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| Division | P&E Division, |
| Tender No. | SDM(P&E)/ 997 UG OH line TPI/ENQ/ 26 |
| Description | Enquiry for obtaining quotation for Third Party Inspection (TPI) Agency for the work of “Supply, Installation, Testing and Commissioning of 33 kV Over Head Line & Under Ground Cable from Intake Substation to GC Berth Substation for strengthening of power supply arrangement of RMQC-3 of HDC, KoPT”. |
| Last Due date & time of submission of Offer online. | 28.01.2021, from 15:30 Hrs(IST). |
| Date & time of opening of Techno commercial Bid and Price bid of Tender. | 29.01.2021, 15:00 Hrs. (IST) |
| <p>Submitted for hoisting in the website of HDC/SMP as per schedule detailed above please.</p> <p>Encls : NIT with tender document.</p> <p>With Regards,</p> <p>(R.N.Roy) Sr.Dy. Manager (P&E) Haldia Dock Complex</p> | |



**SYAMA PRASAD MOOKERJEE PORT,
KOLKATA
(Formerly Kolkata Port Trust)
HALDIA DOCK COMPLEX
AN ISO-9001:2015 ORGANISATION**

**Office of Plant & Equipment Division
Operational Administrative Building (1st floor),
Chiranjibpur, Haldia; Pin – 721 604
Dist. Purba Medinipur, State: West Bengal, India**



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No. SDM(P&E)/ 997 UG OH line TPI/ENQ/ 26

Dated:14.01.2021

- | | |
|---|---|
| 1. IRCLASS SYSTEMS AND SOLUTIONS PVT. LTD. | 4. BUREAU VERITAS INDUSTRIAL SERVICES (India) PVT. LTD., |
| 2. ABS INDUSTRIAL VERIFICATION (INDIA) PVT. LTD. | 5. DET NORSKE VERITAS (DNV), |
| 3. LLOYD's REGISTER ASIA. | |

Dear Sir,

Sub: Enquiry for obtaining quotation for Third Party Inspection (TPI) Agency for the work of “**Supply, Installation, Testing and Commissioning of 33 kV Over Head Line & Under Ground Cable from Intake Substation to GC Berth Substation for strengthening of power supply arrangement of RMQC-3 of HDC, KoPT**”.

Haldia Dock Complex, Syama Prasad Mookerjee Port, Kolkata (Formerly Kolkata Port Trust) intends to engage a Third Party Inspection (TPI) Agency for Technical Inspection & Certification of major equipment / items and installation & commissioning jobs in connection with the subject work, i.e.” Supply, Installation, Testing and Commissioning of 33 kV Over Head Line & Under Ground Cable from Intake Substation to GC Berth Substation for strengthening of power supply arrangement of RMQC-3 of HDC, KoPT”, as per the Bill of Quantities (Unpriced) & Technical Specification of the relevant Contract [enclosed as Annexure-I & Annexure-III].

You are requested to send your sealed offer for the subject Third Party Inspection, as per the enclosed “PRICE SCHEDULE” format [at Annexure-IV], based on the enclosed terms & conditions [at Annexure-II]. The rates & amounts quoted by the bidders in the “PRICE SCHEDULE”, include all incidental charges [excluding Goods and Services Tax (GST)], as necessary. Applicable GST (%) is to be indicated in the “PRICE SCHEDULE”. Selection of the successful bidder will be made on the basis of the lowest Total Basic Price. Your offer should be accompanied by the documents, in support of having experience of similar work, in the recent past.

The offer should be submitted within 15.30 Hrs. (IST) of 28.01.2021 at the following address :

Office of Sr.Dy. Manager (P&E), Operational Administrative Building (1st Floor), Haldia Dock Complex, Syama Prasad Mookerjee Port, Kolkata (Formerly Kolkata Port Trust), Chiranjibpur, P.O. Haldia, Dist. Purba Medinipur, WB Pin- 721604.

The sealed offers, received within the aforesaid closing date & time, will be opened on 15.00 Hrs. (IST) of 29.01.2021 onwards, at Operational Administrative Building, Haldia Dock Complex, Syama Prasad Mookerjee Port, Kolkata (Formerly Kolkata Port Trust).

You are requested to send your sealed offer, as sought for, within the above mentioned closing date & time of submission.

Offers from bidders, as mentioned above, will only be entertained.

Thank you,
Yours faithfully,

**(R.N.Roy)
Sr.Dy. Manager (P&E)
Haldia Dock Complex**

Encl: Annexure-I, Annexure-II, Annexure-III & Annexure-IV.

TECHNICAL SPECIFICATION

1.0

GENERAL

1. The works will be executed to comply with the General Specifications for Electrical works and conforming to the Indian Electricity Act & rules, BIS & direction of Engineer.
2. The work will be executed as per general arrangement drawing and detailed fabrication drawings duly approved by the Engineer. The various items of equipment will be ordered only after the drawings are approved and quantities in detail of various items are ascertained as per actual requirements. Therefore the actual quantities / measurement may vary from the stipulated quantities, which are only estimate.
3. The contractor/agency will engage suitable qualified/experienced/ licensed engineering supervisor for the work and suitable skilled personnel with required license for doing the erection work. Required special tools to be operated in the execution of the job.
4. The work will be performed as per the day to day instruction and approval of the engineer. All materials/ equipment will be used after taking approval of the Engineer.
5. Equipment will be duly inspected in the manufacturer's works / premises by TPI AGENCY before dispatch to the site.
6. The work will be executed as per the programme of completion of the project. The delivery & erection schedule of various materials/ equipment will be as per approval of Engineer.
7. The contractor holds responsibility for the entire job as per relevant specifications. If any item is left out within the schedule of work but if it is considered essential for the completion of the job, the contractor has to carry out the items as extra substituted item.
8. The contractor shall have to make arrangements, at his own risk and cost, for transportation of materials from the point of issue of stores to site of work, if any.
9. The contractor shall ensure that the staff employed by him for execution of the electrical work, possess the valid electrical license issued by competent authority. Consequences arising due to the default of the contractor in not complying with the above condition shall be the entire responsibility of the contractor.
10. All concealed work and earthing shall be done in the presence of the Engineer-in-charge or his authorized representative.
11. The schematic diagram/dimensional drawings of the various electrical cubical panels shall be got approved from the Engineer-in-charge before fabrication and shall comply with specifications and Indian Electricity Rules. The panels shall conform to IS: 8623/1993.
12. All panels/DB shall be suitable for 45°C ambient temperature.
13. The MCB shall be of the same make as that of MCB DB's. Contractor shall obtain approval of the Engineer-in-charge before procurement of MCB DB's. All DB's shall be double door type conforming to minimum IP-54 degree of protection.
14. Miniature Circuit Breaker shall comply with IS –8828-1996 / IEC 898. Miniature Circuit Breakers shall be quick make and break type for 230 / 415 V A.C., 50Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10KA

- at 415V A.C. The MCB shall be DIN mounted. The MCB shall be current limiting type (Class – 3).
15. MCB shall be as per their tripping characteristics curves defined by the manufacturer. The MCB shall have the minimum power loss (watts) per pole defined as per the IS / IEC and the manufacturer shall publish the values.
 16. The MCB housing shall be heat resistant and having high impact strength. The terminal shall be protected against finger contact to IP20 degree of protection.
 17. All model of modular accessories required for the work shall be got approved from the Engineer among the approved makes. The base plate shall be preferably in sheet steel or otherwise in unbreakable polycarbonate. The cover plates shall be screw less type in shade approved by the Engineer. The GI box shall be of the same make as the modular accessories.
 18. Contractor shall have to check the site order Book for any instructions of Engineer or his authorized representative and sign the site order book. He shall be bound to ensure compliance with the instructions recorded there in.
 19. All the MCCB's shall have microprocessor based trip unit for reliable protection and accurate measurement. The rated Service breaking capacity (kArms) shall be 100% of Ultimate breaking capacity (kArms). All MCCB's shall be current limiting type with features as per relevant IS codes and specification. There has to be total discrimination between the incoming and outgoing MCCB's and MCB's, as required, at the MDB's and DB's level.
 20. MCCB's shall be used with rotary handle and terminal spreaders and all terminals shall be shrouded to avoid direct contact.
 21. All measuring CT's, unless otherwise specified shall be cast resin CT's with class 0.5 accuracy. All digital measuring meter shall be with class 0.5 accuracy unless specified otherwise.
 22. Mechanical Castle key interlock shall be provided among the incomer MCCB's, wherever, as applicable, two different incomer sources are provided in the panel as per the directions of the Engineer. The same is deemed included in the scope of work.
 23. All measuring and indicating instruments shall be protected through MCB's of 0.5 Amps rating.
 24. General arrangement drawing of the switchboard, LT/HT switchgear shall be approved by the Engineer before commencement of manufacturing.
 25. Conduit layout as per switching arrangement shall be prepared by contractor and got approved from the Engineer before slab casting. At all expansion joints in the building suitable arrangement shall be ensured during conduiting.
 26. Ratings, sizes and quantities shall be checked and considered for satisfactory operation of electrical system complete in all respect.
 27. Conduits, Switchboards, Sockets to be provided on walls shall be open type unless specifically approved by Engineer.
 28. Conduits on ceiling in existing system may be provided on surface and in new construction shall be open type.
 29. All measuring and indicating instruments shall be protected through MCB's and isolating switches.
 30. Breaker shall have LCD display to show the metering and protection parameters.

31. Equipments are to be inspected in the respective manufacturer works before dispatch and test reports as applicable as per BIS standards shall be provided for each equipment to Third Party Inspection (TPI) Agency. The TPI Agency is appointed by the port and cost of TPI Agency is borne by the Port.
32. The firm shall deploy only licensed personnel as required under IE Rules, for execution of the electrical works. The firm shall be liable to submit the list of such personnel along with the attested copy of the licenses at the time of execution.
33. It is important that every equipment is tested fully before dispatch.
34. All materials for the work shall be supplied from approved list of manufacturer and any item, not covered in approved list, shall be supplied after getting approval from Engineer-in-charge or his authorized representative.
35. Any materials brought for work which is not matching with specification will be rejected and the rejected materials shall be removed from site on the same day.
36. All fees payable to concerned authorities and other local bodies if any shall be paid by the contractors.
37. **Any part or whole of the system which requires approval of the Central Electricity Authority, or any other statutory body, should be arranged by the Contractor at his cost. It is the responsibility of the Contractor to submit the system drawings with all details to the Electrical Inspectorate and obtain their approval.**
38. Contractor shall obtain permit/approval from concerned authorities before commencement of work. All documents/drawings required for such permit/approval shall be prepared by the contractor.
39. Contractor shall have a valid "A" class electrical contract licence with HT installation issued by appropriate authorities.
40. Test certificates both type test and routine tests wherever required shall be furnished along with supply for all Electrical/Mechanical items.
41. Inspection / acceptance, in no way shall absolve the contractor from supplying material as per standards / codes and warranty or other obligations under the contract.
42. The contractor shall arrange the testing/measuring equipment by own cost to carry out pre-commissioning test of all equipment at site as per IER.
43. All electrical works shall be tested by the contractor in the presence of TPI Agency and to the entire satisfaction as per IE Rules.
44. Soil bearing capacity:-5T/sq.mtrs. at the depth of 2.5Mtrs.
45. Data to be furnished by the bidder after award of order
 - a) The contractor shall submit detail shop/fabrication/layout drawings for Package substation, cables, trench, High Mast, Feeder Pillar Boxes, Load Point Panels, Luminaire etc.
 - b) **Five** Set of copies of installation, operation and maintenance manuals, descriptive bulletins etc, shall be furnished prior to / at the time of despatch of all materials. Manuals shall include the following aspects:
 - i) Outline dimension drawing showing relevant cross sectional views, earthing details and constructional features including foundation drawing.

- ii) Rated voltage, current, duty cycle and all other technical information which may be necessary for correct operation of the switchgear.
 - iii) Storage details for prolonged duration.
 - iv) Unpacking.
 - v) Handling at site.
 - vi) Erection
 - vii) Pre-commissioning test.
 - viii) Operating procedure.
 - ix) Maintenance procedures.
 - x) Precaution to be taken during operation and maintenance work.
- c) Test Certificates
The contractor supply equipments from the Manufacturers, who are having type test certificate issued by CPRI / ERDA. Also, the contractor shall furnish the type test certificate issued by CPRI / ERDA to the manufacturers of similar rating during approval of above equipments.
- d) On completion of work the contractor shall submit all drawings, manuals and test certificates, etc. for all equipment / materials ordered and as specified by the Engineer.

2.0 SCOPE OF WORK

(a) **Electrical Works (Supply, Delivery, Installation, and Testing & Commissioning) at Intake sub-station.**

- 1) 33kV, 800A, VCB PCVCB (1Sets).
- 2) Control relay Panel(1Set)
- 3) 3 Nos. 33 kV, Outdoor Single phase Current Transformer.
- 4) 3 Nos. 33 kV, Outdoor Single phase Potential Transformer.
- 5) 2 Nos. 33 kV, 800A Gang Isolator.
- 6) 2.5'' Aluminium IPS Bus Bar.
- 7) Lattice type mounting structure for above equipments.
- 8) 30V Battery Bank and battery chargers for Control supply of PCVCB.
- 9) Earthing of all equipment at Yard and sub-station mentioned above.

(b) **Electrical Works (Supply, Delivery, Installation, and Testing & Commissioning) UG Cable and Overhead Line from Intake sub-station to GC Berth Sub-station.**

- 1) 33kV (E) XLPE, 3C X 120Sq.mm., Screened, Aluminium, armoured cables along with straight through and heat shrinkable cable end terminations (2Runs).
 - i) From 33kV Gang Isolator at Intake sub-station to be erected to 33kV, four pole Rail structure to be erected near Chiranjibpur fire station (2Runs).
 - ii) From 33kV, four pole Rail structure to be erected near GC Berth Main gate,

Permit office to GC Berth sub-station(33kVPanel) (1Runs).

- 2) 33kV Double circuit, ACSR Dog conductor, Overhead Line connecting between four pole Rail structures near Chiranjibpur fire station to GC Berth Main gate, near Permit office.

Used /2nd hand Rail poles in requisite quantity and size would be supplied by HDC, KoPT on free of cost basis. However contractor shall arrange to transport Rail poles to site from stores of HDC.

- 3) Dismantling of existing 11kV Overhead Line (Single circuit Panther Conductor) and transporting dismantled items i.e. Rail pole, ACSR Conductors, Insulators etc. to site store of HDC. (Approx.300Mtrs. span).

(c) Electrical Works (Supply, Delivery, Installation, and Testing & Commissioning) at GC Berth sub-station.

- 1) 33kV, 1250A, VCB Panels (8 Panel).
- 2) 1 No. 33/3.3 kV, 6MVA Oil type Transformer.
- 3) 3.3kV, 1250A, VCB Panels (2 Panel).
- 4) 33kV (E) XLPE, 3C x 120 Sq.mm., Screened, Aluminium, armoured cables along with heat shrinkable cable end terminations. (From newly supplied 33kV VCB Panel to newly supplied 33/3.3kV, 6MVA transformer as mentioned above (2 Run of 3C x 120 Sq.mm.).
- 5) 3.3kV (UE) XLPE, 1C X 1000 Sq.mm., Screened, Aluminium, armoured cables along with heat shrinkable cable end terminations.(From newly supplied 3.3kV VCB Panel to newly supplied 33/3.3kV, 6MVA transformer as mentioned above (4 Run of 1C x 1000 Sq.mm.).
- 6) 30V Battery Bank and battery chargers for Control supply of HT Panel.
- 7) Earthing of all equipments.

(d) Civil Works

- 1) Design & Construction of **RCC Cable trench** from 33kV Gang isolator at Intake sub-station to out going cable trench with in sub-station premises. Design drawing shall be submitted before commencement of construction for approval.
- 2) Design & Construction of **PCC foundation for Rail pole structures for ACSR Dog conductor line**. Design drawing shall be submitted before commencement of construction for approval.
- 3) Design & Construction of **RCC Foundation** for PCVCB, Isolators, PTs and CTs at Intake sub-station.
- 4) Design & Construction of **RCC Foundation** for 6MVA transformer at GC Berth sub-station

(e) Salient Points.

- a. Equipment installation layout shall be submitted by the contractor before erection of equipment at site after approval by HDC, KoPT. Contractor shall arrange for all necessary means to erection / installation equipments as per manufacturer's guidelines.
- b. Laying of cables, cable end termination and straight through joints with the cables are to be executed by a Cable Jointer (having valid Electrical Workman's Permit, authorised for 33,000 Volts grade Cable laying

and jointing, by the competent authority), under continuous supervision of the Contractor's Engineers/ Supervisors, holding certificate of competency.

- c. **Obtaining necessary clearance/permission for Road Crossing/ Railway Track Line Crossing/Utility crossing need to be obtained from National Highway Authority of India (NHAI)/Haldia Development Authority (HDA)/ South Eastern Railway (SER)/ Indian Oil Corporation Ltd. (IOC Ltd.) is in the scope of the contractor.**

However, clearance for Road Crossing/ Railway Track Line crossing under the jurisdiction of HDC, KoPT would be given by competent authority of HDC.

- d. Programme for Road Crossing, Railway Track Line Crossing wherever required (for Casing Pipe laying etc.), shall have to be coordinated
- Through the authorized representative of the South Eastern Railway (SER)/ National Highway Authority of India (NHAI)/Haldia Development Authority(HDA) in advance, for having due clearance of blockage of Road/ Rail [for non Port Railway Track/ Road]
 - Through the authorized representative of the General Manager (Engg), HDC in advance, for having due clearance of blockage of Road/ Rail. Such clearance will be given within 7 (seven) days from the date of receipt of request from the contractor.

In case of Road Crossing, 50 % of the road width should be kept open for vehicular traffic movement. All roads so cut for the work, should be made good immediately after the purpose of road cutting is fulfilled.

- e. During execution of the work, if any damage takes place in the existing utility, the same will have to be mended good by the contractor, at their risk, cost and arrangement. Otherwise, the same will be repaired/ replaced by HDC, either departmentally or through outside agency and the cost of repairing/ replacement will be recovered from the contractor, with departmental charges.
- f. The lengths of Reinforced Concrete Pipes, Galvanised Mild Steel Tubes, lengths of cable run through existing duct/ trench/ tunnel/ laid pipe/ installed cable tray inside the existing tunnel etc., as given in the Bill of Quantities are indicative only. The contractor shall have to ascertain the exact quantity and execute the work accordingly.
- g. For the purpose of application (by HDC, KoPT) for obtaining necessary approval/ clearance from the Regional Inspectorial Organization, Central Electricity Authority / Statutory Authority, the contractor would have to submit/ deposit required documents, drawings, test certificates/ reports etc. to HDC, KoPT. The contractor along with the required documents, drawings, test certificates/ reports etc. would also have to be present during inspection by the Regional Inspectorial Organization, Central Electricity Authority / Statutory Authority.
- h. The contractor should clearly understand that though the application would be made by HDC, KoPT to the Regional Inspectorial Organization, Central Electricity Authority / Statutory Authority, for obtaining necessary approval/ clearance from them, it is the responsibility of the contractor concerned to obtain the approval/ clearance from the Regional Inspectorial Organization, Central Electricity Authority / Statutory Authority against the work executed by the contractor.

3.0 INTAKE SUB-STATION.

Scope of the contractor is to design, supply, erect, test and commission all switchgears in the existing 33kV bay of Intake sub-station of HDC, KoPT.

Existing Isolator No.1/15 in 33kV Bay shall be utilised for bus changeover.

A tentative equipment layout of station is enclosed for reference.

3.1 33kV Porcelain Clad Vacuum Circuit Breaker

A TYPE

- i. Outdoor type Vacuum Circuit Breaker suitable for installation in open yard and in heavily polluted environment.
- ii. Three identical single pole units linked together for simultaneous operation, complete with supporting frames and tie-rods.
- iii. Capable of interrupting small inductive currents caused by switching of unloaded transformers and low capacitive current without causing undue over-voltage.
- iv. The circuit breaker is to be supplied complete with its control and relay panel.

B OUTDOOR APPLICATION:

Vacuum circuit breaker for outdoor application shall be fixed type of construction and the vacuum interrupter units together with the HV connections shall be enclosed in a sealed housing (preferably of porcelain) conforming to IP- 65 protection (IS: 2147). The operating mechanism, links, etc. shall be housed in a suitable cubicle and should be accessible for maintenance. The indicators and operating handle etc. shall be provided on the front side with a hinged door and locking device. The door shall open upwards (with hinge at the top) for protection against rain (when in open position).

C TECHNICAL PARTICULARS:

| Item Description | Technical Particulars |
|---|--|
| Standards | IEC 56 –1 through 6, 1987 |
| Nominal system voltage | 33kV |
| Highest system voltage | 36kV |
| BIL | 170kVp |
| Power Frequency withstand voltage | 70 kV rms |
| Rated frequency | 50Hz |
| Rated continuous current | 800A |
| Closing mechanism | Electrical spring charging With 230 V AC motor and local manual closing. |
| a. Closing coil/tripping coil (2 nos.) b. No. of Poles | 30V D.C. 3 |
| Short time current rating (3 secs) | 31.5kA |
| Symmetrical short circuit withstand capacity | 78.75kA |
| Capacitive current break capability | Shall be suitable for breaking capacitive current equivalent to rated current. |
| Temperature rise | Not to exceed 55°C above ambient temp. of 50°C. |
| Operating duty | 0-3 min. CO-3 min.-CO |
| Dead time of breaker | Adjustable from 0.3 sec. to 15 sec. |
| Total break time for any current up to the rated breaking current measured from the instant of trip coil energisation | Less than 3 cycles |
| First pole to clear factor | 1.3 |
| Whether breaker is intended for rapid re – closing | Yes |
| Latching requiremnt | Trip free |
| System neutral | Solidly earthed |
| Min. creeping distance | 25mm/kV |

| | |
|---|-------------------------|
| Control supply voltage | 30V D.C. |
| Auxiliary, contacts with each circuit breaker | 6NO+6NC |
| Accessories | Interchangeable at site |
| Type tests for performance verification | As per standards |

D Bushings

- Equalized electrical stress internally and over the bushings surface.
- Free from radio interference.
- Provision for operation over normal operating temperature range.
- Leak – proof magnetic indicator at the top of the bushing to indicate oil level at all times.
- Bushing with combination potential and power transformer test cap.

E Operating Mechanism

- Electrically / Manually operated mechanism. Breaker shall be provided with trip free mechanism.
- It shall be suitable for remote control from the control room.
 - The operating mechanism shall be of spring charging type by electrical control under normal conditions. The mechanism shall be trip free electrically and mechanically.
 - The motor for spring charging shall be suitable for operation on 230 V AC supply and shall have overload protection.
 - A local control switch with locking arrangement shall be provided for each breaker for local operating i.e. tripping and closing during maintenance, test etc.
 - Trip/Normal/Close control switch shall be at remote & ON – OFF push button & Local/Remote selector switch shall be provided to be in mechanism cabinet.
 - Interlocking shall be provided so as to prevent operation of breaker from remote position with selector switch in local position.
 - Also facilities for remote indication of breaker “Open / Closed” position shall be visible in control room.
 - Each breaker shall have ON / OFF indication lamps along with a mechanical “Open / Closed” position indicator visible to operating personnel standing in front of cubicle with the mechanism cabinet closed.
 - An operation counter for each breaker shall be provided.
 - Provision of connecting oscillograph recorder to measure the operation timings of the breaker.
 - Provision of anti – pumping relay to prevent repetitive operations of breaker due to high-speed operation on release of the control switch.
 - Two nos. of trip and one no. of close coils.
 - Cabinet for operating mechanism and its accessories shall be as of IP – 55 protection with padlocking facility. Cabinet shall be simplex type, all equipment mounted on front side and wiring on back in proper wire ways.
 - Panel illumination and anti-condensation heater shall be provided in the local and remote control panel with load break fuse switch and thermostat. It shall house relays for control & interlocking as per scheme requirement. Panel illumination shall be provided with door switch.
 - Closing circuit to operate satisfactorily from 70% to 110% of the rated control voltage and tripping from 50% to 110% of the rated voltage.

F INTERLOCKS:

Opening or closing of the isolator / disconnecting switch shall be prevented when the breaker is in closed position.

G TERMINAL CONNECTIONS:

- Shall be suitable for 2.5” aluminium tube.
- Shall be suitable for terminal earth connector for earthing connections.

3.2 Indoor Control & Relay Panel :

Control and Relay Panel (associated with outdoor type 33 kV Circuit Breaker, as at Clause No.5.5.1),

should be of Floor Mounted, Indoor, Free Standing, Cubical type. The Panel should consist of **fabricated Sheet Steel Enclosures** [duly painted (both inside and outside)] on the side, front, rear and top. The rear of the Panel should be in the form of lockable hinged flap door. The front of the Panel, which accommodates most of the mountings, should be fabricated with Sheet Steel of thickness not less than 3 mm. For the rest of the Panel, Sheet Steel of thickness not less than 2.5 mm. should be used.

The Panel should have adequate size and should be completed with wiring, earthing bar, fuses, links, vermin proof fitments, internal panel lighting arrangement (operated by a door switch), space heater, un-drilled Cable Gland Plate, etc. The Panel should be provided with facility for Remote Switching of the 33 kV Outdoor type Vacuum Circuit Breaker and should accommodate the followings :-

a) **Relays :**

- i. **I.D.M.T. type**, Numerical relay having **Over Current & Earth Fault** element (element of 5A), with **instantaneous** unit, shall have event logging features & shall be compatible with SCADA system
- ii. **Electro-** magnetic Type, master trip relay, supply voltage 30V DC.
- iii. Electro- magnetic Type, Trip circuit supervision relay.

The Relays should have necessary arrangement for re-setting the Trip Indication from outside of the Relay Cover.

- b) **Digital Display type Load Manager.**
- c) **Analogue type Voltmeter with Selector Switch**
- d) **Static TRIVECTOR Meter (for measuring Static kWH, Maximum Demand, Frequency, PF, kVAH. kVRH etc.)**
- e) **Static Power Factor Meter**
- f) **Necessary Indication Lamps (LED Type) & Push Buttons**
- g) **Any other equipments considered necessary to make the Panel complete in all respect.**

All the above equipments including Relays, Indicating Instruments, etc. should be flush mounted and to be provided on the front side of the Panel.

Mimic Diagram and **Symbols** showing the exact representation of the system complete with **Symbols & Colour Strips** to represent the Buses, etc. should be provided in the front of the Control Panel.

A Load Manager & Voltmeter:

The Load Manager should be of **digital type** and provided with direct reading scale. Accuracy class of Load Manager shall be Class-1.

Voltmeter shall be analogue type with selector switch. The maximum scale value of the Voltmeter should be 50% in excess of the Primary Voltage of the associated Potential Transformers. The rated voltage of the Voltmeter shall be 110 V AC, Accuracy Class 0.5 as per IS: 1248.

B Static TRIVECTOR Meter:

The Technical Specification of the Static **TRIVECTOR** Meter should be complied with IS: 14697

and following features:-

- Class of Accuracy : 1.0
- Frequency : 50 Hz. \pm 5%
- Supply Voltage : 3 Phase, 3 Wire, 110 V
- Display Panel: Back-lit LCD type

C Indication Lamp:

Indicating Lamp should be of LED type suitable for Panel Mounting with rear terminal connections. Lamp Covers should be of screwed type and translucent to defused light. The Lamp Covers should be coloured as:

“Red” for indicating **closed position** of the Breakers.

“Green” for indicating **opened position** of the Breakers.

D Selector Switches:

4 positions (3 way and off) should be provided for Voltmeter.

Two sets of Instruction Manuals for Erection, Operation & Maintenance and two sets of Drawings for Equipment Details should be submitted along with the above Control & Relay Panel.

3.3 Current Transformers

A Type:

- 33kV outdoor suitable for installation in open yard where no protection against sun, rain and inclement atmospheric conditions exist.
- Oil immersed, nitrogen topped, hermetically sealed type, self-cooled.
- Suitable for service in industrial environment.

B Secondary Circuit:

- Knee point voltage, burden, accuracy class shall be decided during detail engineering.
- Change in CT ratio shall be independent of primary circuit.
- All transformer leads from the multi – ratio current transformers to be carried in a single conduit to terminal blocks in the mechanisms housing for convenience in changing ratios.

