cross section	
	Aluminum	105 mm²
	Steel	13.55 mm²
	Total	118.7 mm²
4	Conductor Diameter	14.15 mm
5	Ultimate Strength	3310 kg
6	Coefficient of Linear Expansion	19.8 × 10 -6
7	Standard Mass of Conductor	394 kg/km

8	Electrical DC Resistance at 20^0C	0.2722 ohm/km
9	Standard non jointed length on reel	1000 m
10	Nominal Copper Area	65 mm²
11	Standards	BS:215 Part 2, IEC 209

3.2.4. TESTS AND PACKAGING

The manufactured conductors shall be subjected to the routine test at the manufacturer's premises before shipment.

The following tests will be carried out as per IS398: Part 2 1976 Aluminum conductor, ACSR conductor (Second edition):

a. Breaking Load Test
b. Ductility Test
    i. Torsion Test
    ii. Elongation Test
c. Wrapping Test for Al. wires & Galvanized Steel wires
d. Resistance Test
e. Galvanizing Test

Each reel of conductor furnished shall contain only one length of conductor in other words there should not be any joint in the conductor rolled in a reel.

All conductors shall be packaged in non-refundable wooden reels and shall be protected against damage in handling, shipping and storage by heavy wood lagging securely applied to each reel. All reels shall be sufficiently sturdy to withstand to shipment, storage and field construction operation without distortion or disintegration.

All reels shall be legibly marked in paint with the following information:

a. Size of Conductor
b. Type of Conductor
c. Length in meter
d. Net weight of Conductor
e. Direction of Rolling
f. Total weight of the whole reel

3.2.5. BID DOCUMENTATION

The bidder shall provide with the bid two (2) clear copies of the standard governing fabrication of the conductor and two (2) clear copies of all other specification referenced therein as relevant to the fabrication and testing of the ACSR conductor

The supplier shall also provide with the certificate of compliance, as specified in BS215 Part 2: 1970 at the time of the shipment of each lot of the conductor or as required by the appropriate selection of the equivalent national standard.

The bidder shall provide certified type test results of all types of ACSR conductors as required by governing standards.

All data, drawings, catalogue and others technical documents shall be bound separately from the Bid document.

DATA SHEET

(To be filled in by the Bidder/Manufacturer/Supplier)

The Bidder/Manufacturer/Suppliers are required to furnish the following information in the Data Sheet. Separate sheets can be used if additional space is required. The information furnished shall be supported by the catalogue and test reports. Any deviation from EMPLOYER's requirements shall be clearly mentioned giving the reasons thereof.

0.1 sq. inch ACSR Conductor

TECHNICAL DATA SHEET

(To be completed by Bidder)

	Item	**0.1 Sq. Inch ACSR Conductor "DOG"**
	Description	**Unit**
A	Manufacturer	
B	Governing Standards	
C	Copies of Standard Attached	Yes/No
D	Copies of Type Test Attached	Yes/No
E	If standards is not BS: 215 (Part 2) are the conductor specifications same as the BS: 215 requirements in respect to the following?	
	Diameter	Yes/No
	Strand Size	Yes/No
	Direction of Lay	Yes/No
	Lay Ratio	Yes/No
	Materials	Yes/No
F	Technical Data	
	1. Size	
	2. Number/Dia. Of wire	
	a. Aluminum	

b. Steel

3. Cross Section

a. Aluminum

b. Steel

c. Total

4. Conductor Diameter

5. Ultimate Strength

6. Modulus of Elasticity

7. Coefficient of Linear Expansion

8. Standard Mass of Conductor

9. Electrical DC Resistance at 20°C

10. Standard non-jointed length on reel

11. Breaking Load

12. Mass of Zn Coating in Steel Standards

3.3. SPECIFICATION OF STEEL TELESCOPIC POLE (B27)

3.1.1. Scope

1.1. This Specification covers the design, fabrication, testing and supply of steel telescopic poles to be used to support overhead electric lines and equipment.

3.1.2. Description

2.1. The poles shall be telescopic, uniformly tapered circular in cross-section. The poles shall be fabricated in sections as specified in Table 2 out of welded tubes of suitable lengths. The diameters of the top and the bottom end of the completely assembled pole shall be as specified therein.

2.2. The sections of the steel poles shall be designed such that the butt end of the top section fits on the top end of the second section, the butt end of the second section fits on the top

end of the third section and so on. The various sections shall be fitted together by pressed friction joints. The completely assembled telescopic pole shall have the design loads as specified in Table 1. The separate pole cap shall be provided with top section of the pole. The bottom section of the pole shall be provided with a base plate.

3.1.3. Material

3.1. The telescopic pole sections and fittings shall be manufactured from standard steel as per BS 4360 Grades 43 C, D, E or 50 C, D, E or equivalent national/ international standards.

3.2. The steel tubes shall confirm to the requirements of BS 6323 Parts 1 to 8 Steel Tubes.

3.1.4. Manufacture

4.1. The pole shall be erected by friction joint without involvement of through bolt, site welding or any type of additional device of joint at the time of erection.

4.2. It shall be the responsibility of the Bidder to determine the thickness of the tubing adequate to sustain the load and test requirements. The Bidder shall determine the thickness of the tubing to develop the required pole strength in accordance with the Bidder's method of fabrication. However, the thickness of the tubing shall not be less than **3 mm**, and the following tolerances shall be maintained:

a.	Tolerance on diameter:	+/- 1% from Bidder's data sheet.
b.	Tolerance on weight:	+/- 10% on each pole. +/- 7.5% on a bulk load of up to 20 tons.
c.	Tolerance on thickness:	+/- 10% on each sheet.
d.	Tolerance on telescopic poles:	For each section it shall not exceed +10mm and -0 mm. After assembly the telescopic poles shall not exceed+/-75 mm of their stated length in the Technical data sheet.

e. The out-of-straightness of the assembled pole shall not exceed 1/600 of the height.

4.3. For 13m Pole

Each segment of the Pole has been denoted by the designation B2, B3, B4, B5, B6, B7. A combination of several pieces of these segments will form a pole. Each piece of segment shall be measured 2.5 m in length and tapered in such a way that each adjacent numbered pieces fit into the other for assembling the required type of pole such as Pole B26 and B27. Assembling segments B2, B3, B4, B5 and B6 shall form the Pole B26. And assembling segments B2, B3, B4, B5, B6 and B7 shall form the Pole B27.

4.4. All welding of the poles shall be carried out at the manufacturers' plant.

4.5. 4.5 Welds parallel to the longitudinal axis of the poles shall be fillet welds. Each section of the pole shall have only one longitudinal weld. However the bottom section B6 of

11m long poles and B6 & B7 sections of 13m long poles can have maximum one additional longitudinal weld. No circumferential joints/welds of the tubes are permitted. All welds shall be capable of withstanding, without failure or cracking, the stresses in a pole when subjected to its ultimate design loads

4.6. All seam welds on joint mating surfaces shall be ground flush. All high spots in the galvanizing on the mating surface shall be ground and if the galvanizing is damaged in the process, it shall be repaired.

4.7. The pole shall have hole configurations and sizes as shown in the drawings attached herewith. The hole sizes and the locations of the hole must, however, be confirmed with the office prior to manufacture.

4.8. The steel tubular telescopic poles must be manufactured by a company approved to quality standard ISO 9001:2000. The ISO 9001 certification number, the name of the authorized approving authority with the contact address and telephone and fax numbers shall also be stated. The Bidder shall enclose a copy of the ISO 9001 certificate with the bid.

4.9. The minimum overlap between the following segments shall be as follows:

i. For 13m Pole

B2-B3	B3-B4	B4-B5	B5-B6	B6-B7
300 mm.	350 mm.	400 mm.	450 mm.	500 mm.

3.1.5. Corrosion Protection

All sections of the pole shall be hot dip galvanized both internally and externally in accordance with IS: 2629-1985 or equivalent national or international standard. After galvanizing, the external surface of poles below ground level and 500mm above ground level shall be painted as follows:

a. Thorough clean brush and solvent degrease, then one coat of phosphoric acid based etch primer both inside and outside followed by,

b. One coat airless spray of epoxy based bituminous black paint of 1x100 microns dry film thickness inside of the pole base

c. Two successive coat airless spray of epoxy based bituminous black paint of 2x100 microns dry film thickness outside of the pole base.

3.1.6. Marking of Pole

The pole shall have an identification marked with indelible paint on the pole at a position approximately 3.5 m. from the butt end, which is clearly and indelibly marked with:

a. Date of manufacture and identification mark of manufacture.

b. Length of pole in meters and its design working loads as defined in this specification.

The pole shall be marked with a permanent horizontal line at a point 1/6th of the pole height from the butt end of the assembled pole. The mating depth of the relevant sections of pole shall also be indelibly marked.

3.1.7. Footstep Holders, Earthing Lug, Base Plate and Pole Cap

i. Each type of pole shall be provided with the Footstep Holders and the Earthling Lug and these shall be fabricated and shop-welded to the pole pieces as described below:

a. The footstep holders shall be fabricated and shop-welded on the segments so that after assembly of the required type of pole these should be located alternatively on the opposite sides of the poles at a vertical distance of 0.6 m to 0.7 m. from each other. The Footstep holders shall be provided only on the pole segments that lie above 2.0 m above the ground level and 1.0 m below the Cross-arm level. The Contractor shall also provide Footsteps of adequate type, size and strength to hold on two man-weights (about 150 kg) in maximum and in numbers not less than 2% of the total numbers of Footstep holders welded on.

b. The earthling lug shall be welded on the relevant segment of the pole so that it lies about 1.0 m below the ground level.

ii. Each steel telescopic pole shall be provided with pole cap and base plate of suitable type and size. The materials of the base plate and pole cap shall be same as that of pole and should also be galvanized. The minimum thickness of pole cap and base plate shall be 2mm and 4mm respectively.

a. The size of pole cap should be designed so that it just hold tightly on the top of the topmost segment of each pole **by three numbers of 8mm dia screws** and hold the rain water from entering into the Pole.

b. The size of base plate for different types of poles shall be designed by the manufacture considering 50 kN/m2 as the maximum bearing capacity and 1.5 as the Factor of safety against overturning.

3.1.8. Design

The data and the drawings related to the poles and fittings provided in this specification are only conceptual. Contractor shall have to carry out detail design and submit for

approval. Only after approval of the submitted drawings the contractor can manufacture the poles and the fittings. In the following sections pole details are given for design calculation. After the design calculation, the weight of the poles shall not be less than 2.5% of the guaranteed weights for acceptance. Greater than above tolerance value will not be accepted. It shall be clear to the Contractor that if the actual weight of the pole and/or fittings is less than guaranteed weight then a proportional deduction on the Contract cost will be made by the Owner as per the reduction of the weight of the pole and/or fittings. No increase in cost will be given to the Contractor for any increase of the weight of the pole.

Pole Type	Length of Pole			Dia of Pole		Minimum Thickness (mm.)	Load Pt. from Top (m.)	Max. Load Applicable (Design-working Load) N (kg.f)
	Total (m.)	Above Ground (m.)	Below Ground (m.)	Top (mm.)	Bottom (mm.)			
B27	13.00	11.00	2.00	151	454	3.00	0.60	3679(375)

The strength of steel material and design load shall be as per below:

	13 m. Pole
Tensile Strength of Steel	Min. 430/580 N/mm²
Yield Strength of Steel	Min. 330 N/mm²
Transverse Load	375 kgf
Vertical Load	375 kgf
Wind Load	60 kg/m²

The design working load shall be the yield strength reduced by factor of safety of 2.0.

3.1.9. Tests

The Contractor shall keep the employer informed about the status of manufacture of the goods so that the inspection and testing can be performed in the presence of the employer or his representative. Before inspection & testing the Contractor shall satisfy himself that the work in all respect is in accordance with the specification and ready for inspection & testing.

All parts shown to be defective during testing & inspection shall be rejected or replaced at the Contractor's cost to the satisfaction of employer.

No parts of the goods shall be dispatched to the site before it has passed the tests or has been inspected and found to comply with the specification to the satisfaction of employer.

A program for factory tests to be performed is to be mutually agreed on by the Contractor and the Employer. The Contractor shall work out a complete program for testing of the poles and

accessories to be supplied with a description of the various test procedures. All instruments and equipments necessary for carrying out the tests shall have evidence of recent calibration. The test program shall be submitted to the Employer for review & approval at least 15 days before the actual inspection date sought by the Contractor.

The following test shall be performed for each type of poles. All testing shall be fully documented and the certified test report shall be provided to NEA.

a. Checking of dimensions and the weight of each type of individual part of segment of the Tendered Goods assuming **material density as 7850 kg/m3**.

b. Assembly test and checking of the Dimension and the weight of the Assembled Pole and the Fittings.

c. Drop Test from a height of 2 meters.

d. Deflection test & Permanent set test by applying the **1.2 times the maximum permissible load**.

e. Break Test **of the pole equals or exceeds 2 times the design working load**.

f. Testing of the thickness of the **Zinc coating**.

g. Tensile tests and chemical analysis of Sulfur and phosphorus contents.

Number of each type fittings selected for conducting the above-mentioned tests shall be as follows:

Lot size	Nos. of Poles for Dimension Check	Nos of Poles for Assembly & Other Test
Up to 100	5	1
More than 100 up to 500	10	2
More than 500	15	3

Above described testing of poles at the factory shall be performed in accordance with the following or the related standards or the practices:

a. **For conducting the Drop Test**, the assembled pole shall be dropped vertically from a height of about **2.5 m or one sixth of the total pole height**. The Drop Test may not result with any break in the welding of any of the pole segment. Any break observed in any of the pole segment may cause to reject the consignment at the Engineer's direction.

b. **For conducting the Permanent Set Test**, the assembled pole selected shall be rigidly supported for a distance from its base equivalent to its scheduled buried depth. It will then be gradually loaded up to a load equal to the maximum permissible load. The load shall be applied at right angles at the point of load application located 30 cm from the top of the pole for poles of length less than 5 m and 60 cm from top of the pole for poles of length longer than 9 m. The load shall be gradually and uniformly applied in increments of 10% of the design-working load up to 120% of the design-working load. At each increment of load, deflection of the pole tip shall be measured. The 120% loading shall be maintained for 5 minutes. The load shall be gradually reduced to zero and the amount of permanent deflection of the pole tip shall be recorded.

   The permanent deflection at this state shall not exceed **4mm per meter length of the free portion of the tested pole**. If the Permanent Deflection Value exceeds the maximum specified value, in this case also the test is repeated on another sample from the consignment. Further failure in this test may also cause the rejection of the consignment at the Engineer's direction.

c. Other tests shall be carried out as per the related standards or the practices.

Should any of the poles first selected fail to pass any of the tests specified above, two further poles shall be selected for testing from the same batch i.e. same pole length, manufactured on the same day in respect of each failure. Should one or both these additional poles fail, the test material represented by the test samples shall be deemed as not complying with the requirement of the specification.

All inspections and testing shall be done at the Employer's cost.

