

HTLS CARBON COMPOSITE CORE ALUMINIUM
(equivalent to Panther) conductor except
GAP conductor

High Temperature Low Sag (HTLS)conductor Annealed aluminium except GAP conductor

Specification

The work involves dismantling of existing ACSR Panther Conductor, supply of HTLS CARBON COMPOSITE CORE ALUMINIUM (equivalent to Panther) **conductor of minimum 1050 A capacity corresponding to maximum allowable operating temperature & with unit weight equal to or less than that of ACSR Panther** conductor and associated conductor hardware fittings, clamps & vibration dampers and stringing of the HTLS conductor on existing 132KV transmission line structure after survey of the lines. ROW if any for execution of work & approach to worksite shall be resolved by contractor at his cost. However, BSPTCL will provide necessary assistance.

Submission of complete technical details of the proposed HTLS conductor with relevant calculation along with the bid to adjudge the sufficiency of existing towers for carrying out the up-rating works. This shall be carried out in compliances / adherence to all safety and standard requirements as per Indian Electricity Rules 1956. Design parameters and submission of detailed drawings of conductor hardware and accessories and preparation of sag tension chart, stringing chart, of the conductor used showing, sag & tension at various temperatures are included in the scope of the Contractor as per latest IS/IEC/ASTM.

The entire stringing work of HTLS (equivalent to Panther) conductor shall be carried out by tension stringing technique except where geographical / topographical or other site constraints do not permit use of tension stringing equipment. In such cases manual stringing along with other appropriate tools and equipment may be employed with the approval of engineer in charge. The contractor shall indicate in their offer, the sets of tension stringing equipment he is having in his possession and the sets of stringing equipment he would deploy exclusively for this package. The contractor shall also engage sufficient manpower so that stringing of the conductor can be completed within the allowed shut down period.

In 132KV D/C Transmission lines, road crossings and lines passing over civil structures will have double insulator strings. Vibration dampers are to be provided in all suspension & tension locations.

The rollers which will be used during stringing should be so designed that the line can be charged with the roller.

One conductor manufacturing engineer with master instructor should remain present on the site during erection process.

Conductor Type:

The actual conductor type is to be suggested by contractor having physical, mechanical and electrical characteristics such as,

- i) Outer diameter in mm-----not exceeding 21mm
- ii) Outer diameter of core in mm----- not exceeding diameter of core of existing ACSR conductor
- iii) Weight in kg/km ----- < OR =that of ACSR Panther
- iv) Tension at every day condition (32°C,nowind)----- Not exceeding 25% of UTS of offered conductor
- v) Current carrying capacity----- not less than 1050AMP
- vi) Tension at 32°C, full wind(52 kg/m²)-----≤ 2763 Kg (for ruling span of 233meters)

≤ 2896 Kg (for ruling span of 305meters)

≤ 2986 Kg (for ruling span of 365meters)

vii) The net expansion of the HTLS Panther equivalent conductor / unit length at maximum operating temperature should be less than the net expansion of ACSR panther conductor /unit length at(75°C)

viii) Sag (in meters) ≤ 3.37 metres (for ruling span of 233meters)

≤ 5.56 metres (for ruling span of 305meters)

≤ 7.71 metres (for ruling span of 365meters)

ix) Sag of offered HTLS Conductor at maximum continuous operating temperature < sag of ACSR Conductor at 75 Deg C considering same span length

x) DC resistance at 20°C and AC resistance at 75°C should be at least 15% less than ACSR Panther conductor.

xi) The conductivity at 20 Deg C (corresponding to % IACS) of aluminum or aluminum alloy used in the offered HTLS conductor should not be less than the % IACS Conductivity of Aluminum used in ACSR type conductor (IACS: International Annealed Copper Standard)

Note: Current carrying capacity of the offered conductor shall be calculated corresponding to following ambient conditions:

1. Ambient temperature (°C) =45
2. Solar Absorption coefficient =0.8
3. Solar Radiation (w/sqm) =1045
4. Emissivity constant =0.45
5. Wind Velocity = 0.56m/sec.

During execution, if there be any constraint regarding tension, sag, span, weight/mtr, diameter, ampacity and modulus of elasticity of the conductor, then the contractor shall formulate and submit these data in favour of BSPTCL after detailed engineering and the revised data shall be implemented after written approval of the buyer/BSPTCL.

Current Carrying capacity / Ampacity of offered Conductor

The Contractor in his bid shall furnish calculations for the ampacity based on IEEE-738 standard for the offered HTLS conductor. The design of conductor shall be suitable for operation at steady state conductor temperature at flow of minimum **1050 Amperes AC**. The Contractor shall also indicate the maximum permissible conductor temperature for continuous operation at maximum ampacity quoted at still air & at 45ambient without any deterioration of its electrical, mechanical & metallurgical properties.

The contractor shall indicate the technical particulars and details of the construction of the conductor in the relevant schedule of GTP. The contractor shall also guarantee the DC resistance and AC resistance at temperature corresponding to the continuous operating current of 1050 under normal condition. The contractor shall submit the supporting calculations for the AC resistance indicating details & justification of values of temperature coefficient of resistance & DC to AC resistance conversion factor with due reference to construction & geometry of the conductor. The Contractor shall submit the type test reports in support of DC resistance and the calculations for AC resistance.

Sag-Tension calculations of the existing ACSR Panther conductor and offered HTLS (EQUIVALENT TO PANTHER) conductor are to be submitted along with bid under following conditions.

- i) 32°C, No wind
- ii) 32°C, Full wind
- iii) 05°C, 2/3rd wind
- iv) 65°C, No wind
- v) 180°C, No wind

vi) Emergency temperature no wind.

Contractor shall also furnish details of creep characteristics based on laboratory investigations/experimentations conducted on the HTLS conductor as per IEEE 1138 and shall indicate creep strain values corresponding to 1 month, 6month, 1year creep at tensions corresponding to the above conditions.

Calculations for Sag & tension shall be as described below:-

Design of Hardware & accessories should be compatible with the supplied HTLS (EQUIVALENT TO PANTHER) conductor and existing insulators & structures.

Major Qualifying Projects (MQP) for offered Conductor and hardware/accessories manufacturing is to be submitted with technical bid.

Workmanship

- i) All the conductor strands shall be smooth, uniform and free from all imperfections, such as spills and splits, cracks, die marks, scratches, abrasions, rust etc.
- ii) The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and / or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc), dirt, grit etc.

Joints in wires

a) Aluminum OR Aluminum Alloy Wires

During stranding no Aluminum/ aluminium Alloy welds shall be made for the purpose of achieving the required conductor length

b) Core Wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no joints or splices in any length of the completed stranded core. However, for composite core wires, splicing of the galvanic protection barrier is allowed, provided diameter specifications are maintained adhering to ASTM B987-17 and its upgradation (if any)

Tolerances

Manufacturing tolerances on the dimensions to the extent of one percent shall be permitted for individual strands and the complete conductor. However, For composite cores, the manufacturing tolerance shall be +/- 0.05 mm of the stated nominal value adhering to ASTM B987-17 and its upgradation (if any)

Materials

The materials used for construction of the conductor shall be such that the conductor meets the specified technical and the performance requirements.

Outer Layer

i) The material of outer layer of HTLS (EQUIVALENT TO PANTHER) conductor shall be of high temperature resistant aluminum/ aluminum alloy/Annealed Aluminium added with any suitable elements to electrolytic aluminum having purity not less than 99.5% and a copper content not exceeding 0.04%. Contractor shall guarantee the chemical composition in the schedule GTP and also furnish description of the manufacturing process in the bid.

Core

The core wire strands may be of any composite materials or special steel and shall have properties conforming to the technical performance requirements of the finished conductor. Contractor shall furnish properties and composition of the core wire strands in the GTP schedule. The composite material for core shall be of such proven quality that its properties are not deteriorated by the normal operating conditions of 132KV transmission line in tropical environment conditions as experienced by the existing lines. The Contractor shall provide adequate details including specifications / test reports / operating experience details / performance Certificates etc. in support of the suitability of the offered materials. Care to be taken for internal friction due to different material having different thermal coefficient of expansion.

Conductor Length

The Contractor after his survey of the existing line shall determine the most appropriate individual conductor lengths to be manufactured & supplied keeping in view of the tower schedules, section lengths, special crossings etc. The drum drawing as per IS 1778 or any international standard shall be submitted to purchaser for review and approval. The Contractor shall also indicate the maximum single length of conductor that they can manufacture, in the GTP. Contractor has to do survey, route, profile & engineering etc. of the existing line.

STANDARDS

The conductors & accessories shall comply in all respects to the clauses of this specification as indicated above & with the standards noted in Appendix-I, Appendix-II.

STRANDING

8.4.1 For all, constructions, each alternate layer shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the under laying wire or wires. The final layer of wires shall have a right hand lay.

PACKING AND MARKING

The conductor shall be wound in non-returnable reels or drums conforming to Indian Standard 1978-1961 specification for Reels and Drums for Bare Wire, or any other authoritative better standard and marked with the following:-

- a) Trade name, if any b) Contract/Award letter Number
- c) Name of manufacturer d) Name & Address of Consignee
- e) Drum Number f) Length of conductor
- g) Size of conductor h) Gross Weight of drum with conductor
- i) Weight of empty drum j) Net and gross weight of conductor with lagging.
- k) Arrow marking for un-winding

The reel shall be of such construction as to assure delivery of conductor in the field free from displacement & damage and should be able to withstand all stresses due to handling and the stringing operations so that conductor surface is not dented, scratched or damaged in any way during manufacture, transport and erection. The conductor shall be properly lagged on the drums and the method of lagging to be employed may be clearly stated in the offer. It should be stacked to suit the reel and held in place by steel strapping. Lagging shall not be nailed or bolted in place.

The conductor drum should be suitable for wheel mounting. Before reeling, the cardboard or other suitable material shall be secured to the drum and inside flanges of the drums. After reeling the conductor, the exposed surfaces should be wrapped with suitable soft material to prevent the conductor from dirt and grit. Any space between drum lagging and conductor should be suitably filled with soft filler material compactly packed.

Evaluation of Ohmic Losses and Differential Price Loading

Based on the conductor parameters guaranteed by the bidders, average ohmic losses for different type of conductors offered by the bidders shall be calculated as per the following formula:

Average Ohmic loss (kW) = Loss Load Factor X conductor length X (Continuous operating current under normal conditions)² X AC Resistance corresponding to continuous operating current

For total conductor requirement of _____ kms, loss load factor = 0.50, continuous operating current of 1050Amp;

$$\begin{aligned}\text{Average Ohmic loss(kW)} &= \text{_____} \times 0.50 \times (1050)^2 \times R_{ac} / 1000 \\ &= \text{_____} \times R_{ac}\end{aligned}$$

Where R_{ac} is the AC resistance per km guaranteed by the bidder at temperature corresponding to the continuous operating current of 1050A under normal condition.

Differential price evaluation for the conductors offered by the bidders shall be carried out considering the average ohmic losses calculated as above and considering Rs. 1,52,600 per kW.

The best parameter of loss (lowest ohmic loss for conductor) corresponding to lowest AC resistance quoted among bidders by any technically responsive and qualified bidder shall be taken as basis and that quoted by the particular bidder shall be used to arrive at differential price to be applied for each bid.

TESTS AND TEST CERTIFICATES

1.7.1 Type Tests on Conductor

The following type valid test certificates are to be furnished along with the bid.

i) Breaking Load Test on Stranded conductor

The test is to be carried out as per IS 398 Part V or as per IEC 61089 and the results should conform to the guaranteed values furnished by the contractor.

ii) D.C Resistance Test on stranded conductor

The tests is to be carried out as per IS 398 Part V or as per IEC 61089 and the results should conform to the guaranteed values furnished by the contractor.

iii) Test on Composite CarbonCore

The offered conductor is acceptable only if the conductor passes the tests on Composite Carbon Core as per relevant IS/IES/ASTM.

Note:- Apart from above if any test is desired to be done by BSPTCL, agency should do the same and arrange it on discretion of BSPTCL. Price implication for the same shall be borne by BSPTCL.

Acceptance tests on conductor

The following acceptance tests will be made in the presence of the representatives of the owner. However, these tests are subject to change as per the technical discussion between the owner & contractor.

i) Breaking load test on conductor strands and D.C resistance test on conductor strand

The conductor strands and DC resistance should meet the requirements of ASTM B.

ii) Aluminium Area measurement on complete conductor

The test is to be carried out as per ASTM B 263. The aluminium area should conform to the guaranteed values furnished by the contractor.

iii) Check for Lay ratios of various layers

The lay- ratios of various layers shall be checked to ensure that they conform to the guaranteed values furnished by the contractor.

iv) Visual and Dimensional check on drums

The drums shall be visually and dimensionally checked to ensure that they conform to the approved drawings.

In case of composite core type conductors, composite Core manufacturer must have successfully performed design validation tests prior to bid submission as per ASTM B987 on the class of core being offered and it must be witnessed by the representative (s) of Utility or witnessed by representative of a Laboratory which is accredited to ISO/IEC 17025 (different than that of laboratory where tests were performed).

8.7.4 Tests on Accessories

8.6.3.1 Dead end strength, high temperature endurance, current cycling, sustained ampacity, aeolian vibration, & corrosion tests will be conducted on the accessories according to the standards specified at appendix-IV.

1.7.4 Additional Information

i) Contractor should have experience of stringing of HTLS/ High Ampacity Conductors of same technology as offered in the bid.

ii) Laying of HT cable/stringing of HTLS / High Ampacity Conductor shall be carried out in presence of OEM/authorized representative of OEM.

GUARANTEED TECHNICAL PARTICULARS

The contractor shall fill in the guaranteed technical particulars in the Performa below and submit the same with his tender, without which bid will not be considered.

GUARANTEED TECHNICAL PARTICULARS OF “HTLS CARBON COMPOSITE CORE ALUMINIUM (EQUIVALENT TO PANTHER) ” CONDUCTOR

Sl. Description Unit Value guaranteed by the Contractor

1. Name of Manufacturer

2. Address of Manufacturer

3. Name of the conductor

4. Construction of conductor/

Designation of conductor as per IEC:61089

5. Particulars of Raw

Material Outer Layers

a) Type of conductor strand.

b) Chemical composition of Conductor strand.

i) %

ii) %

iii) %

iv) %

v) %

Inner Core

a) Material of core

b) Chemical composition of core

i) %

ii) %

iii) %

iv) %

v) %

vi) %

6. Outer Aluminium Alloy Strand afterStranding Number of outer layers Nos.

Diameter mm

a) Nominal mm

b) Maximum mm

c) Minimum mm

Minimum Breaking load of strand

a) Before stranding KN

b) After stranding KN

Resistance of 1m length of strand at 20 deg. C. Ohm

7. Inner core strands/inner core after stranding Number of layers in inner core No.

Diameter mm

a) Nominal mm

b) Maximum mm

c) Minimum mm

Minimum Breaking load of strand/Core

a) Before stranding KN

b) After stranding KN

Min. no. of twists which a
single strand shall withstand
during torsion test for a length
equal to 100times dia of wire
after stranding. Nos

8. Complete conductor UTS of Conductor KN

Lay ratio of conductor Maximum Minimum

a) 1st layer (outer most layer)

b) 2ndLayer

c) 3rdLayer

d) 4thLayer

Maximum permissible conductor
temperature for continuous
operation DegC

Maximum permissible conductor
temperature for short term
operation DegC

Permissible duration of above
short term operation Minutes

Maximum length of conductor
that can be offered as single length KM

DC resistance of conductor at 20°C Ohm/km

AC resistance at maximum
continuous operating temperature
corresponding to specified
maximum operating current
(minimum 1050 A under maximum
ambient conditions and zero wind
as per Technical Specification) Ohm/km

Details of Creep characteristic for
conductor enclosed (as per
Technical Specification)Yes/No

Sag Tension Calculation

Sag Tension Calculation enclosed Yes/No

Sag & tension at 32 deg. C & no wind Meters &KN

Sag & tension at 32 deg. C & full wind Meters & KN 103

Sag & tension at 05 deg. C & 2/3rd wind Meters &KN

Sag & tension at 65 deg. C & no wind Meters &KN

Sag & tension at 150 deg. C & no wind Meters &KN

Sag & tension at maximum operating temperature & no wind
Meters & KN

Sag & tension at emergency temperature & no wind

Meters & KN

Tolerance on standard length of conductor%

Direction of lay for outside layer

Linear mass of the Conductor

a) Standard Kg/Km

b) Minimum Kg/Km

c) Maximum Kg/Km

Standard length of conductor KM

9.0 Drum is as per specification Yes/No

10.0 Accessories as per specification/standards Yes/No

SAG TENSION CHARTS AND SAGTEMPLATES

The contractor shall supply six copies of sag tension charts and sag templates each in respect of the conductor. The contractor shall also supply sag template in celluloid, which shall be subject to the approval by the owner and without involving any extra charges. The sag template will be used for changing the tower positions in future.

ACCESSORIES

The Contractor after his survey of the existing line shall determine the quantity and type of the accessories required for the turnkey job, which are to be supplied by them. These accessories should be suitable for the supplied conductor for its entire operating range without degradation of mechanical, metallurgical and electrical properties. The steady state temperature of hardware and accessories must not exceed 90°C during no wind and 50°C ambient temperature at minimum 800Amp load. The contractor shall be responsible for satisfactory performance of complete conductor, hardware and accessories, offered by him, for continuous operation at temperatures corresponding to various conditions stipulated at 2.4 of this technical specification.

EXECUTION OFWORK

The erection works consist of

(a) dismantling of existing ACSR Panther Conductor, Construction of new Transmission line on narrow base tower having pile foundation, supply of HTLS CARBON COMPOSITE CORE ALUMINIUM (EQUIVALENT TO PANTHER) conductor of minimum approx 1050 A capacity corresponding to maximum allowable operating temperature & with unit weight equal to or less than that of ACSR Panther conductor and associated conductor hardware fittings, clamps & vibration dampers and stringing of the HTLS conductor on existing 132KV transmission line structure. ROW if any for execution of work & approach to worksite shall be resolved by contractor at his cost. However, BSPTCL will provide necessary assistance. In case, Tower strengthening is required where there is missing tower members, agency will install the missing members of tower (if required) and the payment shall be done on actual consumption.. The summary of the work is asfollow-

a. Insurance of materials during storage-cum-erection.

b. Distribution of materials at erection site.

c. Stringing of conductor up to both ends of the lines, with the help of tensioner and puller machine and if required, manually with the approval of the owner.

d. Guarantee of all the activities carried out from (a) to (e) and submission of FQP for carrying out of all above activities.