C Technical Particulars:

| Item Description | Technical Particulars |
|---|------------------------------|
| Standards | Relevant IS / IEC standards. |
| Nominal system voltage | 33kV |
| Highest system voltage | 36kV |
| BIL | 170kVp |
| Power Frequency withstand voltage | 70 kV rms |
| Rated frequency | 50Hz |
| System neutral connection | Solidly earthed |
| Rated continuous current | 150/5/5/5. |
| Short time current rating (3 secs) | 31.5kA |
| Symmetrical short circuit withstand capacity | 78.75kA |
| Class of insulation | B |
| Temperature Rise: | |
| - Oil top housing (measured by thermometer) | 40°C |
| - Winding (measured by resistance method) | 50°C |
| - oil level guage and pressure relief devices to be | Yes |

| | |
|--|------------------------------------|
| provided for all CTs | |
| Mounting on steel structure | On steel structure |
| Creepage distance Total | 25mm/kV |
| Protected | 50% of the total creepage distance |
| Accuracy Class Class – 0.5 Class – 5P20 & PS | Metering Protection |

3.4 Voltage Transformers**A Type:**

- 33kV outdoor suitable for installation in open yard where no protection against sun, rain and inclement atmospheric conditions exist.
- Oil immersed, nitrogen topped, hermetically sealed type, self-cooled.
- Suitable for service in industrial environment.
- Single phase PT.

Secondary Circuit:

- Burden, accuracy class shall be decided during detail engineering.

B Technical Particulars:

| Item Description | Technical Particulars |
|---|------------------------------------|
| Standards | Relevant IS / IEC standards. |
| Nominal system voltage | 33kV |
| Highest system voltage | 36kV |
| BIL | 170kVp |
| Power Frequency withstand voltage | 70 kV rms |
| Rated frequency | 50Hz |
| System neutral connection | Solidly earthed |
| Ratio | $33000/\sqrt{3} / 110/\sqrt{3}$. |
| Short time current rating (3 secs) | 31.5kA |
| Symmetrical short circuit withstand capacity | 78.75kA |
| Class of insulation | B |
| Temperature Rise: - Oil top housing (measured by thermometer) - Winding (measured by resistance method) - oil level guage and pressure relief devices to be provided for all CTs | 40°C 50°C Yes |
| Mounting on steel structure | On steel structure |
| Creepage distance Total | 25mm/kV |
| Protected | 50% of the total creepage distance |
| Accuracy Class Class – 0.5 Burden | Metering 100VA |

3.5 LIGHTNING ARRESTORS**A Type**

- Station class, 10 kA, heavy duty, non-linear resistance, metal oxide type gapless lightning arrester for 33 kV system.
- Self-supporting type in single pole assembly for line to earth connection.

- Suitable for pedestal mounting, outdoor installation in open yard.
- Shall be designed to provide maximum protection against overvoltage during switching of capacitor banks, unloaded transformers and reactors and lightning and switching surges.
- Las shall be capable of discharging severe switching and lightning surges.
- The installation shall be complete with line and earth side connections, operation counter, leakage current indicator and other accessories and devices including guiding rings for improving voltage distribution.

B Constructional Features

The arrestors shall be hermetically sealed type of self-supporting construction and shall be suitable for mounting on concrete or steel structures. They shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes.

- The lightning arrestors shall be fitted with pressure relief devices and arc diverting ports suitable for preventing shattering of porcelain housing and providing path for the flow of rated fault current in the event of an failure.
- Arrestors shall incorporate anti – contamination feature to prevent arrestor failure consequent to uneven voltage distribution across the stack, in the event of contamination of the porcelain.
- Seals shall be provided in such a way that these are always effectively maintained even when discharging the maximum lightning current.
- The end fittings shall be made of non – magnetic and corrosion proof material.

C Fittings & Accessories

- Arrestors shall be complete with insulating bases having provision for bolting to flat surface of structure.
- Self-contained discharge counters, suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation, shall be provided for each single pole unit. The cyclometer counters shall be visible through inspection window. The counter terminals shall be robust and of adequate size and shall be so located that incoming & outgoing connections are made minimum possible bends.
- Discharge counters shall be suitable to be mounted on support structure of the arrestors.
- The connecting conductor from LA earth terminal to discharge counter incoming terminal shall be insulated for a minimum of 4kV.
- Grading corona rings shall be provided on each complete arrestor unit as required for proper stress distribution.

D Technical Particulars:-

| Item Description | Technical Particulars |
|--|-----------------------------|
| Standards | Relevant IS / IEC standards |
| Type | ZnO, Gapless |
| Nominal system voltage | 33kV |
| Highest system voltage | 36kV |
| BIL | 170kVp |
| Power Frequency withstand voltage | 70 kV rms |
| Rated frequency | 50Hz |
| Rated Arrestor voltage | 30kV |
| Continuous operating voltage (rms) | 24kV |
| System neutral connection | Solidly earthed |
| Front of wave spark over voltage | |
| a) Max. spark over voltage. | 150kV peak |
| b) Virtual steepness of front rate of rise | 300kV/micro – sec. |
| Maximum discharge capacity (4/20 micro – second wave) | 100 kA peak |
| Nominal discharge current for 8/20 micro sec. | 10kA peak |
| Long duration discharge class as per IEC-99-4 | 3 |
| Maximum residual voltage at nominal (peak) discharge current of 10/20 micro sec wave | 100 kVP |

| | |
|---|---|
| Maximum steep current impulse (1/20 micro sec.) residual voltage at nominal discharge current | 110 kV (peak) |
| Thermal discharge capacity | Shall be adequate for switching surges, long duration surges and multiple strokes (shall be capable of withstanding internal pressure developed due to the above discharge without operation of pressure relief vents). |
| Creepage Distance (nominal) | Suitable for heavily polluted atmosphere 30 mm/kV of highest system voltage |

3.6 33kV Isolators / Disconnecting Switches

- **Application:**

These are to be used for:

- Breaker isolation/connection on no load
- Line connection/isolation/ on no load.

A **Type & Construction:**

- ❖ Triple pole gang operated suitable for outdoor installation in open yard under the specified site conditions.
- ❖ Two post type with contacts coming in horizontal plain preferred.
- ❖ Common actuating mechanism for all three poles.
- ❖ Manually operable.
- ❖ Interchangeable single pole units.
- ❖ Clearance between live parts and ground structures, shall be as per the relevant standards.
- ❖ Length of break in full open position shall be such that there is possibility of arc over from the live parts to the de – energized parts.
- ❖ Switchblades shall be of copper and of one solid piece construction.
- ❖ Inter-phase clearance shall be minimum 3 meters and minimum-mounting height shall not be less than 3 meters.
- ❖ Speed of operation during opening or closing shall ensure minimum arcing.
- ❖ 33 kV isolator shall be horizontal double break type mounted on structure.

B **Making & Interrupting Capability**

Disconnecting blades shall be capable of carrying rated current continuously as well as specified short circuit current for the duration indicated without causing mechanical damage to any part under maximum temperature rise without damaging the insulation.

The switches shall be capable of making on to faults specified and withstanding the dynamic stresses involved.

Shall also be suitable for interrupting small inductive and capacitive currents such as those, which occur while disconnecting lines at no – load, bus transfer current or voltage transformers under energized condition.

C **Contacts:**

- High-pressure self-aligning adjustable type.
- Contact pressure shall be released before any movement of the blades in the opening direction takes place and shall be applied after the closing travel is completed.
- Contacts shall be of high-grade high conductivity heat resisting copper and silver-plated.
- Sufficient wiping action to make contacts self cleaning.
- Temperature rise of contacts shall not exceed 55°C over the ambient temperature of 50°C.

D Operating Mechanism:

- a) Operating mechanism and its controls shall be so designed that under no circumstances the travel of the switchblades is interrupted before it reaches the fully closed or open position.
- b) Provision for padlocking the mechanisms in either the open or closed position shall be provided.

E Interlocks

To be interlocked with associated isolators and circuit breakers through castle key and electrical interlock arrangement.

F Terminal Connections

Shall be provided with high conductivity terminal connecting suitable for tubular / ACSR conductors.

G Technical Particulars

| Item Description | Technical Particulars |
|--|--|
| Standards | Relevant IEC / IS / BIS standards |
| Nominal system voltage | 33kV |
| Highest system voltage | 36kV |
| BIL | 170kVp |
| Power Frequency withstand voltage | 70 kV rms |
| Between poles to earth across Isolating distance | 195 kV |
| Rated frequency | 50Hz |
| Type | Outdoor station type, double break, triple pole double throw with turn and twist mechanism. Off load, horizontal rotating, with earth switch. |
| Rated continuous current | 800A |
| Short time current rating (3 secs) | 31.5kA |
| Symmetrical short circuit withstand capacity | 78.75kA |
| Minimum creep age distance | 25mm/kV |
| Operating mechanism | Gang operated, manual. |
| Termination | ACSR conductor / 2.5" Al. tubular bus on both sides |
| Auxiliary contacts | 6 NO + 6 NC for isolator 6 NO + 6 NC for earth switch |
| Installation | Outdoor or Pole structure with Padlocking facility |
| Castel key interlock | With 33kV CB. |
| Hardware | Hardware for isolator mounting and mechanical operation shall be hot dip galvanized. |
| Electrical interlock | i. With upstream circuit breaker / isolator. |
| Control voltage | 30V D.C. |
| Spares required | One insulator column. |
| Temperature rise above 50°C | Not to exceed 55°C above ambient temp. of 50°C. |
| Support Structure | Hot dip Galvanized |
| Arcing horns | To be provided |

| | |
|---|-------------|
| Creepage distance - insulator stack - mechanical forces withstand capacity (minimum) | >900 500 |
|---|-------------|

3.7 Busbars and Busbar Connections

A Bus Work

- The overhead bus bars shall be tubular type comprising tubular aluminium conductor. Aluminium tubes shall comprise of hard drawn aluminium with aluminium 61% IACS conductivity at 20 deg C.
- The temperature of tubular bus conductor shall not exceed 75 deg. C when carrying the specified full load current.
- The jointing sleeves shall be six times the nominal size of the tubes and inner diameter of the sleeve shall fit snugly in the main tube.
- The sizes of the conductors shall be adequate to carry the required continuous current and withstand the thermal and dynamic stresses due to the specified short circuit currents.
- The inside diameter shall have no positive tolerances and outside diameter shall have no negative tolerances.
- Provision shall be provided to take care of expansion & contraction of the bus bars.
- The bus bar system shall be supported with fully insulated supports and fastened as to withstand forces likely to develop by the specified short circuit currents.
- Necessary bus supports, jumpers, connectors, insulators, structural work and other hardware as required shall be supplied with the bus bars to make the installation complete in all respects.

B Technical Particulars:

| Item Description | Technical Particulars |
|--|----------------------------|
| Nominal system voltage | 33kV |
| Highest system voltage | 36kV |
| BIL | 170kVp |
| Power Frequency withstand voltage | 70 kV rms |
| Rated frequency | 50Hz |
| Short time current rating (3 secs) | 31.5kA |
| Symmetrical short circuit withstand capacity | 78.75kA |
| Bus conductor | 2.5" Al. tube |
| Minimum Clearances | |
| a) Between Phases | 915 mm |
| b) Between one phase and earth for rigid connection | 610 mm |
| c) Minimum height of any bus bar above ground level of platform where personnel may stand with the gear alive. | To meet site requirements. |

3.8 Insulators, Clamps & connectors

- Supporting insulators of circuit breakers, disconnecting switches and lighting arresters, bushing insulators for instrument transformers as well as all post type insulators & string insulator assemblies for supporting bus work shall be made of assemblies for supporting bus work shall be made of best quality porcelain and shall be brown glazed.
- Porcelain shall be homogeneous, free from any limitation, cavities, flaws and other imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.
- The glaze shall be uniform shade, smooth, hard and shall completely cover all exposed parts of insulators.
- All insulators shall be suitable for heavily polluted atmosphere and shall be able to withstand the duty requirements of the associated equipment.

- When operating at normal rated voltage, there shall be no electric discharge between the conductors and bushing, which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action.
- No radio interference shall be caused by the insulators / bushings when operating at the normal rated voltage.
- All iron parts shall be hot dip galvanized and all joints shall be air tight. The zinc used for galvanizing shall be grade Zn.99.5
- All current carrying contact surfaces shall be silver-plated. Silver plating shall not be less than 25microns in thickness.
- The strain insulators shall be of ball and socket type. The socket shall be of malleable cast iron and the pin shall be of steel.
- After machining is completed, the balls and sockets shall be hot dip galvanized.
- Ball and socket connections shall be provided with adequately strong retaining pins of locking devices of suitable material.
- Individual units of each string shall be identical and interchangeable and shall be suitable for forming either suspension or strain strings and shall be so designed as to prevent formation of any defect due to expansion or contraction in porcelain or metal fittings.
- Porcelain shall not engage directly with metal but shall be mounted with suitable non-deteriorating interposing material.
- Tension string assembly as mentioned below shall be supplied along with suitable turnbuckles at one turn buckle per string.

A Technical Particulars

Post insulators

| | | |
|--|---|---|
| • Standard | : | IS 2544 (1973) |
| • Rated voltage | : | 33kV |
| • Minimum creepage distance | : | |
| - Total (mm) | : | 25mm/kV |
| - Protected (mm) | : | 50% of the total creepage distance |
| • Rated voltage, kV (rms) | : | 33kV |
| • Impulse withstand voltage, kV (peak) | : | 170kV |
| • Power frequency withstand dry test, kV (rms) | : | 75kV (rms) |
| • Power frequency withstand wet test, kV (rms) | : | 75kV (rms) |
| • Power frequency withstand puncture test on units | : | 1.3 time the actual dry flash Over voltage of the unit) |
| • Visible discharge test, kV(rms) | : | 27kV |

Disc Insulators

| | | |
|--|---|------------------------------------|
| • Standard | : | IS 731 (1993) |
| • Type | : | Fog type insulator |
| • Minimum creepage distance | : | |
| - Total (mm) | : | 25mm/kV |
| - Protected (mm) | : | 50% of the total creepage distance |
| • Power frequency withstand Test voltage | : | |
| Dry (kV) | : | 75 kV (rms) |
| Wet (kV) | : | 75 kV (rms) |

- 1.2/50 micro sec. impulse flash over : 170kV(peak)
- Puncture voltage (kV) : 1.3 times the actual dry flash over voltage of the unit
- Visible discharge test kV(rms) : 27 kV

4.0 **33KV DOUBLE CIRCUIT ACSR CONDUCTOR OVERHEAD LINE.**

The codes and/or standards referred to in the specifications shall govern, in all cases wherever such references are made. In case of a conflict between such codes and/or standards and the specifications, latter shall govern. Such codes and/or standards, referred to shall mean the latest revisions, amendments/changes adopted and published by the relevant agencies unless otherwise indicated. Other internationally accepted standards which ensure equal or better performance than those specified shall also be accepted, subject to prior approval by the owner. In case no reference is given for any item in these Specifications, latest REC specification & Construction Standards shall be referred to.

The span should be as near as possible to the basic design span so that the minimum ground clearance should not less than 7.5 Mtrs. in cross country at maximum sag condition. In case of Rail/Road crossing same shall be 8.5 Mtrs. by reducing span length.

The stringing of the conductors and earth wire has been done as per the approved sag and tension charts and desired clearances as clearly available.

All other requirements for completion of works such as fixing of danger plate and anti-climbing device have been fulfilled.

The contractor shall provide & install “cradle type” protective guarding for 33 kV line, The guarding shall be provided at all the crossing i.e. road, telecommunication & power lines, railway line, nallaha etc.

The contractor is required to follow local statutory regulations stipulated in Electricity (Supply) Act 1948, Indian Electricity Rules 1956 as amended and other local rules and regulations referred in these specifications
Trimming of tree branches or cutting of a few trees en-route during survey is within the scope of survey to be done by the contractor.

During erection of the line, compensation for tree cutting, damage caused to crops, actual cutting and falling of the trees shall be arranged by the contractor at his cost. The contractor will identify the number of trees and detail of obstructions to be removed for erection of the line and intimate the employer well in advance in case of any help.

A) TECHNICAL SPECIFICATION FOR HARDWARE FITTINGS TO BE USED FOR 33KV DOUBLE CIRCUIT ACSR 100Sq.mm. CONDUCTOR LINE.

The Combined units shall conform to the provisions of Indian Standards relevant to each individual component except where specified otherwise The following I.S. amended up to date shall be the guideline for manufacture & testing.

| | | | |
|------|--|---|---|
| i) | IS 2486 (Part 1) : 1993 | : | Specification for metal fittings of insulators for overhead power lines with nominal voltage greater than 1000 V. |
| ii) | IS 2486 (Part 2) : 1989 IS : 2486 (Part III) – 1989 | : | Specification for Insulator fittings for overhead power lines with nominal voltage greater than 1000 V. |
| iii) | IS 4759 : 1996 | : | Specification for hot-dip zinc coatings on structural steel and other allied products. |
| iv) | IS : 6745 – 1872 | : | Determination of mass of zinc coating on zinc coated iron and steel articles. |
| v) | IS : 2633 – 1986 | : | Method for testing uniformity of coating on zinc coated. |
| vi) | IS:1573 – 1986 | : | Specification for electroplated coatings of zinc on iron and steel. |

General Requirements.:

- i) Ball diameter should be 16 mm.
- ii) Hardware Fittings with ultimate tensile strength of 70KN should be used for ASCR Dog conductors.
- iii) The Fittings shall be free from defects, corrosion protected and shall meet the requirements of) Galvanizing Test etc as per IS.
- iv) All forging and casting shall be of good finish and free from flaws and other defects. The edges of the fittings such as the tongue, clevis and holes shall be rounded.
- v) All parts of different fittings which provide the interconnection shall be made such that sufficient clearance is provided at the connection point to ensure free movement. All tongue and clevis connection shall be free in this manner but care shall be taken that too much clearance for the tongue & clevis is avoided.
- vi) Spring washer should be electro galvanized- Coating thickness as per IS: 1573-1986.

U bolt, Hexagonal Bolt, Nut, Plain Washer and all other ferrous parts shall be Hot dip Galvanized. In case of Hot Dip Galvanization, minimum Value of Mass of zinc coating should be 610 g/m².

The split pin to be used on the cotter pin shall be of Humpback type & shall be made of Stainless Steel conforming to IS: 5522-1992 with a minimum hardness of 160 HV.

Locking devices (R Type) for ball and socket lockers shall be of Stainless Steel conforming to IS: 6603-1972 with minimum hardness of 160 HV. The dimension shall conform to IS: 2486 (Part 3)-1974.

Tongue and Clevis:

All forgings shall be of good finish and free from any flaws and any other defects which may cause decrement of efficiency while in operation. Connection/attachment with other component of the unit shall provide reasonable clearance/ensure free movement at the connecting/attaching point. **Care should be taken to avoid too much clearance while used with insulators.**

Drg. Enclosed for reference.

Cross-arm Straps:

Cross-arm straps shall be manufactured from MS Flat hot dip galvanized and to connect the cross-arm/bracket of the structure at one end and the Ball Clevis at the other end. It should be complete with hexagonal bolts, nuts, spring washers and Cotter pin at the threaded end to lock the unit. Minimum Threaded portion of the bolt shall be 30mm. CROSS-ARM STRAPS to be used for Minimum Ultimate strength (Tensile strength) ACSR Dog Conductor 70 KN Dimensions shall be in accordance with IS: 2486 (Part-2) unless otherwise specified. Drg. Enclosed for reference.

Ball and Clevis & Socket and Tongue:

All forgings shall be of good finish and free from any flaws and any other defects which may cause decrement of efficiency while in operation. Connection/attachment with other component of the unit shall provide reasonable clearance/ensure free movement at the connecting/attaching point. Care should be taken to avoid too much clearance while used with insulators. Materials for Ball Clevis & Socket Tongue should be as stated below:-

Ball clevis – Forged Steel and hot dipped galvanised.

Socket Tongue – Forged Steel and hot dipped galvanised.

BALL CLEVIS & SOCKET TONGUE to be used for Minimum Ultimate strength (Tensile strength) of 70 KN.

All dimensions of Ball Clevis & Socket Tongue shall be in accordance with IS:2486 (Part-2) unless otherwise specified.

Drg. Enclosed for reference.

Bolted type Tension Clamp:

All forgings & castings shall be of good finish and free from flaws or any other defects which may cause decrement of efficiency while in operation. The edges on the outside of the fittings and the grooves shall be smooth & rounded. Sharp radius of curvature, ridges etc. which may lead to localised pressure or cause damage to the conductors in service shall

be avoided. The clamp shall permit the conductor to slip before the failure of conductor occurs. Tension clamps for ACSR Dog conductor shall be three bolted type with minimum one no. keeper. Ultimate tensile strength of Tension clamps should not be less than 70 KN. The materials for Tension clamps & keeper should be high strength Aluminium Alloy.

The slip strength should not be less than 95% UTS of the respective conductor. Tension clamps shall be fitted with rivet, flat washer, cotter pin, 'U' bolts & nuts, flat washers & spring washers.
Drg. Enclosed for reference.

Suspension Clamp:

All forgings & castings shall be of good finish and free from flaws or any other defects which may cause decrement of efficiency while in operation. The edges on the outside of the fittings and the grooves shall be smooth & rounded. Sharp radius of curvature, ridges etc. which may lead to localised pressure or cause damage to the conductors in service shall be avoided. The clamp shall permit the conductor to slip before the failure of conductor occurs. Envelope type, Suspension clamps for ACSR Dog conductor shall be minimum two bolted type, with minimum one no. keeper.

Suspension clamps shall have minimum failing load of 70 kN. The material for suspension clamps & keeper should be high strength Aluminium Alloy. The suspension clamp shall have slip strength not exceeding 20% of conductor rated strength. The conductor shall not slip at loads less than 12.5% of rated strength of conductor.

As per enclosed drg

Parallel Groove Clamp:

The fittings used on the overhead conductors for electrical continuity which are not subjected to tension are classified as non-tension joints. Such fittings include parallel groove clamps.

Non-tension joints shall be designed so that they meet the requirements of the normal service conditions. A rated current shall be assigned to every joint. Fittings intended to connect conductors of two dissimilar materials shall be so designed that harmful bimetallic corrosion when erected in exposed atmospheric condition is minimised.

Fittings for non-tension joints shall be manufactured and finished so as to avoid sharp radius of curvature, ridges which may lead to the localised pressure or damage to the conductor in service.

Non-tension joints are made of Aluminium alloy. Three bolted design, suitable for conductor size 100mm². Drg. enclosed for reference.

Inspection

The following tests shall be carried out by TPI /representative of General Manager (Engg) before acceptance of any materials at site.

1. Visual check.
2. Verification of dimensions.

Test reports to be submitted:

1. Galvanizing test report as per the relevant IS shall be submitted.
2. Dimension checking will be carried out on 1% of the offered lot up to a maximum of 5 nos.
3. Routine Tests certificate shall be submitted according to IS: 2486 (Part-I).

Tolerance:

Tolerance shall be as per IS: 2486 (Part-I).

B) TECHNICAL SPECIFICATION FOR 33KV PIN INSULATOR

The pin shall be a single piece obtained preferably by the process of forging. They shall not be made by joining, welding, shrink-fitting or any other process from more than one piece of material. They shall be of good finish, free

from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided and the collar or the seating surface shall bed down correctly on to the cross arm when fixed to that through a hole and the diameter of which is 2 mm. greater than the diameter of the shank.

All parts of metal fittings for insulator shall be inherently resistant to the atmosphere, corrosion or be suitably protected against corrosion, both during storage and in service. All ferrous metal parts except those made of stainless steel/nuts shall be protected by hot dip galvanizing.

The pins shall be complete with spring washers and hexagonal nuts.

| 33 KV G.I. PIN | | | |
|----------------|----------------------|---|--|
| 1. | Minimum total weight | : | 3000 gm. |
| 2. | Minimum failing load | : | 10 KN |
| 3. | Stalk diameter | : | a) Just below head: 27 mm b) Near Collar : 44 mm. |
| 4. | Stalk length | : | 300 mm. |
| 5. | Shank length | : | 150 mm. (with 100mm. thread) |
| 6. | Collar diameter | : | 67 mm. |
| 7. | Shank diameter | : | 24 mm. |
| 8. | Collar thickness | : | 6 mm. |

Technical Particulars:-

| Environment | | Moderately Polluted atmospheres | heavily polluted atmospheres |
|-------------|---|---------------------------------|------------------------------|
| 1. | Nominal system Voltage | 33 KV | 33 KV |
| 2. | Highest system Voltage | 36 KV | 36 KV |
| 3. | Minimum Specific Creepage Distance | 580 mm | 840 mm |
| 4. | Minimum failing load | 10 KN | 10 KN |
| 5. | P.F Visible Discharge Voltage | 27 KVrms | 27 KVrms |
| 6. | P.F Minimum flash over voltage | | |
| | a) Dry | 130KVrms | 130KVrms |
| | b) Wet | 90KVrms | 90KVrms |
| 7. | Impulse flashover voltage 1.2/50 micro second wave : | | |
| | a)Positive | 210KVp | 210KVp |
| | b)Negative | 230KVp | 230KVp |
| 8. | P.F. Withstand Voltage : | | |
| | a)Dry | 95KVrms | 95KVrms |
| | b)Wet | 75KVrms | 75KVrms |
| 9. | Impulse withstand voltage 1.2/50 micro second wave : | | |
| | a) Positive | 170KVp | 170KVp |
| | b) Negative | 180 KVp | 180 KVp |
| 10. | Power Frequency puncture withstand voltage | 180KVrms | 180KVrms |

Inspection

The following tests will be carried out by TPI /representative of Engineer-in-charge before acceptance of any materials at site.

1. Dimension checking carried out on 1% of the offered lot up to a maximum of 5 nos.
2. Visual Check.

Test reports to be submitted:

1. Galvanizing test report as per the relevant IS shall be submitted
2. Dimension checking will be carried out on 1% of the offered lot up to a maximum of 5 nos.
3. Routine Tests certificate shall be submitted according to IS: 2486 (Part-I).

Tolerance:

Tolerance shall be as per IS: 2486 (Part-I).

C) TECHNICAL SPECIFICATION FOR 33 KV POST INSULATORS & DISC INSULATORS

The Insulators covered by this specification should conform to the latest editions of Indian Standard Specification IS: 731, IS: 2544 and IS: 5350 or any other authoritative standard.

The Porcelain shall be sound, free from defect, thoroughly vitrified and smoothly glazed. The Insulators shall be brown in colour. The glaze shall cover all the Porcelain parts of the Insulators except those areas which Serve as support during fixing or left un-glaze for the purpose of assembly.

Cement used in construction of insulators shall not cause fracture by expansion or loosening by construction and propose care must be taken in "Curing". The cement used shall not give rise to Chemical Reaction with the metal Fittings and its thickness shall be uniform as possible.

33KV POST INSULATORS:

- i) The Post Insulator shall be sound, free from defects, thoroughly verified, smoothly glazed and type of Post Insulator shall be stack type. The glaze shall be brown in colour. The glaze shall cover the exposed Porcelain parts of the Insulator.
- ii) The Post Insulator shall be designed and manufactured to avoid stresses due to expansion and contraction which may lead to deterioration, stress concentration due to direct engagement of Porcelain with metal fittings and shapes which do not facilitate cleaning by normal methods.
- iii) Cement used in the construction of post insulator shall not cause fracture by expansion or loosening by contraction and shall not give rise to chemical reaction with the metal fittings and its thickness shall be uniform.
- iv) All ferrous metal parts except those of stainless steel shall be hot dip galvanised and uniform zinc coating shall satisfy the requirement of IS:2633. The parts shall be galvanised after machining and the galvanised surface shall be smooth.
- v) The tapped holes suitable for bolts with threads shall have anti-corrosion protection. The effective length of the thread shall not be less than the nominal diameter of the Bolt.
- vi) The electrical and mechanical characteristics of Post Insulator shall conform to the specific technical parameters of this specification.
- vii) Post Insulator shall be suitable for upright mounting on steel structures & the Cap & Pedestal of Post Insulators shall be of Malleable Cast Iron. Diameter of Cap & Base will be 108 mm.