3.1.10. Pole Fittings and Accessories

The poles are utilized for forming the following two kinds of pole sets. The dimension and other relevant parameters specified for forming all of the three pole sets are shown on the table below. The Bidders are required to check the correctness of the dimensions the Pole Clamps carefully and are welcomed to suggest better type of Clamps (if any) for improvement based on their past experience in this field. If the Bidders suggest for better type of Clamps they shall quote for the suggested type of Clamps. The minimum strength of the end fittings shall not be less than 70kN.

For 13m Pole

a) Pole Fittings and Accessories for Pin Insulator Single Pole

S. No.	Description of Materials	Unit	Qty.	Dimension
1	Lower Cross Arm	No.	6	7×50×100×1650 mm.
2	Iron Plates	No.	12	6×100×390 mm.
3	Pole Clamp 'Y1' with nut, bolt and washer	No.	3	As Per Drawing
4	Bracing Plates	No.	12	6×50×984 mm.
5	Pole Clamp 'Y' with nut, bolt and washer	No.	1	As Per Drawing
6	Stay Clamp set with V hanger with nut. bolt and washer	Set.	1	As Per Drawing

b) Pole Fittings and accessories for Dead end H- Pole

S. No.	Description of Materials	Unit	Qty.	Dimension
1	Cross Arm Channel	No.	6	6×50×100×3400 mm.
2	Iron Plates	No.	12	6×100×370 mm.
3	Pole Clamp 'Y1' with nut, bolt and washer	No.	6	As Per Drawing
4	Horizontal Bracing Angle (Up)	No.	1	6×75×75×2450 mm.
5	Pole Clamp 'X1' with nut, bolt and washer	No.	2	As Per Drawing
6	Horizontal Bracing Angle (Below)	No.	1	6×75×75×2550 mm.
7	Pole Clamp 'X2' with nut, bolt and washer	No.	2	As Per Drawing
8	Cross Bracing Angles	No.	2	6×75×75×2567 mm.
9	Stay Clamp set with V hanger with nut. bolt and washer	Set	2	As Per Drawing

3.1.11. Drawing of the Clamps, Cross Arms, Horizontal & Cross Bracing

11.1. Typical drawing of the Pole clamps, Cross Arms, Bracing etc. are shown on the drawings herein. On which the size of clamps varies and stated as Clamp-X, Clamp-XI, Clamp-X2 and so on. Their dimensions are mentioned on the drawing. Thickness and width of the clamp must be as stated in drawing.

11.2. Hexagonal Nut-Bolts and Washers shall be of 16-mm. diameters and with varying lengths and threaded portions and shall confirm the strength to BS. The size (length) and quantity of Nut-Bolts and Washers shall be as per required to fix the channels, clamps, bracing plates etc.

11.3. The Bidders have to check the correctness of the length of the Bracing and the Clamps and if founds any, incorrectness they have to suggest the correct length and should quote the price for the correct length and type.

11.4. Number of stay clamp with V hanger as per total number of poles quantity.

3.1.12. Bid Documentation

12.1. The Bidder shall provide with the Bid two (2) clear copies of the governing standards for selection of tubings, fabrication and testing of Telescopic Tubular Steel Poles and two (2) clear copies of all other relevant standards referenced therein.

12.2. The Bidder shall provide a complete design, description and certified dimensional drawings of each type of pole; otherwise the bid offer shall be rejected.

12.3. Two (2) clear certified copies of all type tests performed on at least one type of pole and similar working loads shall be submitted otherwise the bid offer shall be rejected. The type test must have been carried out in recognised national or international testing laboratory.

12.4. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

12.5. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

TECHNICAL DATA SHEETS
(To be completed by Bidder)
Steel Telescopic Poles
13 m. Pole

S. No.	Description	Unit	Data
1	Manufacturer		
2	Governing Standard for Steel		
3	Governing Standard fot Galvanisation		
4	Governing Standard of Welding		
5	Copy of Standard Attached?	Yes/No	
6	Overall Length of pole in m.		
7	Number in sections		
8	Section B2		
	Length	m.	
	Thickness	mm.	
	Top Dia. (Outer)	mm.	
	Bottom Dia. (Outer)	mm.	
	Weight	Kg.	
9	Section B3		
	Length	m.	
	Thickness	mm.	
	Top Dia. (Outer)	mm.	
	Bottom Dia. (Outer)	mm.	
	Weight	Kg.	
10	Section B4		
	Length	m.	
	Thickness	mm.	
	Top Dia. (Outer)	mm.	
	Bottom Dia. (Outer)	mm.	
	Weight	Kg.	
11	Section B5		
	Length	m.	
	Thickness	mm.	
	Top Dia. (Outer)	mm.	
	Bottom Dia. (Outer)	mm.	
	Weight	Kg.	
12	Section B6		
	Length	m.	
	Thickness	mm.	
	Top Dia. (Outer)	mm.	
	Bottom Dia. (Outer)	mm.	
	Weight	Kg.	

13	Weight of Pole includinf base plate and pole cap	Kg.	
14	Guaranteed min. Transverse failure load	Kgf	
15	Guaranteed max. Permanent Deflection	mm.	

3.4. CONSTRUCTION STANDARD

3.4.1. POLES AND CROSS ARMS

1.1. Pole Numbering:

Poles and structures shall be numbered in accordance with a numbering system provided. Each pole shall be marked permanently through template with the assigned number.

1.2. Pole Framing:

a. Pole and structures shall generally be framed in accordance with Construction Standards. Where special framing requirements are necessary, the Site Engineer or Engineer shall provide framing instructions for the specific structure.

b. Each cross-arm shall be attached to the pole by a pole clamp or by machined bolts of sufficient length to pass completely through the holes provided on the pole and cross-arms and receive their full complement of nuts.

c. Bolts of proper length shall be used. Excess nuts shall not be used to make use of a bolt, which would otherwise be too long. The end of a machined bolt projecting more than 3 centimeters beyond the nut shall be cut off to a length of 2 centimeters beyond the nut. Each bolt, when installed, shall have its full complement of nuts.

d. Washers shall be used where specified in these standards.

e. During the erection work at the field there may be necessity to modify galvanized steel hardware and may have to be drilled, reamed, filed or cut. Under such a condition the area of the steel exposed, after these modifications, shall be coated with a zinc-rich paint to protect the steel from corrosion.

1.3. Excavation

All excavations made for the installation, or demolition, of facilities shall be accomplished in a timely manner according to the scheduled installation. Required excavations shall be opened, material installed, and backfill placed, as specified, in a continuing operation to the greatest extent practicable.

Any excavation left open during discontinuous construction, which is accessible to the public or along public thoroughfare, shall be covered or barricaded, and marked by suitable visual means, to prevent a public hazard.

Excavations shall be properly located and sized for the intended use. Pole and stay plate/ anchor excavations shall be correctly sized to retain undisturbed soil to the greatest extent consistent with the means of excavation. Pole holes shall be made by power-driven auger or by manual methods; power-driven shovel equipment shall not be used. Pole holes shall be excavated to the specified depth with no tolerance shallow and tolerance of ten (10) centimeters deep. The bottom of pole holes shall be undisturbed soil, gravel or rock. Stay plate holes shall be excavated by manual methods to specified depth with no disturbed soil in the direction of the anchor rod.

All excavations shall be backfilled with excavated material, or as specified for the installation. Backfill shall be free of foreign materials and shall be well tamped with excess backfill graded over the excavated area to prevent depressions resulting from eventual natural compaction.

1.4. Pole Setting

Poles shall be set in accordance with the appropriate Sections of the Construction Standards.

Each pole shall be assigned a unique construction number at the time of structure staking for preliminary identification and preparation of SDS.

Pole holes shall be dug large enough in diameter to admit a tamping bar all around the periphery of the pole and shall have a uniform dimension as per the type of pole used at the top and bottom. Poles shall be planted in the ground to the depth specified in construction. Drawings before planting a pole, the bottom of the hole made for planting the pole, shall be cleaned of free soil and firmly tamped, to prevent the hole from settling.

The stability of a pole, particularly a pole without stay, is greatly influenced by the size of the pole hole, the nature of the soil and the care exercised in back filling and tamping. Two active hand tampers and one slow shovel shall result in good compaction.

Poles shall be set to stand perpendicular except at terminals, angles and other points of excessive strain where they shall be given a rake not to exceed 10 centimeters against the direction of strain. Poles located at the sides of banks or other locations, where washouts may occur, shall be protected by suitable cribbing, or shall be referred to the Engineer for recommended action.

After the pole is in position and the hole is back filled and tamped, soil shall be piled and packed firmly around the pole. Pole setting shall be inspected prior to acceptance and any back fills that have sunk shall be refilled.

Where it is necessary to set poles at locations where the soil has very low bearing value, or in swampy conditions, a pole may be fitted with a bog shoe in accordance with construction drawings the engineer may specify that type of construction.

Poles located in shallow riverbeds shall be protected by gabions as designated by the Site Engineer or Engineer. Gabions should be approximately 2 meters x 1 meter x 1 meter. Four such gabions are required for each pole.

Set pole and pour 860 mm diameter foundation as per construction standard construction drawing. Level areas around pole and set gabions in pattern shown in construction drawing. It is important to lace adjacent gabions together along the perimeter of all contact surfaces. Fill gabions with hard, durable, clean stone, 100 mm to 200 mm in size in three layers. Install two connecting wires at each layer. Lace gabion lids securely making certain all edges are closed. Fill void between pole and gabion with hard, durable, clean rock 200 mm minimum size.

3.4.2. STAYS

2.1. Installation of Stays: Where stays are installed on a line angle structure, line of stay shall bisect the outside line angle. The span of stay extending between poles shall not be greater than 60 meter. Anchor and anchor rods shall be set so that the axis of the rod and line of stay shall be straight. The portion of the anchor rod above the ground shall not be bent at an angle to connect a stay wire. If this occurs, anchor and anchor rod shall be reset. The anchor rod shall not be exposed for more than 15 centimeters above the ground after the anchor is set. If gravel back fill is required to set anchor in soft or unstable soil, as per construction drawing the Contractor will have to carry out the gravel back fill as directed by Engineer.

The Contractor, in general, shall install at least one stay for the supports in the following cases:

2.1.1. Dead end structure

2.1.2. Tee-off (Tap) structure

2.1.3. Double H – pole structure

2.2. Stay Insulators: Stay insulators shall be installed on all stays in accordance with the construction drawings.

3.4.3. CONDUCTOR

Aluminum Conductor Steel Reinforced (ACSR) "Dog" conductor shall be used for 33 kV double circuit overhead lines.

3.1. Sagging: Conductors shall be sagged in accordance with the sag chart specified by these specifications. Conductors must not be sagged too tightly (less than specified sag) as unspecified extra tensions may result in failure of conductor structure. Conductors sagged too loosely (more than specified sag) may contact adjacent conductors hardware or any structure. Excess sag can reduce clearance beneath the line with the ground to the point of danger.

3.2. Sag Charts: Unless otherwise noted, all sag charts are calculated on the basis of 35 kg/m^2 wind pressure. Sag is always measured vertically, without wind, when conductors are being installed or re-sagged. Unless otherwise specified by the Site Engineer or Engineer for a specific condition, initial or stringing sag shall be applied to the installation of all new unstressed conductors.

3.3. Damaged Conductor: Damaged conductors shall be repaired by using a repair sleeve provided that no more than 2 strands of the outer aluminum layer are damaged and further provided that none of the sleeve core strands are damaged. For a conductor damaged in excess of the above conditions, the damaged section of the conductor shall be cut out and a tension splice installed. When cutting out damaged section of conductor, no more than 1 tension splice shall be permitted in a span and no splice is made within 8 meters of an insulator attachment.

3.4. Sag Error: Sag error shall not exceed ± 40 mm from the sag defined by the sag chart.

3.5. Conductor Attachment: Conductors shall be secured to pin insulators with pre-formed conductor ties or with tie wire. Insulator ties, except at jumper supports in structures, shall be made with pre-formed ties when available. Conductors shall be connected to dead end assemblies with tension set.

3.6. Line Splices for Tensioning and Looping: Cleaned and polished contact surfaces are necessary to make conductor splices so that it shall remain free from trouble. Great care shall be taken to completely clean the strands of aluminum conductor. The splicing sleeve must be centered over the conductor ends before compressing to make a splice of required strength. Appropriate sleeve shall be used for splicing ACSR conductors prior to installation. The outer strands of aluminum shall be carefully cleaned with a wire brush to remove all foreign matter till the aluminum shines brightly. The cleaning applies to both new and old conductors. The manufacturer pre-filled with inhibitor compound supplies splicing sleeves for aluminum conductor. Splices in line conductors shall be so located that the end of the splicing sleeve is at least 30 cm from the end of a suspension or dead end clamp. Non-tension loops, such as between dead ends, shall be spliced with a connector when the conductors are of same metal and size.

3.7. PG Clamps: PG clamps are furnished in a full range of sizes for application in the non-tension connection in 33 kV circuits. In all applications of PG clamp fittings, the conductor metal shall be wire-brushed to a bright condition to remove surface oxidation on the conductor.

3.8. Line Construction:

3.8.1. **Attachments to Poles:** Bolt holes are provided on poles for cross-arms, cross-arm braces and stay bolts.

3.8.2. **Conductor Ties:** Pre-formed ties and grips shall be used for attaching conductors to structures when available. If pre-formed materials are not available, the wire shall be soft conductor so that when made up, the tie wire will bind the conductor tightly. No tie wire shall be used for a second time. Tie wire shall be of the same metal as that of the bare conductor to which the tie is applied.

3.8.3. **Conductor Support:** The conductor supports on straight lines shall be carried on the top wire groove of the pin insulator. Conductors shall be attached to the side conductor groove of pin insulator on the outside of angles so that transverse conductor tension will tend to hold the conductor in the insulator groove. Conductor ties shall not hold a conductor on the insulator when uplift exists.

3.4.4. INSTALLATION CRITERIA

4.1. The line alignment should be as straight as possible to minimize requirements for stays. The basic span shall be maintained within the following limits:-33 KV line: 55m to 65 m

4.2. All types of line clearances shall be maintained as per the construction standards provided to the Contractor. Deviations from the standards may be allowed only for unique or special conditions.

4.3. Safety rules of the NEA shall be strictly observed at all times by the Employee and the Contractor and their personnel. Special care shall be taken to maintain the optimum conductor sag to provide adequate safety to the construction and the property or people.

4.4. All fastenings (e.g. nut bolts, stays and the like) shall be so installed that the constructed line components shall not fail to remain within the safety margin while maximum working load is applied.