All works shall be carried out in accordance with the revised and latest provisions under Indian Electricity Act and Rules made thereunder.

All the erection tools required during erection of lines shall be arranged by the Contractor at his own cost. The Contractor shall also be responsible for any damage to and / or loss of his erection tools.

In case of any deviation in quantities from the tendered quantity, payment will be made with the approval from the corporate office of the owner.

It will be the Contractor's sole responsibility to take the materials up to the location. Any pathway, temporary road, temporary bridge required for the work, same will be provided by the contractor at his cost. If, for any reasons the above is not feasible, the contractor at his own cost shall have to arrange transportation by headloads.

STRINGING

The stringing work shall be carried with the help of tensioner and puller machines. Wherever it is not possible to install the tensioner, it can be done manually with the approval of site engineer of the owner. Stringing shall mean, the activities of paying, jointing, tensioning, clamping with armor-rod, providing dampers and fixing the conductor at tension hardware and jumpering etc.

Stringing of conductor shall be done up to gantry at both ends of the individual lines. Installation tension is not allowed to exceed beyond maximum allowable tension of existing ACSR. The stringing work should be planned in such a manner in consultation with the Engineer in charge of the Owner that minimum shut down of power line crossings are required. Revenue loss due to any undue shut down due to contractor's irresponsibility shall be recoverable from the contractor. Before commencing of stringing work, Contractor shall obtain approval of sag tension charts showing final sag and tension for various temperature and spans.

The Contractor shall be responsible and will take care of proper handling of conductor drums. Sufficient numbers of aluminum snatch blocks shall be used for paying out the Conductors. Necessary precautions shall be taken to avoid conductor rubbing on the ground by providing adequate ground roller, rollers on supports. Additional rollers shall also be provided to cross thorny hedges, tower footing and other obstructions to avoid scratching of conductor. The conductor shall be made to sag correctly as per stringing charts, before they are finally transferred to the hardware and clamps. No mid span joint shall be made at less than 30 meters from the tower end and no mid span joint shall be permitted in road and other important crossings spans. There shall not be more than one joint in the same span of individual conductor. The sag shall be adjusted to suit the sag indicated against actual temperature. The thermometer shall be provided at the conductor point during the stringing work. Dynamo meters shall be used in tensioning the conductors. All conductors shall be stressed to their load at the time of stringing, as per approved stringing charts.

The minimum clearance between the lowest point of conductor and ground shall not be less than as specified in the chart. All compression joints should be carefully made and a record of initial and final lengths of the joints, jointly signed by contractor and BSPTCL representatives shall be maintained. Check for sag should also be made at intervals when conductors are drawn up. Over stressing, causing damage to towers must be avoided. Care

should be exercised not to over tension the conductor.

To avoid contact with the ground or any object above ground level the conductors shall be pulled by the controlled tension methods using neoprene lined double pulled wheel type tension stringing equipments. The equipment shall be capable of maintaining continuous tension of not less than of 3000 kg. per conductor.

When the conductor is on the stringing rollers before sagging-in, it shall be ensured that the conductor is not damaged due to wind, vibration, vehicles or other causes. Scaffolding should be used to cross the important road crossings for minimum interruption to traffic. The conductor shall be pulled up to desired sag and left in serial stringing sheaves for at least one hour after which the sag shall be rechecked and adjusted, if necessary, before clipping in and transferring the conductors from the serial stringing sheaves to the suspension clamps.

The stringing rollers, when suspended on the transmission structure for supporting conductors, shall be so adjusted that the conductor will be on the rollers at the same height as the suspension clamp to which it is to be secured.

Armour rods and vibration dampers shall be fitted at each suspension and tension tower before final clamping of conductor with Insulator strings. Vibration dampers are to be fixed with clamping bolt and in correct vertical position in relation to conductor.

Compression type joints are to be used for jointing of conductors. Each part connected with joints shall be perfectly cleaned & precautionary measures taken before final compression. All the joints of conductors shall be made with the best workmanship and shall be perfectly straight and having maximum possible strength.

Proper guys shall be provided to counter balance the paying out tension of conductor at the tension locations, to avoid damage to towers and/or accident.

FIELD QUALITY PLAN(FQP)

Contractor shall invariably submit the FQP along with Technical Bid for erection of line, including all the activities such as dismantling, stringing, construction etc. with detailed checklist to be referred.

WASTAGE

The maximum permitted ceiling for wastages for conductor permitted is 0.5% (maximum) which takes into account the additional length for sag & jumpers.

No wastage is allowed for any material except the percentage limit mentioned for Conductor here in above in Clause No.13.1

LOSSES

In the event of any material used for transmission line found broken or damaged or received short during transit or failed during the erection / testing at site before commissioning of line, the contractor shall replace the same free of cost.

COMMISSIONING

The contractor shall ensure that at the end of each sub-activity the surplus material is immediately removed from the work-site to avoid loss and injury to the public.

The contractor has to make reconciliation of material account and to settle final bill including signature in all relevant papers required for passing of final bill within three months from the date of charging / commissioning offline.

APPENDIX- I

Sl. no	Title	International Standard
1.	Specification for aluminium conductors for overhead transmission purposes	IEC:1089-1991, BS:215-1970
2	Breaking Strength –Epoxy Ends	Aluminum Association
3	Stress-strain Curves – Epoxy Ends	Aluminum Association or IEC 61089
4	Electrical Resistance	ASTM B193, IEC:468
5	Creep (25 C)	Aluminum Association, IEC 61395, IEEE:1138
6	Sheave Test	IEEE:1138, IEC:61396
7	Core Creep	Aluminum Association
8	Fault Current	IEEE 1138, IEC 61396
9	Aeolian Vibration	IEEE 1138, – use mechanical set-up
10	Galloping	IEEE 1138, – use mechanical set-up
11	Axial Impact, Radial Crush	IEEE 1138, EIA/TIA 455-25A /41A
12	Lightning Strike	IEC 61396

13	Torsional Ductility	IEC 60794-1-2 /ASTM
14	Corrosion & salt spray	ISO 9227:1990 or ASTM B117
15	Outer wire layer	ASTM B941-05/ASTM B609
16	Stranding, workmanship, finish and appearance	ASTM B232/B232M

17	Elongation & strength	ASTM B557
18	Corona	IEEE 4
19	Sustained ampacity test at ambient & elevated temperature	ANSI C119.4, IEEE:738
20	Reels and drums for bare conductors	IS:1778-1980, BS:1559-1949
21	Method of radio interference tests	IS:8263-1990, IEC:437-1973, NEMA:107-1964

APPENDIX- II

Sl. no	Title	Standards	Modifications
1.	Dead-end, Joint Strengths	Aluminum Association, ANSI C119.4	
2	Current Cycling	ANSI C119.4 –ANSI C119.7	
3	Sustained Load (room temperature)	ANSI C119.4	
4	Sustained Load (high	ANSI C119.4	

	temperature)		
5	Aeolian Vibration	IEEE 1138, – use mechanical setup	None
6	Galloping	IEEE 1138, – use mechanical setup	8% RBS

7	Corrosion	ASTM B117	None
8	Corona Testing	IEEE539/656	None
9	Damper Efficiency	IEEE 664	None

Note:- The bidders shall comply CEA guidelines for Rationalized use of HTLS Conductors (in case specifically not mentioned against instant NIT.)

HARDWARE FITTINGS FOR HTLS CONDUCTOR

HARDWARE FITTINGS FOR HTLS CONDUCTOR

1. SCOPE

This section of the specification covers technical specification and other terms and conditions for design, manufacture, testing and supply of conductor/Earth wire accessories and hardware fittings as per details in specification.

2. STANDARD:

Design, Manufacture, Galvanizing and Testing of conductor/Earth wire Accessories and hardware fittings shall conform to the following Indian Standard Specification as amended up to date.

- 1) IS: 2121- Specification for fittings for Aluminum and steel cord Aluminum conductors.
- 2) IS: 2486- Specification for insulator fittings for over-head powerlines.
- 3) IS: 209 - SPECIFICATION FOR Zinc.
- 4) IS: 2629- Recommended practice for hot dip galvanizing for Iron & Steel.
- 5) IS: 2633- Method for testing uniformity of zinc coating on hot dip zinc coated articles.
- 6) IS: 9708- Specification for vibration dampers.
- 7) IS: 2141- (Part-II Mid span compression joint).
- 8) IS: 2141- (Part-II) Specification for vibration damper.

2 TECHNICAL PARTICULARS:

A) GENERAL REQUIREMENTS:

Material offered shall be of best quality and workmanship. All casting shall be free from blow-holes, flaws, cracks or other defects and shall be smooth, close grained and of true forms and dimensions. All machined surfaces shall be true, smooth and well finished.

Metal fittings or drop forged steel or heat treated malleable cast iron for insulator string hardware shall have excellent mechanical and electrical properties, such as strength, toughness and high corrosion resistance and free from corona formation. The material employed in the manufacture of accessories, viz aluminum, aluminum alloys, malleable iron, forged steel and stainless steel depending on the types of application, shall be corrosion resistant and machinable.

Fittings and accessories shall be supplied complete in all respect, suitable for the proposed attachment and for the size of conductor and earth wire for which they are to be used.

All bolts, nuts, screw heads shall be of the Whitworth standard thread. Bolt heads and nuts shall be hexagonal. If required the nuts shall be locked in an approved manner. The threads in nuts and tapped holes shall be cut out after galvanizing and shall be well lubricated/greased. All other threads shall be cut out before galvanizing. The bolt threads shall be undercut to take care increase in diameter due to galvanizing. Washers shall be electro galvanized.

Bolts, nuts, washers split pins, security clip etc. shall be supplied as per actual requirement plus 2.5% extra.

The general design of hardware shall be such as to ensure uniformity, high strength, free from corona formation.

All hooks, eyes, pins, bolts, suspension clamps and other fittings for attaching insulators to the towers or to the line conductors shall be so designed as to reduce to a minimum the damage to conductors, insulators or the fittings arising from the conductors vibrations.

Adequate bearing area between fittings shall be provided and point or line contact

shall not be there.

All fittings shall be resistant to atmospheric corrosion and shall be suitably protected against corrosion both in storage and service.

The accessories shall be such as to avoid local corona formation or discharge likely to cause interference to either sound or vision transmission. Visible corona voltage of conductor accessories shall be greater than 11% or maximum line to neutral voltage of the line.

B) CONDUCTORFITTING:

I) Compression type Mid span Joints.

Compression type mid span straight joints offered shall conform to technical particulars.

III) REPAIRSLEEVS:

Compression type repair sleeves shall be made of extruded aluminum and shall be suitable to provide reinforcement for conductor with broken or damage aluminium strands. The repair sleeves shall be design to make good conductor of which not more than 1/6 of the strands in the outer most layer are damaged /severed. The repair sleeves after compression should present smooth surface. The repair sleeves shall be so designed that conductivity of the joint shall not be less that 100% of that of conductor. Other details will be as per drawings and of technical particulars.

C) STOCK BRIDGE VIBRATIONDAMPERS:

Calculations and complete details of design, weight etc of the damper shall be furnished with the tender together with the damping characteristics and energy dissipation curves of the dampers and guaranteed of their effectiveness for the specified conductor. The offer is liable to be rejected in absence of the above details.

The vibration damper shall be of approved design. The clamp of the vibration damper shall be made of aluminum alloy, so designed as to prevent any damage to or chaffing of the conductor during erection or continued operation if there is any chance of the clamp chaffing, the conductor while in service suitable aluminum liners shall be provided. The messenger cable shall be made of high tensile strength steel strands and preformed in order to prevent subsequent drop of weights in service. The damper weight made of cast iron shall be attached to messenger cable by approved methods, clamping bolt shall be provided with self locking nuts.

All ferrous parts including the messenger cable, shall be hot dip galvanized. The ends of the messenger cable shall be effectively sealed to prevent corrosion. The vibration damper and its attachments shall have smooth surface, to ration damper shall be so designed that in case of loosening of the bolt or changing free part of the clamp it does not allow damper to disengage from the conductor.

D) INSULATOR HARDWAREFITTINGS:

The insulator hardware fittings for suspension and tension towers shall generally constitute of following components:-

- i) Anchor shackle for ball hook for attachment of the suspension strings to tower hanger and tension strings to tower strain plates.
- i) Suitable yoke assembly for double suspension and double tension fittings.
- ii) Suitable arcing horns and fittings.
- iv) Suspension/tension clamps.

- v) Sag adjustment plates for dead end assembly.
- vi) Other fittings i.e eye links, chain link, ball clevises, socket clevis, eye clavic, clevises etc.
- vi) Bolts and nuts, watchers split pins etc.

(E) CLAMPS

a) SUSPENSION CLAMPS

Suspension clamps offered shall be made of high strength aluminium alloy suitable for use with conductor with armour rod. The design shall be such as to avoid hot spot, Kicks cuts, grooves projectors etc. which are likely to damage conductor or lead to localized pressure, clamps shall have satisfactory corona performance, no sharp radius or curvatures, ridge and excrescence etc. cotter pins cotter bolts U, bolts , nuts washers etc. shall be made of galvanized steel. Split pins of suitable size and strength shall be made of brass. The clamps shall permit the conductor to slip before failure of the conductor and shall have sufficient slipping strength to resist conductor tension under broken wire conditions. It shall have sufficient contact surface to minimize damage due to fault current.

b) TENSIONCLAMPS:

Tension clamps shall be made of aluminium alloy and shall be of proper type. The clamps shall not permit, slip of any damage to or failure of the conductor at a load of less than 95% of the ultimate strength of conductor. Mechanical efficiency of the clamp shall not be affected by method of erection involved. Come along or similar clamp during stringing operations.

III) VIBRATION DAMPERS:

Vibration damper shall be of stock bridge type having an aluminium alloy clamp compressed on the steel messenger strand between counter weights made of cast iron and shall be suitable for use on the overhead ground wire.

1. RAW MATERIALS:

Procurement of all raw materials for execution of this contract shall be done by the supplier at their own cost.

2. DRAWINGS:

The tenderer shall submit fully dimensioned drawings to scale indicating the materials of each part for dimension all under supply. The complete string drawing, both suspension and tension, shall indicate the overall length with its variations when subjected to tension as also the spark over distance. The following arrangement of complete insulator strings and their component parts shall be clearly indicated.

- i) Attachment of the tower hanger of strain plate.
- ii) Arcing Horn attachments.
- iii) Suitable ball and socket type fittings for interconnecting insulator units to the top and bottom clamps.
- iv) Detailed drawings of suspension and tension clamps indicating design adopted for preventing damage to the conductor & earthwire.

The materials offered shall be in conformity with the purchaser's drawings. Any deviation from those drawings conforming to any other standard quoted by the tenderer will be subject to technical scrutiny by the purchaser who shall have every right to accept or reject the same without assigning any reason thereof.

3. GALVANISING:

All ferrous metal parts except those made of stainless steel shall be galvanized in accordance with latest issue of IS: 2633. The zinc used for galvanization shall conform to grade Zn-98 as per latest issue of IS:209, Spring washers, where used, shall be electro galvanized.

4. INTERCHANGEABILITY:

All hardware fitting and conductor accessories shall be of standard design and made to gauge or jig and shall be interchangeable in all respects with similar items.

5. TESTS/REPORTS:

Conductor accessories and hardware fittings will be subjected to all tests as per relevant Indian standard specification specified in Para 2.30 . The tests will be categorized in three grades, normally (i) Type ,(ii) Acceptance Tests and (iii) Routine Tests.

6. TYPE TESTS:

Type tests are normally carried out once and is not required to be carried out against all orders. Tenderers are therefore, to submit along with their offer reports in respect of type tests carried out as per provision of Indian standard specification by a reputed / recognized testing laboratory.

7. ACCEPTANCE TESTS:

These are such tests which are carried out for acceptance of material. This will constitute all tests as prescribed in the relevant Indian standard specification.

8. ROUTINE TESTS:

These are such tests which will apply to all fittings.

Reports in respect of all tests carried out during manufacture as per Indian standard specification will be submitted to department for approval at the time material is offered for inspection.

Tenderers shall clearly state in their tender about testing facilities available in the laboratories at their works to confirm their ability to carry out all tests as per Indian standard specification.

Costs in carrying out any/all tests as above will be borne by the tenderer and will be included in their quoted price.

9. PREDESPATCH INSPECTION:

The purchaser or its representative shall, at all reasonable times, have free access in the works and at all places of manufacture where material under order will be manufactured where material under will be manufactured and the manufacturer/supplier shall at his cost provide the purchaser or his authorized

representative all reasonable facilities to satisfy himself that the material to be supplied is in accordance with the specification.

The entire material will be inspected by purchaser's I.S.S before dispatch for which the supplier shall intimate the purchaser in writing the date and place where the material are ready for inspection & testing. On receipt of such intimation, the purchaser will depute his representative for carrying out inspection. A period of three weeks shall be allowed to purchaser for deputing and making travel arrangement of his representative.

In case any part of the material is intended to be manufactured at any premises other than the supplier, this will be done only with due approval of purchaser in writing and in that case the supplier shall have to made arrangement for the purchaser's representative to inspect & tests the materials as if the material were being manufactured at their own premises.

The inspection call shall be given when the material have actually been manufactured and made ready in all respects and not on the basis of anticipated date of completion. If the materials are not found ready for inspection at the time of arrival of purchaser inspector, supplier shall have to pay to BSPTCL a sum of Rs.1,000

/- per day from the date of departure to the date of arrival of the inspecting officer to his headquarters besides the rail/air ticket fair.

After materials are inspected joint inspection report will be prepared with purchaser's inspector and suppliers representative and six copies of such inspection reports will be submitted to the purchaser.

p\purchaser, at his discretion may consider to waive inspection in writing in some cases in which case supplier will have to conduct all necessary tests themselves and send those test reports for approval by the purchaser before dispatch of material.

No material shall be dispatched from its points of manufacture unless it has been satisfactorily inspected, tested, approved and dispatch clearance issued by the purchaser.

Acceptance of any quantity of material on the basis on the basis of above inspection and approval of their however, not absolve the supplier in any manner of their primary responsibility towards the quality of materials to be supplied as per requirement of specification.

QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Bidder's Works or at his sub-bidder's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Bidder shall adopt suitable quality assurance programme to controlsuchactivitiesatallpointsnecessary.Suchprogrammeshallbeoutlined

by the Bidder and shall be finally accepted by the Employer after discussions before the award of Contract.

Quality Assurance Documents

The Bidder shall be required to submit the following Quality Assurance Documents within three weeks before laying/erection of the equipment.

All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.

Welder and welding operator qualification certificates.

Welder's identification list, listing welder's and welding operator's qualification procedure and welding identification symbols.

Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.

Stress relief time temperature charts/oil impregnation time temperature charts.

Factory test results for testing required as per applicable codes/mutually agreed quality plan/standards referred in the technical specification.

The quality plan with verification of various customer inspection points (CIP) as mutually agreed and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

HTLS CARBON COMPOSITE CORE
ALUMINIUM
(equivalent to Zebra) conductor except GAP
conductor

High Temperature Low Sag (HTLS) conductor

Annealed aluminium except GAP conductor

Specification

The work involves dismantling of existing ACSR Zebra Conductor, supply of HTLS CARBON COMPOSITE CORE ALUMINIUM (equivalent to Zebra) **conductor of minimum 1593 A capacity corresponding to maximum allowable operating temperature (180 deg C) & with unit weight equal to or less than that of ACSR Zebra** conductor and associated conductor hardware fittings, clamps & vibration dampers and stringing of the HTLS conductor on existing 132KV transmission line structure after survey of the lines. ROW if any for execution of work & approach to worksite shall be resolved by contractor at his cost. However, BSPTCL will provide necessary assistance.

Submission of complete technical details of the proposed HTLS conductor with relevant calculation along with the bid to adjudge the sufficiency of existing towers for carrying out the up-rating works. This shall be carried out in compliances / adherence to all safety and standard requirements as per Indian Electricity Rules 1956. Design parameters and submission of detailed drawings of conductor hardware and accessories and preparation of sag tension chart, stringing chart, of the conductor used showing, sag & tension at various temperatures are included in the scope of the Contractor as per latest IS/IEC/ASTM.

The entire stringing work of HTLS (equivalent to Zebra) conductor shall be carried out by tension stringing technique except where geographical / topographical or other site constraints do not permit use of tension stringing equipment. In such cases manual stringing along with other appropriate tools and equipment may be employed with the approval of engineer in charge. The contractor shall indicate in their offer, the sets of tension stringing equipment he is having in his possession and the sets of stringing equipment he would deploy exclusively for this package. The contractor shall also engage sufficient manpower so that stringing of the conductor can be completed within the allowed shut down period.

In 220 KV D/C Transmission lines, road crossings and lines passing over civil structures will have double insulator strings. Vibration dampers are to be provided in all suspension & tension locations.

The rollers which will be used during stringing should be so designed that the line can be charged with the roller.

One conductor manufacturing engineer with master instructor should remain present on the site during erection process.

Conductor Type:

The actual conductor type is to be suggested by contractor having physical, mechanical and electrical characteristics such as,

- i) Outer diameter in mm-----not exceeding 28.62 mm
- ii) Outer diameter of core in mm -----not exceeding diameter of core of existing ACSR conductor
- iii) Weight in kg/km ---- < OR =that of ACSR Zebra (<1621 kg/km)
- iv) Tension at every day condition (32°C, no wind) -----Not exceeding 25% of UTS of offered conductor
- v) Current carrying capacity -----not less than 1593 AMP
- vi) Tension at 32°C, full wind (52 kg/m²) --≤..... Kg (submitted during detailed engineering)
- vii) The net expansion of the HTLS Zebra equivalent conductor / unit length at maximum operating temperature should be less than the net expansion of ACSR Zebra conductor /unit length at (75°C)
- viii) Sag (in meters) ≤ metres (submitted during detailed engineering)
Sag of offered HTLS Conductor at maximum continuous operating temperature < sag of ACSR Conductor at 75 Deg C considering same span length
- ix) DC resistance at 20°C and AC resistance at 75°C should be at least 15% less than ACSR Zebra conductor.
- x) The conductivity at 20 Deg C (corresponding to % IACS) of aluminum or aluminum alloy used in the offered HTLS conductor should not be less than the % IACS Conductivity of Aluminum used in ACSR type conductor (IACS: International Annealed Copper Standard)

Note: Current carrying capacity of the offered conductor shall be calculated corresponding to following ambient conditions:

- 1. Ambient temperature (°C) = 45
- 2. Solar Absorption coefficient = 0.8
- 3. Solar Radiation (w/sqm) = 1045
- 4. Emissivity constant = 0.45
- 5. Wind Velocity = 0.56 m/sec.

During execution, if there be any constraint regarding tension, sag, span, weight/mtr, diameter, ampacity and modulus of elasticity of the conductor, then the contractor shall formulate and submit these data in favour of BSPTCL after detailed engineering and the revised data shall be implemented after written approval of the buyer/BSPTCL.

Current Carrying capacity / Ampacity of offered Conductor

The Contractor in his bid shall furnish calculations for the ampacity based on IEEE-738 standard for the offered HTLS conductor. The design of conductor shall be suitable for operation at steady state conductor temperature at flow of minimum **1593 Amperes AC**. The Contractor shall also indicate the maximum permissible conductor temperature for continuous operation at maximum ampacity quoted at still air & at 45 ambient without any deterioration of its electrical, mechanical & metallurgical properties.

The contractor shall indicate the technical particulars and details of the construction of the conductor in the relevant schedule of GTP. The contractor shall also guarantee the DC resistance and AC resistance at temperature corresponding to the continuous operating current of 1593 under normal condition. The contractor shall submit the supporting calculations for the AC resistance indicating details & justification of values of temperature coefficient of resistance & DC to AC resistance conversion factor with due reference to construction & geometry of the conductor. The Contractor shall submit the type test reports in support of DC resistance and the calculations for AC resistance.

Sag-Tension calculations of the existing ACSR Zebra conductor and offered HTLS (EQUIVALENT TO ZEBRA) conductor are to be submitted along with bid under following conditions.

32°C, No wind

- i) 32°C, Full wind
- ii) 05°C, 2/3rd wind
- iii) 65°C, No wind
- iv) 180°C, No wind
- v) Emergency temperature no wind.

Contractor shall also furnish details of creep characteristics based on laboratory investigations/experimentations conducted on the HTLS conductor as per IEEE 1138 and shall indicate creep strain values corresponding to 1 month, 6month, 1year creep at tensions corresponding to the above conditions.

Calculations for Sag & tension shall be as described below:-

Design of Hardware & accessories should be compatible with the supplied HTLS (EQUIVALENT TO ZEBRA) conductor and existing insulators & structures.

Major Qualifying Projects (MQP) for offered Conductor and hardware/accessories manufacturing is to be submitted with technical bid.

Workmanship

- i) All the conductor strands shall be smooth, uniform and free from all imperfections, such as spills and splits, cracks, die marks, scratches, abrasions, rust etc.
- ii) The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and / or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc), dirt, grit etc.

Joints in wires

a) Aluminum OR Aluminum Alloy Wires

During stranding no Aluminum/ aluminium Alloy welds shall be made for the purpose of achieving the required conductor length

b) Core Wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no joints or splices in any length of the completed stranded core. However, for composite core wires, splicing of the galvanic protection barrier is allowed, provided diameter specifications are maintained adhering to ASTM B987-17 and its upgradation (if any)

Tolerances

Manufacturing tolerances on the dimensions to the extent of one percent shall be permitted for individual strands and the complete conductor. However, For composite cores, the manufacturing tolerance shall be +/- 0.05 mm of the stated nominal value adhering to ASTM B987-17 and its upgradation (if any)

Materials

The materials used for construction of the conductor shall be such that the conductor meets the specified technical and the performance requirements.

Outer Layer

i) The material of outer layer of HTLS (EQUIVALENT TO ZEBRA) conductor shall be of high temperature resistant aluminum/ aluminum alloy/Annealed Aluminium added with any suitable elements to electrolytic aluminum having purity not less than 99.5% and a copper content not exceeding 0.04%. Contractor shall guarantee the chemical composition in the schedule GTP and also furnish description of the manufacturing process in the bid.

Core

The core wire strands may be of any composite materials or special steel and shall have properties conforming to the technical performance requirements of the finished conductor. Contractor shall furnish properties and composition of the core wire strands in the GTP schedule. The composite material for core shall be of such proven quality that its properties are not deteriorated by the normal operating conditions of 132KV transmission line in tropical environment conditions as experienced by the existing lines. The Contractor shall provide adequate details including specifications / test reports / operating experience details / performance Certificates etc. in support of the suitability of the offered materials. Care to be taken for internal friction due to different material having different thermal coefficient of expansion.

Conductor Length

The Contractor after his survey of the existing line shall determine the most appropriate individual conductor lengths to be manufactured & supplied keeping in view of the tower schedules, section lengths, special crossings etc. The drum drawing as per IS 1778 or any international standard shall be submitted to purchaser for review and approval. The Contractor shall also indicate the maximum single length of conductor that they can manufacture, in the GTP. Contractor has to do survey, route, profile & engineering etc. of the existing line.

STANDARDS

The conductors & accessories shall comply in all respects to the clauses of this specification as indicated above & with the standards noted in Appendix-I, Appendix-II.

STRANDING

8.4.1 For all, constructions, each alternate layer shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the under laying wire or wires. The final layer of wires shall have a right hand lay.

PACKING AND MARKING

The conductor shall be wound in non-returnable reels or drums conforming to Indian Standard 1978-1961 specification for Reels and Drums for Bare Wire, or any other authoritative better standard and marked with the following: -

- a) Trade name, if any b) Contract/Award letter Number
- c) Name of manufacturer d) Name & Address of Consignee
- e) Drum Number f) Length of conductor
- g) Size of conductor h) Gross Weight of drum with conductor
- i) Weight of empty drum j) Net and gross weight of conductor with lagging.
- k) Arrow marking for un-winding

The reel shall be of such construction as to assure delivery of conductor in the field free from displacement & damage and should be able to withstand all stresses due to handling and the stringing operations so that conductor surface is not dented, scratched or damaged in any way during manufacture, transport and erection. The conductor shall be properly lagged on the drums and the method of lagging to be employed may be clearly stated in the offer. It should be stacked to suit the reel and held in place by steel strapping. Lagging shall not be nailed or bolted in place.

The conductor drum should be suitable for wheel mounting. Before reeling, the cardboard or other suitable material shall be secured to the drum and inside flanges of the drums. After reeling the conductor, the exposed surfaces should be wrapped with suitable soft material to prevent the conductor from dirt and grit. Any space between drum lagging and conductor should be suitably filled with soft filler material compactly packed.

Evaluation of Ohmic Losses and Differential Price Loading

Based on the conductor parameters guaranteed by the bidders, average ohmic losses for different type of conductors offered by the bidders shall be calculated as per the following formula:

Average Ohmic loss (kW) = Loss Load Factor X conductor length X (Continuous operating current under normal conditions)² X AC Resistance corresponding to continuous operating current

For total conductor requirement of ___kms, loss load factor = 0.50, continuous operating current of 1593Amp;

$$\begin{aligned}\text{Average Ohmic loss (kW)} &= ___ \times 0.50 \times (1593)^2 \times R_{ac} / 1000 \\ &= ______ \times R_{ac}\end{aligned}$$

Where R_{ac} is the AC resistance per km guaranteed by the bidder at temperature corresponding to the continuous operating current of 1593A under normal condition.

Differential price evaluation for the conductors offered by the bidders shall be carried out considering the average ohmic losses calculated as above and considering **Rs. 1,52,600 per kW.**

The best parameter of loss (lowest ohmic loss for conductor) corresponding to lowest AC resistance quoted among bidders by any technically responsive and qualified bidder shall be taken as basis and that quoted by the particular bidder shall be used to arrive at differential price to be applied for each bid.

TESTS AND TEST CERTIFICATES

1.7.1 Type

Tests on Conductor

The following type valid test certificates are to be furnished along with the bid.

i) Breaking Load Test on Stranded conductor

The test is to be carried out as per IS 398 Part V or as per IEC 61089 and the results should conform to the guaranteed values furnished by the contractor.

ii) D.C Resistance Test on stranded conductor

The tests is to be carried out as per IS 398 Part V or as per IEC 61089 and the results should conform to the guaranteed values furnished by the contractor.

iii) Test on Composite Carbon Core

The offered conductor is acceptable only if the conductor passes the tests on Composite Carbon Core as per relevant IS/IES/ASTM.

Note:- Apart from above if any test is desired to be done by BSPTCL, agency should do the same and arrange it on discretion of BSPTCL. Price implication for the same shall be borne by BSPTCL.

Acceptance tests on conductor

The following acceptance tests will be made in the presence of the representatives of the owner. However, these tests are subject to change as per the technical discussion between the owner & contractor.

i) Breaking load test on conductor strands and D.C resistance test on conductor strand

The conductor strands and DC resistance should meet the requirements of ASTM B.

ii) Aluminium Area measurement on complete conductor

The test is to be carried out as per ASTM B 263. The aluminium area should conform to the guaranteed values furnished by the contractor.

iii) Check for Lay ratios of various layers

The lay- ratios of various layers shall be checked to ensure that they conform to the guaranteed values furnished by the contractor.

iv) Visual and Dimensional check on drums

The drums shall be visually and dimensionally checked to ensure that they conform to the approved drawings.

In case of composite core type conductors, composite Core manufacturer must have successfully performed design validation tests prior to bid submission as per ASTM B987 on the class of core being offered and it must be witnessed by the representative (s) of Utility or witnessed by representative of a Laboratory which is accredited to ISO/IEC 17025 (different than that of laboratory where tests were performed).

8.7.4 Tests on Accessories

8.6.3.1 Dead end strength, high temperature endurance, current cycling, sustained ampacity, aeolian vibration, & corrosion tests will be conducted on the accessories according to the standards specified at appendix-IV.

1.7.4 Additional Information

i) Contractor should have experience of stringing of HTLS/ High Ampacity Conductors of same technology as offered in the bid.

ii) Laying of HT cable/stringing of HTLS / High Ampacity Conductor shall be carried out in presence of OEM/authorized representative of OEM.

GUARANTEED TECHNICAL PARTICULARS

The contractor shall fill in the guaranteed technical particulars in the Performa below and submit the same with his tender, without which bid will not be considered.

GUARANTEED TECHNICAL PARTICULARS OF “HTLS CARBON COMPOSITE CORE ALUMINIUM (EQUIVALENT TO ZEBRA) ” CONDUCTOR

Sl. Description Unit Value guaranteed by the Contractor

1. Name of Manufacturer
2. Address of Manufacturer
3. Name of the conductor
4. Construction of conductor/
Designation of conductor as per IEC:61089

5. Particulars of Raw Material **Outer Layers**

- a) Type of conductor strand.
- b) Chemical composition of Conductor strand .
 - i)%
 - ii)%
 - iii)%
 - iv)%
 - v)%

Inner Core

- a) Material of core
- b) Chemical composition of core
 - i)%
 - ii)%
 - iii)%
 - iv)%
 - v)%
 - vi)%

6. Outer Aluminium Alloy Strand after Stranding **Number of outer layers Nos.** **Diameter mm**

- a) Nominal mm
 - b) Maximum mm
 - c) Minimum mm
- Minimum Breaking load of strand**
- a) Before stranding KN
 - b) After stranding KN
- Resistance of 1m length of strand at 20 deg. C. Ohm**

7. Inner core strands/inner core after stranding **Number of layers in inner core No.** **Diameter mm**

- a) Nominal mm
 - b) Maximum mm
 - c) Minimum mm
- Minimum Breaking load of strand/Core**
- a) Before stranding KN
 - b) After stranding KN

Min. no. of
twists which a
single strand
shall withstand
during torsion
test for a length
equal to
100times dia of
wire after
stranding. Nos

8. Complete conductor

UTS of Conductor KN

Lay ratio of conductor Maximum Minimum

a) 1st layer (outer most layer)

b) 2nd Layer

c) 3rd Layer

d) 4th Layer

Maximum permissible
conductor temperature
for continuous
operation Deg C

Maximum
permissible conductor
temperature for short
term operation Deg C

Permissible
duration of
above short
term operation
Minutes

Maximum length of conductor

that can be offered as single length KM

DC resistance of conductor at
20°C Ohm/km AC resistance at
maximum

continuous operating
temperature

corresponding to
specified maximum
operating current

(minimum 1593 A
under maximum

ambient conditions
and zero wind

as per Technical Specification

) Ohm/km Details of Creep
characteristic for conductor
enclosed (as per

Technical Specification) Yes/No

Sag Tension Calculation

Sag Tension Calculation enclosed Yes/No

Sag & tension at 32 deg. C & no wind

Meters & KN Sag & tension at 32 deg. C &
full wind Meters & KN 103

Sag & tension at 05 deg. C & 2/3rd wind Meters &

KN Sag & tension at 65 deg. C & no wind Meters

& KN Sag & tension at 150 deg. C & no wind

Meters & KN

Sag & tension at maximum operating temperature &
no wind Meters & KN

Sag & tension at emergency temperature & no
wind Meters & KN

Tolerance on standard length of conductor

% Direction of lay for outside layer

Linear mass of the Conductor

a) Standard Kg/Km

b) Minimum Kg/Km

c) Maximum Kg/Km

Standard length of conductor KM

9.0 Drum is as per specification Yes/No

10.0 Accessories as per specification/standards Yes/No

SAG TENSION CHARTS AND SAG TEMPLATES

The contractor shall supply six copies of sag tension charts and sag templates each in respect of the conductor. The contractor shall also supply sag template in celluloid, which shall be subject to the approval by the owner and without involving any extra charges. The sag template will be used for changing the tower positions in future.

ACCESSORIES

The Contractor after his survey of the existing line shall determine the quantity and type of the accessories required for the turnkey job, which are to be supplied by them. These accessories should be suitable for the supplied conductor for its entire operating range without degradation of mechanical, metallurgical and electrical properties. The steady state temperature of hardware and accessories must not exceed 90°C during no wind and 50°C ambient temperature at minimum 800Amp load. The contractor shall be responsible for satisfactory performance of complete conductor, hardware and accessories, offered by him, for continuous operation at temperatures corresponding to various conditions stipulated at 2.4 of this technical specification.