DISC INSULATORS:

- i) The Insulator discs shall be Cap and Ball Pin type with Ball and Socket coupling suitable for use in suspension or tension strings.

- ii) The porcelain shall be brown colour, non porous having high dielectric mechanical and thermal strength, free from internal stresses, blisters, laminations, voids, foreign matters, imperfections or other defects, which might in any way render it unsuitable as insulator shells. Porcelain shall be smoothly glazed to remain unaffected by climatic condition, ozone, acids, alkalis, zinc or dust. The glaze shall have bright luster, smooth surface, a good performance under extreme weather condition of tropical climate and dust resistant. The glaze shall not crack or chip due to aging under normal service condition or while handling during transit or erection.
- iii) Cement used in the construction of Insulators shall not cause fracture by expansion or loosening by contraction and must have high compressive and shearing strength and be free from change in volume due to aging and temperature change. The cement shall not give rise to chemical reaction with metal fittings. Rapid hardening cement with special sand shall be used for assembly of metal parts.
- iv) The Caps and Ball Pins of Disc Insulator shall be hot dip galvanised and mechanically strong. The Ball Pins shall move freely in the Cap Socket, but shall be so designed that they do not disengage while in service. The Caps shall be made of heat treated malleable cast iron. These shall be free from cracks, shrinks, air holes, burrs and rough edges. All load bearing surfaces shall be smooth and uniform so as to distribute loading stress evenly
- v) The Ball Pins shall be of forged steel and so designed that they will not yield or distract under loaded conditions. The ball and socket insulators shall be provided with „R“ /“W“ clip to prevent uncoupling of insulator units from each other. The „R“ /“W“ clip shall be made of phosphor bronze or stainless steel to safe guard against corrosion.

The electrical and mechanical characteristics of the Disc. Insulator shall conform to IS: 2544.

Note:

The disc insulators shall be of Ball & Socket type.

The cap of disc insulators shall be of Malleable Cast Iron whereas the ball pins shall be of Forged steel.

All metal parts shall be of Hot dip galvanized as per IS: 2633.

Technical Particulars:-

| Sl. No. | Description | Rating | |
|-------------|--|---|-----------|
| | | 11 KV (BALL & SOCKET TYPE – 70 KN) | |
| 1 | Nominal system voltage | : | 11 kV |
| 2 | Highest system voltage | : | 12 kV |
| 3 | Total Creepage distance | : | 320 mm |
| 4 | Spacing | : | 145mm |
| 5 | Minimum Failing Load | : | 70kN |
| 6 | P.F. visible discharge voltage | : | 9kV rms |
| 7 | P.F. Minimum flash over voltage | | |
| a) Dry | | : | 75 kV rms |
| b) Wet | | : | 45 kV rms |
| 8 | Impulse flashover voaltage 1.2/50 micro second wave : | | |
| a) Positive | | : | 115 kVp |
| b) Negative | | : | 120 kVp |
| 9 | P.F. withstand voltage | | |
| a) Dry | | : | 60 kV rms |
| b) Wet | | : | 35 kV rms |
| 10 | Impulse withstand voltage 1.2/50 micro second wave : | | |
| a) Positive | | : | 75 kVp |

| | | |
|-------------|---------------------------------|--|
| b) Negative | : | 80 kVp |
| 11 | P.F. puncture withstand voltage | : 1.3 times the actual dry flashover voltage of the unit |
| 12 | Ball pin, Socket & Security Cap | : As per IS |
| 13 | Nominal Dia of Ball | : 16 mm |
| 14 | Porcelain Diameter | : 255 mm |

Inspection

The following tests will be carried out by TPI /representative of Engineer before acceptance of any materials at site.

1. Dimension checking carried out on 1% of the offered lot up to a maximum of 5 nos.
2. Visual Check.

Test reports to be submitted:

1. Routine Tests certificate shall be submitted according to IS: 2486 (Part-I).
2. Verification of dimensions.
3. Temperature cycle test.
4. Mechanical strength test.
5. P.F. Puncture test.
6. Porosity test
7. Galvanizing test
8. Electromechanical failing load test. (for Disc. Insulator String only).

Tolerance:

Tolerance shall be as per IS: 2486 (Part-I).

D) TECHNICAL SPECIFICATION FOR G.I. EARTHING ROD

This specification covers the technical details of G.I. Earthing Rod complete with the necessary fittings.

1. The earthing rod should be 1853 mm (i.e. 25 + 1752 + 76) long fabricated from 20mm dia. M.S. Rod, the bottom of which is to be cut of the same rod in the shape of a cone – 76 mm long and the forged head made out of the same rod with 30 mm (dia)= 25 mm (height). The earthing arrangements should consist of G.I. Bolt/nut and washers. The earthing rod will be as per enclosed drg.
2. The raw materials, as required for manufacture, shall comply with the relevant latest Indian Standard with all amendments, additions and alternation, for obtaining the required strength.
3. The rod including the head portion should be smoothly and continuously hot dip galvanized as per relevant I.S.S. Other portion i.e. Bolts, nuts and washers should be hot dip galvanized.
4. No crack should develop and deformation in the top head and/or bending of rod should not be appreciable while the rods will be driven into the ground by the application of heavy intermittent block not less than 7.5 Kg. Hammer and in a manner as is usual for driving rods into the grounds.

Inspection

The following tests will be carried out by TPI /representative of Engineer before acceptance of any materials at site.

- B By hammering (8 times) the rods into the normal soil by a hammer (not less than 7.5 Kg) on 1% of the offered lot up to the maximum of 2 nos. No failure will be accepted.

Test reports to be submitted:

1. Galvanizing test report as per the relevant IS will be submitted.
2. Dimension checking will be carried out on 1% of the offered lot up to a maximum of 5 nos.

Tolerance:

½% on total length. (-) 5% on other dimensions.

(-) 10% 25 mm of small forged portion.

Any tolerance on the positive side will be accepted.

E) TECHNICAL SPECIFICATION FOR GALVANISED STAY SET:

This specification covers the details of the Galvanized stay set both in HT complete with stay rod, stay plate, Bow, Cross Head, Ratchet Nut and a Thimble

1. The sizes of stay rods are stated below, dimensions for other parts like bow plate etc. are not stated in details here and shall be as per enclosed drawing.

2. Length = 1830mm, Dia=20 mm, Length of the threaded portion=300mm.

The raw materials as required for manufacture shall comply with the relevant latest Indian Standard with all amendments, additions and alternation, for obtaining the required strength.

3. The complete 1830 mm long stay sets, should with stand minimum breaking loads of 7900 Kg.

4. The rods, cylindrical portion of the bow, plates, nuts and thimble shall be of steel to comply with the requirements as stated in class-2 of this specification.

5. The cross-head of the bow shall be made of sound, strong iron casting.

6. The rods shall be well forged and free from flaws and other defects and the heads shall not fail when the rods are tested to fracture at their full strength by tensile stress. Threads shall have square neck.

7. The sides of each bow shall be well riveted into the cross head and shall not come out from the cross head when the bow is tested to fracture by tensile stress.

8. The ratchet nuts and ratchet face of cross heads shall be well from to match each other.

9. The screw thread design of the stay rod and nut should be as follows:

M 16 x 2 -7H/8g for 16 mm dia. Stay rods and Y 20 x 2.5-7H/8g for 20 mm rod and the sizes of the threads should be as per IS: 4218 (Part-VI) 1967 (tables for coarse pitch series).The screw threads of rods and nuts shall be properly lubricates at the time of supply.

10. The stay plate shall be freely out off and punched and shall be free from cracks after punching.

11. The rods cross heads, bows, ratchet nuts, thimbles and plates shall be smoothly and continuously hot dip galvanized. The galvanizing shall be heavy. The screw threads of the rods, ratchets nuts shall be out after galvanizing. The nuts shall be well finished before galvanizing

12. The Thimbles shall be made from 2.64 mm (12 SWG) thick M.S. Fit. The size of the thimbles shall be follows:
Length- 70mm, Breadth-47mm, Width-20mm.

Inspection

The following tests will be carried out by TPI /representative of Engineer-in-chargebefore acceptance of any materials at site.

1. Dimensional check up on 1% of the offered lot up to a maximum of 10 nos.
2. Visual check.

Test reports to be submitted:

1. Galvanizing test report as per the relevant IS will be submitted.
2. Dimension checking will be carried out on 1% of the offered lot up to a maximum of 5 nos.
3. Tensile strength test for a breaking load on 1% of the offered lot up to a maximum of 5 nos.

Tolerance:

The following tolerance will be allowed in case of stay set.

- a) – 5% tolerance on individual portion except rod length.
- b) – ½ % tolerance on total length of the stay rod.

Any tolerance on positive side will be acceptable.

F) TECHNICAL SPECIFICATIONS FOR G.I STRANDED WIRES FOR STAY AND EARTHING (SHIELD WIRE).

- I. Application Standards The G.I Stay Stranded Wires shall comply with the specific requirements of IS: 2141- 1979. IS: 4826-1979 & IS: 6594-1974 or the latest versions thereof.
- II. Application and Sizes The G.I. stranded wires covered in this Specification are intended for use on the overhead power line poles, The G.I stranded wires shall be of 7/10SWG (7/3.15 mm) for stay supports and 7/12 SWG (7/2.5 mm) for earthing /shield wire.
- III. Materials The wires shall be drawn from steel made by the open hearth basic oxygen or electric furnace process. The individual wires shall be of uniform quality and have the properties and characteristics as specified in this specification. The wires shall not contain sulphur and phosphorus exceeding 0.060% each. Tensile Grade The wires shall be of tensile grade 4, having minimum tensile strength of 700 N/mm² conforming to IS:2141. General Requirements The outer wire of strands shall have a right hand lay. The lay length of wire strands shall be 12 to 18 times the strand diameter. Minimum Breaking Load The minimum breaking load of the wires before and after stranding shall be as follows:

| No. of Wires & Const. | Wire Dia (mm) | Min. breaking load of the Single wire before stranding (KN) | Min. breaking load of the standard wire (KN) |
|-----------------------|---------------|---|--|
| 7 (6/1) | 2.5 | 3.44 | 21.40 |
| 7 (6/1) | 3.15 | 5.46 | 34.00. |

- IV. Construction The galvanized stay wire shall be of 7-wire construction. The wires shall be so stranded together that when an evenly distributed pull is applied at the ends of completed strand, each wire shall take an equal share of the pull. Joints are permitted in the individual wires during stranding but such joints shall not be less than 15 meters apart in the finished strands. The wire shall be circular and free from scale, irregularities, imperfection, flaws, splits and other defects.
- V. Tolerances A tolerance of (+) 2.5% on the diameter of wires before stranding shall be permitted.
- VI. Sampling Criteria The sampling criteria shall be in accordance with IS: 2141.

Tests on Completed Strand.

The completed strand shall be tested for the following tests in accordance with IS: 2141. Tensile and Elongation Test: The percentage elongation of the stranded wire shall not be less than 6%. Chemical analysis Galvanizing Test. The Zinc Coating shall conform to “Heavy Coating” as laid down in IS:4826

- VII. Marking Each coil shall carry a metallic tag, securely attached to the inner part of the coil bearing the following information:

- a) Manufacturers name or trade mark
- b) Lot number and coil number
- c) Size
- d) Construction
- e) Tensile Designation
- f) Lay
- g) Coating
- h) Length
- i) Mass
- j) ISI certification mark, if any

VIII. Packing- The wires shall be supplied in 75-100 Kg. coils. The packing should be done in accordance with the provisions of IS:6594

G) TECHNICAL SPECIFICATION FOR ACSR CONDUCTORS

The conductors shall comply with the Indian Standard Specification IS: 398 (Part I & II) of 1996 with latest amendments.

The material shall be of best quality and workmanship. The stranded steel re-enforced conductors shall be manufactured from hard-drawn aluminium wires and galvanized steel wires, which have the mechanical and electrical properties specified in enclosed drawings. The coating of the galvanized steel wires shall be applied by the hot process or electrolysis process in accordance with IS: 4826-1968 or latest amendment there of. The wires shall be smooth and free from all imperfections such as soils and splits.

The sizes of stranded steel re-enforced aluminium conductors shall be as per enclosed drg. Which also indicate the values of resistance and strengths etc.

The values of the final modulus of elasticity and Co-efficient of linear expansion for ACSR shall be as given hereunder.

| No. of Wires | Final Modulus of Elasticity GN/m ² (Practical) | Co-efficient of linear expansion/°C. |
|--------------|--|--------------------------------------|
| ACSR 6/1 | 79 | 19.1 x 10 ⁻⁶ |
| ACSR 6/7 | 75 | 19.8 x 10 ⁻⁶ |
| ACSR 30/7 | 80 | 17.8 x 10 ⁻⁶ |

JOINTS IN WIRES:

Aluminium Conductor Steel Re-enforced: No two joints shall occur in the aluminium wires closer than 15 meters. No joints shall be permitted in galvanized steel wire unless the core consists of seven or more steel wires. In the later case, joints in individual wires are permitted, but no two such adjacent joints shall be less than 15meters.

STRANDING:

The wires used in manufacturing of stranded conductors shall satisfy all requirements of IS: 398/ 1996 (Part-I & II) before stranding. For ACSR, the lay ratio of the different layers shall be within the limit given below.

In all constructions, the successive layers shall have opposite directions of lay and the outer most layers being right handed. The wires in each layer shall be evenly and closely stranded.

In conductor having multiple layers of aluminium wires, the lay ratio of any aluminium layers shall be not greater than the lay ratio of the aluminium layer immediately beneath it.

LAY RATIO:

The lay ratio (Ratio of the Aerial length of a complete turn of the helix formed by an individual wire in a stranded conductor to the external diameter of the helix) shall be within the limits given below:

Aluminium conductor steel re-enforced.

| No. of wires. | | Lay ratio for steel Core | | Lay ratio for Outside layer | | Al. wire inner most layer | |
|---------------|-------|--------------------------|------|-----------------------------|------|---------------------------|------|
| Al. | Steel | Max. | Min. | Max. | Min. | Max. | Min. |
| 6 | 1 | -- | -- | 14 | 10 | -- | -- |
| 6 | 7 | 28 | 13 | 14 | 10 | -- | -- |
| 30 | 7 | 28 | 13 | 14 | 10 | 16 | 10 |

GROSS WEIGHT:

The gross weight of each wooden drum containing conductor of all sizes shall not exceed 900 kg. with a tolerance limit of $\pm 10\%$.

STANDARD LENGTH:

Minimum length of ACSR DOG should be 1(one) Km. Longer lengths are also acceptable provided they are within gross weight limit. The conductor shall be supplied in standard lengths of not less than 95% of the total quantity. The quantity of the conductor in lengths shorter than standard ones shall not exceed 5% of the total quantity to be supplied. Further, single conductor length in respect of such 5 % (maximum) shall be supplied in random length of not less than 50% of the standard length and shall be supplied in individual drum. Such random length shall be acceptable to the maximum extent of 5% of the offered quantity.

PACKING & MARKING

I) The conductor shall be wound on non-returnable drum strong enough and provided within lagging of adequate strength, constructed to protect the conductor against all displacement during transit, storage and subsequent handling and stringing operation in the field. The drum shall conform to IS: 1778-1980 as amended upto date and the dimensions shall be as per drum under column 9 of Table- 2 of the IS.

II) The drum shall be suitable for wheel mounting.

III) The general construction of drum shall be as shown in IS: 1778-1980. However, the drum shall be suitable for letting off the conductor under controlled tension of the order of 300 kg minimum.

IV) After application of bituminized and plastic paper protective lagging or circumferential batten of minimum 50mm. thickness shall be provided suitably, in order to protect conductor from damage during transit in the event of breakage/detachment of the external protective lagging. The thickness of the external protective lagging or circumferential batten shall be sufficient to nail across grains as far as possible to the flange edges with at least one nail per end. The length of the nails shall be not less than twice the thickness of the battens. The nails shall not protrude above general surface and shall not expose sharp edges or allow the battens to be released due to correction.

V) Outside the protective lagging, there shall be minimum two binders consisting of hoop iron or galvanized steel wire. Each protective lagging shall have recesses to accommodate hoop binders.

VI) The conductor ends shall be properly sealed and secured with the hoop of "B" nails or bolts on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.

TOLERANCE IN QUANTITY:

A manufacturing tolerance upto **(-)5%** subject to maximum one standard drum length against each item of the order, for the last offered lot, will be allowed.

MARKING:

Each drum shall have the following information aluminium on it in indelible ink along with other essential details:

- a) Purchase Order number.
- b) Name and address of the consignee
- c) Manufacturer's name or trade mark.
- d) Drum number
- e) Code name and size of the conductor.
- f) Length of the conductor.
- g) Gross weight of the drum.
- h) Weight of empty drum with protective lagging.
- i) Net weight of the conductor
- j) Arrow marking for unwinding
- k) Position of the conductor end.
- l) Lot number.

Before dispatch, property identification mark 'HDC' shall be engraved in each drum.

CONSTRUCTION OF DRUMS

(a) All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums.

Preservative treatment shall be applied to the entire drum with preservative of such a quality which is not harmful to the conductor.

(b) FLANGES

- (i) The flanges shall be of two ply construction with such ply at right angle of the other and nailed together. The nails shall be driven from the inside face of flanges, punched and then cleaned on the outer face. There shall be at least 3 nail per plank of ply with maximum nail spacing 70- 75 mm.
- (ii) There will be a slot in the flange to receive the inner end of the conductor; the entrance shall be in line with the periphery of the barrel.

(c) Spindle hole shall be provided at the center of the middle planks of the plies and spindle planets with 100 mm diameter holes shall be fitted on either side of both the flanges.

(d) DRUM AND SUPPORTS:

The end supports shall be securely fixed by nailing and may be disc or segmental type. The middle barrel support of the two ply construction of disc type with a 100 mm diameter concentric with the holes in flanges shall be provided at the centers of the barrel supports.

(e) DRUM:

The wooden batons used for making the barrel of the conductor shall be segmental type. These shall be nailed to the barrel supports with at least two nails. The batons shall be closely butted and shall provide a round barrel with smooth surface. The edges of the batons shall be rounded or compared to avoid damage to the conductor.

(f) DRUM STUDS:

Barrel studs shall be used for the construction of drum. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end sufficient to accommodate washers, spindle plates and nuts for fixing at the required spacing.

(g) IRON COMPONENTS

Normally, the nuts on the studs shall stand proud of the flange. All the nails used on the inner surface of the flanges and the drum barrel shall be counter sunk at least 5 mm. deep. The ends of barrel shall generally be flushed with the top of the nuts.

(h) PROTECTIVE ARRANGEMENT:

- i) The inner side of the flanges and drum barrel surfaces shall be painted with bitumen based paint.
- ii) Before reeling, cardboard of double corrugated or thick bituminised water proof bamboo paper shall be secured to the drum barrel and inside the flanges of drum by means of suitable adhesive materials. These protective wrappings and the adhesive material used shall be of a quality which is not harmful to the conductor.

After reeling the conductor, the exposed surface of the outer layer of the conductor shall be wrapped with water proof, thick, bituminised bamboo paper and also with thick plastic sheet to prevent the conductor from dirt, grit and damage during transport and handling.

TOLERANCES:

The following tolerances shall be permitted:

- Tolerance on nominal diameter of aluminium wires: ± 1 (one) percent.
- Tolerance on nominal diameter of galvanized steel wires: ± 2 (two) percent.

Inspection

The following tests will be carried out by TPI /representative of Engineer-in-charge before acceptance of any materials at site.

- Dimensional check up on 10% of the offered lot
- Visual check.

Test reports to be submitted:

- Routine test as per IS:398-II
- Acceptance test as per IS:398-II
- Type test as per IS: 398-II.

H) TECHNICAL SPECIFICATION ALUMINIUM BINDING WIRE

Scope covers supply and fixing of 3.53 mm dia. Aluminium Binding Wire as per IS 398.

The material comprising the wire shall have the following chemical composition:

Aluminium 99.5% minimum. Copper, silicon and iron 0.5% maximum.

The surface of the wire shall be smooth and free from all irregularities and imperfections.

Its cross sections shall closely approximate that of true circle.

Characteristics of Aluminium Binding wire :-

| Diameter of wire (mm) | | | Cross sectional area of nominal dia. Wires | Weight of wire | Breaking Load |
|-----------------------|---------|---------|--|----------------|---------------|
| Minimum | Nominal | Maximum | (mm ²) | kg/km | (kN) |
| 3.15 | 3.53 | 3.55 | 9.787 | 26.45 | 1.57 |

Inspection and Tests

The following routine checks and tests shall be carried out on 10% of the coils of aluminium binding wire. If anyone sample fails to pass any one of the test nominated for that wire, then samples shall be taken from every coil in the consignment and any coil from which a sample proves defective shall be rejected. On no account shall any rejected material be presented for test again unless with the written approval of, and under conditions determined by the Purchaser.

Physical properties

The surface of the finished wires shall be checked to ensure that it is smooth , free from all irregularities, imperfections and inclusions and that its cross section approximates closely that of true circle. The wire shall be checked to ensure that its diameter and weight are within the values given I the table above characteristic of aluminium binding wire.

Ultimate tensile strength

When tested on a standard tensile testing machine, the value obtained for the ultimate tensile stress shall not be less than 1.57KN.

Wrapping test

The wire shall withstand one cycle of a wrapping test as follows:

The wire shall be closely wrapped round a wire of its own diameter form a close helix of eight turns. Six turns shall then be unwrapped and again closely rewrapped in the same direction as the first wrapping. The wire shall not break or crack when subjected to this test.

Packing & Delivery

The aluminium binding wire shall be delivered in 30m coils, with a permitted tolerance of +5%.

Random or non standard lengths shall not be permitted. Each coil shall be adequately guarded against damage due to transportation and handling and shall have an outer layer of tightly wound polythene tape or be contained in a suitable, transparent plastic bag.

The internal diameter of the wound coil shall not be such as to result in a permanent set in the conductor. The coils shall be contained in non returnable wooden cases, with a gross weight not in excess of 300 kg.

The number of coils contained shall be marked on the outside of each case.

I) TECHNICAL SPECIFICATION OF DANGER NOTICE PLATE:

a) The danger plate shall be affixed in a permanent manner on operating side of the panel, Substations, Distribution Boards, Electric poles etc..

b) The danger notice plate shall indicate danger notice both in English & Hindi and with a sign of skull and bones.

c) The danger notice plate in general shall meet to requirements of local inspecting authorities.

d) Dimension of the danger notice

I) For display at 415 V installations – 200x150mm

II) For display at 11 KV / 33KV (or higher voltages) installations – 250x200mm

III) The corners of the plate shall be rounded off.

e) The danger notice plate shall be made from minimum 1.6 mm thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.

f) The letter, the figure, the conventional skull and bones shall etc. shall be positioned on the plate as per recommendations of IS : 2551-1982.

g) The said letter, the figure and the sign of skull and bones be painted in single red colour as per IS : 5-1978.

h) Standards of Danger Plate: The Danger Notice Plates shall comply with IS:2551-1982 or the latest amendment.

i) The danger notice plate, if possible, be of ISI certification mark.

j) The danger plate should be as per drawing enclosed or better look.

k) Tests of Danger Plate: The following tests shall be carried out:

I) Visual examination as per IS: 2551-1982

II) Dimensional check as per IS: 2551-1982

III) Test for weather proofness as per IS: 8709-1977 (or its latest version)

J) TECHNICAL SPECIFICATION FOR G.I. BARBED WIRE

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the G.I. Barbed wire shall conform to the latest revisions available at the time of placement of order of all the relevant standards but not limited to as listed below.

IS: 280:1978 Mild steel wire for general engineering purposes (third revision)

IS: 1340:1977 Code of practice for chromate conversion coating of zinc and cadmium coated articles and zinc base alloys (first revision)

IS: 1521:1972 Method for tensile testing of steel wire (first revision)
IS: 1755:1983 Method for wrapping test for metallic wire (first revision)
IS: 2633:1986 Method for testing uniformity of coating of zinc coated articles(second revision)
IS: 4826:1979 Hot dipped galvanized coating on round steel wires (first revision)
IS: 12753:1989 Electro galvanized coatings on round steel wire – Specification

GENERAL TECHNICAL REQUIREMENTS:

GI Barbed wire shall be 2 PLY with a 2.5mm diameter. The barbs shall have a 2mm diameter and be 12.5mm in length. The barbs shall have four points and shall be formed by twisting two point wires, each two turns, tightly around both line wires making altogether four complete. G.I. Barbed wire shall be of type IOWA with size and dimensions as under:-

Line wire – 2.5 mm

Point wire – 2.0 mm

Distance between two bars shall be 75 mm (+ 12 mm). Wire shall be medium.

ERECTION OF RAIL POLE:

11/12/13Mtrs. Old and used rail pole will be provided to the contractor from the site store of HDC, KoPT on free of cost basis for erection of transmission line towers (Double Pole / Four Pole structure).

Transportation of 13Mtrs. old and used rail to the work site is in the scope of the contractor.

Erection of DP/ FP rail pole structure shall be as per approved drg.

All rail pole FP structure shall be supported by 1/2/3 Nos. rail pole based strut poles for structural stability.

All rail pole DP structure shall be supported by suitable numbers of stay wires for structural stability.

As a thumb rule 1/6th of the erected rail shall be used in the plinth / foundation.

Foundation details for Rail Pole.

Earth Excavation:- 600mm x 600mm x 2200mm.

PCC Base-100mm.

After erection of rail Pole concreting work-600mm x600mmx 2400mm.

Plastering work above Ground level-300mm.

Black Bituminous Painting at Bottom of rail Pole -300mm from finished concrete foundation level.

Erected Rail pole shall be painted 2coats of primer and 2coats of silver paint.

GI ANGLE, CHANNEL, “V” CLAMPS, FLATS, NUTS, BOLTS, WASHERS TO BE USED ON ERECTED RAIL POLE STRUCTURE:

Scope covers supply, fabrication, galvanisation and fixing of angle, Channels, Clamps, Flats, Nuts, Bolts and washers required for commissioning of rail pole structure.

Old and Used 11/12/13Mtrs. Rail Pole in required quantity as per approved drg. will be provided to the contractor on free of cost basis for execution of work.

Transportation of rail pole from sub-store to work site shall be the responsibility of the contractor.

Following are the sizes of Angle and channels to be used for fabrication and fixing, on erected rail pole DP and FP structures.

- 100mm x 50mm x 6mm GI Channel – For holding insulator strings and ACSR Conductors.
- 100mm x 50mm x 6mm GI Channel – For Four Pole structural supports.
- 75mm x 40mm x 6mm GI Channel- For cable raising arrangements, pin insulator mounting.
- 65mm x 65mm x 6mm GI Angle- for cross braising in DP and FP structures.
- 50mm x 50mm x 5mm GI Angle- for shield wire laying and termination.

- f. 65mm x 6mm GI Flats-For making rail clamps,"v" clamps, support clamps etc.
- g. 50mm x 6mm GI Flats for LA earthing, Cable earthing, interconnections between earthing stations and earth spike connection etc.

The material as above shall confirm to IS: 2062.

Upon fabrication of angles, channels, clamps and flats shall be hot dip galvanised to achieve thickness of zinc coating 100micron (min.).

Nuts, Bolts and washers shall be electro galvanized.

The galvanized surface shall be smooth and free from all irregularities and imperfections.

5.0 **33(E) KV, HT CABLE.**

5.1 **Scope**

Supply, laying, inspection, testing, commissioning and making terminations of 33 KV(E) grade XLPE insulated power cables.

5.2 **Codes & Standards**

The design, construction, manufacture and performance of cables shall comply with all currently applicable statutes, regulations and safety codes of the locality where cables shall be installed. Nothing in this specification shall be construed to relieve the successful BIDDER of his responsibility.

All the cables shall conform to the latest applicable IS/IEC standards.