Annex A – Topographical Layout and Profile Drawings

Suri Khola Hydropower Project

33 KV Double Circuit Tranmission Line

N

Baidantol
Maldung
Moldung
Bhorle
Olitar
Jhangreli
Sub Station
Singati Bajar
Suri Dobhan
Sumna
Power House Switch Yard
Suri Mulabari
Mulabari
Kuikep
Surigaun
Chanmara
Tinekhu
Bagnadi
Suridanda

Legend

- Placename
- Power House Switch Yard
- Sub Station
- Pole Position
- Transmission Line
- Building
- Main Road
- Main Trail
- Trail
- Bridge

Contour

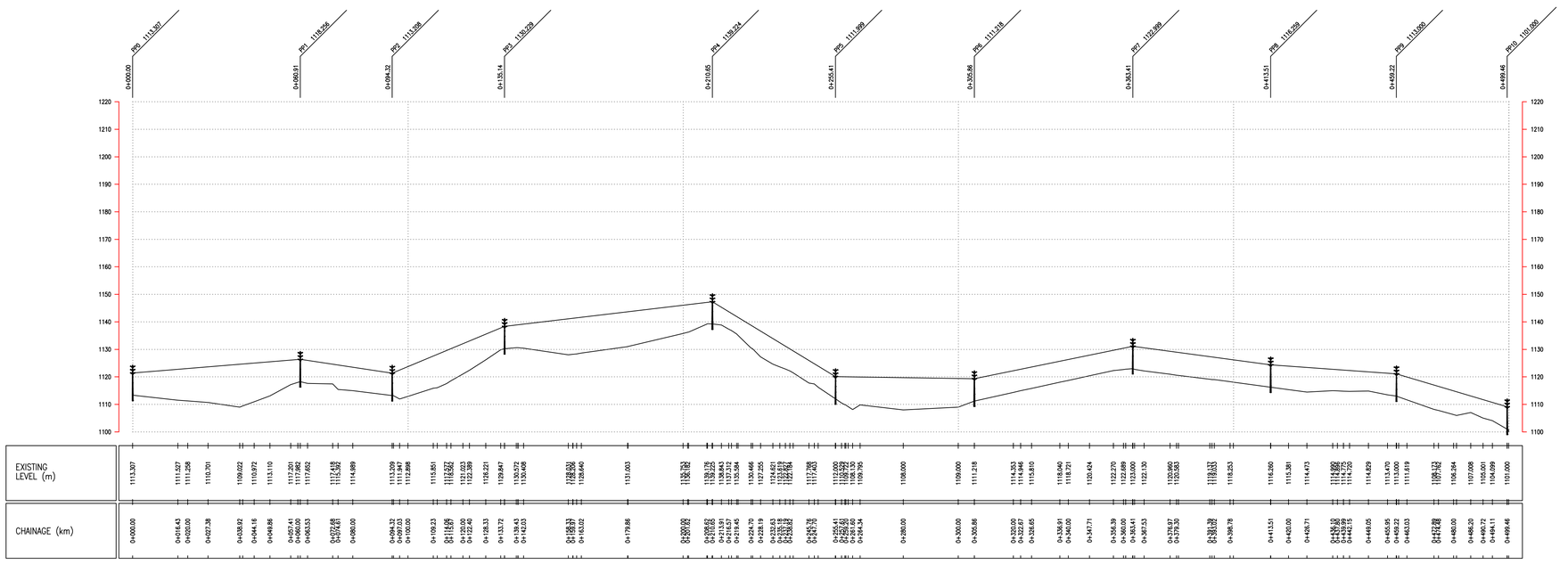
- Index Contour
- Intermediate Contour

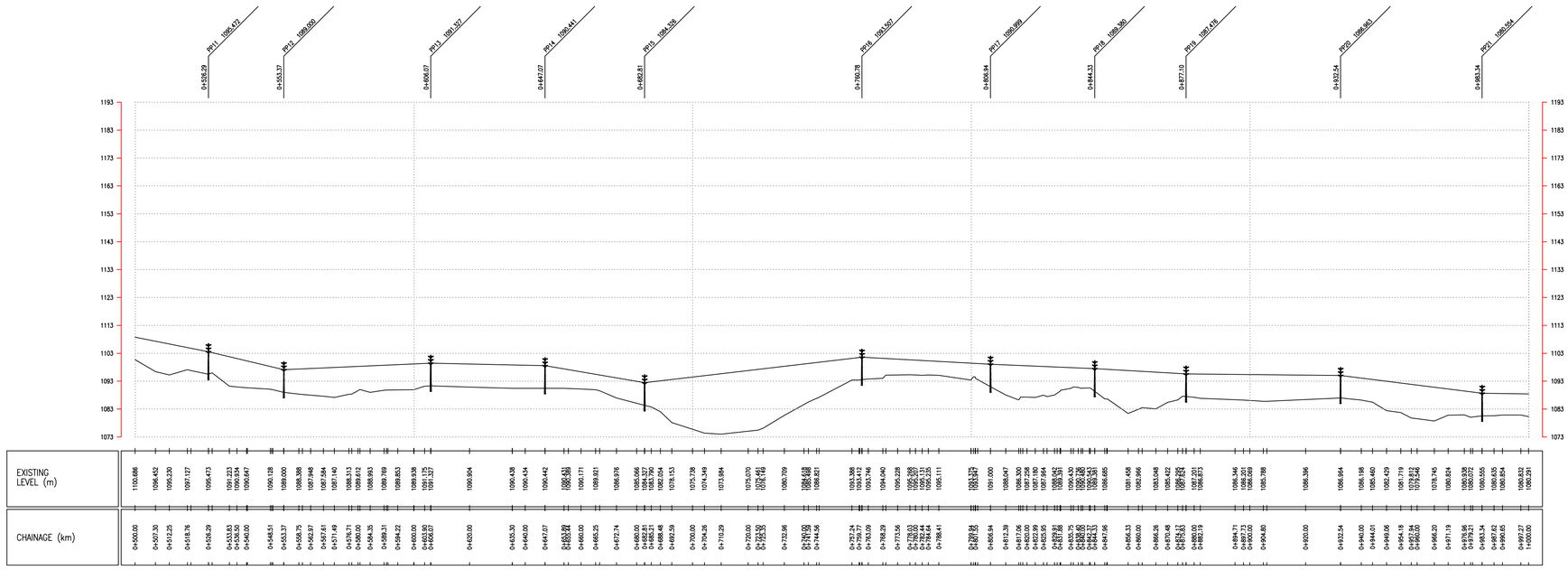
Landcover

- Cultivation
- Forest
- Grassland
- Barren
- Bush
- River; Waterbody

0.35 0.175 0 0.35 0.7 1.05 1.4 Kilometers

1:15,000





CONSULTANT:	SURI KHOLA HYDRO POWER PROJECT	DRAWN BY:	SCALE : 1:1000	DATE:
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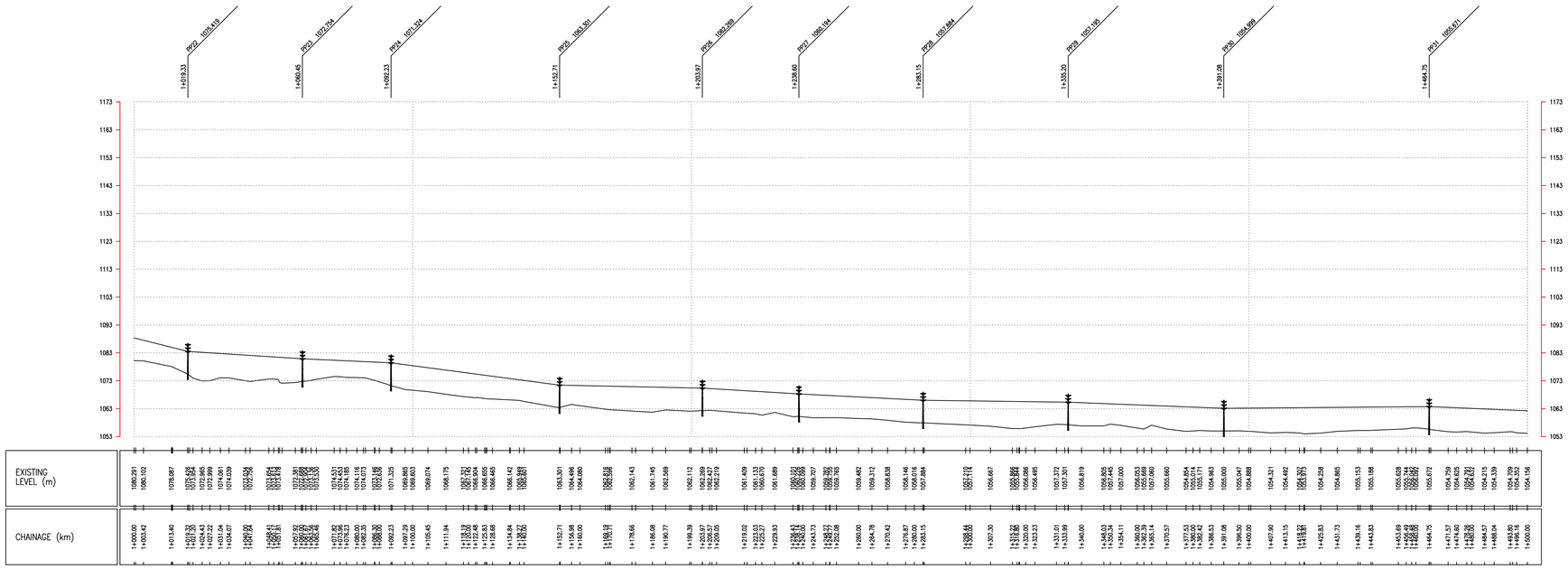

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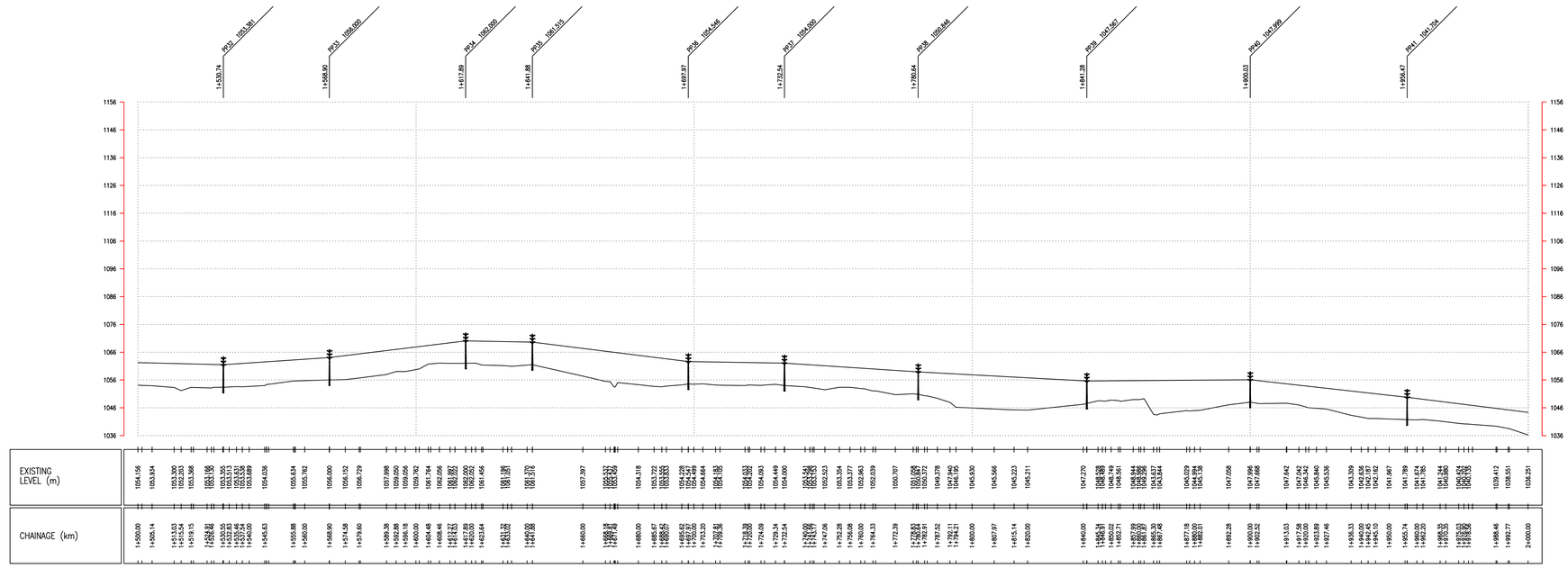

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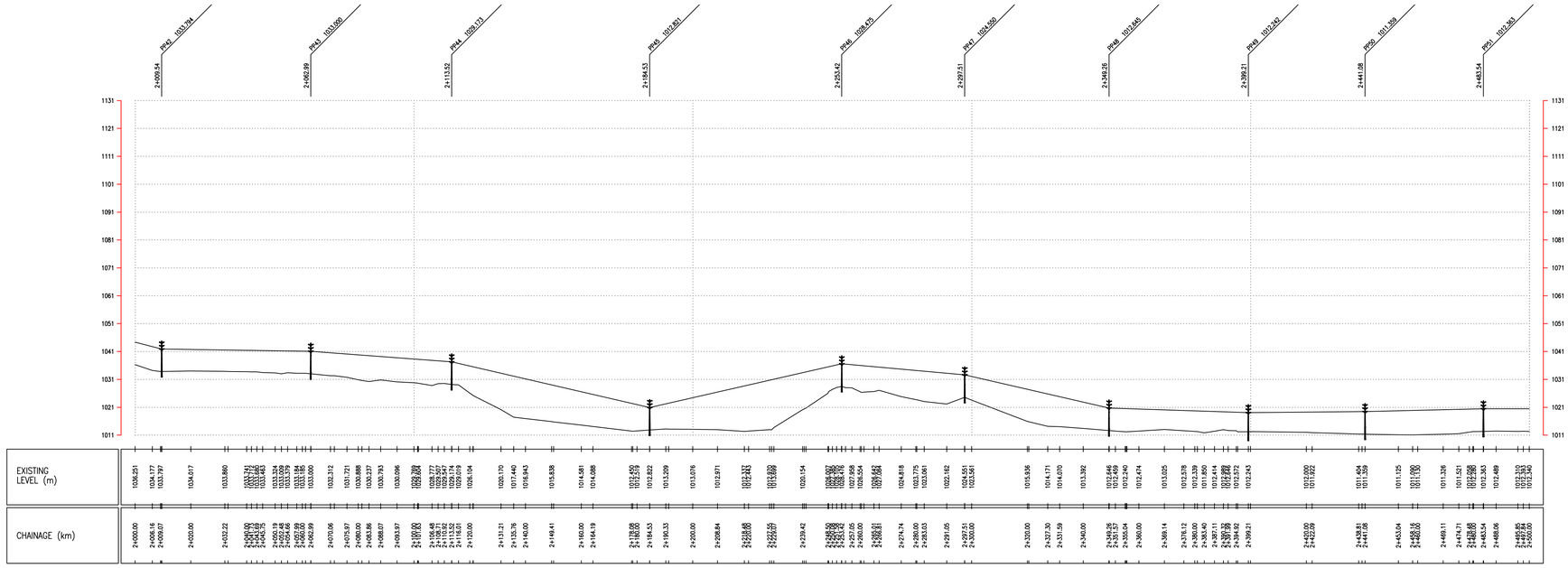
CONSULTANT:	SURI KHOLA HYDRO POWER PROJECT	DRAWN BY: APPROVED BY:	SCALE : 1:1000
PROFILE CH: 1+000 – 2+000	DATE: SHEET NUMBER: PL-02		