EXECUTION OF WORK

The erection works consist of

(a) dismantling of existing ACSR Zebra Conductor, Construction of new Transmission line on narrow base tower having pile foundation, supply of HTLS CARBON COMPOSITE CORE ALUMINIUM (EQUIVALENT TO ZEBRA) conductor of minimum approx 1593 A capacity corresponding to maximum allowable operating temperature & with unit weight equal to or less than that of ACSR Zebra conductor and associated conductor hardware fittings, clamps & vibration dampers and stringing of the HTLS conductor on existing 132KV transmission line structure. ROW if any for execution of work & approach to

worksite shall be resolved by contractor at his cost. However, BSPTCL will provide necessary assistance. In case, Tower strengthening is required where there is missing tower members, agency will install the missing members of tower (if required) and the payment shall be done on actual consumption.. The summary of the work is as follow-

- a. Insurance of materials during storage-cum-erection.
- b. Distribution of materials at erection site.
- c. Stringing of conductor up to both ends of the lines, with the help of tensioner and puller machine and if required, manually with the approval of the owner.
- d. Guarantee of all the activities carried out from (a) to (e) and submission of FQP for carrying out of all above activities.

All works shall be carried out in accordance with the revised and latest provisions under Indian Electricity Act and Rules made there under.

All the erection tools required during erection of lines shall be arranged by the Contractor at his own cost. The Contractor shall also be responsible for any damage to and / or loss of his erection tools.

In case of any deviation in quantities from the tendered quantity, payment will be made with the approval from the corporate office of the owner.

It will be the Contractor's sole responsibility to take the materials up to the location. Any pathway, temporary road, temporary bridge required for the work, same will be provided by the contractor at his cost. If, for any reasons the above is not feasible, the contractor at his own cost shall have to arrange transportation by head loads.

STRINGING

The stringing work shall be carried with the help of tensioner and puller machines. Wherever it is not possible to install the tensioner, it can be done manually with the approval of site engineer of the owner. Stringing shall mean, the activities of paying, jointing, tensioning, clamping with armor-rod, providing dampers and fixing the conductor at tension hardware and jumpering etc.

Stringing of conductor shall be done up to gantry at both ends of the individual lines. Installation tension is not allowed to exceed beyond maximum allowable tension of existing ACSR

The stringing work should be planned in such a manner in consultation with the Engineer in charge of the Owner that minimum shut down of power line crossings are required. Revenue loss due to any undue shut down due to contractor's irresponsibility shall be recoverable from the contractor.

Before commencing of stringing work, Contractor shall obtain approval of sag tension charts showing final sag and tension for various temperature and spans.

The Contractor shall be responsible and will take care of proper handling of conductor drums. Sufficient numbers of aluminum snatch blocks shall be used for paying out the Conductors. Necessary precautions shall be taken to avoid conductor rubbing on the ground by providing adequate ground roller, rollers on supports. Additional rollers shall also be provided to cross thorny hedges, tower footing and other obstructions to avoid scratching of conductor. The conductor shall be made to sag correctly as per stringing charts, before they are finally transferred to the hardware and clamps . No mid span joint shall be made at less than 30 meters from the tower end and no mid span joint shall be permitted in road and other important crossings spans.

There shall not be more than one joint in the same span of individual conductor. The sag shall be adjusted to suit the sag indicated against actual temperature. The thermometer shall be provided at the conductor point during the stringing work. Dynamo meters shall be used in

tensioning the conductors. All conductors shall be stressed to their load at the time of stringing, as per approved stringing charts.

The minimum clearance between the lowest point of conductor and ground shall not be less than as specified in the chart. All compression joints should be carefully made and a record of initial and final lengths of the joints, jointly signed by contractor and BSPTCL representatives shall be maintained. Check for sag should also be made at intervals when conductors are drawn up. Over stressing, causing damage to towers must be avoided. Care should be exercised not to over tension the conductor.

To avoid contact with the ground or any object above ground level the conductors shall be pulled by the controlled tension methods using neoprene lined double pulled wheel type tension stringing equipments. The equipment shall be capable of maintaining continuous tension of not less than of 3000 kg. per conductor.

When the conductor is on the stringing rollers before sagging-in, it shall be ensured that the conductor is not damaged due to wind, vibration, vehicles or other causes. Scaffolding should be used to cross the important road crossings for minimum interruption to traffic. The conductor shall be pulled up to desired sag and left in serial stringing sheaves for at least one hour after which the sag shall be rechecked and adjusted, if necessary, before clipping in and transferring the conductors from the serial stringing sheaves to the suspension clamps.

The stringing rollers, when suspended on the transmission structure for supporting conductors, shall be so adjusted that the conductor will be on the rollers at the same height as the suspension clamp to which it is to be secured.

Armour rods and vibration dampers shall be fitted at each suspension and tension tower before final clamping of conductor with Insulator strings. Vibration dampers are to be fixed with clamping bolt and in correct vertical position in relation to conductor.

Compression type joints are to be used for jointing of conductors. Each part connected with joints shall be perfectly cleaned & precautionary measures taken before final compression. All the joints of conductors shall be made with the best workmanship and shall be perfectly straight and having maximum possible strength.

Proper guys shall be provided to counter balance the paying out tension of conductor at the tension locations, to avoid damage to towers and/or accident.

FIELD QUALITY PLAN (FQP)

Contractor shall invariably submit the FQP along with Technical Bid for erection of line, including all the activities such as dismantling, stringing, construction etc. with detailed checklist to be referred.

WASTAGE

The maximum permitted ceiling for wastages for conductor permitted is 0.5% (maximum) which takes into account the additional length for sag & jumpers.

No wastage is allowed for any material except the percentage limit mentioned for Conductor here in above in Clause No. 13.1

LOSSES

In the event of any material used for transmission line found broken or damaged or received short during transit or failed during the erection / testing at site before commissioning of line, the contractor shall replace the same free of cost.

COMMISSIONING

The contractor shall ensure that at the end of each sub-activity the surplus material is immediately removed from the work-site to avoid loss and injury to the public.

The contractor has to make reconciliation of material account and to settle final bill including signature in all relevant papers required for passing of final bill within three months from the date of charging / commissioning of line.

APPENDIX- I

Sl. no	Title	International Standard
1.	Specification for aluminium conductors for overhead transmission purposes	IEC:1089-1991, BS:215-1970
2	Breaking Strength –Epoxy Ends	Aluminum Association
3	Stress-strain Curves – Epoxy Ends	Aluminum Association or IEC 61089
4	Electrical Resistance	ASTM B193, IEC:468
5	Creep (25 C)	Aluminum Association, IEC 61395, IEEE:1138
6	Sheave Test	IEEE:1138, IEC:61396
7	Core Creep	Aluminum Association
8	Fault Current	IEEE 1138, IEC 61396
9	Aeolian Vibration	IEEE 1138, – use mechanical set-up
10	Galloping	IEEE 1138, – use mechanical set-up
11	Axial Impact, Radial Crush	IEEE 1138, EIA/TIA 455-25A /41A
12	Lightning Strike	IEC 61396

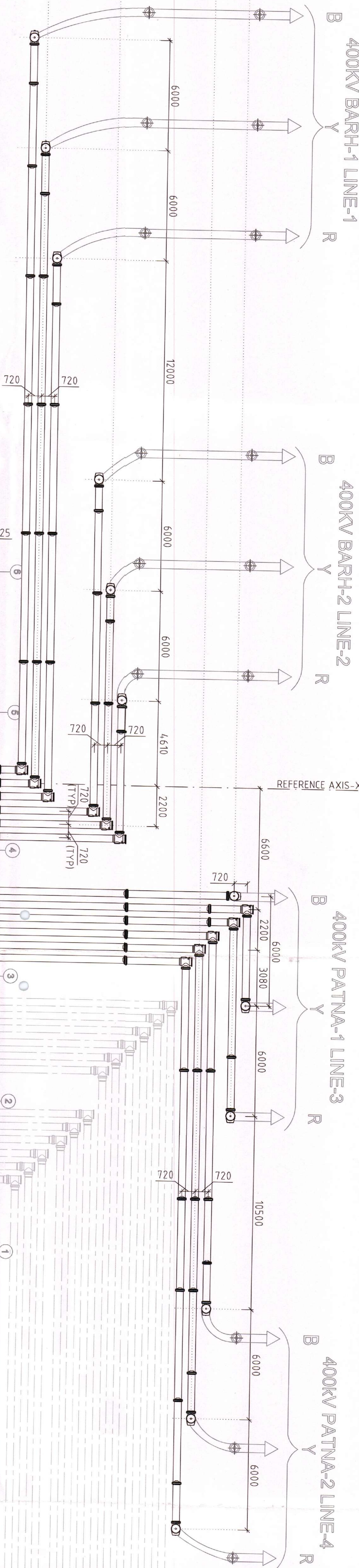
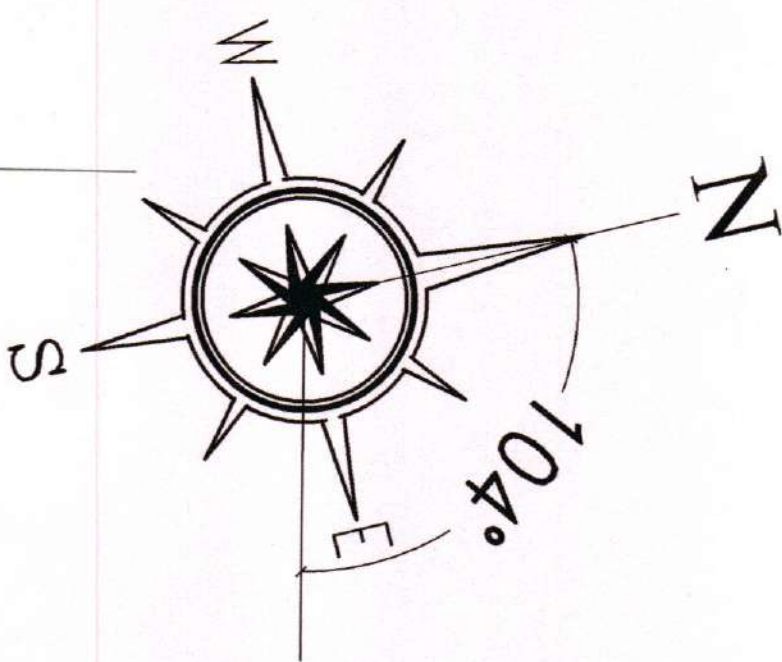
13	Torsional Ductility	IEC 60794-1-2 /ASTM
14	Corrosion & salt spray	ISO 9227:1990 or ASTM B117
15	Outer wire layer	ASTM B941-05/ASTM B609
16	Stranding, workmanship, finish and appearance	ASTM B232/B232M
17	Elongation & strength	ASTM B557
18	Corona	IEEE 4
19	Sustained ampacity test at ambient & elevated temperature	ANSI C119.4, IEEE:738
20	Reels and drums for bare conductors	IS:1778-1980, BS:1559-1949
21	Method of radio interference tests	IS:8263-1990, IEC:437-1973, NEMA:107-1964

APPENDIX- II

Sl. no	Title	Standards	Modifications
1.	Dead-end, Joint Strengths	Aluminum Association, ANSI C119.4	
2	Current Cycling	ANSI C119.4 –ANSI C119.7	
3	Sustained Load (room temperature)	ANSI C119.4	
4	Sustained Load (high	ANSI C119.4	

	temperature)		
5	Aeolian Vibration	IEEE 1138, – use mechanical setup	None
6	Galloping	IEEE 1138, – use mechanical setup	8% RBS
7	Corrosion	ASTM B117	None
8	Corona Testing	IEEE539/656	None
9	Damper Efficiency	IEEE 664	None

Note:- The bidders shall comply CEA guidelines for Rationalized use of HTLS Conductors (in case specifically not mentioned against instant NIT.)



GAS INSULATED BUS DUCT LENGTHS (METER)			
BAY	PHASE	INDOOR	OUTDOOR TOTAL
C01 A	R-phase	6.42	32.98
	Y-phase	37.54	43.96
	B-phase	6.42	42.10
C01 C	R-phase	6.42	15.80
	Y-phase	20.46	26.88
	B-phase	6.42	25.02
C02 A	R-phase	6.42	13.12
	Y-phase	17.68	24.10
	B-phase	6.42	22.24
C02 C	R-phase	6.42	17.12
	Y-phase	12.86	23.54
	B-phase	6.42	17.71
C03 A	R-phase	6.42	24.38
	Y-phase	19.82	30.80
	B-phase	6.42	19.82
C03 C	R-phase	6.42	13.82
	Y-phase	24.69	28.24
	B-phase	6.42	20.25
C04 A	R-phase	6.42	24.69
	Y-phase	20.13	31.11
	B-phase	6.42	28.55
C04 C	R-phase	6.42	42.12
	Y-phase	37.56	48.54
	B-phase	6.42	33.00
C04 A	R-phase	6.42	39.42
	Y-phase	48.56	54.98
	B-phase	6.42	44.00
C04 C	R-phase	6.42	50.42
	Y-phase	38.44	46.86
	B-phase	6.42	38.44
Total Lengths		154.08	885.21

MINIMUM CLEARANCES IN AIR			
Conductor -	Conductor -	4.20 kV	
Earth	Earth	14.25 kV	
Rated Voltage	Rated Voltage	1050 kV	
Rated Switching Impulse	Rated Switching Impulse	1050 kV	
Wind and Voltage	Wind and Voltage	1050 kV	
4200	3500		

In accordance with the standard IEC 61936-1 chapter 3.2.1 it is obligatory for the user to comply with all requirements which concern an enclosed electrical operating area.

For ventilation of SF6 switchgear hall pay attention to IEC 61936-1 section 8.8.2 and to national valid instructions of accident prevention at SF6 switching.

REFERENCE DRAWING:	
1 (I)-G7770-AC11-L160-001 - P-091111 E_C1_880U_BAK_A	OVERALL GENERAL LAYOUT PLAN & SECTION FOR 400/220/12kV
2 (I)-G7770-AC11-L181-001 - P-091111 E_C1_8810_BAK_A	GIS CUB CRP BUILDING FOR 400kV SWD EQUIPMENT PLAN AND SECTION
3 (I)-G7770-AC34-L1E23-001-P-091111 E_C1_8162_BAK_A	400kV GIS - GAS SINGLE LINE DIAGRAM
4 (I)-G7770-AC34-L1E23-001-P-091111 E_C1_8162_BAK_A	400kV GIS - SECTION LAYOUTS (SH 3 & 4)

NOTE:
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE

DO NOT SCALE WORKING DIMENSIONS

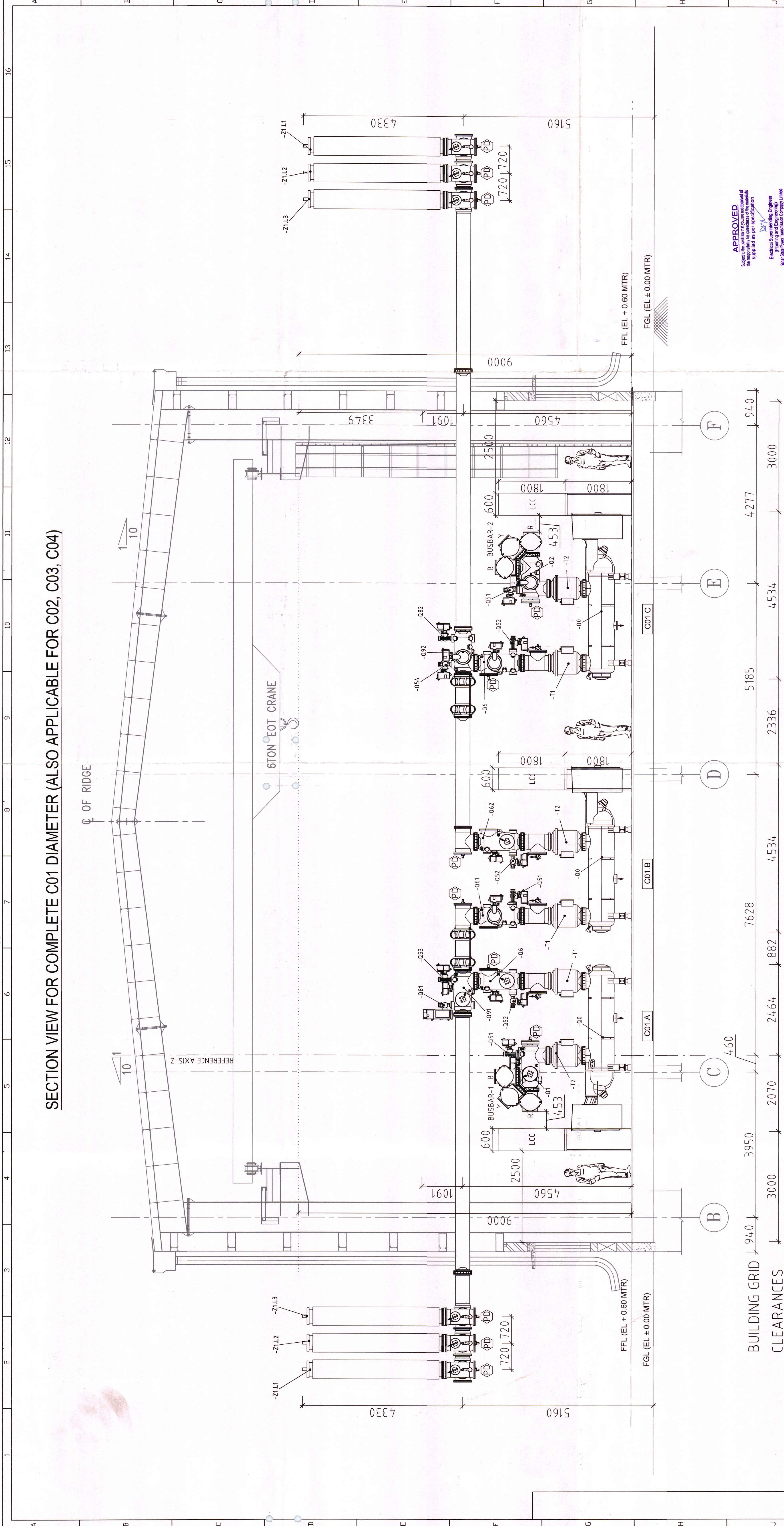
Phase assignment	
L1 = R = I	
L2 = Y = II	
L3 = B = III	

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REVISIONS	
1	Initial
2	Revised
3	Revised
4	Revised
5	Revised
6	Revised
7	Revised
8	Revised
9	Revised
10	Revised
11	Revised
12	Revised
13	Revised
14	Revised
15	Revised
16	Revised
17	Revised
18	Revised
19	Revised
20	Revised
21	Revised
22	Revised
23	Revised
24	Revised

APPROVED
Signed by the project manager and the project engineer
The project manager and the project engineer are responsible for the accuracy of the data and the quality of the work.
The project manager and the project engineer are responsible for the accuracy of the data and the quality of the work.