5.3 **Power Cable**

Power cables should be multicore earthed 33 kV grade aluminium stranded conductor colour coded, extruded XLPE insulated, extruded semi-conducting screened over each core and insulation, extruded inner sheathed, common extruded inner sheathed for multi core cable, galvanised steel strip armoured and overall extruded black sheath conforming to IS-7098 Part II. Armouring of multicore cable shall be of single layer, galvanised steel round wire or flat strip. The Cables shall be suitably designed for variation in power supply as follows:

The voltage variation $\pm 10\%$

Freq. variation $\pm 5\%$

Following cable size shall be supplied by the bidder:

- i. **3Core, 120 Sqmm., HT Cable, 33kV (E) grade, XLPE, U.G. Alu. Screened Cable, Strip armoured, PVC inner sheathed and PVC ST2 type outer sheathed, FR cable.**
- ii. **1Core, 1000Sqmm HT Cable, 3.3kV(UE) grade, XLPE U.G. Alu. Cable, PVC inner sheathed and PVC ST2 type outer sheathed, armoured, FR cables.**

5.4 **Laying of Cables.**

For laying cables along building steel structures and technological structures the cable shall be taken by clamping with **Aluminium** saddles screwed to the GI flats welded to the structure. **The** flats are of **hot** dip galvanised after fabrication.

For laying cables along concrete walls, ceilings etc. the cables shall be taken by clamping with **Aluminium** saddles screwed to the **hot dip GI** flat welded on to the inserts. Where inserts are not available the saddles shall be directly fixed in the walls using metallic anchor fasteners and **GI** flat spacers of minimum 6 mm thick.

The **Aluminium** saddles shall be placed at an interval of not less than 500 mm both for horizontal and vertical runs. However, at the bends it shall be placed within 300 mm and where terminating to the equipment/junction box the cable shall be clamped immediately before such termination.

Cable Net Work shall include Power Cables, which shall be laid in buried trenches/ cable trays / through G.I. Pipes & Hume Pipes, rising main etc. whichever is applicable.

Cable routing shall be checked in the field to avoid interference with structures, heat sources, drains, piping etc. as far as possible and minor adjustments shall be done to suit the field conditions, wherever deemed necessary without any extra cost.

The HT cables while laying will have to be separated from existing HT, LT, Telecommunication, OFC Cables by adequate spacing or running through independent pipes, trenches or cable trays, as applicable.

All cable routes shall be carefully measured and cables cut to the required lengths leaving sufficient lengths for the final connections of the cables to the terminal of the equipments.

The various cable lengths cut-off from the cable reels shall be carefully selected to prevent undue wastage of cables. The quantity indicated in the Bill of Quantity is only approximate. The Contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works as far as possible. Before starting Cable Laying, Cable Drum Schedule shall be prepared by contractor and get that approved by competent authority.

Cable as far as possible shall be laid in complete, uncut lengths from one termination to other. Cable shall be neatly arranged in the trenches/ trays/ pipes in such a manner so that crisscrossing is avoided and final take- off to the equipment/switch gears is facilitated.

Arrangement of cables within the trenches/ trays/ pipes shall be the responsibility of the contractor.

Removal of concrete covers for purposes of cable laying and reinstalling them in their proper positions after the cables are laid shall be done by the contractor at no extra cost. Cable shall be handled carefully during installation to prevent mechanical injury to the cables. During laying of cables, Cable Drum Lifting Jacks, sufficient numbers of Cable Rollers and other materials etc. as necessary must be used to avoid any mechanical injury to the cables. Directly buried cable shall be laid underground in Cable Trenches duly excavated by the contractor as shown in the enclosed Drawing No.: SK- 334.

The width of the trench shall vary depending upon the number of cables and diameter of each cable. Width of the Cable Trench should be such that all cables should be correctly spaced and arranged. The cables shall be laid in trenches as shown in the enclosed sketch. Before cables are placed, the bottom of the trench shall be leveled and filled with a layer of silver sand as shown in the Drawing No.: SK- 334. This sand shall be leveled and the cables shall be laid over it. Bricks are to be placed at both sides of the cable. Then the cable inside the brick walls to be covered with sand up to the height of walls and sand shall be pressed lightly .A protective covering of Bricks shall be placed on top of protective Bricks placed at both sides of Cable. The remainder of the trench shall then be back filled with soil rammed and leveled. After laying of the cables in the trench and before placement of protective covering by brick, every cable shall be given an insulation test in presence of site engineer/ authorized representative. Also after back filling the trench with soil, rammed and leveled, insulation test of the cable shall be carried out in presence of Site Engineer/Authorized representative.

All wall openings/Pipe Sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside buildings/lined trench. At road/drain/pavements crossing, suitable sizes of G.I. Pipes are to be used. After the cables are installed and all testing is complete, the conduit/pipe sleeve ends shall be plugged with a suitable weatherproof plastic compound/ PUTTI, for sealing purpose. The cost of the same shall be deemed to have been included in the installation of cable laying through pipe sleeves/conduits and no separate payment shall be made. When cables pass through foundation walls, or other underground structures, if necessary, ducts or opening shall have to be provided by the contractor.

However, shall it become necessary to cut holes in the existing foundations or structures, the contractor shall determine their locations and obtain approval from competent authority before cutting is done. Cutting, if necessary and mending good of any cut portion should be done by contractor without any extra cost. At Road Crossing and other places where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables do not stack and get damaged by pipe ends. Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule. All G.I. Pipes shall be laid as per site requirements. The open ends of the pipes shall be suitably plugged after they are laid in final position. Laying of the cable will be as per the enclosed Drawing No. SK- 334. The contractor will have to submit the detailed cable route diagram, with detailing of the Hume Pipes & G.I. Pipes used, position of the straight through cable joints etc. for checking at our end and subsequent approval of the same. As built drawing (in triplicate) of the above cable route will have to be submitted after completion of the above work.

MEASUREMENT:

Cable length should be measured jointly prior to giving clearance for earth back filling etc. Distance between Socket of one end and Socket of other end of the laid cable to be considered for payment against both supply & laying of cable.

5.5 Laying of Cables in Exposed/Embedded GI Pipes/Hume pipe Road Crossing, Railway Crossing, Drains, Culverts or any similar concrete structure etc.

GI Pipes /Hume pipe for drawing cables in plant buildings shall be of **Heavy Duty**, galvanised, electric resistance welded, screwed type conforming to IS: 1239 (Part-I). GI Pipe/Hume pipe of the following sizes shall be used:

- a) 150 mm nominal bore GI pipe
- b) 150 mm dia. Heavy duty NP-4 Hume pipe.

For installation of cables in GI Pipe /Hume pipe. Complete system shall be installed first without cables but having suitable pull wires laid in the pipes to facilitate cable pulling.

Insulated type end bushings shall be used where conductors enter or leave GI pipe.

Ends of GI pipe shall be cut square and the threads out in the field shall have the same effective length and the same dimensions and taper as specified for factory out threads. Ends of pipe shall be reamed to remove burrs and sharp edge after threads are cut.

Exposed GI pipes shall run parallel or perpendicular to column lines or building lines so as to match with the architectural arrangement of the building. Concealed GI pipes shall run in direct lines with minimum bends.

Laying of Reinforced Concrete Pipe and Galvanized Mild Steel Tubes should be done wherever necessary, such as at Road Crossing, Railway Crossing, Drains, Culverts or any similar concrete structure etc. The scope includes cutting of road, Railway Crossing, Excavating of Trenches, etc. including mending good work. The depth of laying of the pipes should have to be matched with the underground cable trench, as far as possible and practicable. Making jointing between collars and pipes, with cement mortar (1 cement: 2 medium sand) and cutting the Reinforced Concrete Pipe to the required length, if necessary, to be done by the contractor at their own cost and arrangement. Cutting of Galvanized Pipe to required length and threading, bending, jointing by Socket as required, supply and fixing of support clamps/ brackets should be under the scope of contractor. Re-filling of the trench after laying the reinforced concrete pipes and galvanized mild steel tubes are also to be done by the contractor.

Rates are to be quoted accordingly.

5.6 Depth of laying

| Sl. No. | Cable | Laying Type | Depth of Laying |
|---------|-------|-------------|-----------------|
|---------|-------|-------------|-----------------|

| | | | |
|----|-------------|--|-------------------------|
| 1. | HT Cable | Open cut excavation with brick protection | 1500mm |
| | | Boring through GI pipe (HDD/Manual) | 2500mm |
| | | Open cut excavation through Hume / GI pipe | 1500mm |
| | | Through existing RCC trench / Hume pipe / GI Pipe. | As per available depth. |

Note: 1..Road level to be considered as reference level.

2.However depth of Boring(HDD/Manual) in the region under National Highway Authority of India (NHAI)/Haldia Development Authority (I)/ South Eastern Railway (SER)/ Indian Oil Corporation Ltd. (IOC Ltd) shall be as per clearance/permission obtained for Road Crossing/ Railway Track Line Crossing/Utility crossing of respective firms/Agencies.

5.7 **Bricks**

Crushing strength, efflorescence shall conform to class designation 10 (as per IS 1077, 1986) and as per the specification, given below:

The brick shall have clear ringing sound.

ii) The average size of the bricks shall be in the range of 250 mm (± 4 mm) x 125 mm (± 2 mm) x 75 mm (± 2 mm).

5.8 **Cable Termination (Heat Shrinkable type)**

Termination of aluminium conductor power cables shall be by means of compression method using compression type lugs.

The **End** termination for use on the cables shall be suitable for the type of cables offered.

The accessories shall be supplied in kit form and each component of the kit shall carry manufacturer's mark of origin.

The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. The instruction pamphlet shall also be included in each kit.

The contents of the kits shall be suitable for storage without deterioration under the climatic conditions given in the specification with shelf life exceeding 5 yrs.

5.9 **Cable Straight through Jointing. (Heat Shrinkable type)**

The contractor shall submit cable route plan and tentative location of straight through joints for approval to Competent authority.No straight through joints are allowed in RCC Cable trench.

Additional length (Loop) of 5 mtrs. (approx.) cable should be kept at each end of the cables near the straight through cable joints. It is required to measure the insulation resistances of the cables before and after straight through cable jointing. This scope includes supply of all required materials including complete straight through cable jointing kits, with ferrules and all other accessories.

The accessories shall be supplied in kit form and each component of the kit shall carry manufacturer's mark of origin.

The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. The instruction pamphlet shall also be included in each kit.

The contents of the kits shall be suitable for storage without deterioration under the climatic conditions given in the specification with shelf life exceeding 5 yrs.

5.10 Cable Tags

All cables will be identified close to their termination points by cable nos. Cable numbers will be punched on Aluminium strip/ PVC Strip {2mm. thick (approx.)} securely fastened to the cable and wrapped around it. Alternatively Cable Tags shall be circular in construction to which cable number can be conveniently punched.

Cable designations are to be punched with letter/number punches and the tags are to be tied to cables with piano wires of approved quality and size. Tags shall be tied inside the panels beyond the glanding as well as below the glands at cable entries. Along trays tags are to be tied at all bends.

Each underground cable shall be provided with Identification Tags (made of PVC) securely fastened at every 30 Mtrs. Distance if the continuous length is more than 50 Mtrs. Of its underground length. At least one tag at each end before the cable enters the ground will have to be provided. In unpaved areas, Cable Trenches shall be identified (by means of cable markers). These shall be placed at location of changes in the direction of cables and at intervals of not more than 30 Mtrs. And at Cable Joint Locations.

5.11 Packing and Markings

The cable shall be wound on a steel drum conforming to relevant BIS standard and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material.

Cables to be supplied in returnable steel drums only.

The cable drum shall carry the following information stencilled on the drum:

- i) Manufacturer's Name and Trademark
- ii) Type of cable and voltage grade.
- iii) No. of cores
- iv) Nominal cross-sectional areas of conductor
- v) Cable code
- vi) Length of cable on drum
- vii) No. of lengths on the drum if more than one
- viii) Direction of rotation of Drum
- ix) Gross weight
- x) Weight of Drum with Ballens (if any)
- xi) Weight of cable
- xii) Reference of any Indian standard
- xiii) ISI Marking on the drum
- i) Year of Manufacturing

5.12 Tests & Test Reports

Type test certificate for similar type & Rating of Cables be submitted by successful bidder.

The Routine and acceptance tests specified in the applicable standards shall be arranged by the Contractor and carried out on **Cables** as per latest relevant IS Standards in presence of **Third Party Inspection(TPI) Agency appointed by HDC at the manufacturer's works & at site respectively. The cost of the TPI Agency is borne by Port.** The Certified copies of test certificates shall be submitted before despatch.

6.0 GCBERTH SUB-STATION.

Equipments mentioned as under shall be erected / installed in side newly build sub-station as per approved layout plan. Civil building of the sub-station is not in the scope of the contractor.

6.1 OIL TYPE TRANSFORMERS**A Electrical Design**

- i) Generally as per IS 2026 – Part 1, 2 & 4 of 1977 and Part 3 of 1981.
- ii) 3 phase, core type, oil filled
- iii) Rated output, voltage ratio, vector group shall be provided as specified in technical particulars for design.
- iv) Rated frequency 50 Hz, + 3%, -3%.
- v) Insulation level shall be designed according to the voltages specified below.

| Sl. No. | Description | 33kV System | 11kV System | 3.3kV System |
|---------|---|-------------|-------------|--------------|
| 1. | Nominal system voltage (kV) | 33 | 11 | 3.3 |
| 2. | Max. system voltage (kV) | 36 | 12 | 3.6 |
| 3. | One minute power frequency withstand voltage (kV) | 70 | 28 | 10 |
| 4. | Peak impulse test withstand voltage (kV) | 170 | 75 | --- |

- vi) Transformers shall be capable of delivering rated current at an applied voltage up to 105% rated voltage without exceeding the temperature limits.
- vii) Overload capacity of the transformer shall be as per IS 6600 – 1972 unless specified otherwise.
- viii) Shall be operable at its rated capacity at any tap with voltage variation of $\pm 10\%$ of corresponding to voltage of the particular tap.
- ix) Permissible maximum temperature at rated output and principal tap at the ambient temperature of 50°C

| | |
|---------------------------------|-------|
| Top oil (by thermometer) | 85°C |
| Windings (by resistance method) | 95°C |
| Maximum Hot Spot Temperature | 105°C |

- x) Transformers shall be designed to withstand the thermal and dynamic stresses due to short circuits at its terminals or symmetrical/asymmetrical faults on any winding. Short circuits withstand capacity for the bolted fault at the terminals shall not be less than 5 second duration with respect to fault level specified. Design calculation to be submitted for concurrence.
- xi) The maximum temperature at the end of the specified duration shall not be more than 250°C with the temperature prior to short circuit corresponding to maximum permissible overload.
- xii) Transformer shall be designed for minimum no-load and load losses within the economic limit.
- xiii) Designed for suppression of harmonics especially 3rd and 5th.

B Magnetic Circuit

- i) Low loss CRGO silicon steel shall be used.
- ii) Laminations shall be annealed in a non-oxidizing atmosphere to relieve stresses and restore the original magnetic properties of CRGO sheets after the cutting and punching operations.
- iii) CRGO sheets shall be coated with insulation varnish compatible with the sealing liquid.
- iv) Insulation to withstand annealing temperature as high as 850 Deg. C and shall reduce eddy current to minimum
- v) Ducts to be provided to ensure adequate cooling.

- vi) Core, framework and clamps arranged and tightened to securely hold laminations in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits.
- vii) Flux density under specified over voltage or frequency conditions shall be within the maximum permissible for the laminations. However it shall not exceed 1.6 tesla at rated voltage & rated frequency.
- viii) Transformers shall be designed to withstand 110% over fluxing corresponding to rated voltage.
- ix) Magnetising current shall be maximum 1% of the rated current.

C Windings

- i) Material shall be electrolytic grade work hardened copper of high proof stress with more numbers of radial support.
- ii) Shall be pre-compressed, press board, pre-stabilization of coil & shall be subjected to shrinkage treatment.
- iii) Completed core and winding to be vacuum dried in full vacuum and impregnated immediately.
- iv) Shall be braced to withstand shocks due to rough handling, and forces due to short circuit, switching or other transients.
- v) Permanent current carrying joints in winding and leads shall be brazed. Connections to bushings & OLTC shall be crimped.
- vi) Coils shall be supported using dried and high-pressure compressed wedge type insulation spacers, blocks & cylinders.
- vii) Insulating materials shall be compatible with transformer liquid under all service conditions.
- viii) Leads to the terminal board and bushings shall be rigidly supported.

D Insulation

Inter turn and inter coil insulation shall be designed such that dielectric stress is uniformly distributed throughout the windings under all operating conditions.

E Tank

- i) Welded thick gauge low carbon steel grade plates stiffened and reinforced to withstand without deformation all stresses applied during transport and operation or short circuit conditions.
- ii) Oil tight welds and joints shall be provided.
- iii) Fully assembled transformer with its radiators, conservator and other fittings shall withstand for one hour a pressure corresponding to twice the normal head of liquid or to the normal pressure plus 35 kN/sq.m, whichever is lower, measured of the base of the tank.
- iv) Plates shall be protected internally against corrosion due to insulating liquid.
- v) Provided with inspection opening and cover/with handling equipment) to provide access to bushing connections.
- vi) Form of cover shall be such as to prevent any stagnant water deposit and to drain gas bubbles towards the buchholz relay
- vii) Tank (with radiators when welded to tank) shall be capable of withstanding of 250 mm of mercury vacuum.
- viii) Tank shall be suitably designed to suppress harmonics available in the system as well as

generated by transformer.

F Conservator And Breather

- i) Conservator mounted on frame, integral with tank in such a manner that under all conditions and the lowest oil level the bushings remain under the head of liquid.
- ii) Conservator volume shall be sufficient to maintain oil seal from ambient to oil temperature of 90°C
- iii) Oil filling hole with cap and a drain valve to drain the oil completely shall be provided. One end of the conservator shall be bolted into position so that it can be removed for cleaning purposes.
- iv) Silica gel breather with inspection window and oil seal shall be mounted at 1.4 m from ground level and connected to conservator.
- v) Prismatic type oil level gauge with maximum and minimum levels marked.
- vi) One no. 150 mm dia dial type magnetic oil level gauge with alarm & trip contacts shall also be provided.

G Oil

- i) The oil shall be as specified in IS: 335 and shall be suitably treated, free from moisture and have uniform quality throughout.
- ii) Oil shall be supplied for the first fill of oil and 10% excess in non-retunable drums.

H Pressure release device

- i) Adequate number of Pressure release device shall be provided on tank at suitable locations. This shall operate at static pressure less than hydraulic test pressure of tank. This should have one potential free contact for alarm/trip and should be wired to Marshalling box.
- ii) Discharge of Pressure release device shall be taken through pipes away from transformer and prevented from spraying on tank.

I Buchholz Relay

- i) Double float relay as per IS 3677 – 1985.
- ii) Shut off valves on either sides of the buchholz relay
- iii) Pot cocks at the top and bottom of relay drain plug, inspection window, calibrated scale, terminal box with oil tight double compression type brass gland.
- iv) Potential free, self reset independent alarm and trip contacts, rated to make, break and carry minimum 2 amps at 30 V DC. No auxiliary relay shall be used to multiply the contacts. Contacts are to be wired to the marshalling box.

J Cooling

The cooling system provided is as follows.

ONAN - Oil Natural, Air Natural

K Radiators

Radiators shall be detachable type directly mounted or separately mounted. Flanged, gasketed and bolted connections shall be used for connecting the radiators to the tank.

The following accessories shall be provided for each radiator/radiator bank

- I. Top and bottom shut off valves and blanking plates.
- II. Bottom drain plug and top filling plug.
- III. Lifting lugs

- IV. Thermometer pockets with thermometers in the inlet and outlet pipes (for separately mounted radiator banks).
- V. Top and bottom filter valves (for each separately mounted radiator bank).
- VI. Air release devices.
- VII. Provision for earthing

L Valves And Connections

- i) Valves of sluice type with hand wheels
- ii) All valves including radiator valves shall be made of gun metal only.
- iii) Clear indication of open and closed position
- iv) Provided with blanking plates or screwed plugs
- v) Padlocking facility to lock in closed/open position.

M Terminations

It shall be possible to withdraw the transformer easily after disconnecting the connections without disturbing the cable terminations.

- i) For cable termination
 - a) Air insulated cable end box suitable for the type and number of cables specified.
 - b) Air insulated disconnection chamber with inspection opening
 - c) Compressed type brass cable glands with tinned copper lugs.
 - d) Bolted type gland plates (non-magnetic material wherever specified).
 - e) Sealing kits with associated accessories like stress relieving cones, insulating tape, trifurcating boot, HT insulating tape.
- ii) For bus duct termination
 - a) When bus duct termination is specified, flanged throat shall be provided to suit termination of bus duct. Flange ends and inspection openings shall have weatherproof gaskets.

N Bushings

- i) Conforming to IS 3347 and IS 2099 for HT and IS 7421 for LT system.
- ii) Minimum rated current of line and bushings shall be 1.5 times rated current of the corresponding windings
- iii) Clamps and fittings made of steel or malleable iron shall be hot dip galvanized.
- iv) Bushings rated 400 Amps and above shall have non-magnetic clamps and fittings only.
- v) Bushing shall be solid porcelain type for LT system, solid porcelain / oil communicating type for voltage class upto 36 kV .
- vi) Porcelain shall be homogenous and free from cavities
- vii) Oil filled condenser type bushings should have the following:
 - Oil level gauge
 - Oil filling pipe and drain valve (if not hermetically sealed)
 - Tap for capacitance and tan delta test.
- viii) All clamps and fittings shall be hot dip galvanized.
- ix) No arcing horns should be provided on bushings
- x) Neutral bushings shall be provided as required for earthing of neutral point. This shall be connected to brass / tinned copper bar and brought to ground level through porcelain insulators.

O Bushing Current Transformers (Where Applicable)

- i) CTs for back up earth fault shall be provided on the neutral end.
- ii) Removable at site without opening transformer tank cover/active parts.
- iii) Secondary leads shall be brought to a weatherproof terminal box and from there to the marshalling box with 4 sq.mm copper armoured cable.

P Oil Temperature Indicator

150 mm dial type thermometer with manual reset maximum reading pointer. There shall also be two potential free contacts for alarm and trip signals. The alarm and trip settings shall be independently adjustable. The temperature-sensing element mounted in a pocket of oil, shall be connected to the indicator through capillary tubing. Contact rating at DC shall be minimum 0.5 amps.

Temperature indicator dials shall have linear gradations to clearly read at least every 2°C. Accuracy shall be better than +/- 1.5%.

Q Winding Temperature Indicator

- i. Local winding temperature indicator (WTI) for each winding, shall have a 150-mm diameter dial type indicator with a manual reset maximum reading pointer. There shall be two potential free contacts for alarm and trip signals. For transformers with forced cooling, another set of contacts shall be provided to start/stop the forced cooling system automatically. The settings for closing/opening of each contact shall be independently adjustable. Contact rating at DC11, 30 V DC shall be minimum 0.5 amps. The device shall be complete with lamp, sensing element, image coil, calibration device, auxiliary CTs etc. as required.
- ii. Temperature indicator dials shall have linear gradations to clearly read atleast every 2°C. Accuracy shall be better than +/- 1.5%.
- iii. Remote winding temperature indicator with resistance type temperature detector shall be provided additionally.

R Marshalling Box

- i) All outgoing connections from the transformer i.e buchholz relay, temperature indicators, level indicators, CT secondary, fault contacts for annunciation etc. shall be wired to a marshalling box.
- ii) Degree of protection of enclosure shall be IP 55.

S Off-Circuit Tap Switch

- i) Externally hand operated with easily accessible links.
- ii) Designed for sustained over current of at least 150% of the rated current of the winding.
- iii) Shall not occupy any intermediate position between clearly marked tap positions.
- iv) Capable of repeated operation and withstanding short circuit forces.
- v) Tap position indication diagram
- iv) Inspection and/or repair shall not require removal of transformer core from tank.

A solid state facia window type annunciation system shall be provided for this purpose, with the following features:

- i) On incidence of fault – A hooter comes ON & window lamp starts flashing.
- ii) On acceptance of fault – Hooter stops, Lamp becomes ready.

On pressing RESET button – Lamp goes OFF if fault is removed.

Lamp continues to glow if fault persists.

The required alarm / trip contacts shall be wired to the marshalling box for connection to the annunciation system.

T Earthing

- i) All metal parts of the transformer with the exception of individual core laminations, core bolts, and clamping plates shall be maintained at fixed potential by earthing.
- ii) Two tinned copper earthing terminals with nuts, washers etc. to be provided at diagonally opposite corners suitable to connect 75x12 GI strip.
- iii) One end of bushing CTs shall be earthed.

U List Of Fittings And Accessories

- i) Identification plate
- ii) Rating and diagram plates.
- iii) Valve schedule plate (For Power transformers)
- iv) First fill of oil as per IS-335, 1993 with 10% excess in non-returnable drums
- v) Cooling system complete with accessories (as specified)
- vi) Off-circuit tap switch (as specified)
- vii) OLTC (as specified)
- viii) Conservator with oil level gauge and drain plug.
- ix) Oil filling pipes with flange and dummy cover on conservator for filling/ topping up of oil.
- x) Suitable number of Dehydrating breathers.
- xi) Double float Buchholz relay with alarm and trip contact and shut off valves on either sides.
- xii) Oil filter valves at top and bottom of tank
- xiii) Drain off valve at lowest location to allow complete draining
- xiv) Oil sampling device at top and bottom
- xv) Explosion vent with double diaphragm and oil level gauge between 1st & 2nd diaphragm (for distribution transformers).
- xvi) Pockets for thermometers for oil temperature and winding temperature indicators.
- xvii) Dial type magnetic oil level gauge with low level alarm contacts.
- xviii) HV, LV and neutral bushings.
- xix) Dial type winding temperature indicator with maximum reading pointer and alarm and trip contacts
- xx) Dial type oil temperature indicator with maximum reading pointer and alarm and trip contacts
- xxi) Lifting lugs and jacking pads. For transformers with bell tank design, lifting lugs shall be provided on core and winding also.
- xxii) Earthing terminals and lugs
- xxiii) Inspection cover
- xxiv) By-directional rollers with locking arrangement (for distribution transformers)
- xxv) Marshalling box.
- xxvi) Haulage holes.
- xxvii) Bushing CTs as specified.
- xxviii) Flat base & foundation bolts.

TRANSFORMER, 6MVA, 33/3.3 kV

Supply of Transformer:-

Supply of 6MVA, 33/3.3 kV Oil type indoor distribution Transformers with OLTC and RTCC Panel, manufactured as per relevant IS. The transformer shall be designed for the specification given below:

Technical Details:

Technical particulars:-

| Sl. No. | Particulars | | 6000 kVA, 33/3.3kV |
|---------|---|----|--|
| 1. | Specification | | IS 2026, Part I - 1977 Part II - 1977 Part III – 1981 Part IV - 1977 |
| 2. | Type | | Three phase, core type, oil filled |
| 3. | Duty | | Indoor |
| 4. | Voltage HV/LV | | 33/3.3 kV |
| 5. | Frequency | | 50 Hz |
| 6. | No. of phase | | 3 |
| 7. | Continuous rating | | 6000 kVA |
| 8. | Conductor | | Copper |
| 9. | Insulation class | | Class A |
| 10. | Cooling | | ONAN |
| 11. | Winding connection | | Delta / Star |
| 12. | Vector group | | Dyn 11 |
| 13. | Neutral grounding | | Solidly earthed |
| 14. | System earthing | HV | Solidly earthed |
| | | LV | Solidly earthed |
| 15. | Percentage impedance | | 6.9% |
| 16. | Termination | HV | Cable end box suitable for termination of 4 no. 3C x 120 mm ² XLPE cable |
| | | LV | Suitable for Bus duct or cable connection |
| 17. | Temperature rise over 50°C ambient temp | | |
| | a) Top oil (measured by Thermometer) | | 35°C |
| | b) In winding (measured by Resistance method) | | 45°C |
| | c) Hot Spot temp | | 55°C |
| 18. | Bushing mounted CT's | | |
| | a) LV Neutral bushing CT for EF class PS | | 1 |

| | | |
|-----|--|--|
| | b) LV Neutral bushing CT for standby E/F protection class 10P15. | 1 |
| 19. | Tap changer | OLTC |
| | a) Range | +5% to -15% |
| | b) Total tap positions | 5 |
| | c) Taps above nominal voltage | 2 |
| | d) Taps below nominal voltage | 2 |
| | e) Voltage per step variation | 1.25 % [16 step/17 position] |
| | f) Tap change controls | Manual |
| 20. | Impulse test withstand voltage | As per IS 2026, Part III – 1981 |
| 21. | One minute dry and wet power frequency withstand voltage | - do - |
| 22. | Withstand time without injury for 3 phase short circuit at terminals | 5 Secs. |
| 23. | Auxiliary supply voltage | 240 V AC/220V DC |
| 24. | Parallel operation | Suitable for parallel operation with transformers of similar ratings |
| 25. | Overload capacity | As per IS 6600 –1972 |
| 26. | Radiators | Detachable type on the tank |
| 27. | Flux Density | 1.6 tesla (Max.) |
| 28. | Magnetizing current | 1% of rated current |
| 29. | Paint | Epoxy |
| 30. | Paint shade | Shade 632 as per IS – 5 |
| 31. | Short circuit level on HV side | 450MVA |
| 32. | RTCC Panel | |

Installation of Transformer.