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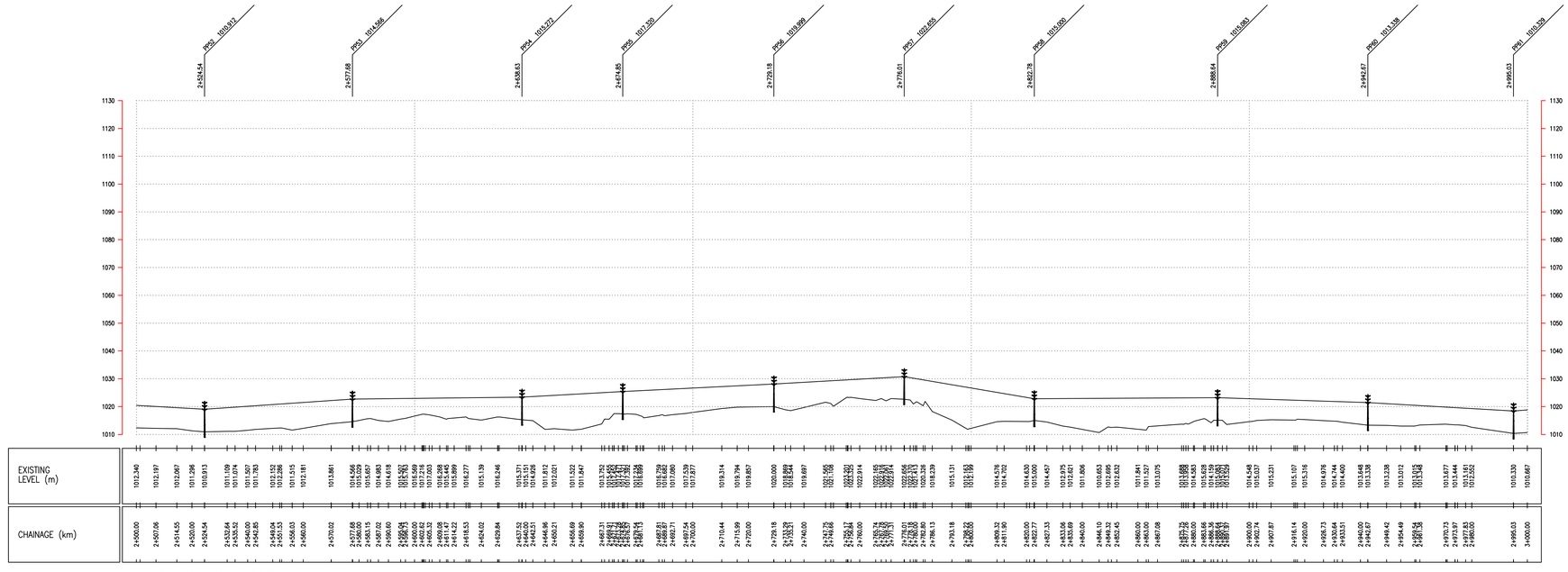

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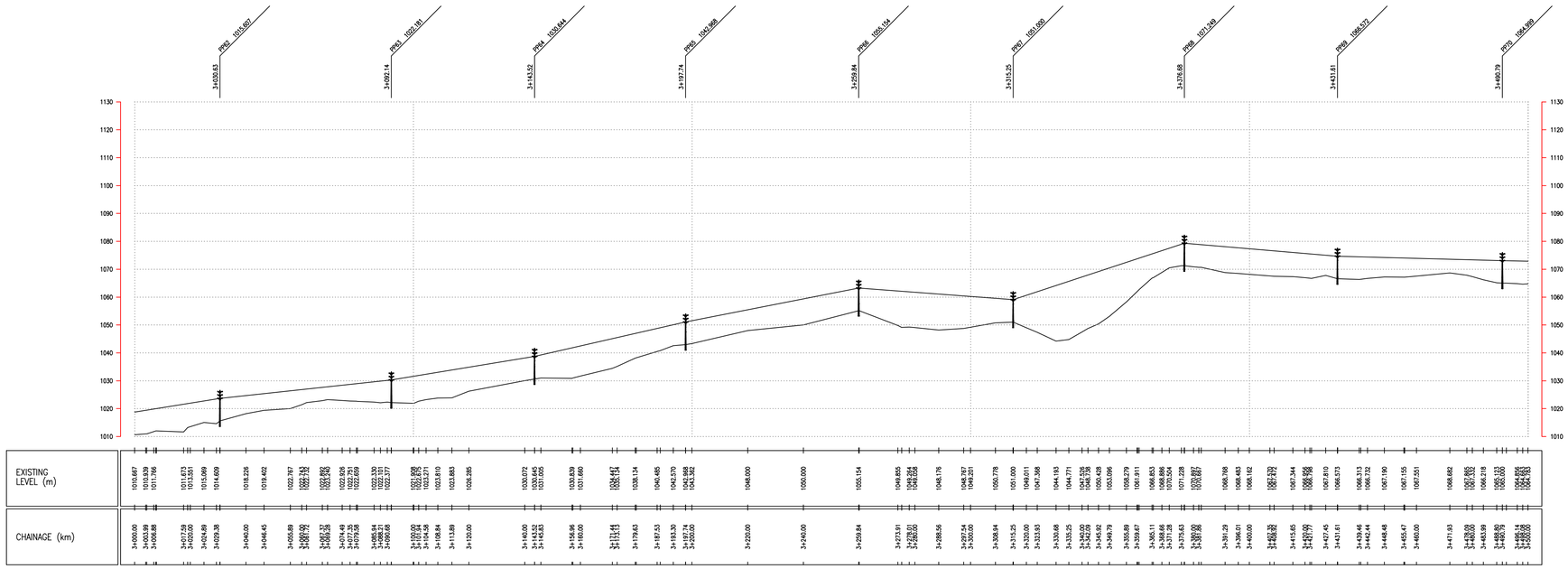

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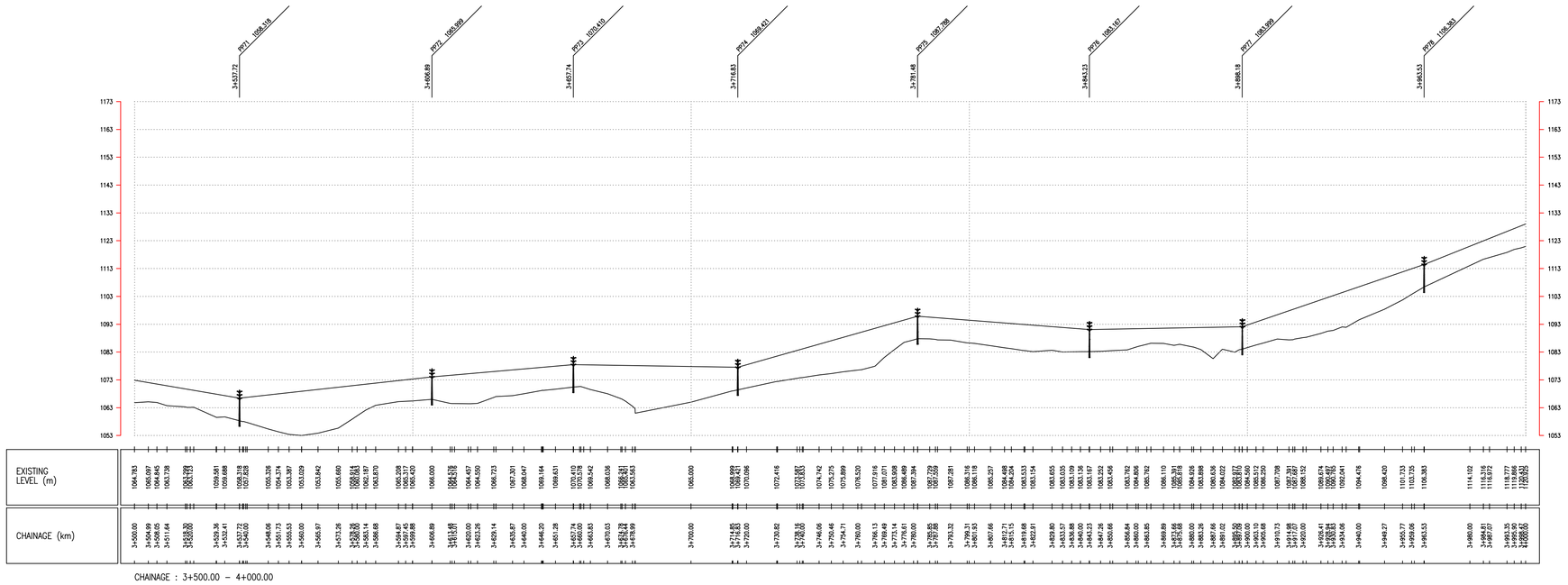

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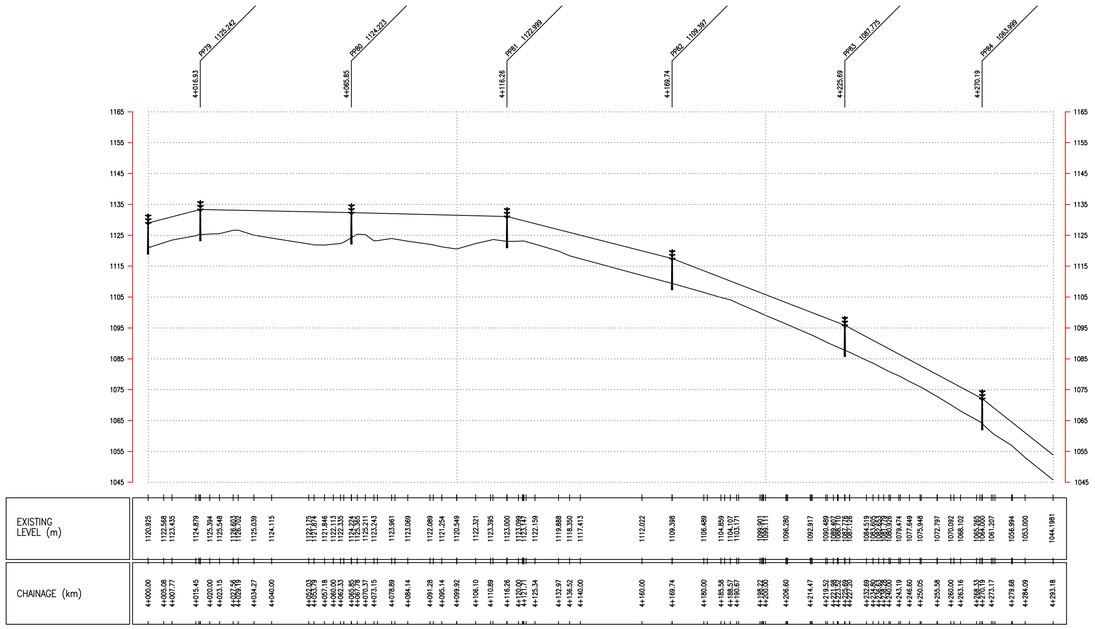

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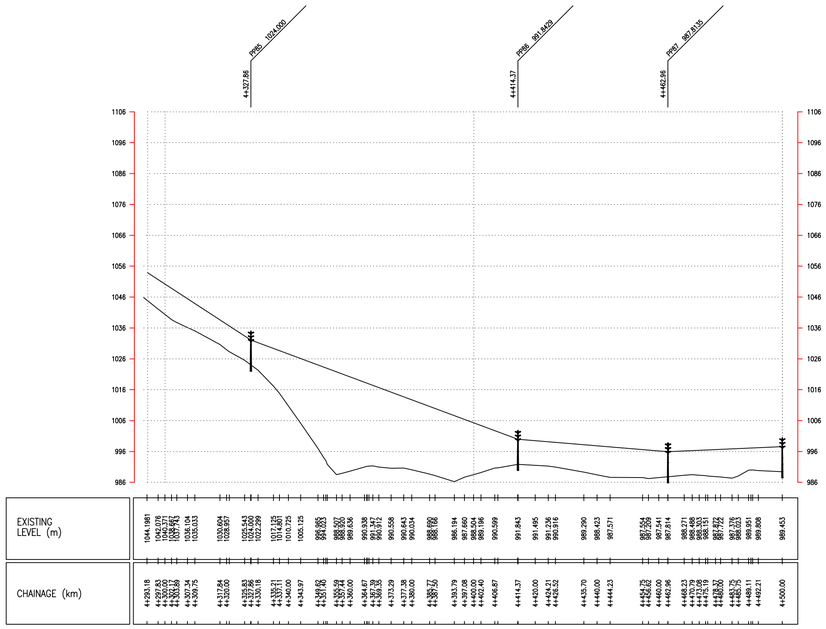

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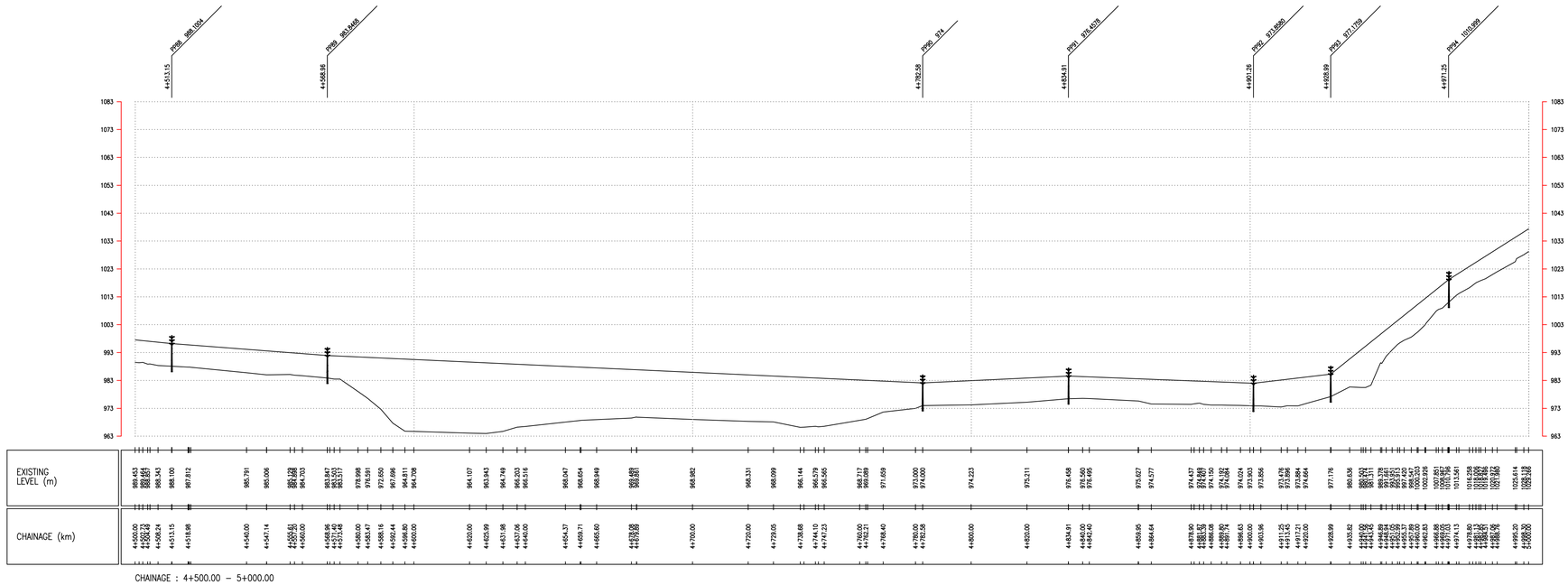