SECTION VIEW FOR COMPLETE C01 DIAMETER (ALSO APPLICABLE FOR C02, C03, C04)



For ventilation of SF6 switchgear hall pay attention to IEC 61936-1, section 8.8.2 and to national valid instructions of accident preventions at SF6 switchgear.

In accordance with the standard
IEC 61936-1 chapter 3.2.1
it is obligatory for the user to comply
with all requirements which concern an
enclosed electrical operating area.

Legend		
Equipment	Legend	
Circuit breaker	 -06, -06B, -06C, -06D, -06E, -06F, -06G, -06H, -06I, -06J, -06K, -06L, -06M, -06N, -06O, -06P, -06Q, -06R, -06S, -06T, -06U, -06V, -06W, -06X, -06Y, -06Z	
Disconnecter (Motorised)	 -01, -02, -06, -06I, -06J, -09I, -09J	
Earthing switch (Insulated) (Motorised)	 -05I	
Earthing switch (Motorised)	 -05Z, -05J, -05L, -08Z	
High speed earthing switch (Insulated)	 -08I	
Current transformer	 -T1, -T2	
SF6-Air Termination	 -Z1	
Partial discharge sensors		

Phase assignment	Client designation
L1 = R = I	
L2 = Y = II	
L3 = B = III	

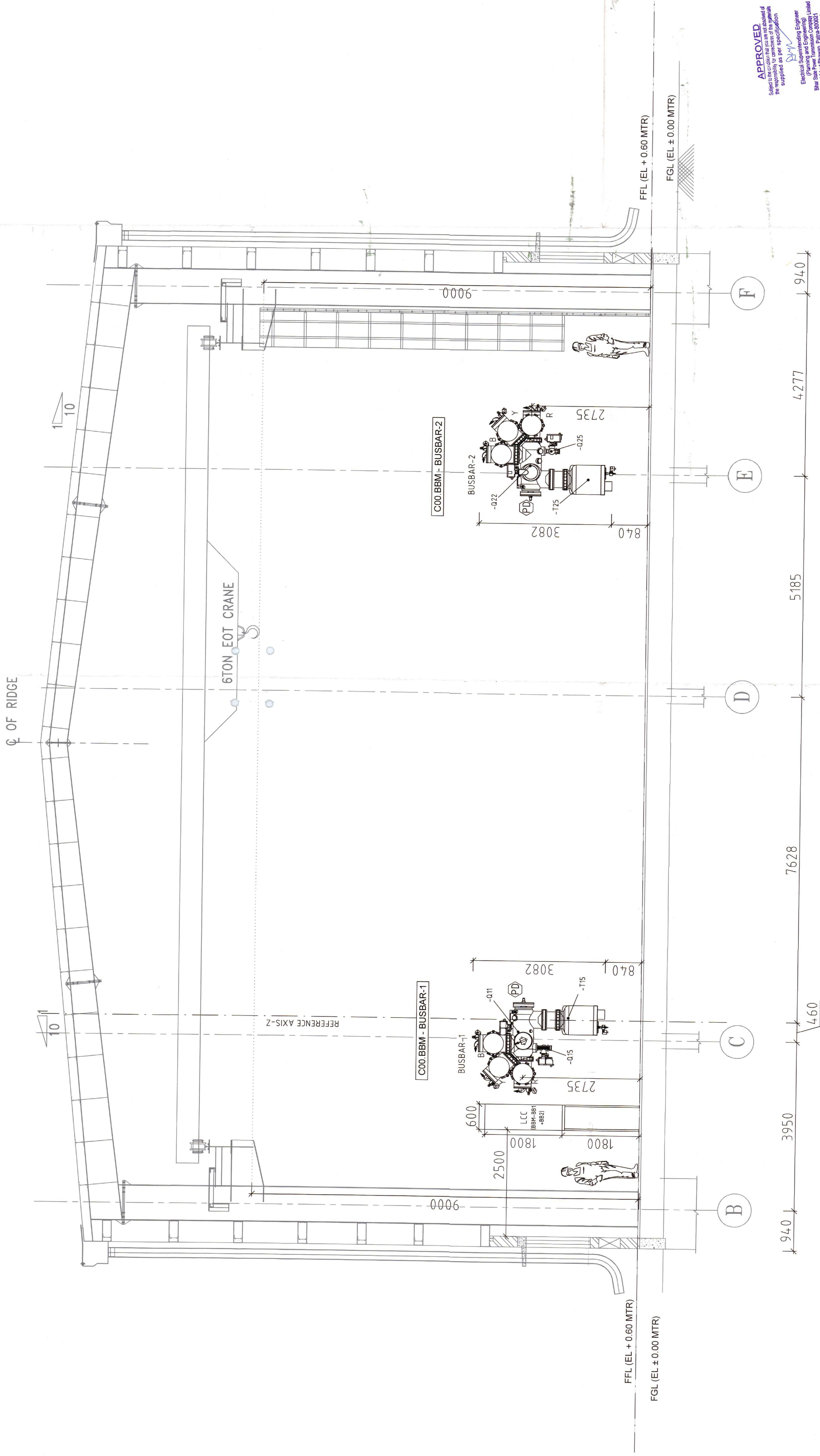
NOTE:
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.

DO NOT SCALE WORKING DIMENSIONS

REFERENCE DRAWING:		OVERALL GENERAL LAYOUT PLAN & SECTION FOR 400'x220'x32'
1	(1-G717770-AC111-L160-001 - P-091111)_E_C1_880A_BAK_A	GAS CRP BUILDING FOR 400KY SWYD
2	(1-G717770-AC111-L181-001 - P-091111)_E_C1_8810_BAK_A	EQUIPMENT PLAN AND SECTION
3	(1-G717770-AC347-E231-001-P-091111)_E_C1_8162_BAK_A	400KY GIS - GAS SINGLE LINE DIAGRAM
4	(1-G717770-AC347-E231-001-P-091111)_E_C1_8162_BAK_A	400KY GIS - PLAN LAYOUT

C	04.06.2020	Q32 CHANGED TO MPF TYPE AS PER BEPTCL SPECIFICATION	Q32	Q32	Q32	SM
B	01.06.2020	REVISED AS PER LATER OVERALL LAYOUT	Q32	Q32	Q32	SM
A	23.03.2020	REVISED AS PER LATER OVERALL LAYOUT	Q32	Q32	Q32	SM
	28.01.2020	FIRST ISSUE	Q32	Q32	Q32	SM
Rev.	Rev. Date	Modification	Drawn By	Created By	Approved By	
(Drawing/ITC/247-E231-001-P.206111_E_C1_8182_BAX_C) Contractor Customer BIHAR STATE POWER TRANSMISSION COMPANY LIMITED  Project CONSTRUCTION OF (2x500 MVA - 2x160 MVA) 400/220/132 KV GIS SUB-STATION AT BARKHAPUR ON TURKEY BASIS UNDER STATE PLAN NDA No.: Scale 1 : 50 Paper Size A0 Date 28-01-2020 Signed 28-01-2020 Drawn By Q32 Document Type 400KV GIS DRAWINGS Title PLAN & SECTION LAYOUT FOR 400KV GIS SUBSTATION Approved By SM Date 28-01-2020 Rev. 28-01-2020 Language EN Sheet 06 of 04 M						

SECTION VIEW FOR BUSBAR MEASURING AND EARTHING (C00.BBM)



APPROVED
 Subject to the condition that you are not absolved of
 the responsibility for correctness of the materials
 supplied as per specification

[Signature]

Electrical Superintending Engineer
 (Planning and Engineering)
 State Power Transmission Corporation Limited
 Bhair Sahyad Bhawan, Patna-800021

8/2/2018

PAINT SHADE EXTERIOR - RAL 7032

NOTE:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.

Phase assignment	Client designation
L1 = R = I	
L2 = Y = II	
L3 = B = III	

DO NOT SCALE WORKING DIMENSIONS

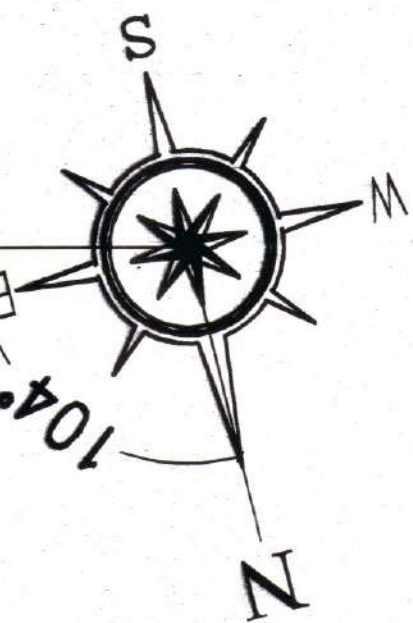
REFERENCE DRAWING:	
1	(I)-G717770-AC111-L160-001 - P-091111_E_C1_8804_BAK_A OVERALL GENERAL LAYOUT PLAN & SECTION FOR 400/220/152KV
2	(I)-G717770-AC111-L181-001 - P-091111_E_C1_8810_BAK_A GIS CUM CRP BUILDING FOR 400KV SWYD EQUIPMENT PLAN AND SECTION
3	(I)-G717770-AC347-E231-001-P-091111_E_C1_8162_BAK_A 400KV GIS - GAS SINGLE LINE DIAGRAM
4	(I)-G717770-AC347-E231-001-P-091111_E_C1_8162_BAK_A 400KV GIS - PLAN LAYOUT

Legend	Equipment	Legend
	Disconnector (Motorised)	-011,-022
	Earthing switch (Motorised)	-015,-025
	Voltage transformer	-T15, -T25
	Partial discharge sensors	

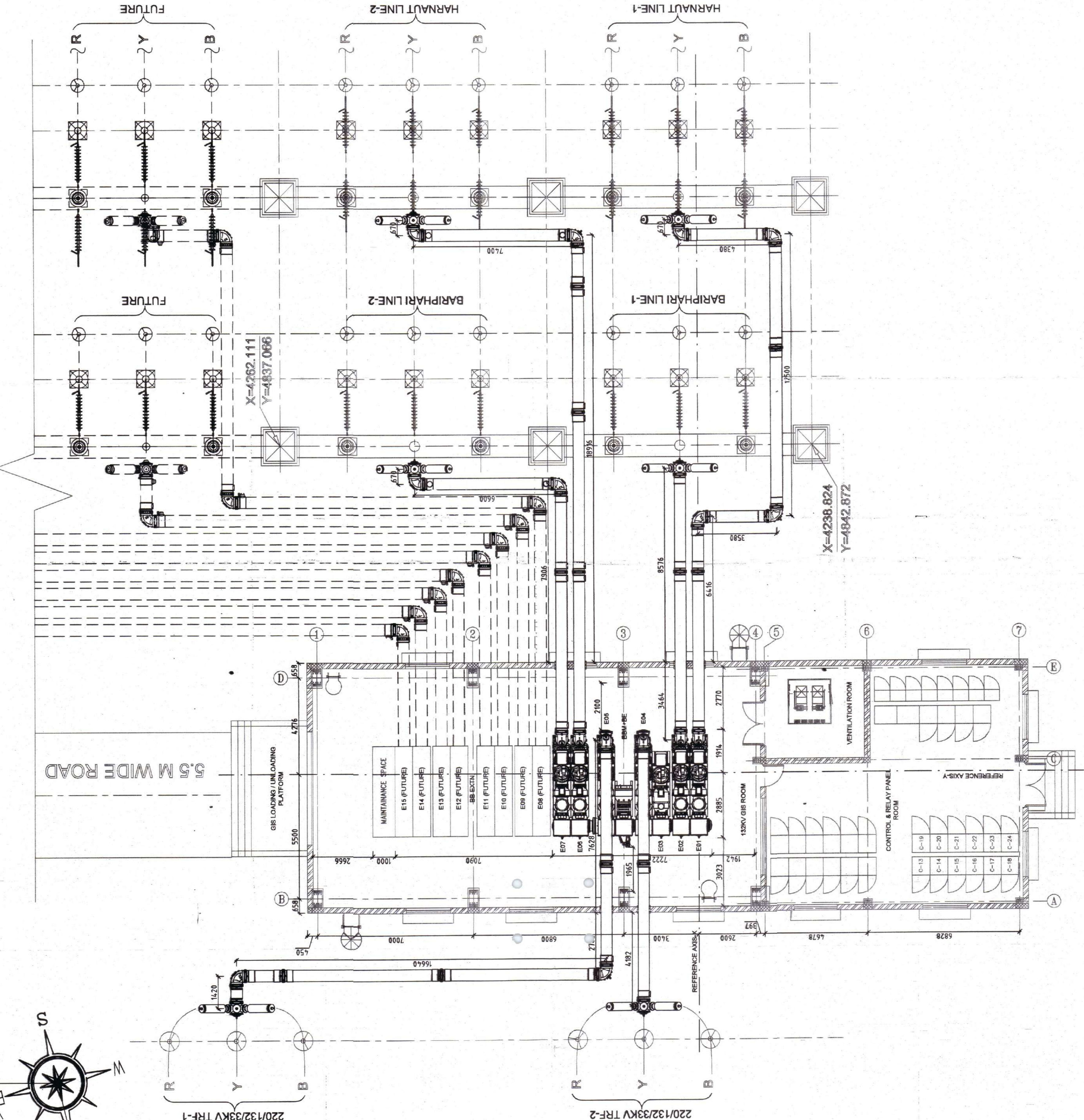
For ventilation of SF6 switchgear hall pay attention to IEC 61936-1, section 8.2 and to national valid instructions of accident preventions at SF6 switchgear.

In accordance with the standard
IEC 61936-1 chapter 3.2.1
it is obligatory for the user to comply
with all requirements which concern an
enclosed electrical operating area.

C	04-06-2020	2DC CHANGED TO WF TYPE AS PER SPTCL SPECIFICATION	GG	GG	SW	
A	01-06-2020	REVISED AS PER LATEST OVERALL LAYOUT	GG	GG	SW	
B	23-03-2020	REVISED AS PER LATEST OVERALL LAYOUT	GG	GG	SW	
D	28-01-2020	FIRST ISSUE	GG	GG	SW	
	Rev. Date	Modification	Drawn By	Created By	Approved By	
Drawing/Document Number (I) G51719-452347-E231-500-P-091111_E_C1_8102_B&K_C						
Contractor						
GEPEC INFRA TECH LIMITED & SIEMENS LIMITED CONSORTIUM Customer BHARAT STATE POWER TRANSMISSION COMPANY LIMITED Project CONSTRUCTION OF (2X500 MW+2X1600 MW) 400/220/132 KV GIS SUBSTATION AT BAKHTIYARPUR ON TURNER BUSIS UNDER STATE PLAN						
Scale	Paper Size	Date	Sign.	Drawn By	Created By	Approved By
1:50	A4	28-01-2020	Sd/-	GG	GG	SW
Responsible Dept.	GP E&S					
NOA No.: 7246409/2019/14/2019 84 Trans/Misc/1442018 Dt: 28-1-19			NIT No.: 19/PR/RSPTCL/2019 Dt: 28-1-19		Document Description 400KV GIS DRAWING PLAN A SECTION LAYOUT FOR 400KV GIS SUBSTATION	
Released for PRELIMINARY ENGINEERING APPROVAL CONSTRUCTION			Date of Issue 28-01-2020		Language EN	
						



5.5 M WIDE ROAD



Phase assignment	
Client designation	
L1 = R = I	
L2 = Y = II	
L3 = B = III	

MINIMUM CLEARANCES IN AIR	
Conductor - Earth 1300	Rated Voltage 14.5 kV
Conductor - Conductor 1300	Rated Voltage 650 kV
Conductor - Earth 1300	Rated Power frequency 275 kV

REFERENCE DRAWING:

1 (I)-G71770-AC111-L160-001 - P-091111_E_C1_880L_BAK_B	OVERALL GENERAL LAYOUT PLAN & SECTION FOR 400/220/132KV
2 (I)-G71770-AE 111-L181-001-P- 091111_E_C1_8810_BAK_0	GIS Cup. CRP Building for 132KV - EQUIPMENT PLAN & SECTION
3 (I)-G71770-AE349-E231-001-P-091111_E_C1_8162_BAK_0	132KV GIS - GAS SINGLE LINE DIAGRAM
4 (I)-G71770-AE349-E231-001-P-091111_E_C1_8162_BAK_0	132KV GIS - SECTION LAYOUTS (Sh 3 & 4)

GAS INSULATED BUS DUCT LENGTHS (METER)			
BAY	INDOOR	OUTDOOR	TOTAL
E01	4.30	27.55	31.85
E02	4.30	8.58	12.88
E04	10.29	4.18	14.48
E05	10.29	20.82	31.12
E06	4.30	26.99	31.29
E07	4.30	15.18	19.48
TOTAL LENGTH	37.78	103.29	141.07

APPROVED
Subject to the condition that you are not to be held liable for the responsibility for consequences arising from the materials supplied as per specification

Dr. S. K. Singh
Electrical Supervising Engineer
(Planning and Engineering)
Bharat State Power Transmission Company Limited
Vijay Bhawan, Patna-800021
07.08.2020