The 6000 kVA, 33/3.3 KV transformers shall be installed on the RCC foundation of size 3000mm x 3000mm. The transformer shall be properly luminium on foundation, including providing suitable stoppers for the transformer wheels. Adequate provision shall be made to enable proper heat shrink type cable terminations at the HT and LT side of the transformer. Before charging the Transformer all the tests shall be carried out as per relevant IS specifications.

6.2 VCB PANEL**Codes and Standards:**

The switchboards and the mounted equipment shall conform to the latest revisions of the following Indian standards:

| | |
|----------|---|
| IS:12729 | General requirements for switchgear and control gear for voltages exceeding 1000 V. |
| IS:13118 | General requirement for circuit breakers for voltages above 1000 V. |
| IS:3427 | Metal-enclosed switchgear and control gear for voltages above 1000 V but not exceeding 11000 V. |
| IS:5082 | Material for data for aluminium bus bars. |
| IS:9920 | Switches and switch isolators for voltages above 1000V. |
| IS:9921 | AC disconnectors (isolators) and earthing switches for voltage above 1000 V. |

| | |
|----------|---|
| IS:9046 | AC contractors of voltage above 1000 V upto and including 1100 V. |
| IS:12661 | HV motor starters. |
| IS:13703 | Low voltage fuses. |
| IS:2705 | Current transformers. |
| IS:3156 | Voltage transformers. |
| IS:1248 | Electrical indicating instruments. |
| IS:722 | Integrating meters. |
| IS:3231 | Electrical relays for power system protection. |
| IS:6875 | Control switches and push buttons. |
| IS:694 | PVC-insulated cables for working voltages voltage upto and including 1100 V. |
| IS:2544 | Porcelain post-insulators for systems with nominal voltage greater than 1000 V. |
| IS:11353 | Guide for uniform system of marking and identification of conductors & apparatus terminals. |
| IS:5578 | Guide for marking of insulated conductors. |
| IS:3618 | Phosphate treatment of iron and steel for protection against corrosion. |
| IS:6005 | Code of practice of phosphating of iron and steel. |
| IS:5 | Colours for ready mixed paints and enamels. |

Wherever Indian Standards are not available, relevant IEC standards shall be applicable.

General Requirement

The switchgear shall be of metal clad, single bus bar/Double bus bar as applicable, self standing, dust proof construction, indoor cubicle type fitted with vacuum circuit breakers in fully draw out execution.

The VCB shall be horizontally isolated, horizontally drawn-out type, truck mounted and ground operated.

The circuit breakers shall be suitable for following duties

- ⇒ To withstand inrush magnetizing currents of transformers and capacitor bank 'ON' and 'OFF' operation.
- ⇒ Transient surge produced by one CB due to severe chopping during rapid interruptions of inductive current e.g motors, shall be within limits allowable for overhauled motors according to IEC34 part 1 otherwise suitable surge absorber shall be provided.
- The controls, indicating lamps, relays and meters shall be mounted on separate control & relay panel.
- Operation counter, close/open mechanical indications spring charged/ discharged indication shall be provided.
- All circuit breakers shall have motor operated spring charged mechanism for closing and shunt tripping coil (30V DC). Closing coil shall be suitable to operate between 85% to 110% of rated voltage and tripping coil between 70-110% of rated voltage. Spring charging motor shall operate between 85-110% of rated AC. Voltage.
- Jumpers in the cubicle also shall be of same current rating as that of the breaker. Only the jumpers connected to CT shall be rated according to CT rating.
- A manually operated device to enable charging of closing springs.
- Manual / Mechanical tripping arrangement for emergency tripping of CBs.
- All circuit breaker truck shall have service, test and draw out positions. Test position shall engage only the auxiliary (control) contacts to close the CB during testing.
- Panel door switch shall be provided for illumination inside panel.
- Anti pumping feature shall be provided.
- All live parts shall be insulated by heat shrinkable sleeve only.
- The cubicle shall be provided with a position changing gear arrangement in such a way that by engaging detachable device from outside the front door, it shall be possible to move the breaker truck and change position without opening the cubicle door. Facilities for pad locking in each position shall be provided.
- Each cubicle shall have mimic diagram with metal strip.
- Each cubicle shall be of compartmentalized construction and shall have separate compartments

for bus bars, CTs and outgoing cables, metering and protection devices.

- All circuit breaker trucks of same rating shall be identical in all respects (except metering and protective devices) and shall be interchangeable with similar breaker panel.
- Continuous earth bus shall be provided throughout the board.
- The position of various control switches, push buttons, and levers, etc. requiring manual operation shall be at a height not less than 450 mm and shall not exceed 1850 mm from the finished floor level.

In the design of the switchgear the following positive interlocking shall be provided.

1. It shall not be possible to move the truck from the isolated to the Service Position unless low voltage plug and socket connections have been made.
2. It shall not be possible to disconnect the low voltage plug and socket as long as the circuit breaker truck is in service position.
3. It shall not be possible to withdraw the truck without disconnecting the low voltage plug and socket.
4. It shall not be possible to move the truck from the service to the isolated position or vice-versa with the circuit breaker in the 'ON' position.
5. It shall not be possible to switch on the circuit breaker when the truck is in between the isolated and the service positions (except in test position).
6. It shall be possible to switch on the earthing switch only when the truck is in the isolated position, wherever an integral earth switch is provided.
7. It shall not be possible to open the circuit breaker enclosure when the breaker is ON or to have access to any part of the draw out assembly which is live when the circuit breaker is in the service position.
8. Shutters shall be lockable in closed position.
9. Where local/remote selector switches are called for, it shall be ensured that:
 - * The breaker can be closed locally only if the breaker truck is in the test position and the local/remote selector switch is in local position.
 - * The breaker can be operated from remote panel (in shop) only when the breaker truck is in service position and the local/remote selector switch is in remote position.
 - * The breaker can be tripped locally regardless of the position of the breaker truck.
 - *

Earthing Mechanism

The operating mechanism parts shall be designed to give longer life, trouble free operation and require minimum maintenance.

The material and components used shall have chopping current limited to minimum.

Insulation Levels

Insulation levels corresponding to the rated voltage shall be as follows:

| | |
|---|------------|
| Nominal voltage (kV) | 33 |
| Highest system voltage (kV) | 36 |
| One minute power frequency withstand voltage (kV) | 70 |
| 1.2/50 micro sec impulse withstand voltage (kV) | 170 |
| Clearance in air | As per IEC |

Short Circuit Strength

- Rated short time withstand current shall not be less than the system short circuit level specified for the stipulated duration.
- Rated peak withstand current shall not be less than 2.5 times the system short circuit level.

Auxiliary Buses for Control & Protection

1. Control supply buses for AC & DC.
2. Signaling supply.
3. PT secondary voltage.

4. Spare buses.**Provision of surge suppressor**

In case of breakers like VCB that give rise to over voltage surges due to current chopping phenomenon, surge suppressors to be provided at the load side terminals of the breakers to limit the switching surges to value limited for as per IEC.

Annunciation Schemes

- Flag indications for all faults for which individual protective relays have been specified.
- Warning signalling (as applicable) on individual panels:
 - a) All transformer warning / signalling conditions (group signal from corresponding transformer control panel / sub-station)
 - b) Loss of trip circuit supply
 - c) Earth fault.
 - d) Control supply failure
 - e) PT fuse failure / MCB tripping
- Emergency signalling for tripping of HT breakers on fault
- One common signal for warning and one signal for emergency from each panel to be wired to a common annunciation panel of the switchboard, where specified.
- Annunciators for warning and emergency aluminium condition on individual panels of solid state facia window type. Common audio aluminium with Accept, Reset, and Test push buttons for the switchboard where common annunciation panel is not specified. Audio aluminium to have distinct tones for warning and emergency.

Bus Bar and Connections

- Power buses shall be of EC grade aluminium alloy equivalent to E91E WP as per IS-5082-1981 or Copper. Both rectangular and Round busbar are acceptable .The busbars shall be tinned /silver plated at joints.
- The continuous rating of the main horizontal bus shall not be less than the rating of the incomer specified.
- The vertical bus rating shall be as follows:-

| | | |
|--------------|---|--|
| incomer | : | Not less than that of horizontal bus |
| For outgoing | : | Not less than that of the outgoing breaker, irrespective of relay setting. |

- Design ambient temperature shall be 50°C & final operating temperature under continuous operation in enclosure limited to 90°C by thermometer method.
- Both horizontal and vertical bus bars to be designed and supported to withstand the thermal and dynamic stress corresponding to rated short time and peak withstand current specified.
- Cross-section of main horizontal bus to be uniform throughout the switchboard and continuous in one transport unit.
- Bus bar arrangement as per IS 375.
- Phase identification by color in each panel.
- Bus bars (horizontal as well as vertical) shall be provided with heat shrinkable, non tracking, low absorption type sleeving conforming to international standards for full voltage for 33 kV, 11kV & 3.3kV switchboards.
- Bus bar support insulators of non-hygroscopic material having high impact and dielectric strength with an anti tracking contour.

Internal Control Wiring

- Control wiring shall be carried out by 1100V grade PVC insulated; single core multi stranded copper wire of minimum cross section 2.5 sq. mm. Similarly for CT circuits minimum cross section of 2.5 sq. mm shall be used.
- Flexible wire of 2.5 sq.mm shall be used from CT chamber to relay chamber and shall have

protection against heat and mechanical damage due to flash over. Use of heatproof sleeves and rigid conduit shall be made to run the control wires from back to front.

- Wiring and terminal arrangement for all panels shall be carried out as per approved scheme.
- Flexible wires protected against mechanical damage for wiring to door mounted devices.
- Wires identified at each end in accordance with schematic diagrams by interlocked type ferrules. These shall be firmly located so that these do not move.
- Color code for control wiring

| | |
|-----------------|--------------------|
| AC – Black | Earth wire – Green |
| DC – Light grey | Trip circuit – Red |

- All telemetering signals shall be wired to terminal strips.

External Terminations

Control Terminations

- 650V grade multi-way open type terminal blocks of non-tracking moulded plastic complete with insulated barriers, stud type terminals, washers, nuts and lock nuts and identification strips.
- All terminals going out of the switchboard shall be brought to a separate terminal board marked “External Termination”. These will be easily accessible.
- External terminal block shall be provided in the relay chamber with proper clamping facilities for cable dressing.
- Control terminals shall be suitable to receive two numbers 2.5 sq. mm copper conductor.
- 20% spare terminals in each control terminal block. Terminal blocks in separate groups shall be provided for DCS/PLC, remote control panels, transformer marshalling boxes, local push button stations, etc.
- Gland plate for control cables shall be of adequate size to accommodate and to facilitate glanding of all the control cables coming from external equipment.
- Terminal blocks shall be placed separately for internal looping and external looping.

Power Terminations

- Suitable for accepting cable/bus trunking as specified.
- Sufficient space and support arrangement inside each panel to accommodate HT cable termination kits and sealing kits suitable for the size and number of XLPE cables. Dummy panels to be provided adjacent to the switch panel, where the required number cable terminations cannot be accommodated in the cabling chamber of the main panel. Rear extension not acceptable.
- Where more than one cable has to be terminated per unit, the arrangement shall permit connection and disconnection of cables separately without disturbing other cables.
- Push – ON type/Heat-shrinkable type cable end terminations / straight-through jointing kits shall be used wherever required.
- Where specified the following cable termination accessories, suitable for the type, size and number of cables to be terminated, to be supplied with switchboard.
 - ⇒ Cable sockets with all HT terminals (sockets set at such an angle that cable tails can be brought up for termination with minimum bending and setting)
 - ⇒ HT cable termination and sealing kits
 - ⇒ Power cable termination facilities shall be designed to facilitate easy approach to CTs.
 - ⇒ Double compression type brass cable glands and crimping type tinned heavy duty copper lugs for HT, LT power and control cables.

Protection and Measurement

Electrical Protection

Selection of protective scheme will be based mainly on reliability, sensitivity, selectivity. All main protections shall be fast acting type in order to clear the faulty system from the healthy system in earliest possible time to minimise damage to equipment and ensure continuity of power supply.

Protective scheme requirement

- All the main protective relays shall be microprocessor based numerical and communicable type.
- Auxiliary relays, timers switches, etc. required to make the scheme complete shall be considered as part of the scope of work.
- All CT-PT shall be suitable for the relay-meter requirement – lead burden
- All CT-PT wires shall be brought to test terminal blocks before connecting to circuits.
- The circuits of various protections (coming from other panels) shall be connected to master trip relays through auxiliary relays (flag indicated).
- VAA type auxiliary relays shall be provided for each transformer fault. Connection of the relay shall be through links to facilitate maintenance.
- Relay ranges and scale of meters shall be finalized during drawing approval stage.
- Contact arrangement, number of poles/ways in control/selector switches shall be as per the requirement/approved scheme.
- ICTs whenever considered necessary shall be included in the scope
- For control supply distribution, panel to panel separate set of terminal blocks shall be provided at top of the panel. All items / accessories required for above in each panel and in incoming panels shall be provided by the supplier.
- All relays shall be hand/self-reset type with flag indication. NO/NC contacts for relays shall be as per the requirement of approved protection, annunciation and interlock schemes. Wherever required supplier shall provide auxiliary relays for contact multiplication.
- Annunciation facia shall be mounted on Incomer switchgear panels and details shall be finalized during drawing approval stage.
- Centre line of switches, lamps, meters shall be matched to give uniform appearance and mounting height of switches shall be between 1.1 to 1.8 m.

Current Transformer (Panel Mounted)

- Separate sets of current transformers shall be used for differential protection and separate cores shall be used for, over current protection and measurement purposes. CT's on incomer side shall be mounted before incomer breaker and CT's for outgoing feeder shall be mounted after the breaker.
- Short time ratings and insulation level of CT's shall be similar to rating of associated breaker.
- CT ratios specified are provisional. Where outputs and accuracy are not specified, these shall be such as may be required by the circuits in which they are used. Generally the protection CT's and metering CT's shall have 5P20 and 0.5 class respectively.
- CT's shall be bar/ window primary type.
- CT's shall have shorting link on secondary side to facilitate insertion of meters on secondary side without opening CT circuits.
- CT Ratio shall be as marked on the Single Line Diagram attached with this Specification.

Potential Transformers

- Fixed type line PT mounted in separate panel shall be acceptable. However, if line PT is located in incomer breaker panel, draw out type PT shall be considered.
- High voltage side of PTs shall have fuses and MCCB's on low voltage side
- Low voltage star winding shall have all three phase and neutral connections brought out to terminals and one phase shall be earthed.
- Insulation levels shall be similar to rating of associated board.
- Accuracy class 1.0 shall be used.
- VA burden shall be selected based on meters and relays connected with the PT.

Relays

- Relays shall be Microprocessor based numerical and communicable type. Protocol for communication shall be IEC 61850.
- All relays shall be flush mounted in dust proof cases and shall be mounted on front side of cubicle.

- Major relays are as indicated in the specification or single line diagram.
- Master trip relay shall be hand reset and shall have 3 NO and 3 NC contacts in addition to those required by the protection/control scheme.
- All timers and protection relays shall have flag indicators.
- Relay ranges, exact type, number of aux. relays, timers shall be finalized during drawing approval stage.
- All instantaneous current protection relays shall be of 3 pole type.

Indicating Instruments

- All indicating instruments shall conform to IS: 1248-1983 and IS – 2419-1979.
- Shall be capable of withstanding system fault current taking into account CT saturation.
- Shall be back connected.
- Shall be located in the upper part of the panel.
- Shall have 96 sq. mm square flush case, non-reflecting type, clearly divided and indelibly marked scales, sharply out lined pointers and zero adjusting device.
- The minimum scale reading shall not be more than 10%. Maximum reading shall be 150% full load for transformers panels.
- Each voltmeter shall be calibrated with coil hot. The scale shall be open between 60% to 125% of normal volts and shall be suppressed below 60% of normal volts.
- Class of accuracy shall be 1.0 or better.
- The full load reading of each ammeter shall occur at the most prominent part of the scale. The minimum scale reading shall not be more than 10%. Maximum reading shall be 150% full load for transformer panels and 600% full load for motor panels.

Annunciators

- Shall be of static type.
- Hooter and bell for trip and alarm indication respectively.
- Shall be suitable to work on DC supply as specified.
- Test, accept and reset facilities (with push button) shall be provided on each panel.
- Suitable audio – visual indication shall be provided on DC failure. Audio alarm with reset facility shall be provided. Visual indication shall be panel- wise.
- Spare annunciation points shall be wired upto terminal blocks. 20% spare facias shall be provided.
- Each point shall have two bunch LEDs in parallel.
- All trip points facia shall have red color and non trip points white color.
- The cover plate of facia shall be flush with panel
- Shall be capable to receive simultaneous signals
- Shall be capable to receive signal during testing mode
- Scope of supply includes all interconnections, bell hooter, buzzer, alarm facility, push button etc. required to achieve complete function of above scheme.
- Sequence shall be as follows:

| | Visual | Audio |
|------------------------|------------------|-------|
| On occurrence of fault | Lamp flashing | on |
| On acceptance | Lamp steady “on” | off |
| On reset | Off | off |
| On test | Lamp flashing | on |

- Annunciation in the switchboard shall have following provisions:
 - Each transformer & other feeder shall have 12-way uniform facia.
 - Each bus PT shall have 12-way uniform facia.
- Bus coupler or tie shall have sufficient facia (for each feeder to indicate tripping +20% spare)
- One common point shall be provided to indicate operaton of annunciation system of the complete board (in case of any trouble in the board in tie feeder, bus coupler, incomer etc.)
- All auxiliary relays of transformer feeders shall have 4 NO contacts all master trip relays shall have

2 NO contacts for remote/DCS/PLC indication for repeat annunciation in addition to contacts required for scheme under scope of works.

Control supply

- Control supply buses shall run throughout the switchgear.
- Two DC feeders shall be taken in each board controlled by MCCB's.
- In each panel for controlling of its DC supply MCCB (DC duty) shall be used. DC auto changeover and manual changeover facility shall be provided. Failure of DC supply shall be monitored in the switchboard as well as at remote.
- 240V AC shall be taken from station aux. board.
- Each section shall have separate feed with automatic change over scheme.
- Each panel shall have one MCB for controlling its AC supply.
- Sub circuits shall be protected with HRC fuses/ MCB in each panel for indication lamps, closing & tripping circuits.

Earthing Devices

- Either integral earthing switch or a separate earthing switch shall be provided to facilitate earthing of busbars and any feeder circuit.
- Earthing truck (if included) shall have PT and alarm provision. (Separate trucks shall be provided for feeder and bus earthing through bus PT panel in each switchboard). One no. earthing truck for feeder earthing and one no. for busbar earthing shall be provided for each board. It shall not be possible to use bus-earthing truck for feeder earthing and vice-versa.
- Rating of earthing device shall be in line with associated board.
- Interlock provision shall be there so that incomer cannot be closed if bus-earthing device is connected.
- In case feeders are having integral earth switch, earthing trucks may not be required.

Control and Selector Switches

- Control switches for circuit breaker ON/OFF control – 3 position spring return to neutral with lost motion device and pistol grip handle.
- Other control and selector switches – stay put type with wing type knobs.
- Ammeter selector Switches- 4 position, make before break.
- Voltmeter selector switches- 7 positions as required.
- Colour : Black
- Contact Rating:

| | |
|------------|-----------------------|
| Continuous | 10 amps |
| AC11 | 4 amps, 240V |
| DC11 | 0.5A, 30V, L/R- 40ms. |

Push buttons

Contact Rating

| | |
|------------|-----------------------|
| Continuous | 10 amps |
| AC11 | 4 amps, 240V |
| DC11 | 0.5A, 30V, L/R- 40ms. |

COLOR:

| | |
|--------|--------|
| ACCEPT | BLUE |
| RESET | BLACK |
| TEST | YELLOW |

Control Circuit Fuses:

HRC link type conforming to IS 9224-1979.

Protective Earthing

- Continuous earth bus of minimum size 50x6 mm of copper or equivalent aluminium/galvanized steel section, designed to carry the peak short circuit and short time fault current as specified.
- Provided at the bottom extending throughout the length of the board, bolted/brazed to the frame work of each panel with an earthing terminal at each end for terminating external earth conductor.
- Vertical earth bus for earthing individual functional units.
- Hinged doors earthed through flexible earthing braid.
- Looping of earth connection resulting in loss of earth connection to other devices when the loop is broken not permitted.
- Withdrawable units provided with self aligning, spring loaded, silver plated copper scraping earth contacts of make before/break after type, ensuring earth continuity from service to the test position.

Test and Maintenance Equipment

Each board to be supplied with 1 set of test plugs.

Constructional Features

Mechanical Design

- Sheet steel clad, compartmentalized, floor mounted, free standing design.
- Minimum sheet steel thickness: doors and covers – 2 mm cold rolled, other load bearing members – 2.5 mm
- Doors shall be provided with lock and key arrangement
- Degree of protection shall be IP5X.
- Assembled on base channel of structural steel ISMC 75 painted black.
- Operating height shall be between 450 to 1800 mm. Switchboard height not to exceed 2500 mm.
- Earthed metallic barriers between compartments and between vertical sections.
- Seal off bushings wherever bus bars pass through metallic partition.
- Lockable front doors with concealed hinges with door not forming part of the draw-out truck.
- Panels shall be extensible on both sides.
- Removable sheet steel covers shall be provided at rear.
- Explosion vent for each chamber
- Control cables entry shall be from front side.
- CTs shall be located in such a way that they are easily accessible.
- Panel door switch shall be provided for illumination inside the panel.
- All live parts shall be insulated by taping, supported by suitably designed insulators. Proper insulation of bus bars, upper and lower contacts of breakers and sealing of opening of bushings shall be provided to eliminate accidental contacts.
- Screw wire mesh in the power cable chamber of incoming feeder is to be provided.

A) INDOOR 33KV HT VCB PANEL

This includes, Design, fabrication, supply, installation, testing and commissioning of HT panel indoor 33KV, 1250Amps, 3phase, 50Hz, 25KA VCB for 3sec.

Incoming Feeder with PT:

This includes supply at site, Vacuum Circuit Breaker, suitable for 33KV, 25KA, 1250A, 500MVA, 3 Phase, 50 HZ effectively earthed, neutral system comprising of proper housing of breaker, safety shutters, isolating plugs and socket and VCB trolley with 3 nos. Vacuum Interrupters with safe aligning finger type, isolating contacts suitable for vertical/horizontal isolation and horizontal draw out. Necessary control Protection and metering circuits are completely assembled, wired and enclosed in a weather and dust proof cubicle.

The HT Panel shall be made of sheet steel enclosure, dust and vermin proof, suitable for indoor use. This shall be

suitable to receive power at 33 KV, 50 Hz, 3 phase AC with all equipment fittings and accessories for efficient and trouble free operation.

- a) 33KV, 1250A VCB The self-tripping mechanism with numerical relay with IDMT, over current, earth fault and Instantaneous protection including TVM, MFM and all others panel's indications lamps.
- b) Incoming cable entry box shall be provided for the required cable entry.
- c) Insulation level
 - i) 1.2/50 microsecond Impulse withstand 170 kV peak voltage
 - ii) One minute power frequency withstand 70 kV rms voltage
- d) Rated current
 - i) Continuous

| | |
|-------------------------------------|--------|
| - Bus bar | 1250 A |
| - Incoming/outgoing circuit breaker | 1250 A |
 - ii) Short time current for 3 seconds 25 kA rms
- e) Circuit breaker
 - i) Rated breaking capacity Symmetrical. 25 KA / 3 Sec.
 - ii) Rated making capacity 62.5 KA
 - iii) Total breaking time 7 cycles maximum
 - iv) Operating sequence As per IS/IEC
- f) Type of charging: Manual as well as motorized mechanism with 230V AC operated motor.
- g) Make : As per the list of makes enclosed herewith.
- h) Shunt trip coil : 30 V DC
- i) Closing coil : 30 V DC
- j) Busbar chamber with Copper busbars, heat shrinkable PVC sleeved/ powder coated with colour code. The busbars shall be of high conductive electrolyte copper.
- k) 230VAC space heaters with ON-OFF switch and thermostat.
- l) 1phase, resin cast with fuse unit, draw out, line connected PT ratio of 33000/ $\sqrt{3}$ /110 / $\sqrt{3}$ Volts of 100VA burden to meet with auxiliary power requirement of metering and protection. Having accuracy of 0.5/3P.
- m) Epoxy cast resin CTs with 15VA burden, STR of 25 KA for 1 sec., metering accuracy class 0.5 and protection accuracy 5P20 and having of CTR 400-200/5-5A.
- n) The Trivector meters shall be digital type of approved make and it should display Amps, Volts, KVA, KW, KWHr, KVAR, PF and MD etc. The meter shall provide with external port for remote monitoring.
- o) The Multi-Function Meter (MFM) shall be digital type of approved make and it should display Amps, Volts, KVA, KW, KWHr, KVAR, PF, Frequency and etc. The meter shall provide with external port for

remote monitoring.

- p) Breaker ON-OFF LED indicating lamp.
- q) Circuit trip/healthy indicating LED lamp with pushbutton.
- r) Breaker spring charged LED lamp indication.
- s) TNC (Trip Neutral Close) switch.
- t) Numerical relays consist of IDMTL + Inst 3 O/C + Inst E/F relay.

VAX – 31 Trip circuit supervision.

VAJH – 23 master trip.

Numerical relay shall be compatible with SCADA and shall have event logging features.

- u) Operating handle, spring charging handle and other required accessories shall be supplied.
- v) Cable box suitable for receiving single length of 2Runs of 3C x 120 Sq. mm HT XLPE cable.
- w) Hand held lamps for panel internal illumination shall be provided with 240V AC source.
- x) Hooter for tripping.
- y) 30V DC external supply shall be provided for control circuit of complete breaker operation.
- z) Bus bar support insulator:-Non hygroscopic, track resistant, high strength insulator. (Calculation for validating dynamic force withstands capability to be submitted during drg. Approval)

Outgoing Feeder (Without PT):

Technical Specification shall be similar to Incoming feeder, but without PT. The electro-mechanical type auxiliary relay for transformer shall be provided.

Numerical type Differential relay for all transformer feeders shall be provided.

The VCB shall be complete with necessary interconnection with fine feruled wiring, foundation bolts, earthing, etc. The VCB shall be supplied to conform to relevant IS, amended up to date, along with manufacturers test certificate. Required no. of Danger board /Stickers of HT voltage in two languages English/Hindi is to be provided on the panel. Epoxy cast resin CTs with 15VA burden, STR of 25 KA for 1 sec., metering accuracy class 0.5 and protection accuracy 5P20/PS and having of CTR 200-100/5-5-5A.

The necessary approval of the drawing of VCB panel shall be obtained from HDC before fabrication. Panel shall be connected with earthing as per IER.

INSTALLATION OF INDOOR HT VCB PANEL:

This includes installations, testing and commissioning of VCBs at 33KV sub-station VCB with P.T. as incomer and without PT as outgoing feeder.

All the VCB's shall be erected by using suitable size of M.S. channel, foundation bolts including grouting of the bolts of each VCB panel. Each panel shall be connected with separate and distinct Earthing. After installation of VCB panel, necessary test and trial are to be carried out for proper functioning of safety, devices, relay etc. and before charging VCB all the tests required under relevant ISS and IEC – Rules 1956 shall be carried out and the result shall be in conformity with specifications and copies of test results shall be furnished to EIC. The work includes all Labour & materials required for installation & commissioning of VCB and shall be done as directed by E.I.C.