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CONSULTANT:	SURI KHOLA HYDRO POWER PROJECT	DRAWN BY:	SCALE : 1:1000	DATE:
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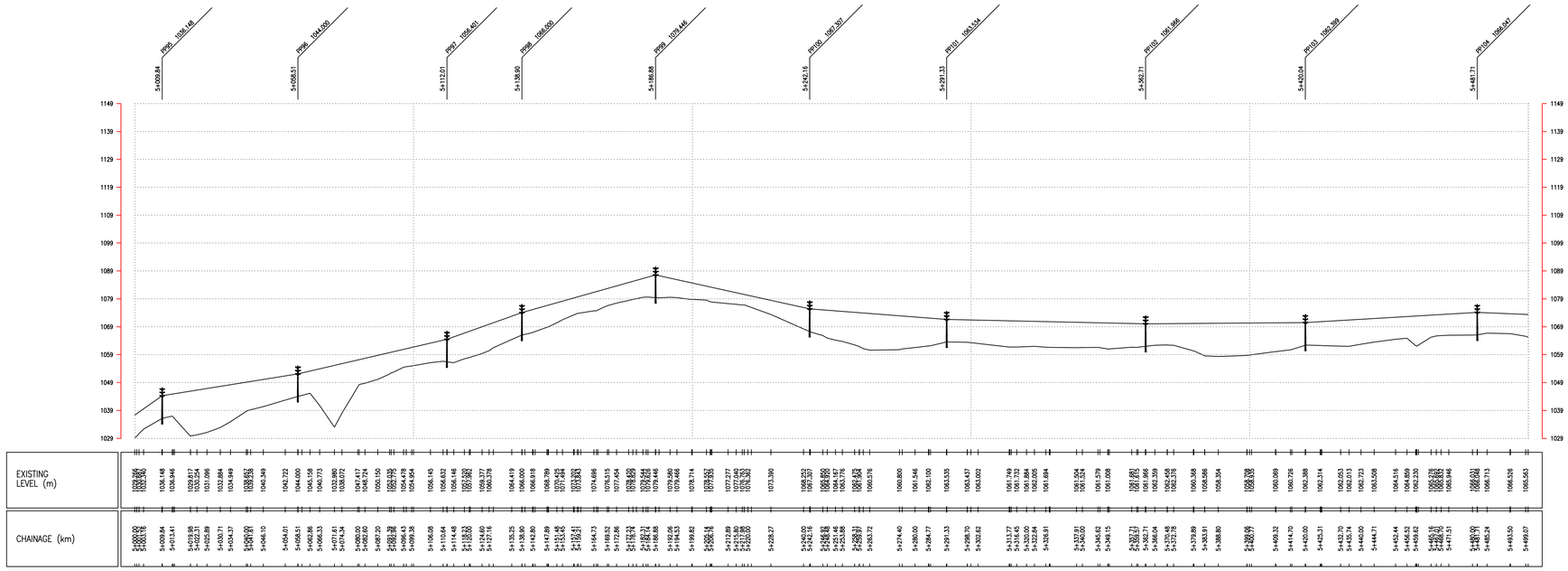

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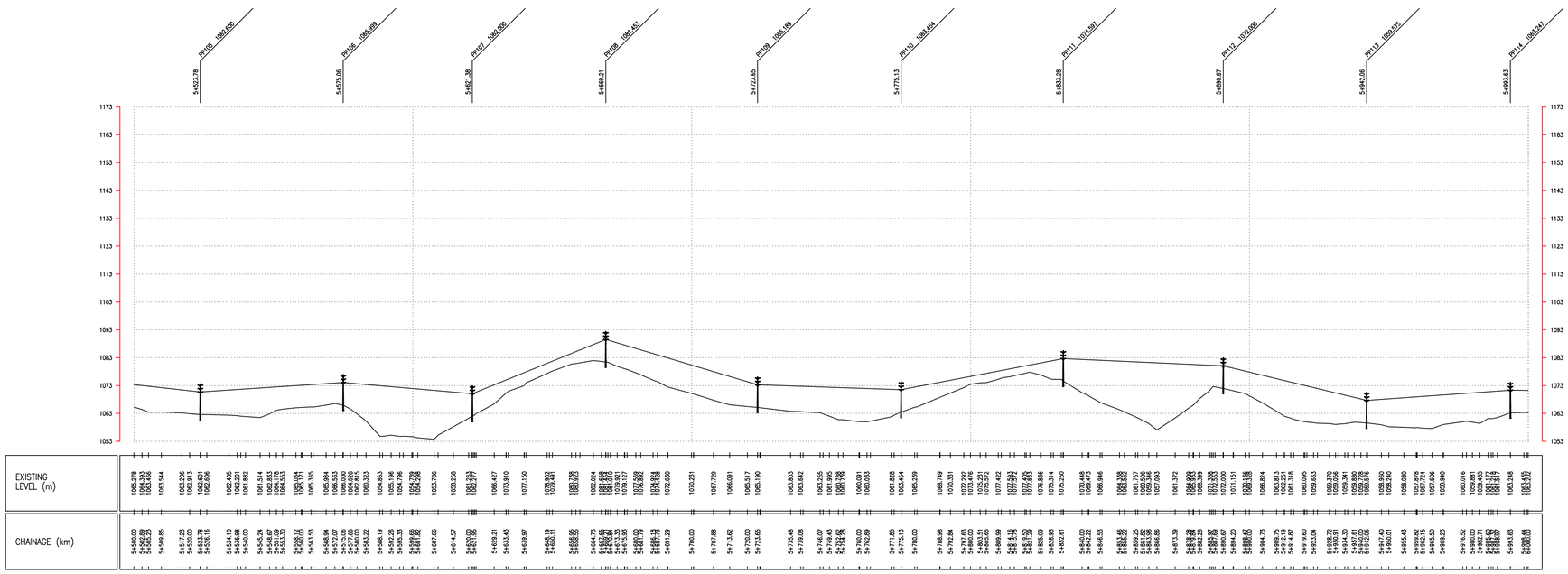

CHAINAGE : 5+500.00 – 6+000.00

CONSULTANT:	SURI KHOLA HYDRO POWER PROJECT	DRAWN BY:	SCALE : 1:1000	DATE:
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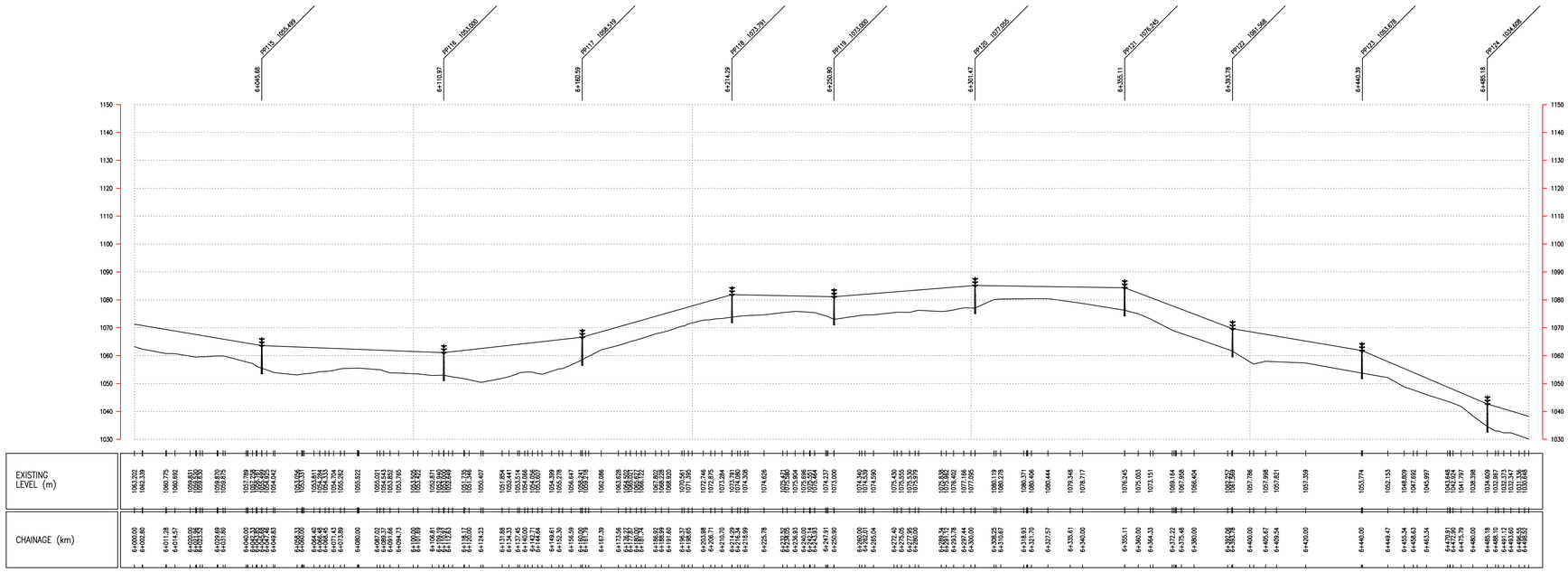
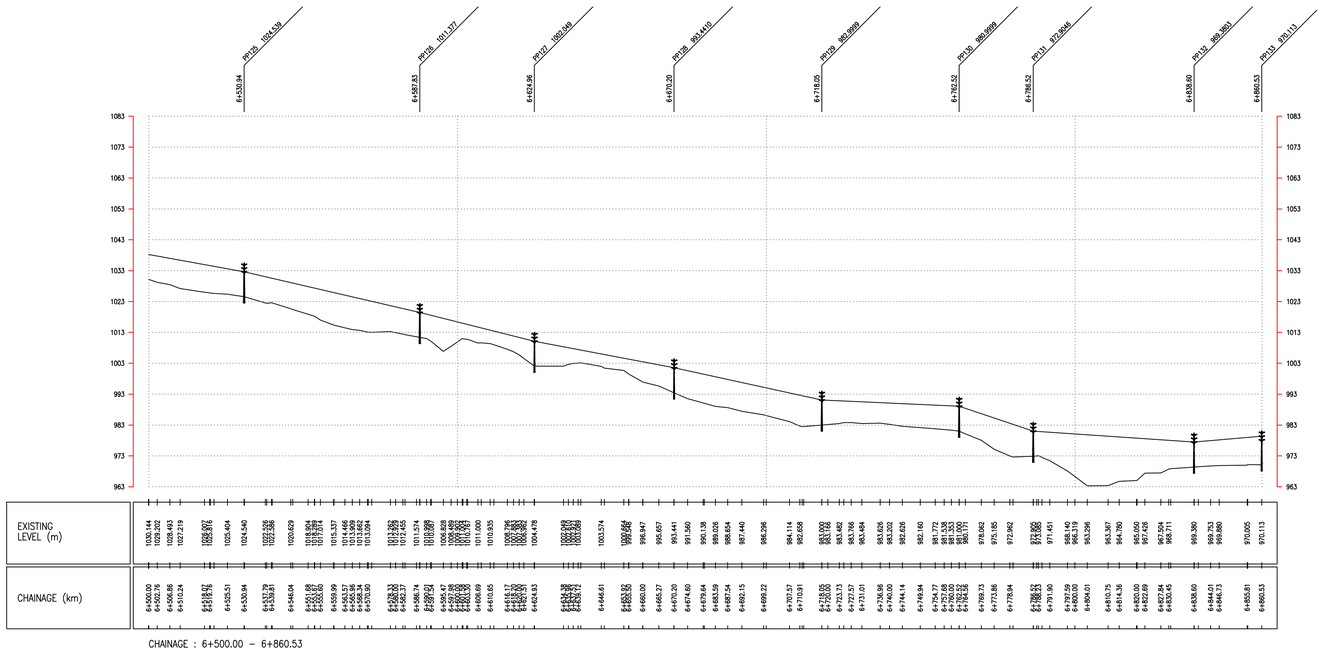




CONSULTANT:	SURI KHOLA HYDRO POWER PROJECT	DRAWN BY: APPROVED BY:	SCALE : 1:1000
PROFILE CH: 6+000–6+860.53	DATE: SHEET NUMBER: PL–07		

Annex B – Design and Construction Data

CEPAD Hydro Consultants Pvt. Ltd.

Suri Khola Hydropower Project

33 kV Transmission line

Dolakha, Nepal

Pole Location (cordinates)

S.No.	Label	Easting	Northing	Altitude (m.)	Chainage	Pole Type
1	PP 0	423289.2290	3070817.8750	1113.31	0	H
2	PP 1	423244.4490	3070859.1610	1118.26	60.91	H
3	PP 2	423214.5992	3070874.1620	1113.21	94.32	SP
4	PP 3	423178.1190	3070892.4950	1130.23	135.14	SP
5	PP 4	423107.9960	3070920.5010	1139.22	210.65	H
6	PP 5	423063.3910	3070916.7865	1112	255.41	SP
7	PP 6	423013.1210	3070912.6003	1111.22	305.86	SP
8	PP 7	422955.7636	3070907.8238	1123	363.41	H
9	PP 8	422910.4081	3070929.1031	1116.26	413.51	SP
10	PP 9	422869.0276	3070948.5174	1113	459.22	H
11	PP 10	422838.5909	3070974.8386	1101	499.46	SP
12	PP 11	422818.2921	3070992.3927	1095.47	526.29	SP
13	PP 12	422797.8111	3071010.1043	1089	553.37	H
14	PP 13	422749.0948	3071030.2138	1091.33	606.07	SDP
15	PP 14	422712.7488	3071049.1864	1090.44	647.07	SP
16	PP 15	422680.7497	3071065.0892	1084.33	682.81	SP
17	PP 16	422608.5092	3071094.4429	1093.51	760.78	SP
18	PP 17	422564.6546	3071108.8218	1091	806.94	SP
19	PP 18	422529.0468	3071120.2295	1089.38	844.33	SP
20	PP 19	422497.5324	3071129.2307	1087.48	877.10	SDP
21	PP 20	422442.9593	3071138.9661	1086.96	932.54	SDP
22	PP 21	422395.7686	3071157.7821	1080.55	983.34	SP
23	PP 22	422362.5636	3071171.6615	1075.42	1,019.33	SP
24	PP 23	422324.7853	3071187.9127	1072.75	1,060.45	SP
25	PP 24	422296.1317	3071201.6505	1071.32	1,092.23	H
26	PP 25	422252.7006	3071243.7426	1063.3	1,152.71	SP
27	PP 26	422215.8962	3071279.4123	1062.27	1,203.97	SP
28	PP 27	422191.0225	3071303.5191	1060.19	1,238.60	H
29	PP 28	422146.8841	3071309.5673	1057.88	1,283.15	SP
30	PP 29	422095.3192	3071316.6330	1057.2	1,335.20	SP