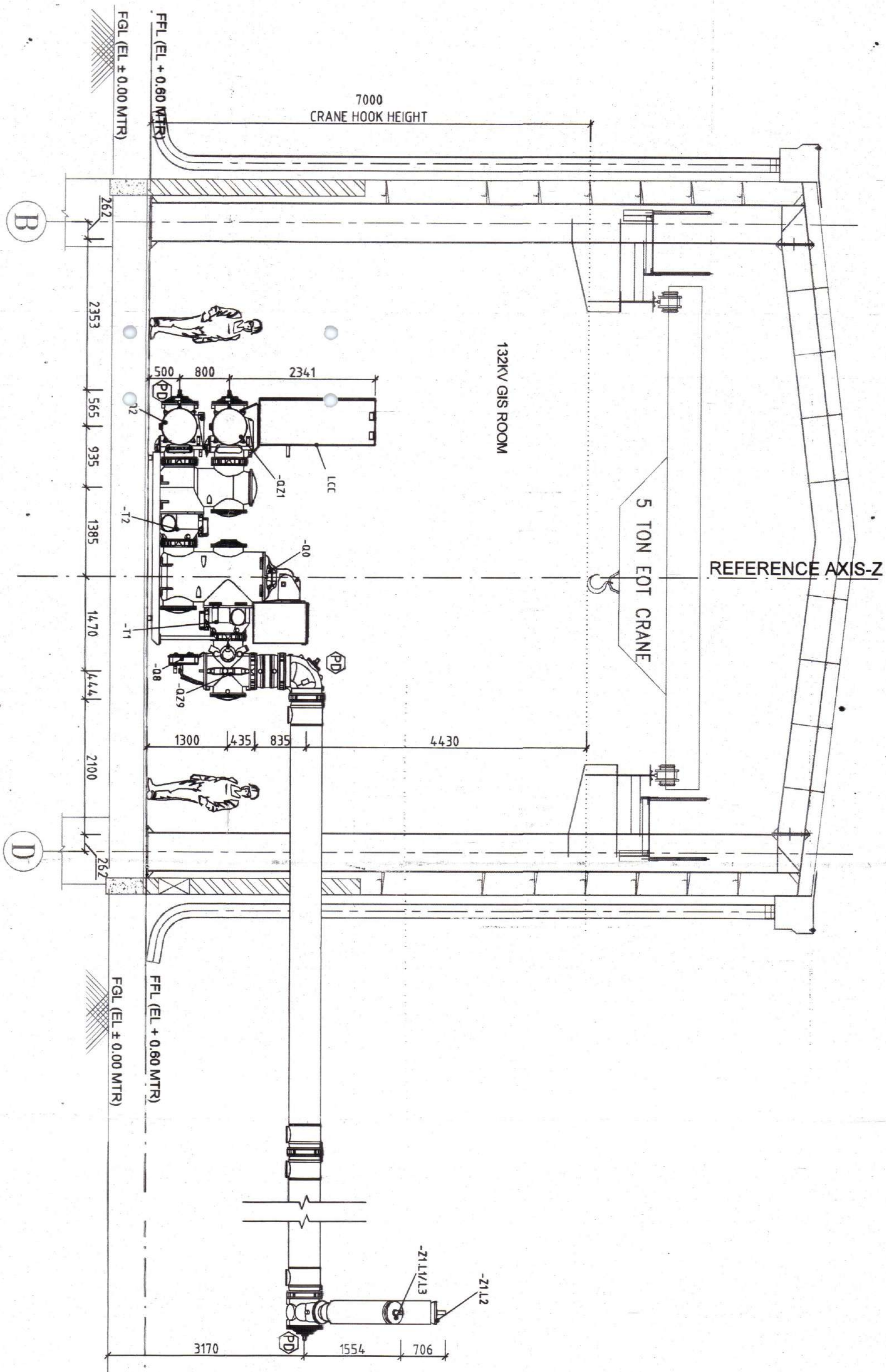
NOTE:
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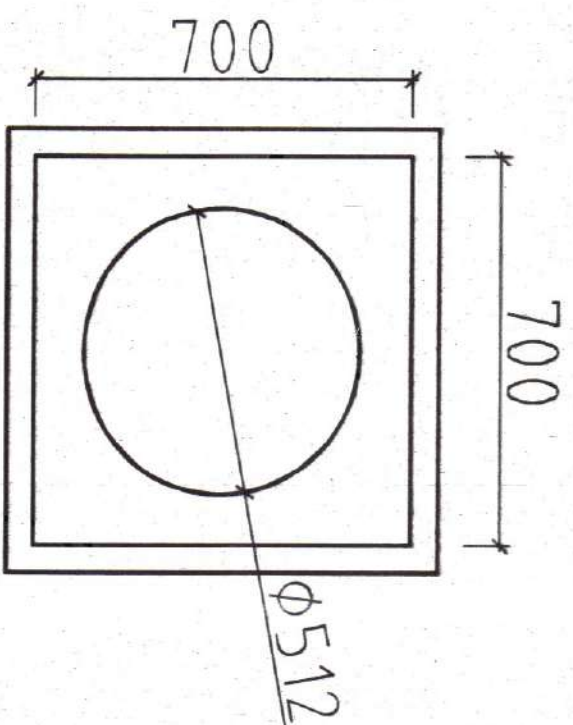
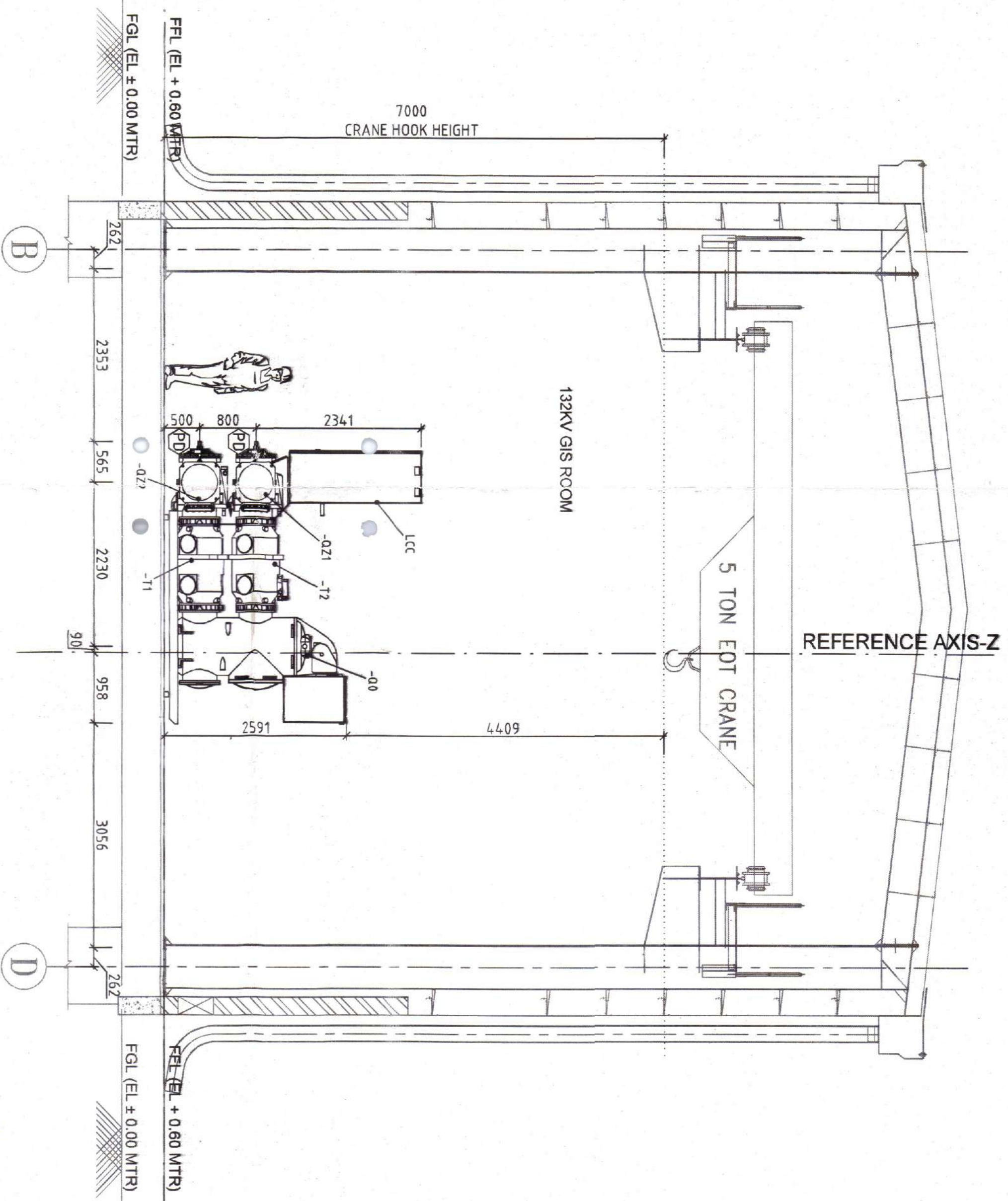
DO NOT SCALE WORKING DIMENSIONS

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TYPICAL SECTION VIEWS FOR LINE BAYS (E01 / E02 / E06 / E07)



TYPICAL SECTION VIEWS FOR BUS COUPLER (E03)



TYPICAL DETAIL OF WALL OPENING FOR BUSDUCTS

Legend	
Equipment	Legend
Circuit breaker	-Q0
Three-position switch (Insulated)	-Q21, -Q22
Three-position switch (Non-Insulated)	-Q29
Disconnect	-Q2, -Q11, -Q12
High speed earthing switch (Non-Insulated)	-Q8
Maintenance Earthing switch (Non-Insulated)	-Q15, -Q25, -Q8
Current transformer	-T1, -T2
Voltage transformer	-T15, -T25
SF6-Air Termination	-Z1
Partial discharge sensors	PD

REFERENCE DRAWING:	
1 (H-GT7770-ACT11-L160-001 - P-091111_E_C1_880A_BAK_B	OVERALL GENERAL LAYOUT PLAN & SECTION FOR 400/220/132KV
2 (H-GT7770-AE 111-L181-001 P-091111_E_C1_8810_BAK_0	GIS Cum. CRP Building for 132KV - EQUIPMENT PLAN & SECTION
3 (H-GT7770-AE349-E231-001-P-091111_E_C1_8162_BAK_0	132KV GIS - GAS SINGLE LINE DIAGRAM
4 (H-GT7770-AE349-E231-001-P-091111_E_C1_8162_BAK_0	132KV GIS - PLAN LAYOUT

In accordance with the standard IEC 61936-1 Chapter 52.1 it is obligatory for the user to comply with all requirements which concern an enclosed electrical operating area.

For ventilation of SF6 switchgear hall pay attention to IEC 61936-1, section 8.8.2 and to national valid instructions of accident prevention at SF6 switchgear.

NOTE:
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.

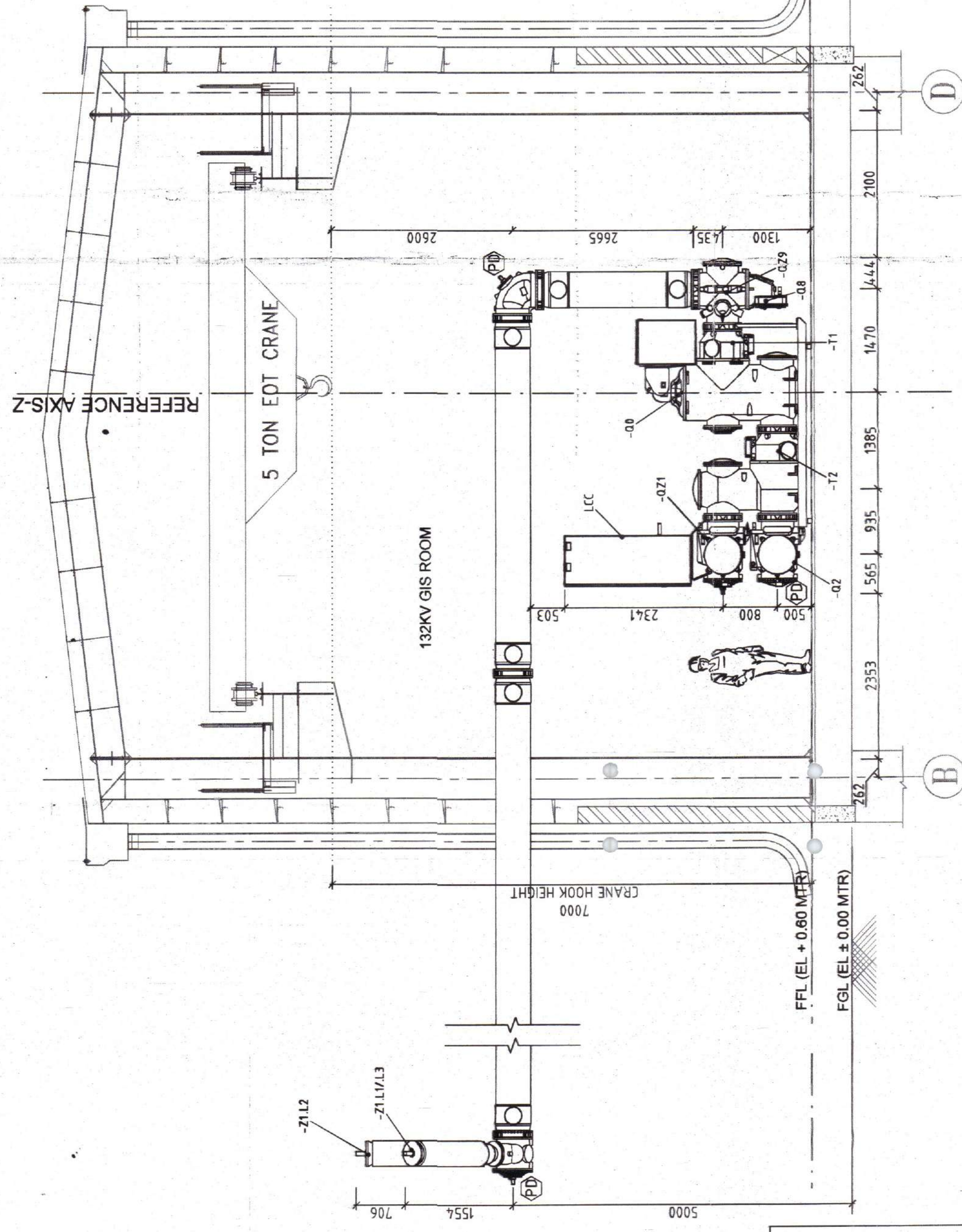
PAINT SHADE EXTERIOR - RAL 7032
DO NOT SCALE WORKING DIMENSIONS

APPROVED
Subject to the condition that you are not responsible for the materials supplied as per specification

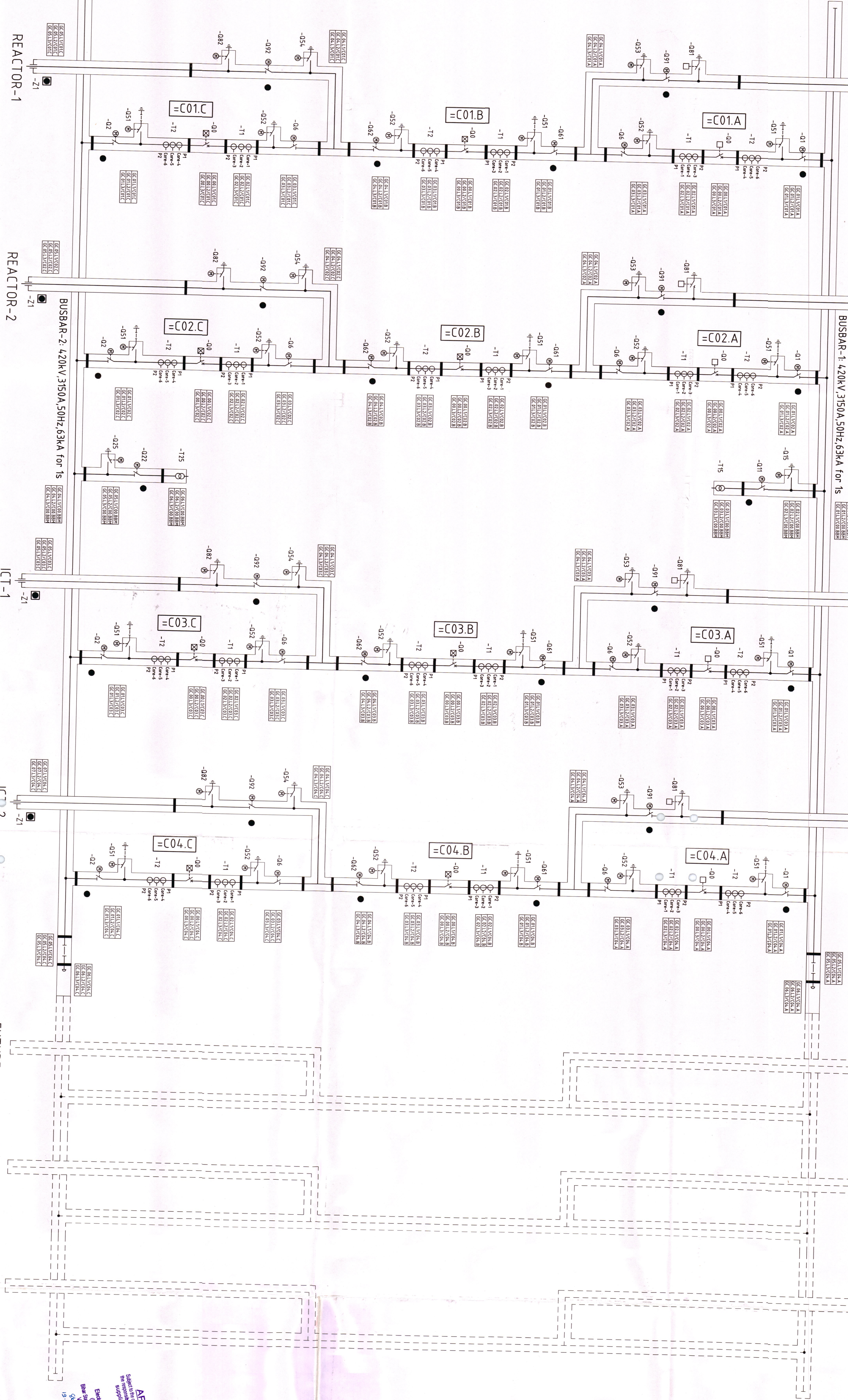
Electrical Supervising Engineer
(Planning / Engineering)
Bharat State Power Transmission Company Limited
Vijay, Bhawan, Patna-80002

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TYPICAL SECTION VIEWS FOR TRANSFORMER BAYS (E04 / E05)