Tentative lay out:-

| | | | | | | | |
|-------|---------------------------------|--------------------------------|----|-----------------------|---------------------------------|---------------|-------|
| I/C-1 | O/G- Tr-1 33/3.3, 6MVA | O/G- Tr-2 33/11, 6MVA | BC | O/G- Tr-3 spare | O/G- Tr-4 33/3.3, 6MVA | O/G- spare | I/C-2 |
|-------|---------------------------------|--------------------------------|----|-----------------------|---------------------------------|---------------|-------|

I/C-Incomer

O/G-Outgoing

BC – Bus Coupler

B) INDOOR 3.3KV HT VCB PANEL

This includes, Design, fabrication, supply, installation, testing and commissioning of HT panel indoor 3.3kV, 1250Amps, 3phase, 50Hz, 25kA VCB for 3sec.

- Incoming Feeder With PT:**

This includes supply at site, Vacuum Circuit Breaker, suitable for 3.3kV, 25kA, 1250A, 500MVA, 3 Phase, 50 HZ effectively earthed, neutral system comprising of proper housing of breaker, safety shutters, isolating plugs and socket and VCB trolley with 3 nos. Vacuum Interrupters with safe aligning finger type, isolating contacts suitable for vertical/horizontal isolation and horizontal draw out. Necessary control Protection and metering circuits are completely assembled, wired and enclosed in a weather and dust proof cubicle.

The HT Panel shall be made of sheet steel enclosure, dust and vermin proof, suitable for indoor use. This shall be suitable to receive power at 3.3 kV, 50 Hz, 3 phase AC with all equipment fittings and accessories for efficient and trouble free operation.

- 3.3kV, 1250A VCB The self-tripping mechanism with numerical relay with IDMT, over current, earth fault and Instantaneous protection including TVM, MFM and all others panel's indications lamps.
- Incoming cable entry box shall be provided for the required cable entry.
- Insulation level
 - 1.2/50 microsecond Impulse withstand 75 kV peak voltage
 - One minute power frequency withstand 28 kV rms voltage
- Rated current

- | | | |
|-----|-----------------------------------|-----------|
| i) | Continuous | |
| - | Bus bar | 1250 A |
| - | Incoming/outgoing circuit breaker | 1250 A |
| ii) | Short time current for 3 seconds | 25 kA rms |
- e) Circuit breaker
- | | | |
|------|--------------------------------------|------------------|
| i) | Rated breaking capacity Symmetrical. | 25kA / 3 Sec. |
| ii) | Rated making capacity | 62.5 kA |
| iii) | Total breaking time | 7 cycles maximum |
| iv) | Operating sequence | As per IS/IEC |
- f) Type of charging : Manual as well as motorized mechanism with 230V AC operated motor
- g) Make : As per the list of makes enclosed herewith.
- h) Shunt trip coil : 30 V DC
- i) Closing coil : 30 V DC
- j) Busbar chamber with Copper busbars, heat shrinkable PVC sleeved/ powder coated with colour code. The busbars shall be of high conductive electrolyte copper.
- k) 230VAC space heaters with ON-OFF switch and thermostat.
- l) 1phase, resin cast with fuse unit, draw out, line connected PT ratio of $3300/\sqrt{3}/110/\sqrt{3}$ Volts of 100VA burden to meet with auxiliary power requirement of metering and protection. Having accuracy of 0.5/3P.
- m) Epoxy cast resin CTs with 15VA burden, STR of 25 kA for 1 sec., metering accuracy class 0.5 and protection accuracy 5P20/PS and having of CTR 1250-800/5-5-5A.
- n) The Trivector meters shall be digital type of approved make and it should display Amps, Volts, kVA, kW, kWhr, kVAR, PF and MD etc. The meter shall provide with external port for remote monitoring.
- o) The Multi-Function Meter (MFM) shall be digital type of approved make and it should display Amps, Volts, kVA, kW, kWhr, kVAR, PF, Frequency and etc. The meter shall provide with external port for remote monitoring.
- p) Breaker ON-OFF LED indicating lamp.
- q) Circuit trip/healthy indicating LED lamp with pushbutton.
- r) Breaker spring charged LED lamp indication.
- s) TNC (Trip Neutral Close) switch.
- t) Numerical relays consist of IDMTL + Inst 3 O/C + Inst E/F relay +REF.

VAX – 31 Trip circuit supervision.

VAJH – 23 master trip.

Numerical relay shall be compatible with SCADA and shall have event logging features.

- u) Operating handle, spring charging handle and other required accessories shall be supplied.
- v) Cable box suitable for receiving single length of 3C x 400 Sq. mm HT XLPE cable.
- w) Hand held lamps for panel internal illumination shall be provided with 240V AC source.
- x) Hooter for tripping.
- y) 30V DC external supply shall be provided for control circuit of complete breaker operation.
- z) Type of charging : Manual as well as motorized mechanism with 230V AC operated motor.
- aa) Bus bar support insulator:-Non hygroscopic, track resistant, high strength insulator.(Calculation for validating dynamic force withstand capability to be submitted during drg. Approval).

- **Outgoing Feeder (Without PT):**

Technical Specification same as Incoming feeder but without PT. The auxiliary relay for transformer shall be provided.

The VCB shall be complete with necessary interconnection with fine feruled wiring, foundation bolts, earthing, etc. The VCB shall be supplied to conform to relevant IS, amended up to date, along with manufacturers test certificate. Required no. of Danger board /Stickers of HT voltage in two languages English/Hindi is to be provided on the panel.

Epoxy cast resin CTs with 15VA burden, STR of 25 kA for 1 sec., metering accuracy class 0.5 and protection accuracy 5P20/PS and having of CTR 400-200/5-5-5A.

The necessary approval of the drawing of VCB panel shall be obtained from HDC before fabrication. Panel shall be connected with earthing as per IER.

INSTALLATION OF INDOOR HT VCB PANEL:

This includes installations, testing and commissioning of VCBs at 3.3kV sub-station VCB with P.T. as incomer and without PT as outgoing feeder.

All the VCB's shall be erected by using suitable size of M.S. channel foundation bolts including grouting of the bolts of each VCB panel. Each panel shall be connected with separate and distinct Earthing. After installation of VCB panel, necessary test and trial are to be carried out for proper functioning of safety, devices, relay etc. and before charging VCB all the tests required under relevant ISS and IEC – Rules 1956 shall be carried out and the result shall be in conformity with specifications and copies of test results shall be furnished to EIC. The work includes all Labour & materials required for installation & commissioning of VCB and shall be done as directed by E.I.C.

Tentative lay out:-

| | | | | | | | | | | | |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|-------------|--------------|
| EXISTING PANEL | EXISTING PANEL | EXISTING PANEL | EXISTING PANEL | EXISTING PANEL | EXISTING PANEL | EXISTING PANEL | EXISTING PANEL | EXISTING PANEL | DUMMY PANEL | I/C-Incomer | O/G-Outgoing |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|-------------|--------------|

I/C-Incomer O/G-Outgoing

6.3 BATTERY BANK AND BATTERY CHARGER

➤ TECHNICAL SPECIFICATIONS OF BATTERY

The 30 V DC Battery Bank should be consisted of 15 Nos., 2 V, 60 AH (at 10 Hour Rate) Cells (Maintenance free, Lead Acid type). The **Battery Bank** should be complete in all respect and equipped with all necessary accessories like, **Inter-cell Connectors (Copper)**, **Connecting Leads**, etc. The spares / attachments, which are meant necessary for the smooth functioning of the equipment and specially are not mentioned here shall be assumed to be included in the scope of supply.

Battery racks suitable for accommodating 15 cells should be supplied & installed by the Contractor. The racks should be made of wood and to be so designed and placed as to permit easy handling of the cells while in operation.

The wooden battery racks should have acid resisting and flame proof coating.

➤ TECHNICAL SPECIFICATIONS OF BATTERY CHARGER :

- i) The **Battery Charger**, to be used for charging **30 V, 60 AH Battery Bank**, should be of **Float-cum-Boost Charger** Type, having provision for **auto Changeover** from **Boost to Float & vice-versa** and following Technical features:-

- Should be suitable for Indoor installation and to be supplied with all accessories.
- Should have facility to regulate the Battery Charging current and output voltage as per requirement (to be indicated by the Manufacturer of the Battery Bank) and limiting the total current within the maximum capacity of the charger.
- Should have provision for automatic switching to ensure different applications of both 33 kV & 3.3 kV Panels to be installed at the existing G.C. Berth Substation & newly constructed 3.3 kV Switch-Station. Suitable control arrangement is to be provided to ensure that output D.C. voltage is always within the limits specified, even if the cell voltage is high.
- Should be suitable for operation in **Manual Mode**, besides the **Auto Mode**. Suitable device is to be provided for adjusting charging current and voltage when the charger is to be operated in Manual Mode.

ii) **Other Technical Particulars :**

- Output Voltage:**

Nominal: 30 V DC
Maximum: 36 V DC
Minimum: 24 V DC

b) **Charging Current :**

Maximum continuous output current: 16 Amps

Maximum continuous D.C. Load: as per requirement.

Maximum Battery Charging Current: to be indicated by the manufacturer of the Battery Bank.

c) **Type:** Solid-state, both Auto & Manual Control.

d) **Input Voltage:** 230 V – 250V A.C., Single Phase.

e) **Input Frequency:** 50 Hz \pm 5%.

iii) **Protection :**

a) The charger shall be protected against following conditions with provision of delayed protective and / or indicative action as per scheme requirement.

b) Input Voltage Surge.

c) Input over / under voltage.

d) Output over / under voltage / short circuit / over load.

e) Earth fault in + ve and – ve D.C. output.

f) Battery reverse polarity.

iv) **The Charger shall incorporate the followings :**

a) M.C.B. for incoming / outgoing supply

b) H.R.C. / glass cartridge / semi conductor fuses for different circuits. All fuses shall be properly labelled for proper identification.

c) Surge Arrestors.

v) **Indication :**

The charger shall be provided with following L.E.D. indications to identify abnormalities through incorporation of suitable scheme.

a) Mains ON

b) Output ON

c) Input over / under voltage and power supply fail.

d) Output over / under voltage.

e) Earth Fault

f) Battery reverse polarity

All indicating LED lamps, switches, control knobs, terminal blocks, etc., shall be properly labelled for easy identification.

vi) **Meters :**

Following meters with selector switches shall be provided to measure the following:

a) Analogue Ammeter. Of appropriate scales with Selector Switch for measuring battery float / boost charging current and output current.

b) Analogue Voltmeter of appropriate scales with Selector Switch for measuring battery and output voltage.

c) Analog Voltmeter for measuring input AC Voltage.

vii) **Control :**

Following controlling arrangement shall be provided for different functions of battery charger:

- a) AUTO/MANUAL Selector Switch
- b) Manual operation controlling device
- c) Mains ON
- d) Output ON
- e) Voltmeter Selector Switch
- f) Ammeter Selector Switch

viii) **Enclosure :**

The chargers shall be enclosed in floor mounted type enclosure with provision for proper ventilation.

ix) **Two sets of Instruction Manuals for Erection, Operation & Maintenance, two sets of Drawings for Equipment Details and two sets of Circuit Diagram** should be submitted along with the above Battery Charger unit.

6.4 CABLE TRAY

GI Cable tray

Cable tray shall be prefabricated Trays should be made of M.S Angle of size 50 mm. x 50 mm. x 6 mm. for both side runner with Spans Limited to 2.5 meter(approx.). Cross Support should be of M.S Flats of size 450 mm. x 32 mm. x 6 mm. (approx.) welded to Runner Angle at 300 mm. (approx.) apart. After fabrication the same shall be Hot dip galvanised to achieve thickness of galvanisation shall be as per IS.

Perforated cable trays for control wiring shall also be Hot dip galvanised to achieve thickness of galvanisation shall be as per IS.

Suitable covers shall be provided on cable trays to be fixed outside trenches.

7.0 EARTHING SYSTEM

7.1 General

Only Plate Earthing shall be adopted. The earthing and lightning protective systems shall comply with all currently applicable standards, regulations and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be construed to relieve the Bidder of this responsibility. Wherever the word GI is used it means that hot Dip GI.

Earthing Strip shall be of **hot dip GI** of size **50mmx6mm for Body & of Copper 50mmx6mm for Neutral** protected against corrosion and readily accessible. The strip shall be connected to earthing terminals with Stainless Steel nut – bolts. **The strip shall be clamped with Aluminum saddles and stainless steel nut-bolts. The Cost of Strip and required accessories, labour shall be included in the overall cost (offer).**

The installation work shall conform to the latest applicable Electricity Rules, standards (IS:3043) and codes of practices.

- After award of the Contract, the Contractor shall, carry out soil resistivity measurements at the site. A detailed earthing design shall be submitted for approval based upon the results of these tests.
- The total resistance of the earth grid shall be less than 1 ohm.

- The earthing & lightning conductors and electrodes shall be supplied. Conductors shall be free from rust, scale and other electrical and mechanical defects and all materials used shall conform to relevant standards or approved by the Employer. The sizes, materials and quantity shall be as listed.
- Copper earthing stranded conductors shall be annealed soft drawn type. Copper earthing rods and flats shall be hard drawn type. Lead coating shall be provided on copper conductors to prevent its corrosion in aggressive environments.
- Steel earthing conductors above ground shall be hot-dip galvanized, unless otherwise stated, to prevent atmospheric corrosion. If painted steel conductors are required they shall be painted with two coats of approved anti-corrosive paint.
- Flexible braids of sizes & materials shall be supplied for earthing of operating handles of isolators and earthing of equipment on moving platforms.
- The links in suitable enclosures shall be supplied for connection between each lightning conductor down comer and earth electrode.
- Cad welding type jointing equipment shall be supplied whenever specifically indicated.

7.2 Scope of Installation Work

The successful Bidder shall install bare/insulated, copper/aluminium conductors, braids, etc., required for system and individual equipment earthing. All work such as cutting, bending, supporting, painting/coating drilling, brazing/soldering/welding, clamping, bolting and connecting onto structures, equipment frames, terminals, rails or other devices shall be in the scope of work. All incidental hardware and consumable such as fixing cleats/clamps, anchor fasteners, lugs, bolts, nuts, washers, bitumastic compound, anti-corrosive paint as required for the complete work shall be deemed to be included as part of the installation work.

The scope of installation of earth conductors in outdoor areas, buried in ground shall include excavation in earth upto 600 mm deep and 450 mm wide, laying of conductor at 600 mm depth (unless stated otherwise), brazing/welding/cadwelding as reburied of main grid conductor joints as well as risers of 500 mm length above ground at required locations and backfilling. Backfilling material to be placed over buried conductor shall be free from stones and other harmful mixtures. If the excavated soil is found unsuitable for backfilling, the Bidder shall arrange for suitable soil from outside.

The scope of installation of earth connection leads to equipment and risers on steel structures/walls shall include laying the conductors, welding/cleating at specified intervals, welding/brazing to the main earth grids' risers, bolting at equipment terminals and coating welded/brazed joints by bitumastic paint. Galvanized conductors shall be touched up with zinc rich paint where holds are drilled at site for bolting to equipment/structure.

The scope of installation of electrodes shall include installation of these electrodes such as (a) directly in earth, (b) in constructed earth pits, and connecting to main buried earth grid, as per enclosed drawings/relevant standards. The scope of work shall include excavation, construction of the earth pits including all materials required for construction of the earth pits and connecting to main earth grid conductors.

The scope of installation of lightning conductors on the roofs of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods where necessary, laying, and fastening/cleating/welding of the down comers on the wall/columns of the building and connection to the test links above ground level.

Normally an earth electrode shall not be situated less than 2m from any building. Care shall be taken that the excavations for earth electrodes may not affect the column footing or foundation of the building. In such cases, electrodes may be further away from the building.

The location of the earth electrodes shall be such that the soil has reasonable chances of remaining moist, as far as

possible. Entrances, pavements and roadways are definitely avoided for locating the earth electrodes.

The scope of installation of the test links shall include mounting of the same at specified height on wall/column by suitable brackets and connections of the test link to the earth electrode.

7.3 Work Details

Earthing conductors along their run on walls and columns shall be supported by cleating/welding at intervals of 750 mm and 1000 mm respectively.

Wherever earthing conductors cross underground service ducts and pipes, it shall be laid 300 mm below; the earthing conductor shall be bounded to such service ducts/pipes.

Wherever main earthing conductor crosses cable trenches, they shall be buried below the trench floor.

Suitable earth risers approved by the Engineer-in-Charge shall be provided above finished floor/ground level, if the equipment is not available at time of laying of the main earth conductors. The minimum length of such riser inside the building shall be 200 mm and outdoors shall be 500 mm above ground level. The risers to be provided shall be marked in project drawings.

Earth leads and risers between equipment earthing terminals and the earthing grid shall follow as direct and short a path as possible.

Neutral connection shall never be used for the equipment earthing.

Each neutral point of a transformer shall be earthed to two separate earth electrodes for connection with earthing system.

Shield wire in sub-stations shall be connected to the earthing grid through test links at every alternate switchyard portal tower.

A separate earth electrode bed shall be provided adjacent to structures supporting lightning arrestors and coupling capacitors. Earth connections shall be as short and as straight as practicable. For arrestors mounted near transformers, earth conductors shall be located clear of the tank and coolers.

Wherever earthing conductor passes through walls, galvanized iron sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed by the Bidder by suitable water proof compound. Water stops shall be provided wherever earthing conductor enters the building from outside below grade level. Water stops and above mentioned sleeves shall be provided by the Bidder.

7.4 Earthing Connections

All connections in the main earth conductors buried in earth/concrete shall be welded/brazed type. Connection between main earthing conductor and earth leads shall also be of welded/brazed type. Cadwelding type connections shall be done if specifically indicated.

Connection between earth leads and equipment shall be of bolted type, unless specified otherwise or shown in the drawings. Equipment Bidders shall provide earthing terminals on their equipment.

Welding and brazing operations and fluxes/alloys shall be of approved standards.

All connections shall be of low resistance. Contact resistances also shall be minimum.

All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.

Metallic conduits and pipes shall be connected to the earthing system unless specified otherwise.

7.5 Earth Electrode

Electrodes shall as far as practicable, be embedded below permanent moisture level.

Electrodes shall be housed in test pits with concrete covers for periodic testing of earth resistivity. Installation of rod/pipe/plate electrodes in test pits shall be convenient for inspection, testing and watering wherever required.

7.6 Plate Earth Electrode

For plate electrode minimum dimension of the electrode shall be as under:-

- Copper plate electrode 60 cm x 60 cm x 10 mm thick

Heavy duty cast iron frame with cover shall be suitably embedded in the masonry.

Soil, salt and charcoal placed around the electrode shall be finely graded, free from stones and other harmful mixtures. Backfill shall be placed in the layers of 250 mm thick uniformly spread and compacted. If excavated soil is found unsuitable for backfilling, the Bidder shall arrange for a suitable soil from outside.

7.7 Method of Connecting Earthing Lead to Earth Electrode

In the case of plate earth electrodes, the earthing lead shall be securely bolted to the plate with two bolts, nuts, check-nuts and washers.

All materials used for connecting the earth lead with electrodes shall be GI in case of GI pipe and GI plate earth electrodes and of copper in case of copper pipe / plate electrodes.

The earthing lead shall be securely connected at the other end to the main board.

7.8 Size of Earthing Conductor

The earthing system shall be designed in such a way that over all earth resistance is less than one ohm. The soil resistivity shall be measured at site by the Bidder. If required, number of earth electrodes to be increased by the Bidder to achieve the required earth resistance.

8.0 LIST OF APPROVED MAKES

| SL.No. | ITEM | Name of Manufacturers |
|--------|------------------------|---|
| 1 | Transformer | ABB/VOLTAMP / BHARAT BIJLEE/CGL/ SIEMENS/ SCHNEIDER |
| 2 | VCB Panel | SIEMENS / ABB / SCHNEIDER / |
| 3 | HT Cable | RPG / APAR INDUSTRIES / TORRENT / HAVELLS / UNISTAR/POLYCAB |
| 4 | LT Cable (XLPE) | UNISTAR / HAVELLS / RPG / APAR INDUSTRIES/ TORRENT/POLYCAB |
| 5 | Outdoor CT | SCHNEIDER / JYOTI / KAPPA / PRAGATHI |
| 6 | Outdoor PT | SCHNEIDER / JYOTI / KAPPA / PRAGATHI |
| 7 | Volt meter and Ammeter | AE / MECO / YOKINS / NIPPEN |

| | | |
|----|--|--|
| 8 | PCVCB | SCHNEIDER / SIEMENS / ABB / CGL |
| 9 | Gang Isolator | A BOND STAND/ Any reputed make. |
| 10 | LA | OBLUM / LAMCO / ELEKTROLITES |
| 11 | LT Panels | SIEMENS / L&T / SCHNEIDER / ABB |
| 12 | Cable St.through jointing / end Termination Kit | 3M / RAYCHEM /DENSON |
| 13 | Battery | HBL/EXIDE/AMARON/ AMCO |
| 14 | Selector switches, Push buttons, Emergency Switches | KAYCEE / L & T / GE / BCH / LEGRAND |
| 15 | HRC Fuses | L & T / GE / SIEMENS / ABB / INDO KOPP |
| 16 | Indicating light | AE / KAYCEE / VAISHNAV / L & T /SIEMENS |
| 17 | MCB | L & T / LEGRAND / SIEMENS / ABB / SCHNEIDER |
| 18 | Sub Distribution Board | L & T / LEGRAND / SIEMENS / SCHNEIDER / HENSEL |
| 19 | EL MCB | L & T / SCHNEIDER / LEGRAND / SIEMENS / ABB |
| 20 | PVC insulated copper conductor single/multi core stranded wires of 650/1100 volt grade | HAVELLS / FINOLEX / RPG /UNIFLEX /NICCO /RR Kables |
| 21 | Steel Conduit/PVC Conduit | BEC / AKG / NIC |
| 22 | Switches, TV & Telephone Socket outlets, Boxes | MK / CLIPSAL / LEGRAND / NORTH WEST /ANCHOR |
| 23 | Light Fixtures(LED) | PHILIPS / BAJAJ / WIPRO / CROMPTON/HAVELLS |
| 24 | Cable lug & Cable Gland | DOWELLS / JHONSON / RAYCHEM |
| 25 | Terminal Blocks | WAGO & CONTROLS / PHOENIX CONTACTS / OBO BETTERMANN |
| 26 | Lightning Protection | DUVAL MESSIEN / SOUTH ASIAN ENTERPRISE LTD. / OBO BETTERMANN |
| 27 | Multi-function Meter | ABB / SIEMENS / L&T / HPL SOCOMEC/CONZERVE (ENERCON) |
| 28 | DWC HDPE Pipe | DURA LINE / CARLON / EMTELLE |
| 29 | Contactors | L&T / SCHNEIDER / SIEMENS/ABB / BCH |
| 30 | MCCB | L&T / SIEMENS / SCHNEIDER / ABB |

| | | |
|----|------------------------------------|--|
| 31 | Push Buttons | SIEMENS / ABB / TELEMECANIQUE / L&T / SCHNEIDER |
| 32 | Relays(Numerical/electro-magnetic) | ABB / SIEMENS / SCHNEIDER/AREVA |
| 33 | Timers | L&T / SIEMENS / TELEMECANIQUE/ABB |
| 34 | Indicating Light | L&T / SIEMENS / TELEMECANIQUE / ABB / GE |
| 35 | Indicating Instruments | AE / MECO / CONZERVE / L&T |
| 36 | Panel CTs | L&T / AREVA / JYOTI/ KAPPA / PRAGATHI |
| 37 | Panel PTs | AREVA / KAPPA / PRAGATHI |
| 38 | ACB | SCHNEIDER / SIEMENS / ABB / L&T |
| 39 | Selector Switch | KAYCEE / L&T / SIEMENS / BCH / GE / SALZAR |
| 40 | Capacitor Banks | EPCOS / L&T / UNIVERSAL/ABB |
| 41 | Trivector Meter (Digital) | L&T / SCHNEIDER / SIEMENS / HPL SOCOMEC |
| 42 | Capacitor Panels | ABB / L&T / EPCOS / SCHNEIDER |
| 43 | Power Factor Correction Relay | EPCOS / L & T / ABB |
| 44 | Elastomeric Mat | PREMIER POLYFILM LTD / POLYELECTROSAFE / CHALLENGER |
| 45 | Structure | JINDAL/ SAIL / TISCO |
| 46 | MS & GI Conduits Accessories | STEEL MARK / NIC |
| 47 | Insulator | Aditya Birla/APAR Industries |
| 48 | ACSR | APAR Industries/Sterlite Power/Lumino Industries/ Gupta Power/Alcon |
| 49 | Hardware fitting | Reputed make as per sample approved by the Engineer |
| 50 | Items not covered above | As per samples approved |

9.0

INSPECTION AND TESTING.

Equipment will be duly inspected in the manufacturer's works / premises **by TPI Agency** before dispatch to the site. **Cost of TPI Agency will be borne by the Port.**

Inspection of the items to be supplied by the contractor will be carried out **by the TPI Agency or representative of Engineer prior to despatch**, as per the procedure mentioned in the relevant Item. Such inspection will be carried out within 10 days from the date of receipt of Inspection Call from the contractor.

The Engineer of the Contract reserves the right to waive inspection at Manufacturer's premises (witnessing tests) and to inspect (physically) the materials at site, after delivery, against Manufacturer's Internal Test

Certificate.

The job of installation and commissioning will be inspected by the **representative of Engineer in different stages** and also after completion of the job. For this, the contractor shall have to submit a **Field Quality Assurance Plan (FQAP)**, which will be subsequently approved by the Engineer and the inspection will be carried out in accordance with the approved FQAP.

Inspection and Testing by the representative of **Engineer** shall not relieve the successful bidder of their obligation for supplying the items and execution of the entire work in accordance with the **Contract Condition** and relevant **Acts, Rules and Codes of Practice**.

9.1 33kV Porcelain Clad Vacuum Circuit Breaker :

- a) **Routine Tests** (as per IS: 13118) will be witnessed by the representative of Engineer at Manufacturer's works before despatch.
- b) Manufacturer's Certificate for **Type Test** (as per IS: 13118), for similar type equipments, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection.

9.2 33kV Outdoor Current Transformer :

Following tests will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch:-

- a) **Routine Tests** as per IS: 2705.
- b) **Verification of Terminal Markings and Polarity** as per IS:2705

Manufacturer's Certificate for **Type Test** (as per IS: 2705), for similar type equipments, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection.

9.3 33kV Outdoor Potential Transformer :

Following tests will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch:

- a) **Routine Tests** as per IS:3156
- b) **Verification of Terminal Markings and Polarity** as per IS:3156

Manufacturer's Certificate for **Type Test** (as per IS: 3156), for similar type equipments, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection.

9.4 33kV LA :

Following tests will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch:

- a) **Routine Tests** as per IS:3156
- b) **Verification of Terminal Markings and Polarity** as per IS:3156

Manufacturer's Certificate for **Type Test** (as per IS: 3156), for similar type equipments, should be made available to **the TPI or** the representative of Engineer during the above inspection.

9.5 Indoor Control and Relay Panel :

Inspection will be carried out by **the TPI Agency or** the representative of Engineer before despatch. Manufacturers' Test Certificates for the components like **Relays, Ammeter, Voltmeter, Static kWH Meter & Maximum Demand Meter, Static TRIVECTOR Meter and Static Power Factor Meter** should be made available to the representative of Engineer during the above inspection.

9.6 30 V DC Battery Bank:

The Battery Bank will be inspected at site, after delivery, by **the TPI Agency or** the representative of Engineer, based on Manufacturer's Internal Test Certificate.

9.7 Battery Charger:

The Battery Chargers will be inspected at site, after delivery, by **the TPI Agency or** the representative of Engineer, based on Manufacturer's Internal Test Certificate.