31	PP 30	422039.9626	3071324.2184	1055	1,391.08	H
32	PP 31	421967.8904	3071308.9389	1055.67	1,464.75	SDP
33	PP 32	421901.9085	3071308.0931	1053.38	1,530.74	SDP
34	PP 33	421864.6056	3071316.1430	1056	1,568.90	SP
35	PP 34	421816.7115	3071326.4783	1062	1,617.89	H
36	PP 35	421793.0520	3071322.5220	1061.52	1,641.88	SDP
37	PP 36	421739.2886	3071306.5453	1054.55	1,697.97	H
38	PP 37	421705.8248	3071315.2309	1054	1,732.54	H
39	PP 38	421657.9373	3071310.7432	1050.85	1,780.64	SDP
40	PP 39	421597.4578	3071315.2073	1047.57	1,841.28	SP
41	PP 40	421538.8095	3071318.6572	1048	1,900.03	H
42	PP 41	421486.4155	3071339.6448	1041.7	1,956.47	SP
43	PP 42	421436.3770	3071357.3036	1033.79	2,009.54	SP
44	PP 43	421384.8481	3071371.4976	1033	2,062.99	H
45	PP 44	421334.4070	3071368.4500	1029.17	2,113.52	SP
46	PP 45	421264.1638	3071358.0039	1012.82	2,184.53	SP
47	PP 46	421196.0260	3071347.8710	1028.48	2,253.42	SP
48	PP 47	421152.0810	3071344.2970	1024.55	2,297.51	H
49	PP 48	421100.8203	3071351.3533	1012.65	2,349.26	SP
50	PP 49	421051.3327	3071358.1655	1012.24	2,399.21	H
51	PP 50	421014.5992	3071338.0745	1011.36	2,441.08	SP
52	PP 51	420977.3491	3071317.7010	1012.36	2,483.54	SDP
53	PP 52	420937.6625	3071307.4010	1010.91	2,524.54	SP
54	PP 53	420886.2280	3071294.0520	1014.57	2,577.68	H
55	PP 54	420843.0463	3071251.0258	1015.27	2,638.63	SDP
56	PP 55	420814.1538	3071229.1977	1017.32	2,674.85	H
57	PP 56	420789.2189	3071180.9280	1020	2,729.18	SDP
58	PP 57	420757.5838	3071146.3904	1022.66	2,776.01	SP
59	PP 58	420723.7101	3071114.1511	1015	2,822.78	H
60	PP 59	420662.1802	3071090.6432	1015.08	2,888.64	H
61	PP 60	420621.3204	3071055.2951	1013.34	2,942.67	SDP
62	PP 61	420586.9291	3071015.8108	1010.33	2,995.03	SDP
63	PP 62	420571.3571	3070983.8040	1015.61	3,030.63	H
64	PP 63	420528.9883	3070939.2146	1022.18	3,092.14	SP
65	PP 64	420492.1016	3070903.4450	1030.64	3,143.52	SP
66	PP 65	420453.1757	3070865.6980	1042.97	3,197.74	SDP
67	PP 66	420404.1490	3070827.5770	1055.15	3,259.84	SDP
68	PP 67	420364.5027	3070788.8746	1051	3,315.25	H
69	PP 68	420310.7103	3070759.2018	1071.25	3,376.68	SP
70	PP 69	420262.6120	3070732.6700	1066.57	3,431.61	H
71	PP 70	420224.0560	3070687.7739	1065	3,490.79	SDP

72	PP 71	420199.7675	3070647.6186	1058.32	3,537.72	SP
73	PP 72	420163.9666	3070588.4304	1066	3,606.89	H
74	PP 73	420121.1530	3070561.0080	1070.41	3,657.74	SDP
75	PP 74	420082.3753	3070516.4154	1069.42	3,716.83	SP
76	PP 75	420039.9550	3070467.6340	1087.79	3,781.48	H
77	PP 76	419983.6428	3070442.2809	1083.17	3,843.23	SP
78	PP 77	419933.5434	3070419.7250	1084	3,898.18	H
79	PP 78	419868.7256	3070411.3966	1106.38	3,963.53	SP
80	PP 79	419815.7637	3070404.5915	1125.24	4,016.93	SP
81	PP 80	419767.2360	3070398.3562	1124.22	4,065.85	SP
82	PP 81	419717.2394	3070391.9322	1123	4,116.26	H
83	PP 82	419670.5733	3070365.8130	1109.4	4,169.74	SP
84	PP 83	419621.7482	3070338.4855	1087.78	4,225.69	SP
85	PP 84	419582.9198	3070316.7530	1064	4,270.19	SP
86	PP 85	419532.5892	3070288.5829	1024	4,327.86	H
87	PP 86	419453.0280	3070254.6250	991.843	4,414.37	H
88	PP 87	419408.4230	3070235.3475	987.814	4,462.96	SP
89	PP 88	419362.3560	3070215.4381	988.1	4,513.15	SP
90	PP 89	419311.1233	3070193.2962	983.847	4,568.96	FPS
91	PP 90	419117.6892	3070102.6488	974	4,782.58	FPS
92	PP 91	419085.9636	3070061.0330	976.458	4,834.91	SP
93	PP 92	419044.5011	3070009.2316	973.858	4,901.26	H
94	PP 93	419018.3590	3069999.9830	977.176	4,928.99	SP
95	PP 94	418977.4715	3069989.3147	1011	4,971.25	SDP
96	PP 95	418943.5800	3069970.8630	1036.15	5,009.84	H
97	PP 96	418907.5372	3069938.1582	1044	5,058.51	SP
98	PP 97	418870.5134	3069899.5397	1056.4	5,112.01	SP
99	PP 98	418850.8747	3069881.1640	1066	5,138.90	SP
100	PP 99	418815.8399	3069848.3822	1079.45	5,186.88	SP
101	PP 100	418775.4777	3069810.6156	1067.31	5,242.16	SP
102	PP 101	418739.5720	3069777.0190	1063.53	5,291.33	H
103	PP 102	418678.5400	3069739.9940	1061.97	5,362.71	SP
104	PP 103	418631.7090	3069706.9370	1062.4	5,420.04	SDP
105	PP 104	418586.0810	3069665.4400	1066.05	5,481.71	SDP
106	PP 105	418547.1591	3069649.4695	1062.6	5,523.78	SP
107	PP 106	418499.7181	3069630.0034	1066	5,575.06	H
108	PP 107	418459.3139	3069607.3573	1062	5,621.38	SP
109	PP 108	418417.5935	3069583.9735	1081.45	5,669.21	SP
110	PP 109	418370.1017	3069557.3549	1065.19	5,723.65	SP
111	PP 110	418326.1786	3069530.5119	1063.45	5,775.13	SP
112	PP 111	418277.4281	3069498.8080	1074.6	5,833.28	H

113	PP 112	418236.2157	3069458.8728	1072	5,890.67	SDP
114	PP 113	418208.5454	3069415.5637	1059.58	5,942.06	SP
115	PP 114	418180.8540	3069372.0640	1063.25	5,993.63	SP
116	PP 115	418152.7553	3069328.2421	1055.5	6,045.68	SP
117	PP 116	418113.7903	3069275.8624	1053	6,110.97	H
118	PP 117	418094.1253	3069230.3035	1058.52	6,160.59	SP
119	PP 118	418068.8726	3069182.9041	1073.79	6,214.29	SP
120	PP 119	418051.6623	3069150.6005	1073	6,250.90	H
121	PP 120	418001.7410	3069142.4910	1077.06	6,301.47	H
122	PP 121	417966.4249	3069182.8595	1076.25	6,355.11	SDP
123	PP 122	417936.4868	3069207.3437	1061.57	6,393.78	SDP
124	PP 123	417897.4456	3069232.8021	1053.68	6,440.39	SDP
125	PP 124	417857.2006	3069252.4563	1034.61	6,485.18	SP
126	PP 125	417815.9360	3069272.2360	1024.54	6,530.94	H
127	PP 126	417778.6986	3069315.2420	1011.38	6,587.83	SP
128	PP 127	417754.8220	3069343.6849	1002.05	6,624.96	SP
129	PP 128	417725.6301	3069378.2375	993.441	6,670.20	SP
130	PP 129	417695.5540	3069415.4534	983	6,718.05	SP
131	PP 130	417667.7903	3069450.1970	981	6,762.52	H
132	PP 131	417646.0987	3069460.4721	972.905	6,786.52	H
133	PP 132	417594.1554	3069464.2444	969.38	6,838.60	H
134	PP 133	417572.4595	3069467.4194	970.113	6,860.53	H

FPS : Four Pole Structure
H : H Pole Structure
SDP : Single Dead End Pole
SP : Single Pole

Length of the Transmission Line, Span between Poles and Conductor required

S.No.	Between		Span (m.)	Height Difference (m.)	Total Length of Conductor (m.)
1	PP 0	PP 1	60.91	4.95	61.11
2	PP 1	PP 2	33.41	(5.05)	33.79
3	PP 2	PP 3	40.83	17.02	44.38
4	PP 3	PP 4	75.51	9.00	76.05
5	PP 4	PP 5	44.76	(27.23)	53.04
6	PP 5	PP 6	50.44	(0.78)	50.45
7	PP 6	PP 7	57.56	11.78	58.76
8	PP 7	PP 8	50.10	(6.74)	50.55
9	PP 8	PP 9	45.71	(3.26)	45.83
10	PP 9	PP 10	40.24	(12.00)	42.03
11	PP 10	PP 11	26.84	(5.53)	27.41
12	PP 11	PP 12	27.08	(6.47)	27.85
13	PP 12	PP 13	52.70	2.33	52.76
14	PP 13	PP 14	41.00	(0.89)	41.01
15	PP 14	PP 15	35.73	(6.11)	36.26
16	PP 15	PP 16	77.98	9.18	78.52
17	PP 16	PP 17	46.15	(2.51)	46.22
18	PP 17	PP 18	37.39	(1.62)	37.43
19	PP 18	PP 19	32.77	(1.90)	32.83
20	PP 19	PP 20	55.43	(0.51)	55.44
21	PP 20	PP 21	50.80	(6.41)	51.21
22	PP 21	PP 22	35.99	(5.14)	36.36
23	PP 22	PP 23	41.13	(2.66)	41.21
24	PP 23	PP 24	31.78	(1.43)	31.81
25	PP 24	PP 25	60.48	(8.02)	61.01
26	PP 25	PP 26	51.25	(1.03)	51.26
27	PP 26	PP 27	34.64	(2.07)	34.70
28	PP 27	PP 28	44.55	(2.31)	44.61
29	PP 28	PP 29	52.05	(0.69)	52.05
30	PP 29	PP 30	55.87	(2.20)	55.92
31	PP 30	PP 31	73.67	0.67	73.68
32	PP 31	PP 32	65.99	(2.29)	66.03
33	PP 32	PP 33	38.16	2.62	38.25
34	PP 33	PP 34	49.00	6.00	49.36
35	PP 34	PP 35	23.99	(0.48)	23.99
36	PP 35	PP 36	56.09	(6.97)	56.52

37	PP 36	PP 37	34.57	(0.55)	34.58
38	PP 37	PP 38	48.10	(3.15)	48.20
39	PP 38	PP 39	60.64	(3.28)	60.73
40	PP 39	PP 40	58.75	0.43	58.75
41	PP 40	PP 41	56.44	(6.30)	56.79
42	PP 41	PP 42	53.06	(7.91)	53.65
43	PP 42	PP 43	53.45	(0.79)	53.45
44	PP 43	PP 44	50.53	(3.83)	50.68
45	PP 44	PP 45	71.02	(16.35)	72.90
46	PP 45	PP 46	68.89	15.65	70.67
47	PP 46	PP 47	44.09	(3.93)	44.27
48	PP 47	PP 48	51.74	(11.91)	53.11
49	PP 48	PP 49	49.95	(0.40)	49.96
50	PP 49	PP 50	41.87	(0.88)	41.88
51	PP 50	PP 51	42.46	1.00	42.47
52	PP 51	PP 52	41.00	(1.45)	41.03
53	PP 52	PP 53	53.14	3.65	53.26
54	PP 53	PP 54	60.96	0.71	60.96
55	PP 54	PP 55	36.21	2.05	36.27
56	PP 55	PP 56	54.33	2.68	54.40
57	PP 56	PP 57	46.84	2.66	46.91
58	PP 57	PP 58	46.76	(7.66)	47.39
59	PP 58	PP 59	65.87	0.08	65.87
60	PP 59	PP 60	54.03	(1.75)	54.06
61	PP 60	PP 61	52.36	(3.01)	52.45
62	PP 61	PP 62	35.59	5.28	35.99
63	PP 62	PP 63	61.51	6.57	61.86
64	PP 63	PP 64	51.38	8.46	52.08
65	PP 64	PP 65	54.22	12.32	55.62
66	PP 65	PP 66	62.10	12.19	63.30
67	PP 66	PP 67	55.40	(4.15)	55.56
68	PP 67	PP 68	61.43	20.25	64.77
69	PP 68	PP 69	54.93	(4.68)	55.13
70	PP 69	PP 70	59.18	(1.57)	59.20
71	PP 70	PP 71	46.93	(6.68)	47.41
72	PP 71	PP 72	69.17	7.68	69.60
73	PP 72	PP 73	50.84	4.41	51.03
74	PP 73	PP 74	59.09	(0.99)	59.10
75	PP 74	PP 75	64.65	18.37	67.26
76	PP 75	PP 76	61.76	(4.62)	61.93
77	PP 76	PP 77	54.94	0.83	54.95

78	PP 77	PP 78	65.35	22.38	69.19
79	PP 78	PP 79	53.40	18.86	56.73
80	PP 79	PP 80	48.93	(1.02)	48.94
81	PP 80	PP 81	50.41	(1.22)	50.42
82	PP 81	PP 82	53.48	(13.60)	55.21
83	PP 82	PP 83	55.95	(21.62)	60.13
84	PP 83	PP 84	44.50	(23.78)	50.85
85	PP 84	PP 85	57.68	(40.00)	71.55
86	PP 85	PP 86	86.51	(32.16)	92.49
87	PP 86	PP 87	48.59	(4.03)	48.76
88	PP 87	PP 88	50.19	0.29	50.19
89	PP 88	PP 89	55.81	(4.25)	55.98
90	PP 89	PP 90	213.62	(9.85)	213.90
91	PP 90	PP 91	52.33	2.46	52.39
92	PP 91	PP 92	66.35	(2.60)	66.40
93	PP 92	PP 93	27.73	3.32	27.93
94	PP 93	PP 94	42.26	33.82	55.79
95	PP 94	PP 95	38.59	25.15	46.78
96	PP 95	PP 96	48.67	7.85	49.30
97	PP 96	PP 97	53.50	12.40	54.94
98	PP 97	PP 98	26.90	9.60	28.61
99	PP 98	PP 99	47.98	13.45	49.86
100	PP 99	PP 100	55.28	(12.14)	56.61
101	PP 100	PP 101	49.17	(3.77)	49.32
102	PP 101	PP 102	71.38	(1.57)	71.40
103	PP 102	PP 103	57.32	0.43	57.33
104	PP 103	PP 104	61.68	3.65	61.79
105	PP 104	PP 105	42.07	(3.45)	42.21
106	PP 105	PP 106	51.28	3.40	51.39
107	PP 106	PP 107	46.32	(4.00)	46.49
108	PP 107	PP 108	47.83	19.45	51.78
109	PP 108	PP 109	54.44	(16.26)	56.87
110	PP 109	PP 110	51.48	(1.74)	51.51
111	PP 110	PP 111	58.15	11.14	59.22
112	PP 111	PP 112	57.39	(2.60)	57.45
113	PP 112	PP 113	51.39	(12.42)	52.90
114	PP 113	PP 114	51.57	3.67	51.70
115	PP 114	PP 115	52.06	(7.75)	52.63
116	PP 115	PP 116	65.28	(2.50)	65.33
117	PP 116	PP 117	49.62	5.52	49.93
118	PP 117	PP 118	53.71	15.27	55.88

119	PP 118	PP 119	36.60	(0.79)	36.61
120	PP 119	PP 120	50.58	4.05	50.74
121	PP 120	PP 121	53.64	(0.81)	53.64
122	PP 121	PP 122	38.68	(14.68)	41.46
123	PP 122	PP 123	46.61	(7.89)	47.28
124	PP 123	PP 124	44.79	(19.07)	48.85
125	PP 124	PP 125	45.76	(10.07)	46.87
126	PP 125	PP 126	56.89	(13.16)	58.41
127	PP 126	PP 127	37.14	(9.33)	38.31
128	PP 127	PP 128	45.23	(8.61)	46.05
129	PP 128	PP 129	47.85	(10.44)	48.99
130	PP 129	PP 130	44.47	(2.00)	44.52
131	PP 130	PP 131	24.00	(8.10)	25.37
132	PP 131	PP 132	52.08	(3.52)	52.20
133	PP 132	PP 133	21.93	0.73	21.94
				Total Length of Conductor:	6998.48 m.