BAY	=C01			=C02			=C00-BBM			=C03			=C04			BAY			=C05	=C06			=C07		
SERIAL NO.	31280332 = C01.A			31280335 = C02.A			BUSBAR VT & EARTHING			31280338 = C03.A			31280341 = C04.A			INTERFACE MODULE			31280342 = C04.B			31280343 = C04.C			
	31280333 = C01.B			31280336 = C02.B						31280339 = C03.B			31280342 = C04.B												
	31280334 = C01.C			31280337 = C02.C						31280340 = C03.C			31280343 = C04.C						FUTURE						
LINE-1							LINE-2							LINE-3											



CURRENT TRANSFORMER DETAILS					
Field Type	CT	Cole No.	Application	Current Ratio	Accuracy IEC 61889
All bays	-T1	1	Bus Bar Differential Check	3000 - 2000 - 500/1	PX
		2	Bus Bar Differential Main	3000 - 2000 - 500/1	PX
		3	Meeting	3000 - 2000 - 500/1	0.2S - 0.2S - 0.2S
		4	Meeting	3000 - 2000 - 500/1	0.2S - 0.2S - 0.2S
	-T2	5	Tie Back Up Line Protection	3000 - 2000 - 500/1	PX
		6	Differential Protection	3000 - 2000 - 500/1	PX
Extended primary current : 120 % at 3000/1 A, 180 % at 2000/1 A, 200 % at 500/1 A					

VOLTAGE TRANSFORMER DETAILS					
Field Type	VT	Winding No.	Voltage Ratio	Accuracy Class as per IEC 61889	Burden (VA)
Busbar Measuring	-T1S, -T2S	1	400kV/3 : 110 V/3	0.5/3P	50
		2	400kV/3 : 110 V/3	0.5/3P	50
		3	400kV/3 : 110 V/3	0.2	50
Rated Voltage Factor / Rated line 1.2 / Continuous 1.5 / 30 sec					

GAS PRESSURE LEVELS					
GAS COMPARTMENT designation					
Each gas compartment is equipped with a separate gas monitoring system, consisting of density monitor indicating red/green.					
GC 04_L1 C01A					
Gauge pressures at 20°C					
Normal pressure	Gas refill level	50% low level	50% high level	Zone trip level	
5.6	5.6	5.3	5.2	5.0	4.7
Switchgear compartments except CB and VT					
5.2	5.0	4.9	4.7		

GAS PRESSURE LEVELS					
GAS COMPARTMENT designation					
Each gas compartment is equipped with a separate gas monitoring system, consisting of density monitor indicating red/green.					
GC 04_L1 C01A					
Gauge pressures at 20°C					
Normal pressure	Gas refill level	50% low level	50% high level	Zone trip level	
5.6	5.6	5.3	5.2	5.0	4.7
Switchgear compartments except CB and VT					
5.2	5.0	4.9	4.7		

NOTE:

- EACH GAS COMPARTMENT IS EQUIPPED WITH STATIC FILTER, FILLING VALVE, WITH NRV, DENSITY SWITCHES, SAFETY DIAPHRAGM RUPTURE DISC.
- LOCATION OF PD SENSORS SPECIALLY FOR OUTDOOR BUS DUCT ARE TENTATIVE AND WILL BE FREEZED AFTER FINALIZATION OF GIS LAYOUT.

Rating	
Rated voltage	420 kV
Rated frequency	50 Hz
Rated lightning impulse withstand voltage	1425 kV
Rated short-duration power frequency withstand voltage	650 kV
Rated switching impulse withstand voltage	1050 kV
Rated normal current	3150 A
Rated normal current	3150 A
Rated normal current	3150 A
Rated normal current	3150 A
Rated short-time withstand current	1s 63 kA
Rated short-circuit making current	1575 kAp
Rated supply voltage	220 V DC
Rated supply voltage circuit breaker	220 V DC
Rated supply voltage isolator/earthing switch	220 V DC
Heater voltage	240 V AC

Environmental factors	
Ambient temperature (indoor)	min. -5 °C max. +50 °C
Ambient temperature (outdoor)	min. -5 °C max. +50 °C

Legend		
Equipment	Legend	Symbol
Circuit breaker	-00	
Circuit breaker with controlled switching device (CSD)	-00	
Disconnector	-01, -02, -06	
Earthing switch (insulated)	-051	
Earthing switch (Non-insulated)	-052, -053, -054	
High speed earthing switch	-081	
Current transformer	-T1, -T2	
Voltage transformer	-T1S, -T2S	
SF6-air bushing	-Z1	
Gas tight partition barrier		
UHF Partial discharge sensors (Indoor)		
UHF Partial discharge sensors (Outdoor)		

Device designation to DIN EN 81346 / IEC 81346 (2009)

Device designation according to DIN 40719 part 2 / IEC publication no. 750/1983

PAINT SHADE EXTERIOR - RAL 7032

CONSTRUCTION OF (2X300 MVA + 2X180 MVA) 400/220/132 KV GIS SUBSTATION AT BAKHTYARPUR ON TURNKEY BASIS UNDER STATE PLAN			
Scale	Page No.	Sign.	Date
N.T.S.	23/01/2020	23/01/2020	23/01/2020
Responsible Dept.	By	27/01/2020	27/01/2020
Rev. No.	Rev. Date	Rev. Date	Rev. Date
1	23/01/2020	23/01/2020	23/01/2020
2	27/01/2020	27/01/2020	27/01/2020
3	27/01/2020	27/01/2020	27/01/2020
4	27/01/2020	27/01/2020	27/01/2020
5	27/01/2020	27/01/2020	27/01/2020
6	27/01/2020	27/01/2020	27/01/2020
7	27/01/2020	27/01/2020	27/01/2020
8	27/01/2020	27/01/2020	27/01/2020
9	27/01/2020	27/01/2020	27/01/2020
10	27/01/2020	27/01/2020	27/01/2020
11	27/01/2020	27/01/2020	27/01/2020
12	27/01/2020	27/01/2020	27/01/2020
13	27/01/2020	27/01/2020	27/01/2020
14	27/01/2020	27/01/2020	27/01/2020
15	27/01/2020	27/01/2020	27/01/2020
16	27/01/2020	27/01/2020	27/01/2020
17	27/01/2020	27/01/2020	27/01/2020
18	27/01/2020	27/01/2020	27/01/2020
19	27/01/2020	27/01/2020	27/01/2020
20	27/01/2020	27/01/2020	27/01/2020
21	27/01/2020	27/01/2020	27/01/2020
22	27/01/2020	27/01/2020	27/01/2020
23	27/01/2020	27/01/2020	27/01/2020
24	27/01/2020	27/01/2020	27/01/2020

CONSTRUCTION OF (2X300 MVA + 2X180 MVA) 400/220/132 KV GIS SUBSTATION AT BAKHTYARPUR ON TURNKEY BASIS UNDER STATE PLAN			
Scale	Page No.	Sign.	Date
N.T.S.	23/01/2020	23/01/2020	23/01/2020
Responsible Dept.	By	27/01/2020	27/01/2020
Rev. No.	Rev. Date	Rev. Date	Rev. Date
1	23/01/2020	23/01/2020	23/01/2020
2	27/01/2020	27/01/2020	27/01/2020
3	27/01/2020	27/01/2020	27/01/2020
4	27/01/2020	27/01/2020	27/01/2020
5	27/01/2020	27/01/2020	27/01/2020
6	27/01/2020	27/01/2020	27/01/2020
7	27/01/2020	27/01/2020	27/01/2020
8	27/01/2020	27/01/2020	27/01/2020
9	27/01/2020	27/01/2020	27/01/2020
10	27/01/2020	27/01/2020	27/01/2020
11	27/01/2020	27/01/2020	27/01/2020
12	27/01/2020	27/01/2020	27/01/2020
13	27/01/2020	27/01/2020	27/01/2020
14	27/01/2020	27/01/2020	27/01/2020
15	27/01/2020	27/01/2020	27/01/2020
16	27/01/2020	27/01/2020	27/01/2020
17	27/01/2020	27/01/2020	27/01/2020
18	27/01/2020	27/01/2020	27/01/2020
19	27/01/2020	27/01/2020	27/01/2020
20	27/01/2020	27/01/2020	27/01/2020
21	27/01/2020	27/01/2020	27/01/2020
22	27/01/2020	27/01/2020	27/01/2020
23	27/01/2020	27/01/2020	27/01/2020
24	27/01/2020	27/01/2020	27/01/2020

UPPER TIER	220KV HATHIGAH	220KV SHERKIPURA	220KV SHERKIPURA
	LINE-1	LINE-2	LINE-3
LOWER TIER	220KV HATHIGAH	220KV FAUHA	220KV FAUHA
	LINE-1	LINE-2	LINE-3

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING IS ONLY A SYMBOLIC REPRESENTATION OF EARTHING CONDUCTOR LAYOUT. AT ACTUAL SITE, THE EARTHING CONDUCTOR WILL BE ROUTED IN SUCH A MANNER SO THAT IT DOES NOT FOUL WITH ANY FOUNDATION OR STRUCTURE.
3. EQUIPMENT EARTHING CONNECTION ARE DIAGRAMATIC ONLY AND WILL BE DONE AS PER SITE CONDITION TO THE NEAREST EARTH AVAILABLE.
4. ALL EARTHING WILL BE DONE IN ACCORDANCE WITH IS:3043 UNLESS OTHERWISE SPECIFIED IN THE TECHNICAL SPECIFICATION.
5. ROD ELECTRODE DETAILS:
 - FOR 400V LA : 24 NOS.
 - FOR 400V CVT : 14 NOS.
 - FOR 400V TOWER WITH PEAK : 05 NOS.
 - FOR 220KV LA : 30 NOS.
 - FOR 220KV CVT : 18 NOS.
 - FOR 220KV TOWER WITH PEAK : 08 NOS.
 - FOR 132KV LA : 20 NOS.
 - FOR 132KV CVT : 12 NOS.
 - FOR 132KV TOWER WITH PEAK : 06 NOS.
 - FOR 33KV LA : 18 NOS.
 - FOR 33KV TOWER WITH PEAK : 03 NOS.
 - FOR LIGHTNING MAST : 08 NOS.
6. PIPE ELECTRODE DETAILS:
 - FOR 400/220KV TRANSFORMER NEUTRAL : 04 NOS.
 - FOR 220/132KV TRANSFORMER NEUTRAL : 04 NOS.
 - FOR BUS REACTOR NEUTRAL : 02 NOS.
 - FOR DG SET : 01 NO.
7. EACH INDIVIDUAL STRUCTURE/EQUIPMENT SHOULD BE EARTHED AND CONNECTED TO TWO DIFFERENT GRID ELECTRODES.
8. MAIN EARTHMAT CONDUCTOR LAD 600MM BELOW FROM THE GROUND LEVEL.
9. AT THE TIME OF TOWER FOUNDATION CONSTRUCTION IF MAIN WAT BREAK THEN CORRECT CONNECTION AFTER COMPLETION OF TOWER FOUNDATION.
10. CABLE TRENCH EARTHING WILL BE DONE WITH 500K MS FLAT & RUN ALONG THE CABLE SUPPORTING STRUCTURE. EARTH FLAT OF CABLE TRENCH WILL BE CONNECTED TO MAIN EARTHING GRID AT 50 M INTERVAL.
11. EARTH ELECTRODE CROSSING THE ROAD AND OTHER CIVIL CONSTRUCTION AREAS AS APPLICABLE SHALL BE INSTALLED PRIOR TO START OF CIVIL CONSTRUCTION. OR PVC SLEEVES TO KEEP AT SUCH CROSSING TO INSTALL THE CONDUCTOR LAYERS. ALL EARTH ELECTRODES SHALL BE INSTALLED AND BOUGHT OUT FOR FUTURE EARTHING CONNECTIONS PRIOR TO START OF CIVIL CONSTRUCTION.
12. EACH INDIVIDUAL CB STRUCTURE SHOULD BE EARTHED AND CONNECTED TO TWO DIFFERENT GRID AND SAME DRAWING WILL SUBMIT SEPARATELY.
13. FENCING EARTHING ARE NOT APPLICABLE FOR PRESENT SCOPE.
15. THE LIGHTNING PROTECTION SYSTEM (OF ALL BUILDINGS) SHALL BE CONNECTED TO THE COMMON GRID.

LEGEND:-

- MAIN EARTH GRID: 40mm DIA MS ROD
- RISER INTER CONNECTIONS: 40mm DIA MS ROD
- ROD EARTH ELECTRODE
- PIPE EARTH ELECTRODE

REFERENCE DRAWINGS:-

- (1)-G71770-AC 111-V033-T01 - P-091111_E_C1_8843_BAK_0 - OVERALL FOUNDATION LAYOUT
- (0)-G71770-AD 108-1166-001 P-091111_E_C1_8771_CHL_0 - TYPICAL EARTHING DETAILS

BILL OF MATERIALS

S.NO.	SYMBOL	DESCRIPTION	REMARKS	QTY.
1.		40mm DIA MS ROD	MAIN EARTHMAT	15661 mtrs.
2.		40mm DIA MS ROD	OUTDOOR EQUIPMENT AND OUTDOOR GS	6637 mtrs.
3.		40mm DIA MS ROD	AUXILIARY EARTHMAT	303 mtrs.
4.		40mm DIA MS ROD ELECTRODE WITH TEST LINK 3m LONG	EARTH ELECTRODE	164 nos.
5.		40mm DIA MS ROD ELECTRODE WITHOUT TEST LINK 3m LONG	EARTH ELECTRODE	16 nos.
6.		40mm DIA G.I. PIPE ELECTRODE 3M LONG	PIPE ELECTRODE	17 nos.
7.		75x12mm GI FLAT		3742 mtrs.
8.		50x6mm GI FLAT		2336 mtrs.
9.		50x6mm MS FLAT		1036 mtrs.

AUXILIARY EARTHMAT FOR 33KV ISOLATOR

LEGEND:

APPROVED

Signature of Engineer

Signature of Supervisor

Signature of Project Engineer

Signature of Project Engineer

Signature of Project Engineer

Signature of Project Engineer

Signature of Project Engineer

Signature of Project Engineer

Signature of Project Engineer

Signature of Project Engineer

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Signature of Project Engineer