9.8 33 kV Outdoor Isolator :

Routine Tests (as per IS: 9921) will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch

9.9 33 kV ACSR Dog Conductor :

Routine Tests (as per IS: 398) will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch

9.10 HT XLPE Cables :

Following tests will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch:

I. **Routine Tests** as per IS:7098-II

II. **Acceptance Tests** as per IS:7098-II

Manufacturer's Certificate for **Type Test** (as per IS: 7098), for similar type cable, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection.

9.11 6000 kVA, 33 kV / 3.3 KV, 3 Phase, 50 Hz Transformer :

a) **Routine Tests and Temperature Rise Test** (as per IS:2026) will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch

b) Manufacturer's Certificate for **Type Test** (as per IS: 2026), for any Transformer of at least 33 kV, 6000 kVA rating, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection. In addition to the above, Radiator Banks, Pressure and Vacuum test of the Transformer tank to be tested as per CBIP Manual during manufacturing and test reports shall be submitted during final inspection.

9.12 Vacuum Circuit Breaker Panel

Vacuum Circuit Breaker units:

a) **Routine Tests** (as per IS: 13118) will be witnessed by **the TPI Agency or** the representative of Engineer-in-charge at Manufacturer's works before despatch.

b) Manufacturer's Certificate for **Type Test** (as per IS: 13118), for similar type equipments, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection.

Current Transformers:

Following tests will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch:-

a) **Routine Tests** as per IS: 2705.

b) **Verification of Terminal Markings and Polarity** as per IS:2705

Manufacturer's Certificate for **Type Test** (as per IS: 2705), for similar type equipments, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection.

Potential Transformer:

Following tests will be witnessed by **the TPI Agency or** the representative of Engineer at Manufacturer's works before despatch:

- a) **Routine Tests** as per IS:3156
- b) **Verification of Terminal Markings and Polarity** as per IS:3156

Manufacturer's Certificate for **Type Test** (as per IS: 3156), for similar type equipments, should be made available to **the TPI Agency or** the representative of Engineer during the above inspection.

Complete VCB Panel:

Inspection will be carried out by **the TPI Agency or** the representative of Engineer before despatch. Manufacturers' Test Certificates for the components like **Relays, Ammeter, Voltmeter, Static kWH Meter & Maximum Demand Meter**, should be made available to **the TPI or** the representative of Engineer-in-charge during the above inspection.

9.13 **St. through and end termination jointing kits:**

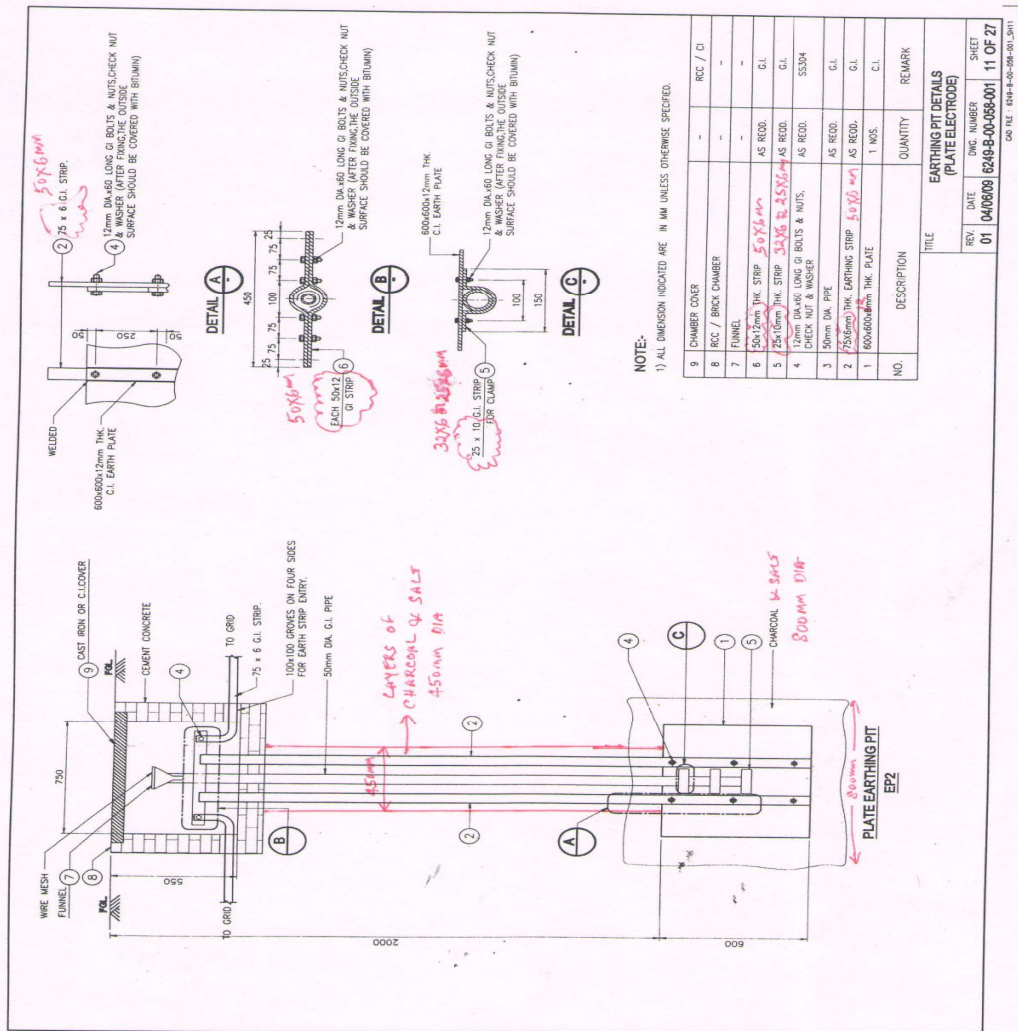
The kits will be inspected at site, after delivery, by **the TPI Agency or** the representative of Engineer, based on Manufacturer's Internal routine Test Certificate as per IS: 7098-I.

10.0 **CIVIL WORKS**

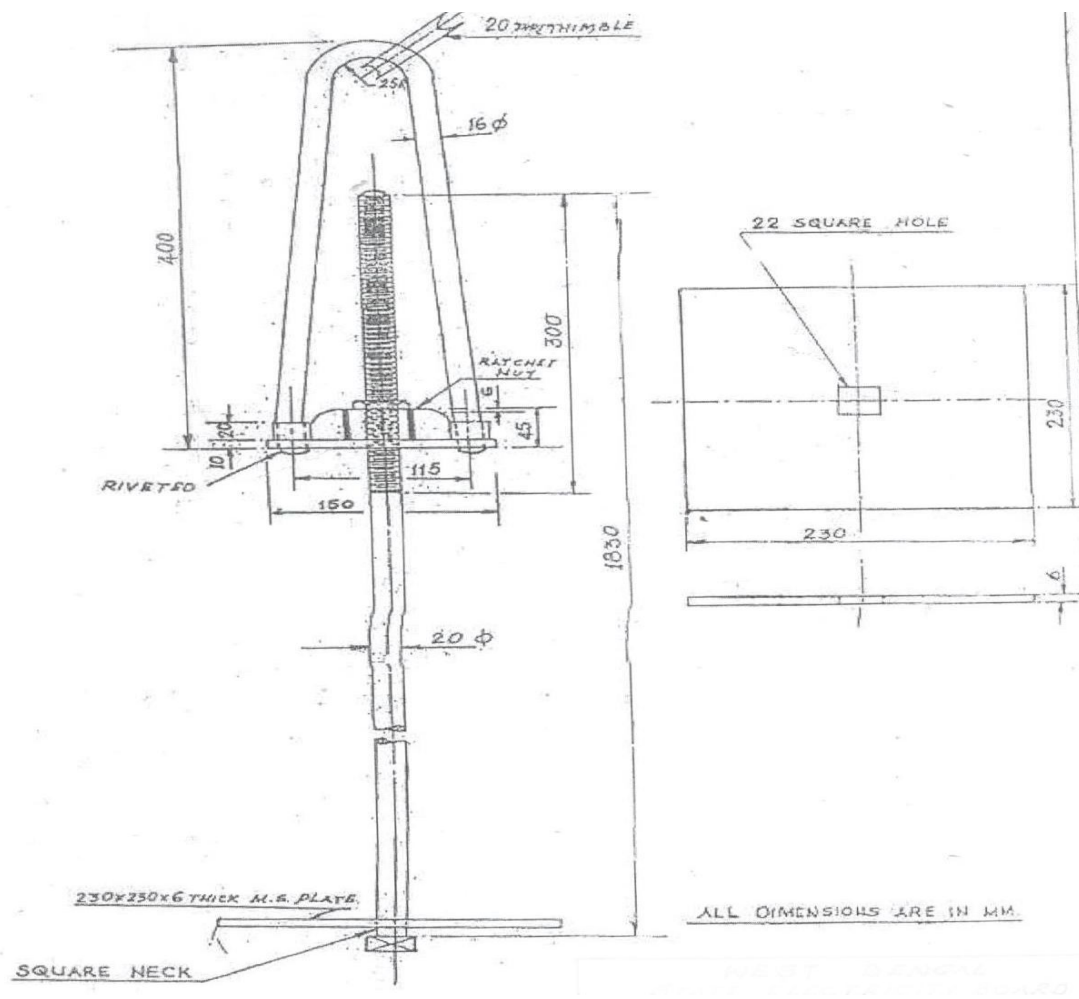
Following civil works are in the scope of the contractor.

1. Civil Foundation for Switchgears and control gear installed at Intake sub-station.
2. **RCC Cable trench** from 33Kv Gang isolator at Intake sub-station to out going cable trench with in sub-station premises.
3. PCC Foundation of Rail pole structures for double circuit Line.
4. Supply of Panel mounting channels of 75mm x 40mm x 6mm as per approved drgs.
5. Chequered Plate for covering cable trench.
6. RCC foundation of 33/3.3KV, 6MVA transformer at GC Berth sub-station.

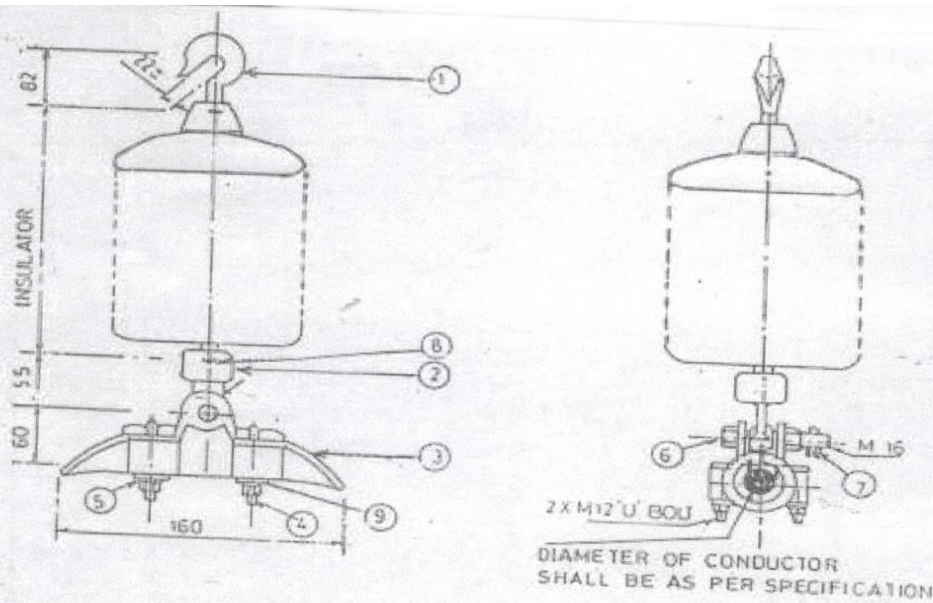
11.0 **DRAWINGS.**



EARTH PIT



GALVANISED STAY SET



NOTES :-

- 1 ALL DIMENSIONS ARE IN mm
- 2 TOLERANCE $\pm 3\%$
- 3 BALL AND SOCKET SIZE 16 mm AS PER IS.2486
4. MIN. BR. LOAD - 30kN

5 CLAMP SLIP STRENGTH BETWEEN 10 % & 20 % OF COND. U.T.S.

| NO. | DESCRIPTION | MATERIAL | QTY. |
|-----|---------------------|------------------------------|------|
| 9. | PLAIN WASHER | 3 mm M.S. H.D.G. | 2 |
| 8 | R-CLIP | NON MAGNETIC STAINLESS STEEL | 1 |
| 7 | SPLIT PIN. | NON MAGNETIC STAINLESS STEEL | 1 |
| 6 | BOLT NUT | M.S. H.D.G. | 1 |
| 5 | SPRING WASHER | SPRING STEEL E.G. | 1 |
| 4 | U-BOLT, NUT, WASHER | NON MAGNETIC S. S. | 4 |
| 3 | SUSPENSION CLAMP | ALU ALLOY. | 2 |
| 2 | SOCKET EYE | FORGED STEEL H.D.G. | 1 |
| 1 | BALL HOOK | FORGED STEEL H.D.G. | 1 |

SUSPENSION HARDWARE SUITABLE FOR ACSR DOG CONDUCTOR

ACSR Dog

SIZES & PROPERTIES OF ALUMINIUM CONDUCTOR GALVANISED STEEL REINFORCED

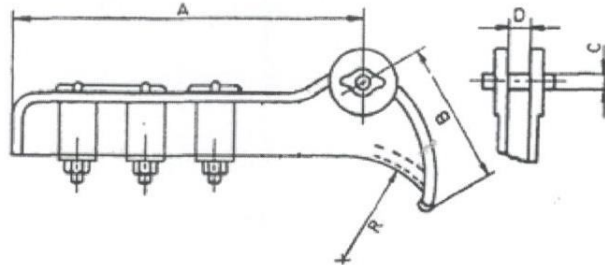
| NOMINAL ALUMINIUM AREA (mm ²) | STRANDING AND WIRE DIAMETER (mm) | | SECTIONAL AREA OF ALUMINIUM (mm ²) | TOTAL SECTIONAL AREA (mm ²) | APPROXIMATE OVER-ALL DIAMETER (mm) | APPROXIMATE MASS (KG/KM) | CALCULATED RESISTANCE AT 20°C MAX (OHM/KM) | APPROXIMATE CALCULATED BREAKING LOAD (KN) |
|---|----------------------------------|--------|--|---|------------------------------------|--------------------------|--|---|
| | ALUMINIUM | STEEL | | | | | | |
| 20 | 6/2.11 | 1/2.11 | 20.98 | 24.48 | 6.33 | 85 | 1.394 | 7.61 |
| 30 | 6/2.59 | 1/2.59 | 31.61 | 36.88 | 7.77 | 128 | 0.9289 | 11.12 |
| 50 | 6/3.35 | 1/3.35 | 52.88 | 61.70 | 10.05 | 214 | 0.5524 | 18.25 |
| 100 | 6/4.72 | 7/1.57 | 105.00 | 118.5 | 14.15 | 394 | 0.2792 | 32.41 |
| 150 | 30/2.59 | 7/2.59 | 158.1 | 194.9 | 18.13 | 726 | 0.1871 | 67.34 |

PROPERTIES OF ALUMINIUM WIRES USED IN THE CONSTRUCTION OF ALUMINIUM CONDUCTORS GALVANISED STEEL REINFORCED

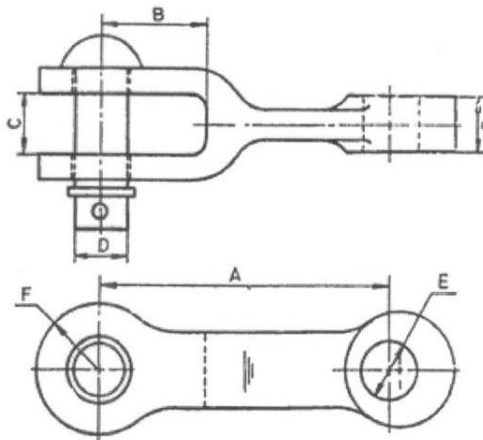
| NOMINAL DIAMETER (mm) | CROSS SECTIONAL AREA OF NOMINAL DIAMETER WIRE (mm ²) | | MASS (KG/KM) | RESISTANCE AT 20°C (MAX) (OHM/KM) | BREAKING LOAD (KN) | BREAKING LOAD AFTER STRANDING (KN) |
|-----------------------|--|------|--------------|-----------------------------------|--------------------|------------------------------------|
| | MIN | MAX | | | | |
| 2.59 | 2.56 | 2.62 | 14.24 | 5.490 | 0.89 | 0.85 |
| 2.11 | 2.09 | 2.13 | 9.45 | 8.237 | 0.63 | 0.60 |
| 3.00 | 2.97 | 3.03 | 19.11 | 4.079 | 1.17 | 1.11 |
| 3.35 | 3.32 | 3.38 | 23.82 | 3.265 | 1.43 | 1.36 |
| 4.72 | 4.67 | 4.77 | 47.30 | 1.650 | 2.78 | 2.64 |

PROPERTIES OF STEEL WIRES USED IN THE CONSTRUCTION OF ALUMINIUM CONDUCTOR STEEL REINFORCED.

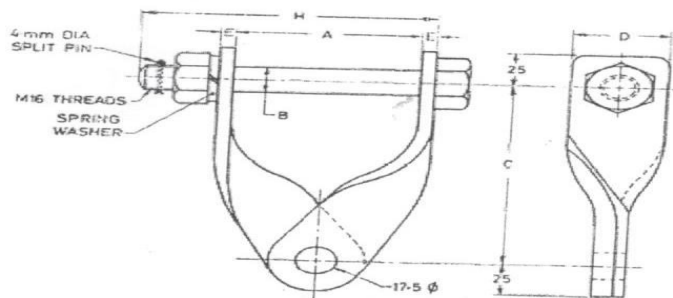
| NOMINAL DIAMETER (mm) | CROSS SECTIONAL AREA OF NOMINAL DIAMETER WIRE (mm ²) | | MASS (KG/KM) | BREAKING LOAD (KN) | BREAKING LOAD AFTER STRANDING (KN) |
|-----------------------|--|------|--------------|--------------------|------------------------------------|
| | MIN | MAX | | | |
| 1.57 | 1.54 | 1.60 | 15.10 | 2.70 | 2.57 |
| 2.11 | 2.07 | 2.15 | 27.27 | 4.60 | 4.37 |
| 2.59 | 2.54 | 2.64 | 41.09 | 6.92 | 6.57 |
| 3.00 | 2.94 | 3.06 | 55.13 | 9.29 | 8.83 |
| 3.35 | 3.28 | 3.42 | 68.75 | 11.58 | 11.00 |

BOLTED TYPE TENSION CLAMP

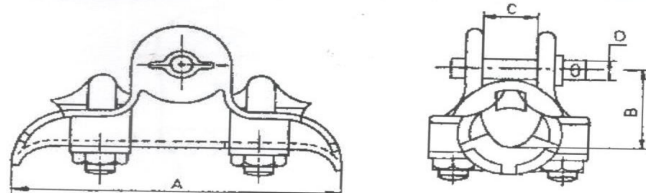
| Material | Conductor Diameter | | Dimensions | | | | | Number of U-Bolts |
|-----------------|--------------------|------|------------|-------|------|----|------|-------------------|
| | Min | Max | A | B | C | D | R | |
| Aluminium alloy | 7.6 | 17.8 | 222.2 | 107.6 | 22.2 | 16 | 76.2 | 3 |

TONGUE AND CLEVIS

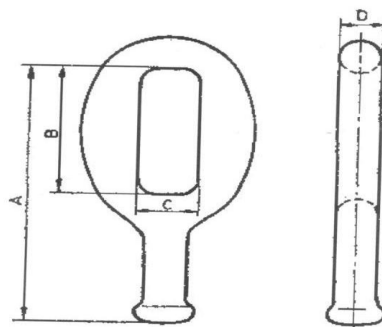
| Dimensions, mm | | | | | | |
|----------------|----|----|----|------|----|----|
| A | B | C | D | E | F | G |
| 89 | 32 | 19 | 16 | 17.5 | 19 | 16 |
| 102 | 35 | 19 | 16 | 17.5 | 22 | 19 |
| 102 | 35 | 19 | 16 | 17.5 | 22 | 25 |
| 140 | 54 | 22 | 19 | 21 | 25 | 29 |
| 140 | 54 | 22 | 19 | 21 | 25 | 32 |
| 140 | 54 | 22 | 19 | 21 | 25 | 35 |
| 140 | 54 | 22 | 19 | 21 | 25 | 38 |

CROSS ARM STRAP

| A | B (Dia) | C | D | E | H |
|-----|---------|-----|----|---|-----|
| 100 | 16 | 140 | 35 | 6 | 145 |



| Conductor Dia, mm | | Dimensions, mm | | | | Socket Size |
|-------------------|------|----------------|-------|----|----|--|
| Min | Max | A | B | C | D | |
| 7.6 | 17.8 | 181 | 60.5 | 19 | 16 | See Fig. 9 for size 16 mm Alternative B |
| 12.7 | 21.1 | 190 | 63.5 | 22 | 16 | |
| 20.3 | 29.2 | 203 | 70.0 | 32 | 16 | |
| 25.4 | 38.9 | 228 | 85.5 | 42 | 16 | |
| 30.0 | 41.9 | 241 | 82.5 | 45 | 16 | |
| 38.1 | 50.8 | 254 | 101.5 | 54 | 16 | |
| 43.2 | 57.2 | 280 | 101.5 | 60 | 16 | See Fig 9 for size 20 mm/16 mm Alternative B |
| 50.8 | 63.5 | 279 | 108.0 | 67 | 16 | |
| 12.7 | 25.9 | 203 | 66.5 | 27 | 16 | |
| 22.9 | 35.6 | 222 | 71.5 | 37 | 16 | |
| 27.9 | 41.1 | 241 | 85.5 | 44 | 16 | |
| 31.8 | 47.0 | 254 | 89.0 | 48 | 16 | |
| 35.6 | 50.8 | 267 | 92.0 | 54 | 16 | |
| 44.4 | 57.2 | 279 | 101.5 | 60 | 16 | |
| 50.8 | 64.8 | 305 | 111.0 | 70 | 16 | |

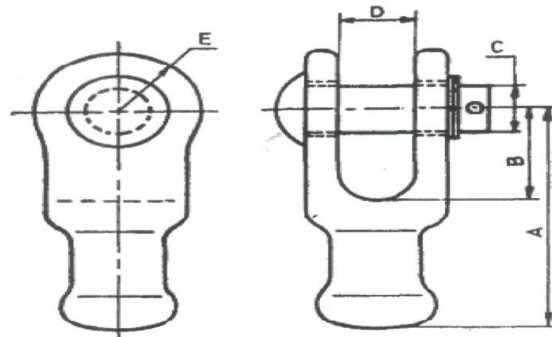
SUSPENSION CLAMP

| Dimensions, mm | | | | Pin Ball Designation* |
|----------------|------|----|------|-----------------------|
| A | B | C | D | |
| 102 | 51 | 19 | 12.7 | 20 mm/16 mm |
| 114 | 63.5 | 22 | 16.0 | 20 mm/16 mm |
| 114 | 63.5 | 25 | 19.0 | 20 mm/16 mm |

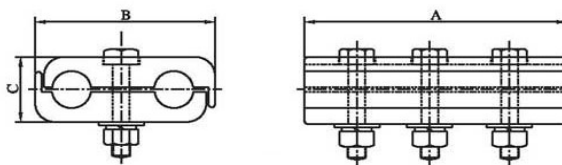
*See Fig. 8

BALL EYE

BALL CLEVIS



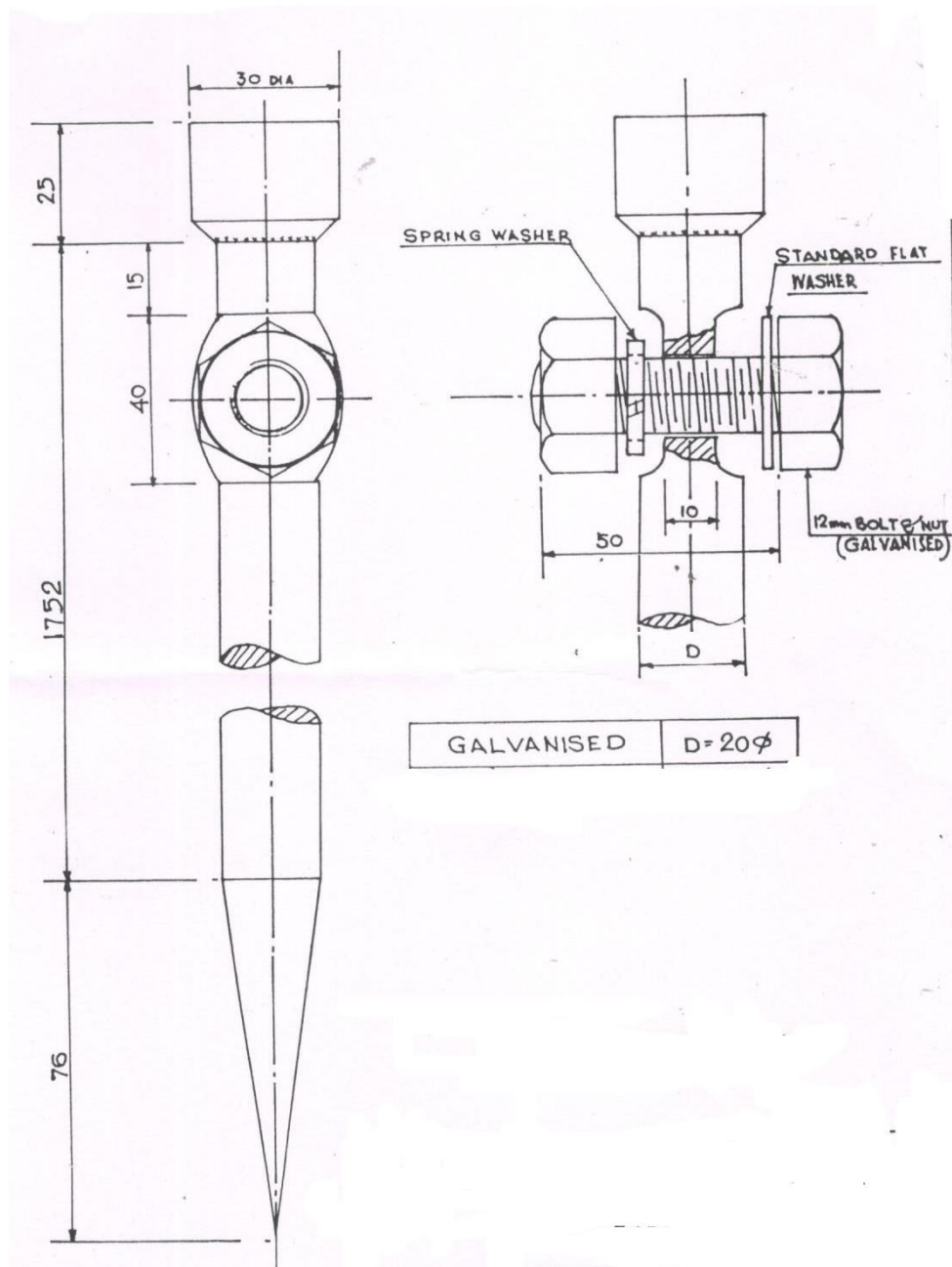
| A | B | C | Pin Ball Designation |
|----|----|----|----------------------|
| 76 | 32 | 16 | 16 mm |