List of Particulars:

CEPAD Hydro Consultants Pvt. Ltd.

Suri Khola Hydropower Project

33 kV Transmission line
Dolakha, Nepal

Cost Estimate

S.No.	Description	Unit	Quantity
1	Supply and Delivery of 13 m. long B27 type Steel Telescopic Poles complete with pole fittings and Accessories		
	a) Single Pole (Pin Type)	Set.	67
	b) Single Dead End Pole	Set.	23
	c) H Pole (Double Dead End Pole)	Set.	42
	d) 4 Pole Structure (Dead End)	Set.	2
2	Supply and Delivery of 0.10 Sq. Inch ACSR Conductor "DOG"	km.	42
3	Supply and Delivery of Porcelain Insulators		
	a) 33 kV Pin Insulator with Spindle	Set.	816
	b) 33 kV Disc Insulator (3 nos. of 11 kV Insulator Assembly) complete with Tension Set	Set.	804
	c) Stay Insulators	no.	115
4	Supply and Delivery of Line Materials		
	a) 8 feet long 7/10" dia Stay set all complete (Turn Buckle, Stay rod, Thimble, Stay Plate: 400×400×6 mm.)	Set.	115
	b) 7/10 SWG GI stay	m.	2070
	c) Aluminum PG Clamp suitable for 0.10 sq. inch DOG conductor	no.	402
	d) Copper Plated Earthing Rod (2 cm dia, 2 m. length)	no.	134
	e) 10 SWG Aluminum Binding Wire	kg.	100

Annex C – Bill of Quantity

CEPAD Hydro Consultants Pvt. Ltd.

Suri Khola Hydropower Project

33 kV Transmission line

Dolakha, Nepal

Cost Estimate

Delivary Site: Dolakha

Job: Supply and Delivery of Line Materials for Construction of 33 kV Double Circuit Line from Powerhouse to Singati Substation, Singati, Dolakha

S.No.	Description	Unit	Quantity	Rate (NPR)	Amount (NPR)	Remarks
1	Supply and Delivery of 13 m. long B27 type Steel Telescopic Poles complete with pole fittings and Accessories					
	a) Single Pole (Pin Type)	Set.	67.00	33,500.00	2,244,500.00	
	b) Single Dead End Pole	Set.	23.00	42,500.00	977,500.00	
	c) H Pole (Double Dead End Pole)	Set.	42.00	85,000.00	3,570,000.00	
	d) 4 Pole Structure (Dead End)	Set.	2.00	134,000.00	268,000.00	
	Sub Total (1):				**6,792,000.00**	
2	Supply and Delivery of 0.10 Sq. Inch ACSR Conductor "DOG"	km.	42.00	100,000.00	4,200,000.00	
	Sub Total (2):				**4,200,000.00**	
3	Supply and Delivery of Porcelain Insulators					
	a) 33 kV Pin Insulator with Spindle	Set.	816.00	1,500.00	1,224,000.00	
	b) 33 kV Disc Insulator (3 nos. of 11 kV Insulator Assembly) complete with Tension Set	Set.	804.00	1,200.00	964,800.00	
	c) Stay Insulators	no.	115.00	1,750.00	201,250.00	
	Sub Total (3)				**2,390,050.00**	

4	Supply and Delivery of Line Materials					
	a) 8 feet long 7/10" dia Stay set all complete (Turn Buckle, Stay rod, Thimble, Stay Plate: 400×400×6 mm.)	Set.	115.00	2,350.00	270,250.00	
	b) 7/10 SWG GI stay	kg.	690.00	150.00	103,500.00	
	c) Aluminum PG Clamp suitable for 0.10 sq. inch DOG conductor	no.	402.00	80.00	32,160.00	
	d) Copper Plated Earthing Rod (2 cm dia, 2 m. length)	no.	134.00	800.00	107,200.00	
	e) 10 SWG Aluminum Binding Wire	kg.	100.00	200.00	20,000.00	
	Sub Total (4)				**533,110.00**	
5	Supply and Delivery of Cement, Sand and Aggregate	Lump	1.00	200,000.00	200,000.00	
	Sub Total (5)				**200,000.00**	
	Total (Sub Total 1+2+3+4+5)				14,115,160.00	
	VAT @ 13%				1,834,970.80	
	Grand Total				**15,950,130.80**	

(In Words:Fifteen Million Nine Hundred Fifty Thousand One Hundred and Thirty Rupees and Eighty Paisa)

CEPAD Hydro Consultants Pvt. Ltd.

Suri Khola Hydropower Project

33 kV Transmission line

Dolakha, Nepal

Cost Estimate

Job: Construction of 33 kV Double Circuit Line from Powerhouse to Singati Substation, Singati Dolakha

S.No.	Description	Unit	Quantity	Rate (NPR)	Amount (NPR)	Remarks
1	Erection of 13.00 m. long steel telescopic poles (B27 type)including transportation from the site store to the construction site, excavation of the footing, making pole vertical and placing in footing, back filling, ramming of soil for strengthening, concreting and fitting accessories (Channels and angles) all complete.					
	a) Single Pole (Pin Type)	Set.	67	3,500.00	234,500.00	
	b) Single Dead End Pole	Set.	23	3,500.00	80,500.00	
	c) H Pole (Double Dead End Pole)	Set.	42	7,000.00	294,000.00	
	c) Four Pole Structure	Set.	2	12,000.00	24,000.00	
2	Stringing of 0.10 Sq. Inch ACSR Conductor "DOG" with proper tension using PG clamp and jointing sleeves binding wire along with transportation from site store to the construction site all complete (per 3 wire)	km.	42	45,000.00	1,890,000.00	
3	Installation of 8 ft long stay set including pit excavation and back filling, stay wire and stay insulator fitting along with transportation from site store to the construction site all complete.	Set.	115	1,700.00	195,500.00	
-	**Grand Total Including VAT**	-	-	-	**2,718,500.00**	-

(In Words: Two Million Seven Hundred Eighteen Thousand and Five Hundred Rupees)

CEPAD Hydro Consultants Pvt. Ltd.

Suri Khola Hydropower Project

33 kV Transmission line

Dolakha, Nepal

Cost Estimate

Job: Construction of 33 kV Double Circuit Line from Powerhouse to Singati Substation, Singati Dolakha

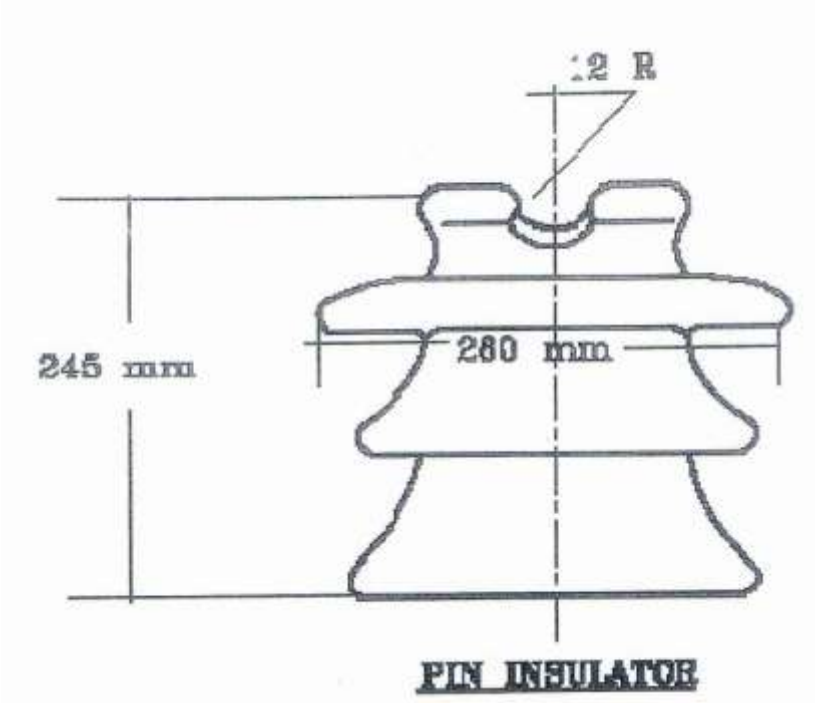
S.No.	Description	Amount (NRs)	Remarks
1	Supply and Delivery of 33 kV Line materials	15,950,130.80	
2	Construction of Line all complete	2,718,500.00	
	Total:	18,668,630.80	

(In words: NPR Eighteen Million Six Hundred Sixty Eight Six Hundred and Thirty Rupees and Eighty Paisa)

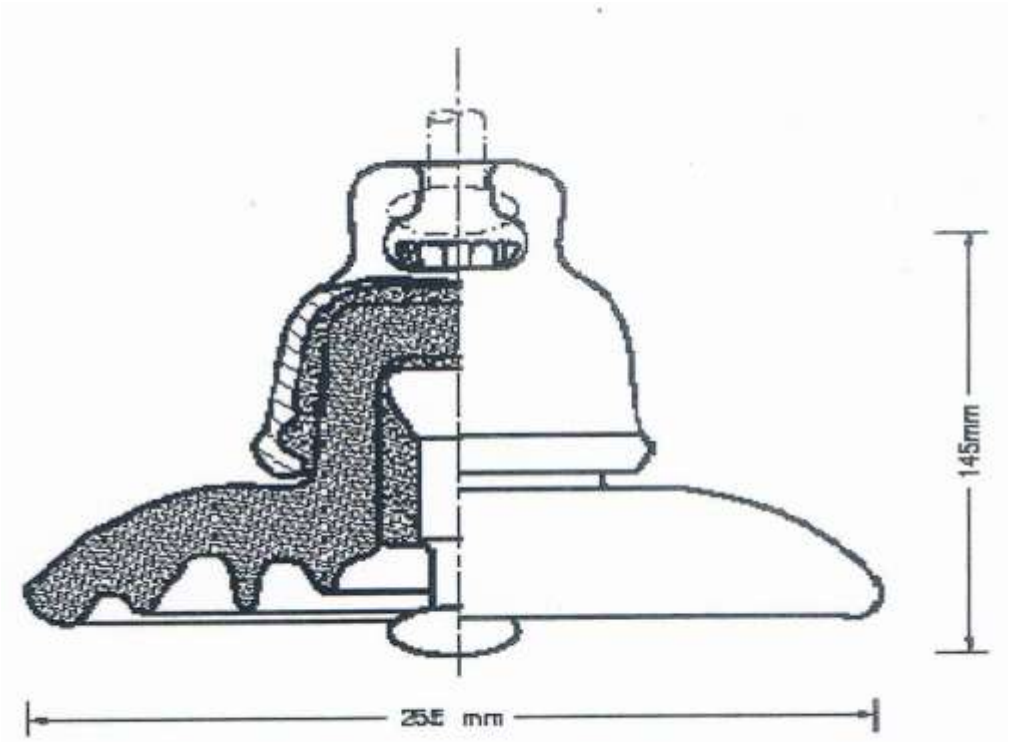
Annex D – Technical Drawings (Steel Telescopic Pole)

Annex E – Technical Drawings

(Hardware and Insulators)