Signature of Project Engineer

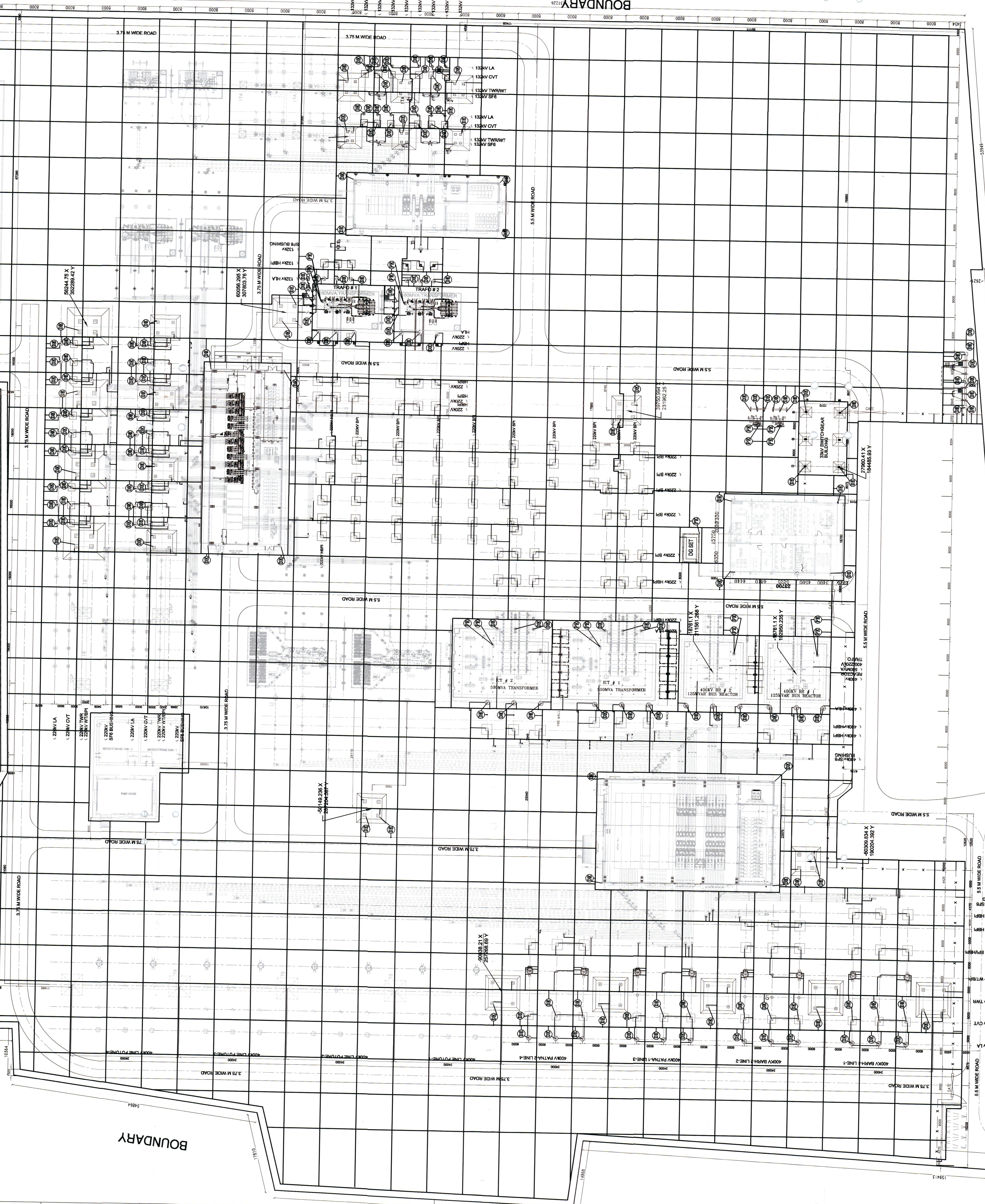
Signature of Project Engineer

Signature of Project Engineer

Signature of Project Engineer

BOUNDARY

FUTURE SPACE FOR 33KV SWITCHYARD



BOUNDARY

BOUNDARY

BOUNDARY

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BOUNDARY

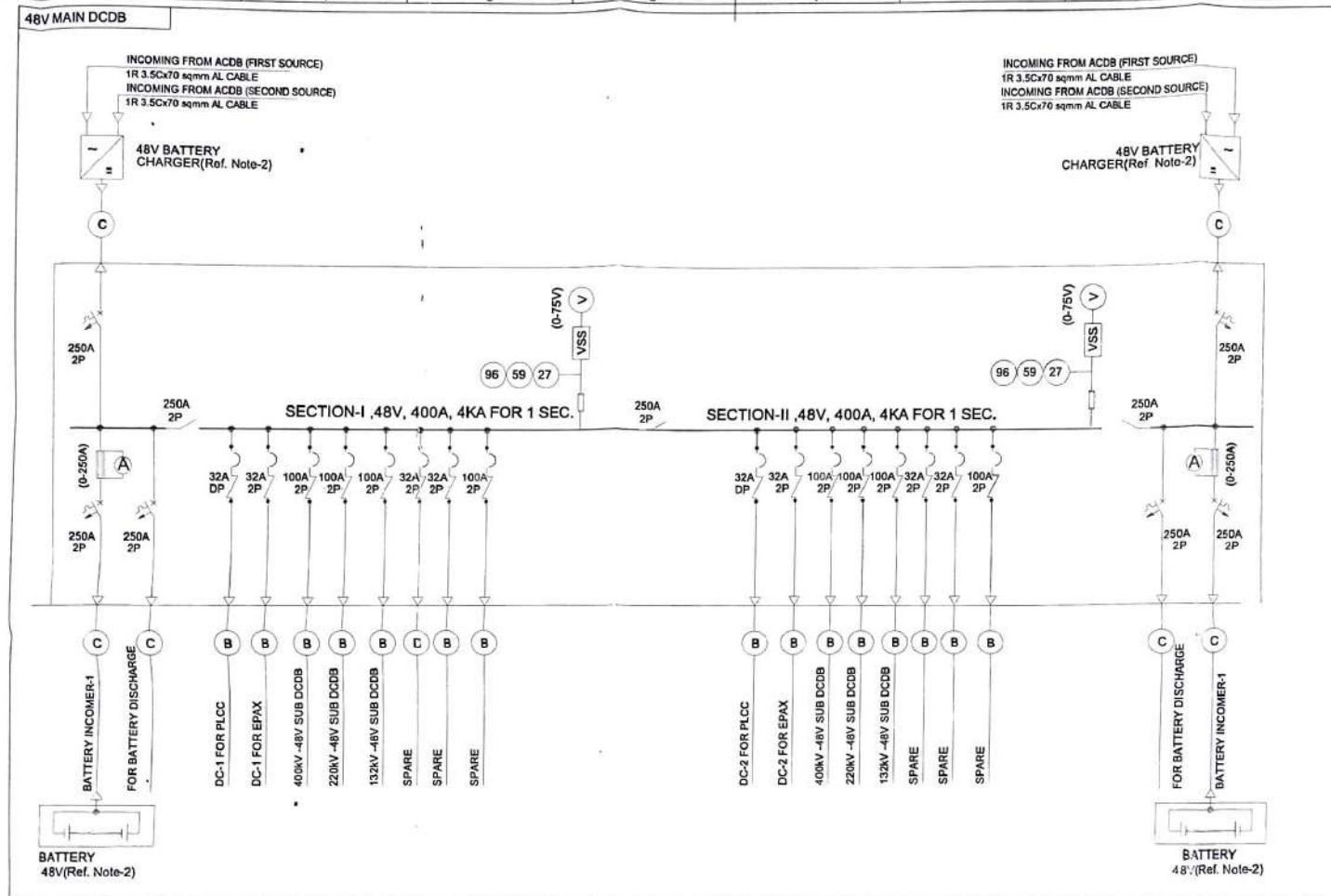
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APPROVED
Subject to the condition that you are not absolved of the responsibility for correctness of the materials supplied as per specification

Electrical Supervising Engineer
(Planning and Engineering)
Bihar State Power Transmission Company Limited
Vijay Bhawan, Patna-800021

Sk. D. D. 2020

NOTES:

- THE FAULT INTERRUPTING CAPACITY OF THE CIRCUIT BREAKER SHALL NOT BE LESS THAN THAT OF SWITCH BOARD ITSELF
- BATTERY AND BATTERY CHARGER RATING WILL BE AS PER THE APPROVED BATTERY AND BATTERY CHARGER SIZING DOCUMENT.
- THE DRAWING SHALL BE READ IN CONJUNCTION WITH BSPTCL SPECIFICATION AND PROJECT SPECIFICATION SCHEME DRAWING.
- SWITCHBOARD AND EQUIPMENT SHALL BE AS PER BSPTCL STANDARD SPECIFICATION OF LT SWITCHGEAR.
- CABLE SIZES ARE TENTATIVE AND THE SAME SHALL BE AS PER FINAL CABLE SCHEDULE
- THE BAY SUPPLY (AC & DC) SHALL BE LOOPED FROM ANY BAY FROM ITS CORRESPONDING D/A
- CABLE SIZES FROM DCDB TO SUB-DCDB SHALL BE AS PER THE CABLE SCHEDULE
- ALL NOTATIONS SHALL BE LED TYPE
- VOLTMETER AMMETER SHALL BE DIGITAL TYPE

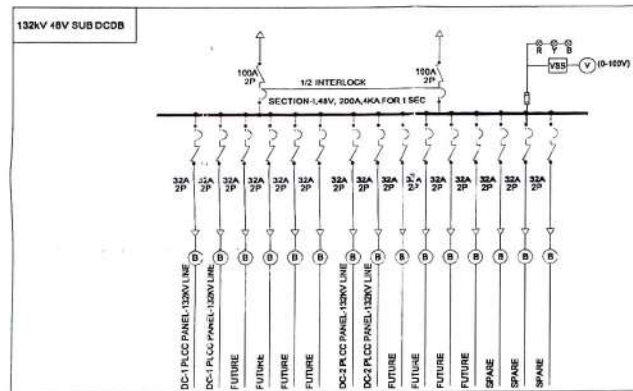
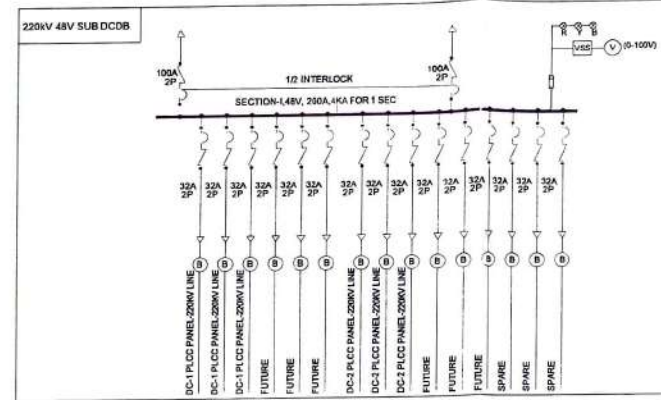
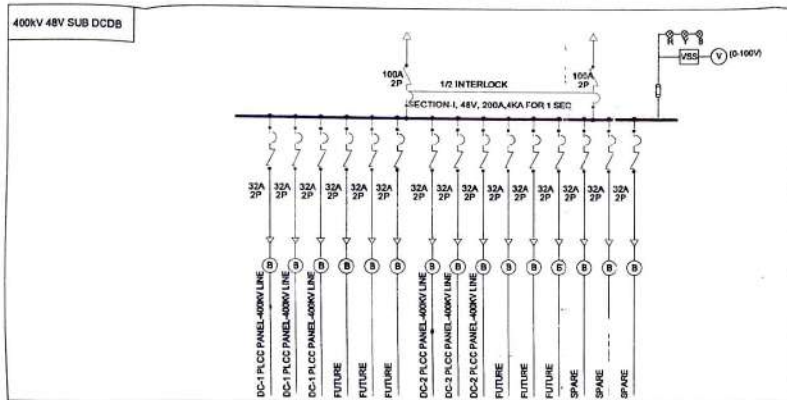
LEGEND:

- 2P MCB FOR DC CIRCUIT
- 2P MCB FOR DC CIRCUIT
- 2P SINGLE THROW AIR BREAK SWITCH
- AMMETER
- VOLTMETER
- UNDERVOLTAGE RELAY
- OVER VOLTAGE PROTECTION
- BATTERY EARTH FAULT (EARTH LEAKAGE) RELAY
- MRC FUSE

CABLE SIZE:

- 1X4CX18 sqmm (PVC)
- 2X1CX150 sqmm (PVC)
- TO BE DECIDED AS PER FUTURE LOAD

D									
C									
B									
A									
0	2020 04 16	FIRST SUBMISSION			SS	SSD		RK	
Rev.	Rev. Date	Modification			Drawn By	Created By		Approved By	
Drawing/Document Number (1)-G71770-AC 111-S153-001 P-091111_E_C1_8833_BAK_0					LOCATION		BAKHTIYARPUR		
Contractor GEPDEC INFRA TECH LIMITED & SIEMENS LIMITED CONSORTIUM					SUB STATION TYPE		GIS SUBSTATION		
Customer BIHAR STATE POWER TRANSMISSION COMPANY LIMITED.					VOLTAGE LEVEL		400/220/132/33KV		
Project CONSTRUCTION OF (2x500 MVA+ 2X160 MVA) 400/220/132 KV GIS SUB-STATION AT BAKHTIYARPUR ON TURNKEY BASIS UNDER STATE PLAN					Released for	PRELIMINARY			
						ENGINEERING APPROVAL		✓	
						CONSTRUCTION			
Scale 1:100mm	Paper Size A2	Sgn.	Date	NOA No. 63, Trans/Misc/P-1/44/2019, Dtd 26-11-19 64, Trans/Misc/P-1/44/2019, Dtd 26-11-19	NT No. 15PR/BSPTCL/2019				
Responsible Dept. EMTS	Drawn By SS		2020 04 16	Document Type SINGLE LINE DIAGRAM	Document Designation C1_8833_BAK_0				
	Created By SS1		2020 04 16	Title LT AUXILIARY SYSTEM FOR 400/220/132KV SYSTEM	Document Title P-091111_E_C1_8833_BAK_0				
	Approved By RK		2020 04 16		Rev.	Date of issue	Language	Sheet	
SIEMENS					0	2020 04 16	EN	04 of 05	



NOTES:

- THE FAULT INTERRUPTING CAPACITY OF THE CIRCUIT BREAKER SHALL NOT BE LESS THAN THAT OF SWITCH BOARD ITSELF.
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- CABLE SIZES ARE TENTATIVE AND THE SAME SHALL BE AS PER FINAL CABLE SCHEDULE.
- TIE BAY SUPPLY (AC & DC) SHALL BE LOOPED FROM ANY BAY FROM ITS CORRESPONDING DIA
- CABLE SIZES FROM DCDB TO SUB-DCDB SHALL BE AS PER THE CABLE SCHEDULE.
- ALL INDICATIONS SHALL BE LED TYPE.
- VOLTMETER/AMMETER SHALL BE DIGITAL TYPE.

CABLE SIZE:

- 1X4CX16 sqmm (PVC)
- 2X1CX150 sqmm (PVC)
- TO BE DECIDED AS PER FUTURE LOAD

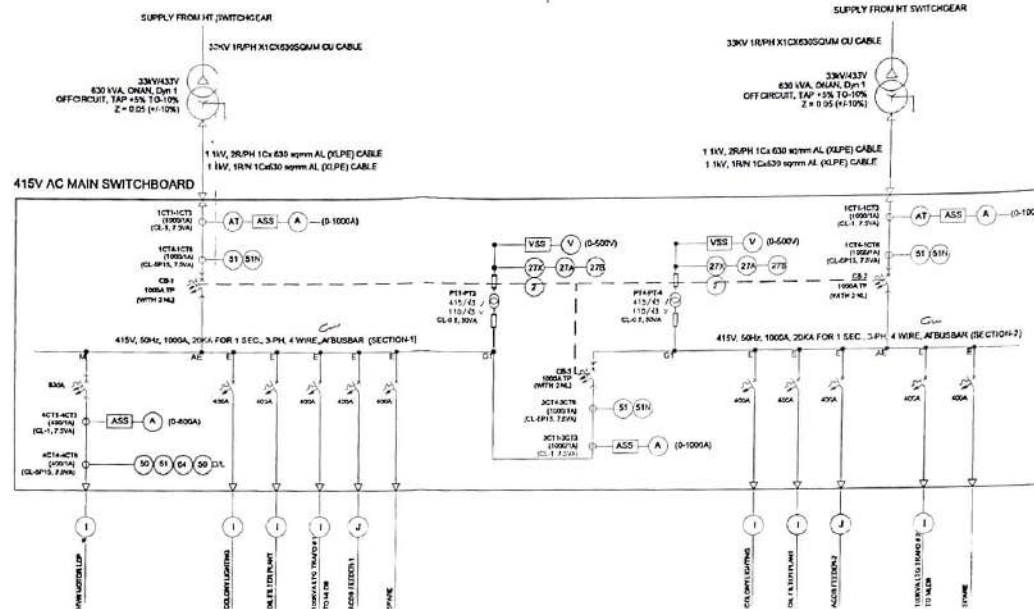
LEGEND:

- 2P MCCB FOR DC CIRCUIT
- 2P MCB FOR DC CIRCUIT
- 2P SINGLE THROW AIR BREAK SWITCH
- AMMETER
- VOLTMETER
- UNDERVOLTAGE RELAY
- OVER VOLTAGE PROTECTION
- BATTERY EARTH FAULT (EARTH LEAKAGE) RELAY
- HRC FUSE

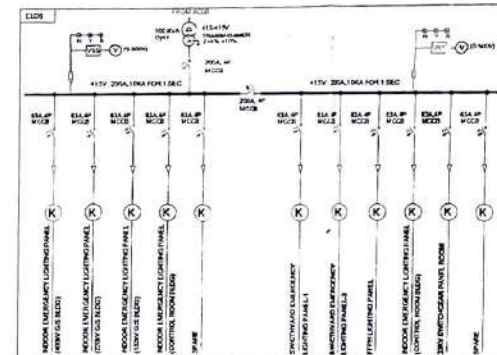
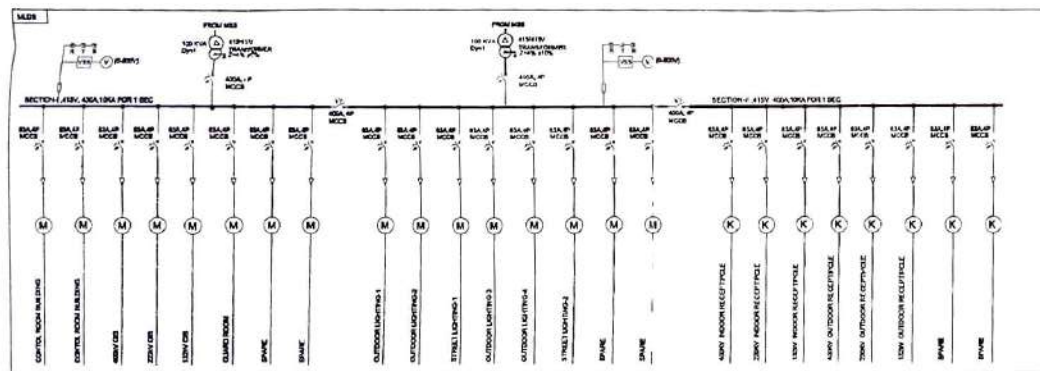
APPROVED
Subject to the condition that you are not released of the responsibility for correctness of the materials supplied as per specification

[Signature]
Electrical Superintending Engineer
(Planning and Engineering)
Bihar State Power Transmission Company Limited
Vijay Nagar, Patna-800017

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- * 415V ACDB shall be on per TS with 20% extra feeder
- * 220V DGB shall be on per TS with 20% extra feeder
- * All ACDB shall be provided with three phases and a neutral busbars and the busbars shall be provided with two busbars
- * All busbars and jumper connection shall be of HDEC of adequate size



APPROVED on *concluded*
 Subject to the condition that you are not bound to
 for responsibility for correctness of the material
 provided as per specification
 Electrical Engineering
 (Planning and Engineering)
 Bihar State Power Transmission Company Limited
 Varanasi, Bihar, India-221001
 Bk 03-03-2020

SYMBOLS:



CABLE SIZE:

- 1R 3.5C430 sqmm (XLPE)
- 2R 3.5C430 sqmm (XLPE)
- 3.5G470 sqmm (PVC)
- 3.5G435 sqmm (PVC)

NOTES:

1. ALL ACB'S SHALL HAVE "SERVICE", "TEST" AND "FULLY WITHDRAWN" POSITIONS. CLOSING OF BREAKER SHALL NOT BE POSSIBLE UNLESS IT IS IN ANY ONE OF THESE POSITIONS.
2. INTERLOCK SHALL BE PROVIDED BETWEEN CB-1, CB-2 AND CB-3 SUCH THAT CB-3 SHALL BE ALLOWED TO CLOSE ONLY IF EITHER OF CB-1 OR CB-2 IS OPEN FOR MSB.
3. THE FAULT INTERRUPTING CAPACITY OF THE CIRCUIT BREAKER SHALL NOT BE LESS THAN THAT OF THE SWITCHGEAR ITSELF.
4. SWITCHGEAR AND EQUIPMENT SHALL BE AS PER BSPTCL STANDARD SPECIFICATION FOR LT SWITCHGEAR.
5. THE CABLE SIZES ARE TENTATIVE AND THE SAME WILL BE FINALIZED AS PER THE FINAL CABLE SCHEDULE.
6. ALL INDICATIONS SHALL BE LED TYPE.
7. VOLT METER/AMMETER SHALL BE DIGITAL TYPE.

D					
C					
B					
A					
Rev.	2020.04.16	FIRST SUBMISSION	SS	SSD	RK
Rev.	Rev. Date	Modification	Drawn By	Created By	Approved By
Drawing/Document Number	(1)G1770-AC 11-S153401 P-081111_E_C1_8833_BAK_0				
Contractor	GEPRDEC INFRATECH LIMITED & SIEMENS LIMITED CONSORTIUM				
Customer	BIHAR STATE POWER TRANSMISSION COMPANY LIMITED.				
Project	CONSTRUCTION OF (2X500 MVA+ 2X160 MVA) 400/220/132 KV GIS SUB-STATION AT BAKHTIYARPUR ON TURNKEY BASIS UNDER STATE PLAN				
Scale	1:100mm	Paper Size	A2	Sign	Date
Responsible Dept.	EMTS	Drawn By	SS	2020.04.16	Document Type
		Created By	BSD	2020.04.16	Document Tree
		Approved By	RK	2020.04.16	Title
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