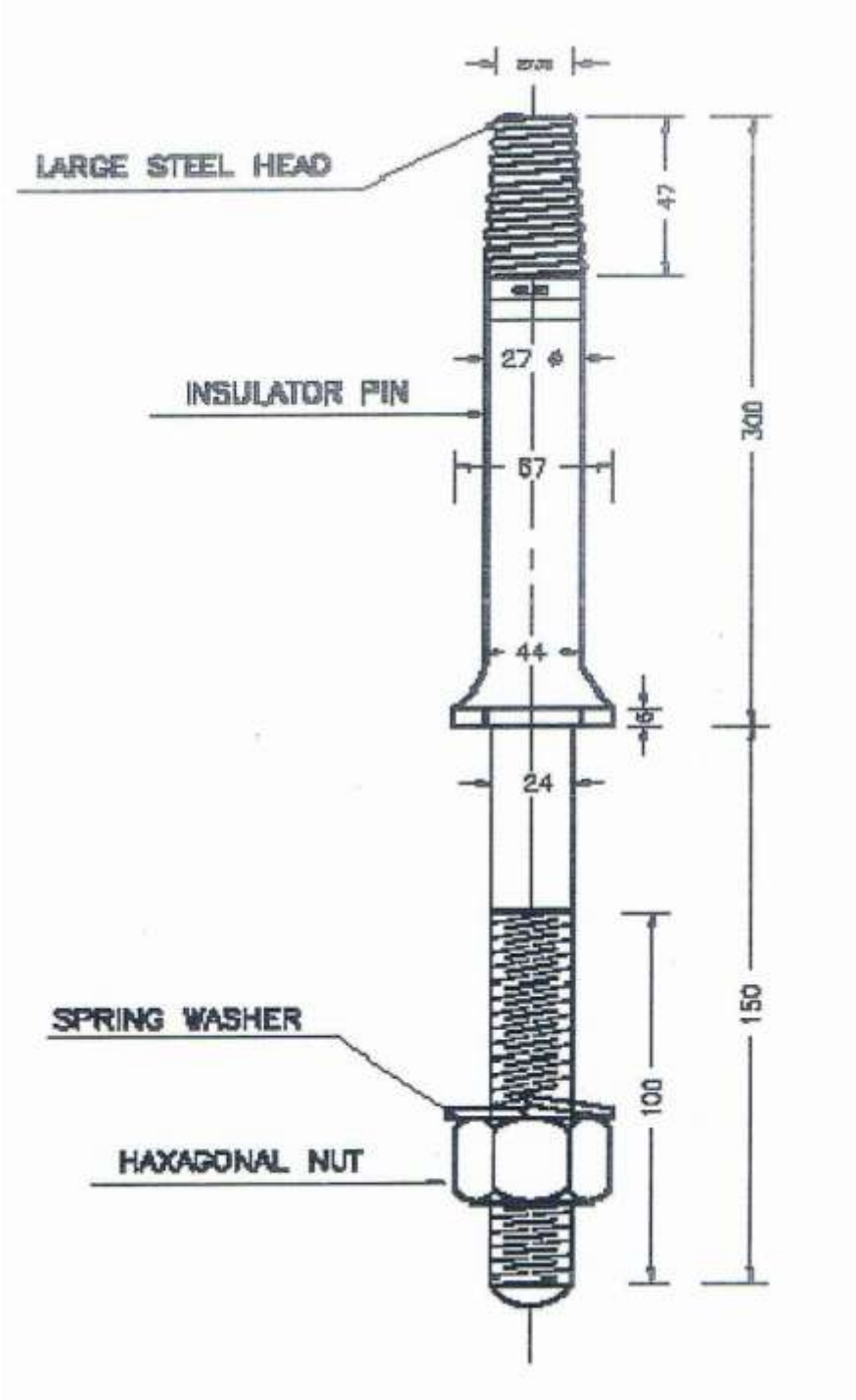


PIN INSULATOR

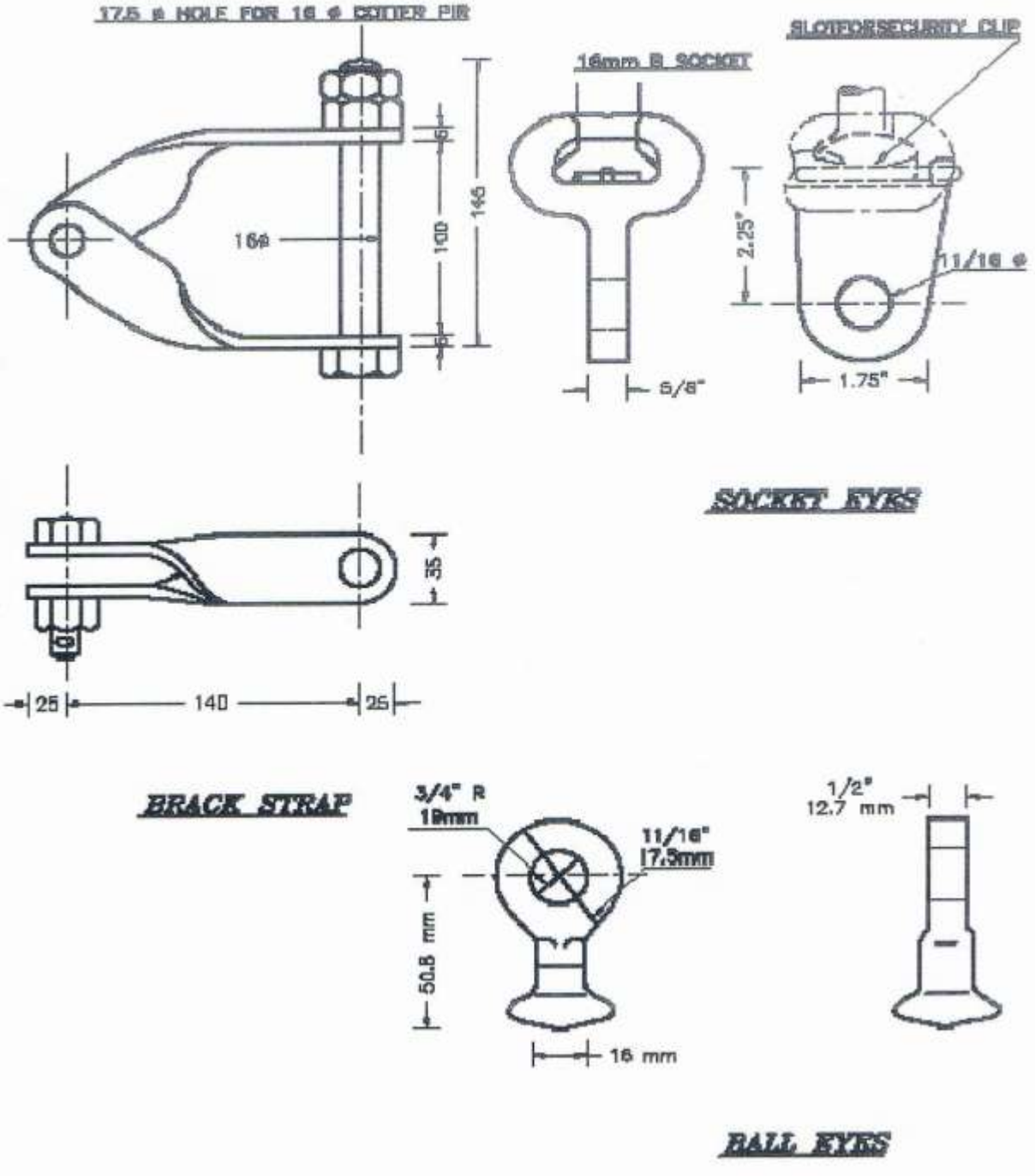


DISC INSULATOR

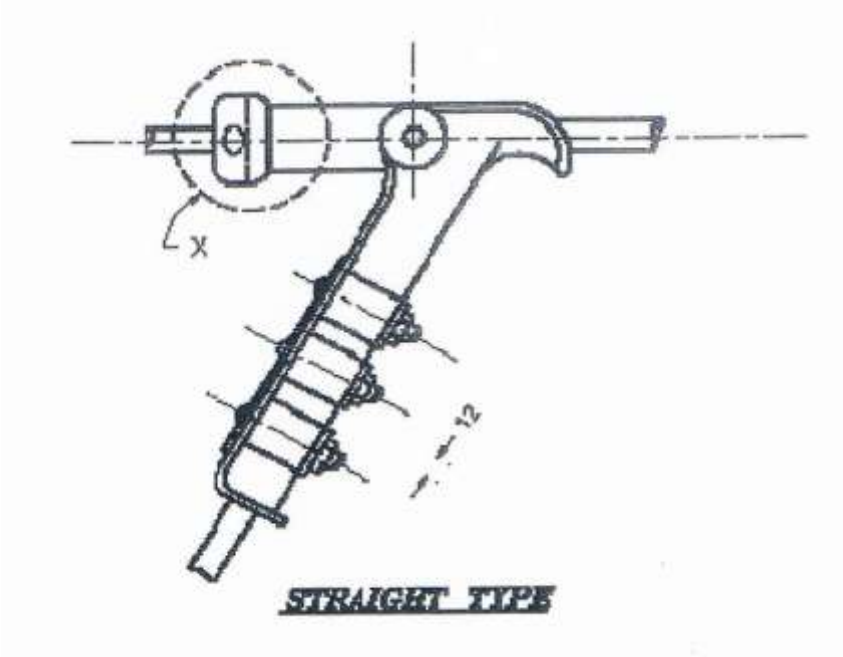
33 kV INSULATORS DWG : 01



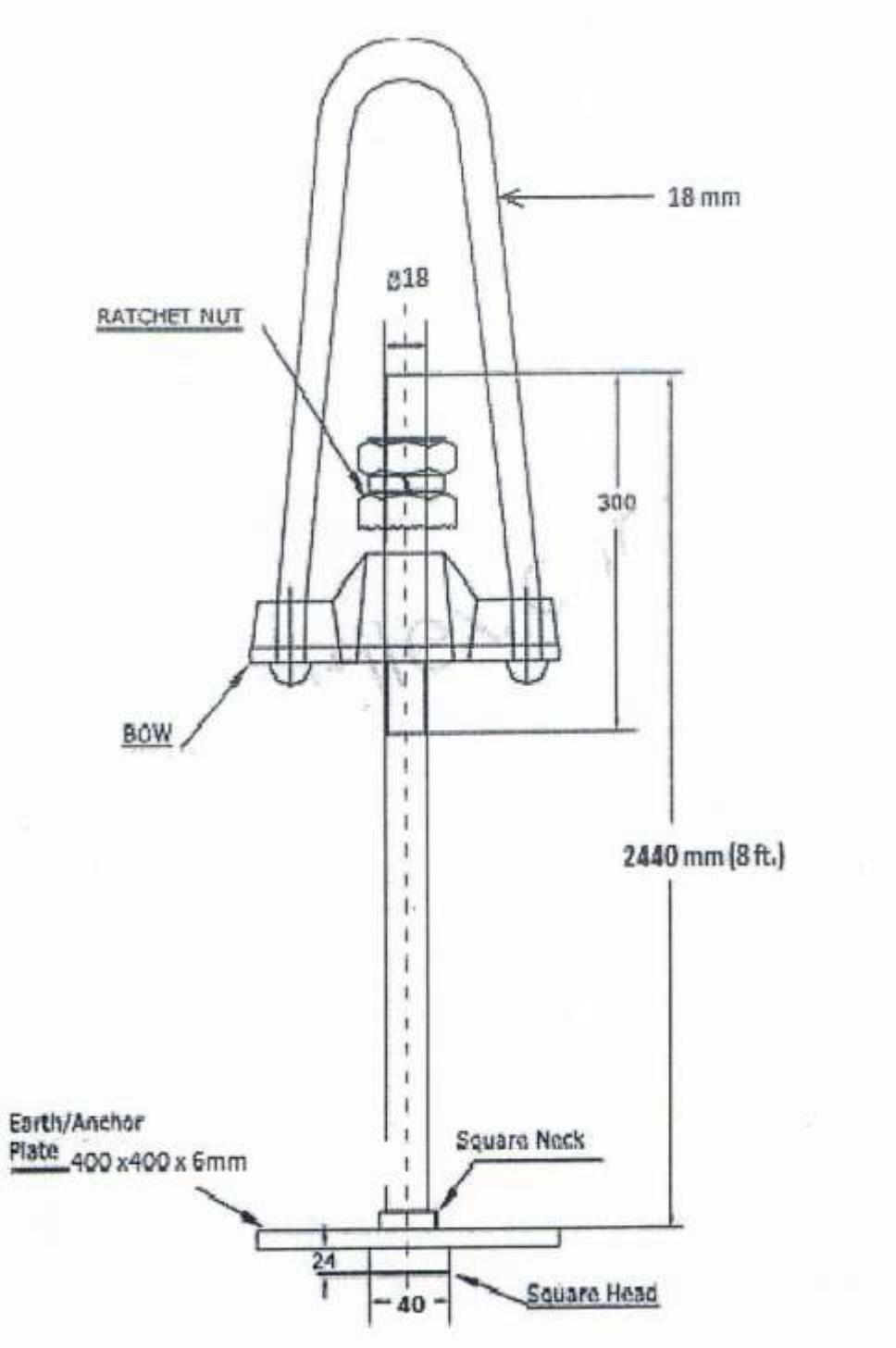
INSULATOR PIN 33 kV DWG : 02



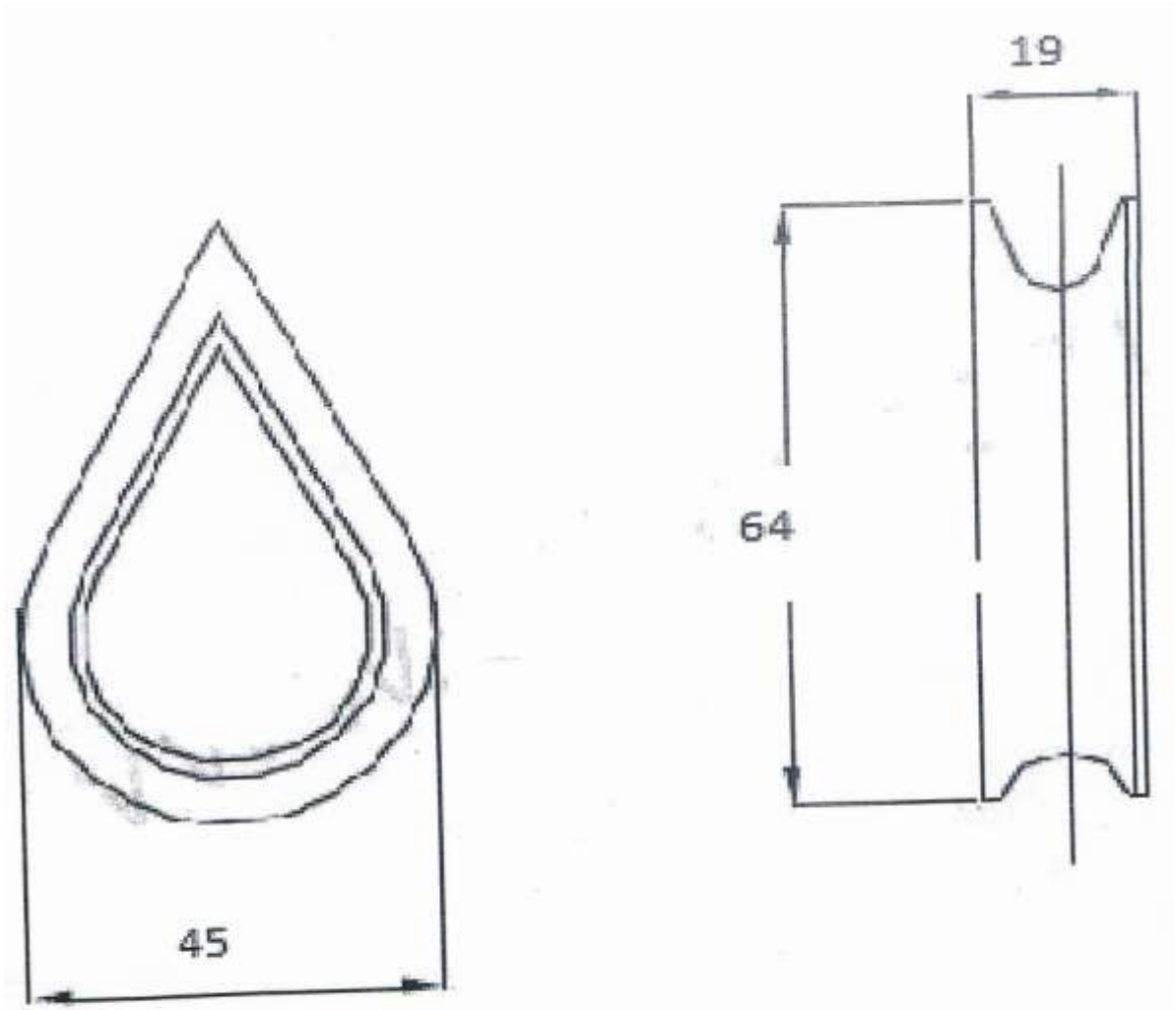
HARDWARES FOR TENSION SET DWG : 03



CONCEPTUAL DRAWING OF TENSION SET DWG : 04



STAY SET DWG : 05



Thimble (2 Pcs/set)

STAY SET THIMBLE DWG :06