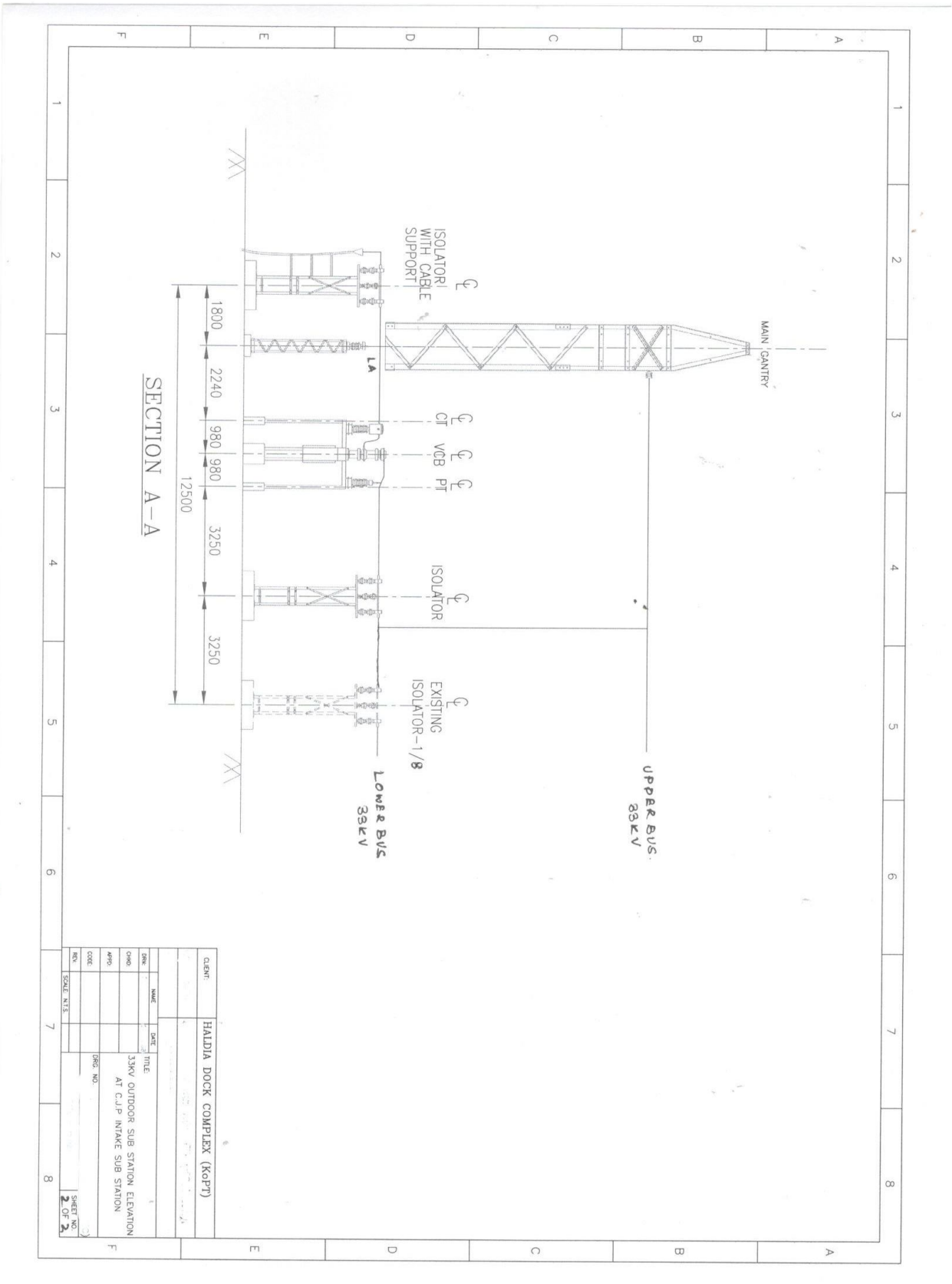
PARALLEL GROOVE CLAMP

| Conductor Dia.(Max.) | A | B | C | No. of Bolts | Bolts Size |
|----------------------|-----|----|----|--------------|------------|
| 06.50 | 65 | 45 | 16 | 2 | M-12 |
| 10.11 | 79 | 48 | 22 | 2 | M-12 |
| 14.45 | 95 | 57 | 28 | 2 | M-12 |
| 17.60 | 127 | 65 | 36 | 3 | M-12 |
| 20.78 | 125 | 65 | 33 | 3 | M-12 |

EARTH SPIKE

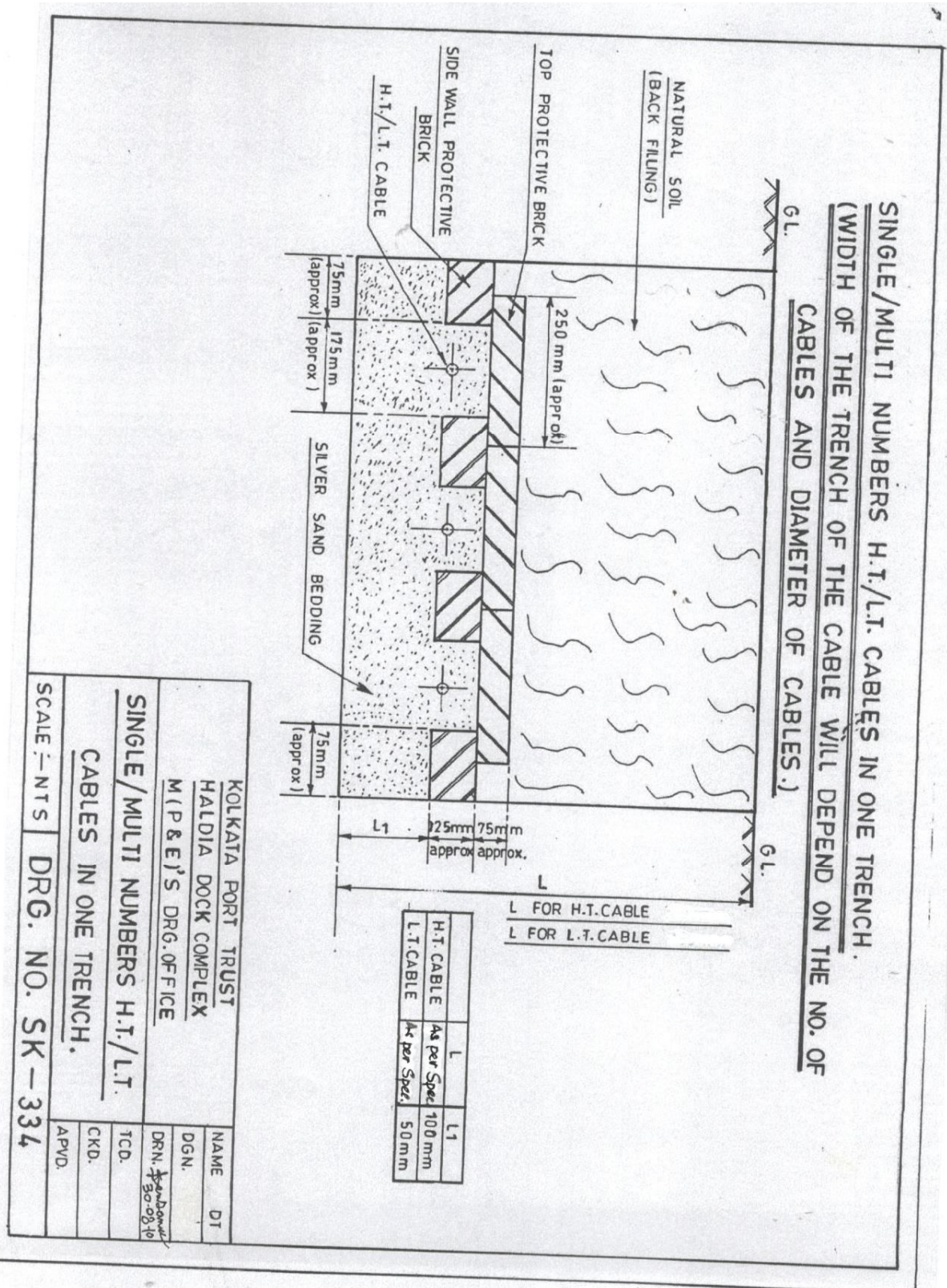


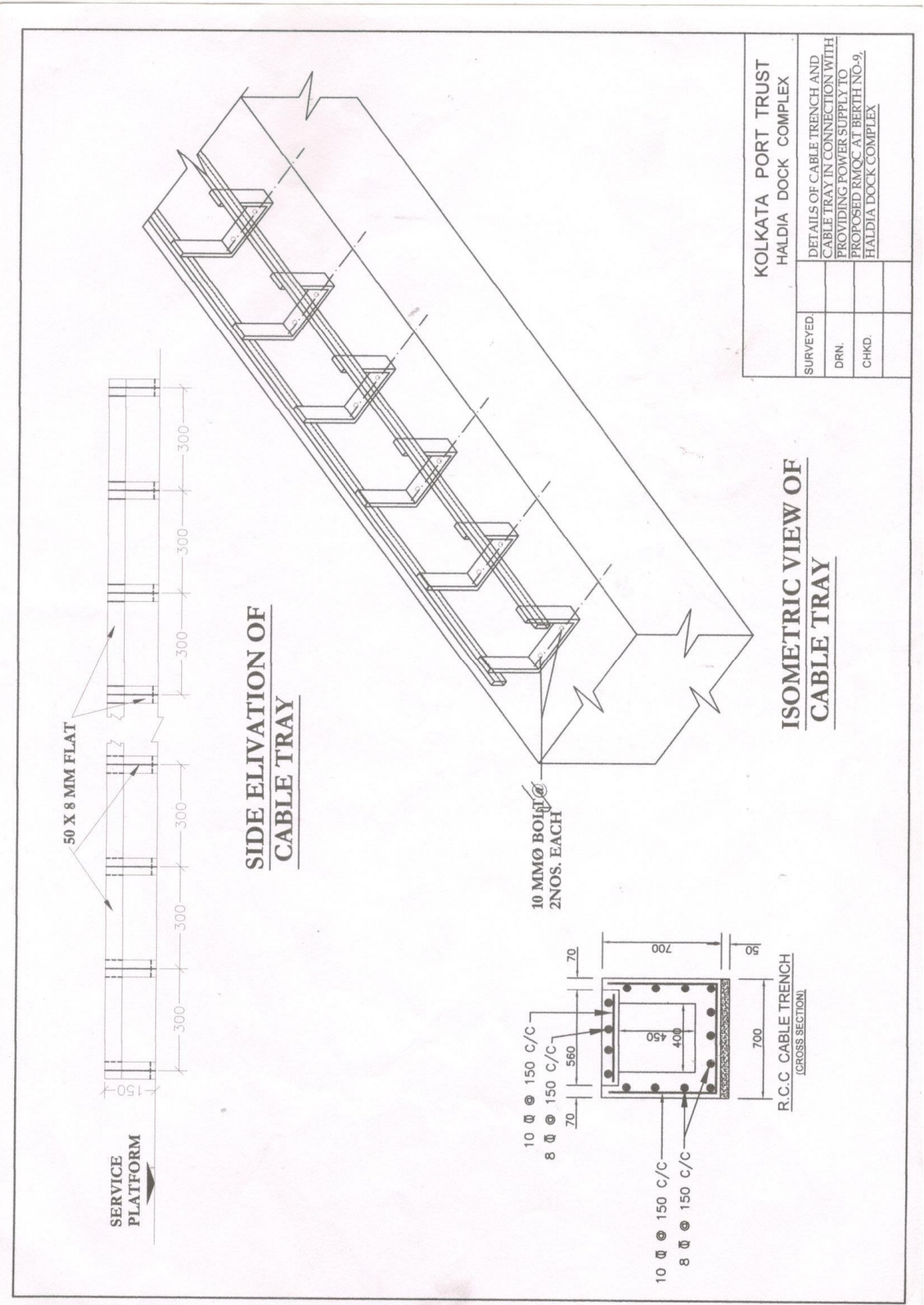
INTAKE SUB-STATION SWITCHYARD EQUIPMENT
LAYOUT



[illegible]

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Third Party Inspection (TPI) for the work of 'Supply, Installation, Testing and Commissioning of 33 kV Over Head Line & Under Ground Cable from Intake Substation to GC Berth Substation for strengthening of power supply arrangement of RMQC-3 of HDC, KoPT

TERMS AND CONDITIONS

1. GENERAL:

Haldia Dock Complex, SMP, Kolkata [formerly Kolkata Port Trust] intends to engage a Third Party Inspection (TPI) Agency for Technical Inspection & Certification of major equipment / items and installation & commissioning jobs in connection with the work of **"Supply, Installation, Testing and Commissioning of 33 kV Over Head Line & Under Ground Cable from Intake Substation to GC Berth Substation for strengthening of power supply arrangement of RMQC-3 of HDC, KoPT"**, as per the Price Schedule & Technical Specification of the relevant Contract [enclosed at Annexure-I]. The inspection would be carried out at manufactures' works and at HDC, SMP, Kolkata site as per approved Quality Assurance Plan (QAP) / Field Quality Assurance Plan (FQAP), approved drawings, manufacturers' standard and relevant IS or equivalent standards.

2. SCOPE OF WORK:

- 2.1 Approval of Design i.e. equipment data sheet and Drawings.
- 2.2 Approval of Quality Assurance Plan (QAP) and Field Quality Assurance Plan (FQAP).
- 2.3 The Scope of Work includes Inspection/ testing at Manufacturer's works based on the approved Quality Assurance Plan (QAP) and Inspection, Testing and Commissioning work at site, based on the approved Field Quality Assurance Plan (FQAP).
- 2.4 After inspection/ testing at Manufacturer's work site, TPI Agency shall issue the dispatch clearance of the materials.
- 2.5 The TPI Agency shall visit the Port site for inspection of items/equipments and works in progress during installation, testing and commissioning of the system. The TPI Agency shall issue the site inspection report/release note for facilitating payment as per the payment terms
- 2.6 In case of imported material/items/equipments, the inspection shall be carried out by the TPI agency at HDC, SMP, Kolkata site based on the documentation/test certificates produced by the Manufacturer/Vendor and shall issue Installation clearance after successful inspection.
- 2.7 The TPI agency shall issue the 'Final Completion Report/ Job completion report' and 'Commissioning Certificate' after successful completion and commissioning of the job, for facilitating payment as per the payment terms.
- 2.8 The details of items/equipment/works, which are to be inspected, are shown below.

Annexure-II

| Inspection/ Testing | | | | | | | |
|--|--|--|---------------------|---------------|--|---|---------------|
| Inspection & Testing at Manufacturer’s site | | | | | Inspection at site (HDC) | | |
| Sl. No. | Description | Make | Qty | Manday (nos.) | Sl. No. | Description | Manday (nos.) |
| 1. | 33 KV Outdoor PCVCB with control and relay Panel. | As per approved make list of the tender. | 1set | 1 | 1. | Erection/Installation of 33 KV Outdoor PCVCB & control and relay Panel. | 18 |
| 2. | 33KV Outdoor CT, PT Isolator, LA. | | 1set | 3 | 2. | Erection/Installation of 33KV Outdoor CT, PT, Isolator, LA, Al. Pipe bus. | |
| 3. | ACSR Dog Conductor. | | 7500Mtrs | 1 | 3. | String and sagging of Over Head Line | |
| 4. | HT Cables ,33KV 3Cx240Sqmm and 3.3KV, 1C x 1000Sqmm. | | 2060Mtrs + 240Mtrs. | 2 | 4. | Laying of HT Cables | |
| 5. | 33KV Indoor VCB Panel. | | 1set | 1 | 5. | Erection/Installation of Indoor VCB Panels | |
| 6. | 3.3KV Indoor VCB Panel. | | 1set | 1 | 6. | Construction of Earthing system | |
| 7. | 33/3.3KV,6MVA Transformer. | | 1No. | 2 | 7. | Erection/Installation of 33/3.3KV, 6MVA Transformer | |
| 8. | Battery and Battery charger. | | 2sets. | 1 | 8. | Erection/Installation and Painting of Overhead line. | |
| 9. | Overhead line hardware, Gang Isolators, structural items and insulators etc. | | LS | 2 | 9. | Testing and commissioning | |
| Total No. of Manday at manufacturer’s site for inspection: | | | | 14 | Total No. of Manday at port site for inspection: | | 18 |

2.11 TPI Agency shall execute the work during the contract period of 12 months and extension, if any.

3. PAYMENT TERMS:

- 3.1 20% payment will be made through e-payment, after completion of approval of Design (Data sheet, General arrangement Drawings), QAP and FQP.
- 3.2 50% payment will be made through e-payment, after completion of stage wise inspections of all material/components at Manufacturers' works and identification of inspected materials during or after erection/ installation after delivery at HDC, SMP, Kolkata site
- 3.3 Balance 30% payment will be released after testing and commissioning of the Installation job by the Contractor and issue of Final Completion Report by the TPI Agency.

The payment will be released within 30 days, on submission of bills along with Inspection and Commissioning Report complete in all respects.

Annexure-II

The following Bank Account details shall be furnished along with a copy of the PAN Card for the payment through ECS:

- | | | |
|------------------|-----------------|------------------|
| (a) Name of Bank | (b) Bank branch | (c) Account type |
| (d) Account No. | (e) MICR code | (f) IFSC code |

4. OTHER CONDITIONS:

The offered rate should be including travel expenses, boarding & lodging, other incidental charges, etc., but exclusive of GST, which shall be paid extra as applicable. The bidder shall indicate the applicable GST rate on the services in the price bid. However, any new tax imposed by State/Central Govt. shall be reimbursed on producing documentary proof.

All necessary facilities for inspection (viz. Instruments, Test equipments, drawings, specifications, labour, electricity, fuel, water, stores, etc.) shall be arranged by the Contractor, according to prior instructions from the TPI Agency.

Final inspection report is to be submitted, after commissioning.

5. VALIDITY:

The price quoted by the TPI Agency must be firm and hold good at least for 120 days from the date of receipt of the quotation.

The above mentioned contract work has been awarded to M/s GNG Ltd., whose address is mentioned below:

M/s GNG Ltd.

K.Khata No.-35/57, Village-Babupur

Gurgaon, Haryana-122017

Ph no. 9910480606 / +91 9899324188

e-mail: info@gnggroup.com /gaurav@gnggroup.com

Contact Persons:

| | | | |
|-----------------|--------------|--------------|--|
| Client | [HDC, | SMP : | Shri R.N.Roy, |
| Kolkata] | | | Sr.Dy. Manager (P&E) |
| | | | Telephone no. + 91-3224-252526 |
| | | | Mobile no. + 91 94340 74411 |
| | | | e- mail : rnroy.hdc@kolkataporttrust.gov.in |
| | | : | Sri D.Dey, |
| | | | Asst. Manager (P&E) |
| | | | Telephone no.+ 91-3224-252577 |
| | | | Mobile no. + 91 94340 33492 |
| | | | e- mail : djdey.hdc@ kolkataporttrust.gov.in |

| | | |
|-----------------------|----------|-----------------------------|
| Contractor | : | Shri Muneem Kumar Saini |
| [M/s GNG Ltd.] | | Mobile no. 9582111707 |
| | | e- mail : info@gnggroup.com |

Third Party Inspection (TPI) for the work of ‘Supply, Installation, Testing and Commissioning of 33 kV Over Head Line & Under Ground Cable from Intake Substation to GC Berth Substation for strengthening of power supply arrangement of RMQC-3 of HDC, KoPT’

Bill of Quantity (Unpriced)

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---|--|------|------|--|---------------------------------------|
| Part A-Electrical Installations at Intake Sub-station. | | | | | |
| 1 | <u>HT 33 KV Outdoor PCVCB with control and relay Panel:-</u> Design, fabricate, supply, installation, testing and commissioning of Outdoor 33 KV PCVCB, 800A, 3 phase, 50HZ, 31.5 kA for 3sec.along with control and relay Panel as per the Technical Specification. | | | | |
| (i) | Supply | Set. | 1 | | |
| (ii) | Installation, testing and commissioning | Set. | 1 | | |
| 2 | <u>HT 33KV Outdoor PT:-</u> Design, fabricate, supply, installation, testing and commissioning of outdoor Oil filled hermitically sealed HT PT 33KV/v3 / 110/v3V 100VA,1 phase, 50HZ, 31.5KA for 3sec. as per the Technical Specification. | | | | |
| (i) | Supply | No. | 3 | | |
| (ii) | Installation, testing and commissioning | No. | 3 | | |
| 3 | <u>HT 33KV Outdoor CT:-</u> Design, fabricate, supply, installation, testing and commissioning of outdoor Oil filled hermitically sealed HT CT 150/5/5/5Amps. 1 phase, 50HZ, 31.5KA for 3sec. For metering and protection as per the Technical Specification. | | | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|--|------|------|--|---------------------------------------|
| (i) | Supply | No. | 3 | | |
| (ii) | Installation, testing and commissioning | No. | 3 | | |
| 4 | <u>HT 33KV Outdoor gantry Isolator:-</u> Design, fabricate, supply, installation, testing and commissioning of outdoor Gantry Isolator 800Amps. 3 phase, 50HZ, 31.5KA for 3sec. as per the Technical Specification. | | | | |
| (i) | Supply | No. | 2 | | |
| (ii) | Installation, testing and commissioning | No. | 2 | | |
| 5 | <u>HT 33KV Outdoor Lighting Arrestor:-</u> Design, fabricate, supply, installation, testing and commissioning of outdoor Lighting Arrestor Metal Oxide Gapless, 33KV, 10KA, 1 phase, 50HZ, as per the Technical Specification. | | | | |
| (i) | Supply | No. | 9 | | |
| (ii) | Installation, testing and commissioning | No. | 9 | | |
| 6 | <u>2.5" IPS Aluminium Tube:-</u> Supply, installation, testing and commissioning of 2.5" IPS Aluminium Tube, as per the Technical Specification. | | | | |
| (i) | Supply | LS | 1 | | |
| (ii) | Installation, testing and commissioning | LS | 1 | | |
| 7 | <u>Lattice Type hot dip GI Gantry structure:-</u> Supply, installation, lattice type hot dip GI gantry structures for installation of PCVCB, CT, PT, Isolator, Cable etc. as per the Technical Specification | | | | |
| (i) | Supply of material | LS | 1 | | |
| (ii) | civil foundation, Installation, testing and commissioning | LS | 1 | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|---|------|------|--|---------------------------------------|
| 8 | <u>Battery Charger with batteries:-</u> Supply and Installation of Maintenance Free Lead Acid battery of 15Nos. of 2Volts each for 30V, 60AH Battery Bank along with Float cum-Boast Charger as per Technical specifications. | | | | |
| (i) | Supply | Set | 1 | | |
| (ii) | Installation, testing and commissioning | Set | 1 | | |
| 9 | <u>33KV(E) XLPE, HT Cable:-</u> Supply and laying of 3C x 120 Sq.mm. HT Aluminum XLPE cable as per Technical Specification. | | | | |
| (i) | Supply | Mtr | 2060 | | |
| (ii) | Laying through existing RCC trench/Hume Pipe/ GI Pipe. | Mtr | 200 | | |
| (iii) | Laying by excavating trench. | Mtr. | 1475 | | |
| (iv) | Laying by excavating trench after removal of paver blocks and refixing of the same after laying. | Mtr. | 50 | | |
| (v) | Laying through 150mm dia. Hume pipe to be laid after excavating including supply of Hume pipe. | Mtr. | 50 | | |
| (vi) | Laying through 150NB GI Pipe to be laid after excavating, including supply of Pipe | Mtr. | 100 | | |
| (vii) | By 150NB GI Pipe to be laid after Boring including supply of Pipe | Mtr. | 125 | | |
| (viii) | Construction of RCC Cable trench as per drg. | Mtr. | 60 | | |
| 10 | <u>33KV XLPE, HT Cable end termination and straight through:-</u> Supply of straight through and heat Shrinkable type end termination kit for three | | | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|--|------|------|--|---------------------------------------|
| | Core 120 Sq.mm. HT Aluminum XLPE cable. | | | | |
| (i) | Supply of Indoor/Outdoor end termination kit | No. | 14 | | |
| (ii) | Supply of st. through jointing kit | No. | 4 | | |
| (iii) | Installation of indoor/outdoor end termination kit and testing and commissioning | No. | 14 | | |
| (iv) | Installation of straight through jointing kit and testing and commissioning | No. | 4 | | |
| 11 | 33KV Double circuit Overhead ACSR DOG Line between Finger Jetty road to GC berth Main Gate. | | | | |
| (i) | Transportation of old used 11/12/13 Mtr. Rail Pole from store/ site of HDC to work site (old and used rail pole of 11/12/13 Mtr each to be supplied by HDC on free of cost basis). [Job also includes dismantling and transportation of existing items i.e. Rail poles, ACSR Conductors, Insulators etc. to site store of HDC. (300 Mtrs. Span consisting 20 Nos. 11/12/13Mtrs. Rail poles approx) from 11KV Overhead Line (Single circuit Panther Conductor)] | No. | 101 | | |
| (ii) | <u>Erection of 11/12/13 Mtr. Rail Pole structure:-</u> a) Erection of 11/12/13 Mtr. Rail Pole (4 Pole) structure complete with out Fitting (Channel, Angle & Clamp) without any insulator etc. | Set | 7 | | |
| | b) Erection of 11/12/13 Mtr. Rail Pole [Double Pole (D.P.)] for strut pole for strengthening of 4 pole structure without fittings. | Set | 7 | | |
| | c) Erection of 11/12/13 Mtr. Rail Pole [Double Pole (D.P.)] 2 pole structure with out fitting. | Set | 19 | | |
| | d) Erection of 11/12/13 Mtr. Rail Pole [Single Pole (S.P.)] for strut pole for strengthening of | Nos. | 21 | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|--|------|------|--|---------------------------------------|
| | 4/2 pole structure without fittings. | | | | |
| (iii) | Supply of GI Channels and angles for Rail Pole structures:- | | | | |
| | a) Supply of GI Channel (100 x 50 x 6 mm) | Kgs. | 3000 | | |
| | b) Supply of GI Channel (75 x 40 x 6 mm) | Kgs. | 900 | | |
| | c) Supply of GI Angle (65 x 65 x 6 mm.) | Kgs. | 2200 | | |
| | d) Supply of GI Angle (50 x 50 x 6 mm.) | Kgs. | 800 | | |
| (iv) | Fixing & fabrication of GI Channel and angles for 11/12/13Mtr. Rail Pole structure:- | | | | |
| | a) Fixing & fabrication of GI Channel (100 x 50 x 6 mm) for 13 Mtr. Rail Pole [4 Pole/ DP] structure For insulator string holding. | Kgs. | 3000 | | |
| | b) Fixing & fabrication of GI Channel (75 x 40 x 6 mm) for 13 Mtr. Rail Pole [4 Pole] structure for cable raising arrangement and structure holding of 4 Pole. | Kgs. | 900 | | |
| | c) Fixing & fabrication of GI Angle (65 x 65 x 6 mm.) on 13 Mtr. Rail Pole [4 Pole] structure as horizontal bracing & cross bracing. | Kgs. | 2200 | | |
| | d) Fixing & fabrication of GI Angle (50 x 50 x 6 mm.) inverted V Bracket on 13 Mtr. Rail Pole structure for shield wire earthing. | Kgs. | 800 | | |
| (v) | Supply fixing and fabrication of GI Clamps:- | | | | |
| | a) Supply, fixing & fabrication of GI Clamp (65 x 6 mm.), as 'V' Clamps, | LS | 1 | | |
| | b) Supply, fixing & fabrication of GI Clamp (65 x 6 mm.), as Support Clamps, for 13 Mtr. Rail Pole structure. | LS | 1 | | |
| | c) Supply, fixing & fabrication of GI Clamp (65 x 6 mm., Commander Patti) for 13.0 Mtr. Rail Pole structure | LS | 1 | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|---|-------|------|--|---------------------------------------|
| (vi) | Supply & fixing of G.I. Nut Bolt 5/8", 8", 3.5", 2.5" & 2" for 13 Mtr. Rail Pole structure | Kgs. | 600 | | |
| (vii) | Supply & fixing of 33 kV Hardware fittings for ACSR 100Sqmm. conductor. | LS | 1 | | |
| (viii) | Supply & fixing of Insulators:- | | | | |
| | a) Supply & fixing of 33 kV G.I. Pin with Insulator | Sets. | 64 | | |
| | b) Supply & fixing of Disc Insulator each string. | Sets. | 216 | | |
| (ix) | Supply & fixing Al. Binding wire | Kgs. | 200 | | |
| (x) | Supply of ACSR 100 Sqmm. conductor. | Mtr. | 7500 | | |
| (xi) | Stringing & sagging of ACSR 100Sqmm. conductor of span of about 50 Mtrs. | Sets. | 156 | | |
| (xii) | Civil work for concrete, plaster, net cement on Rail pole bottom portion. | Nos. | 101 | | |
| (xiii) | Painting of Rail Pole structure with all iron parts with 2 coats of red oxide primer & 2 coats of Aluminium paints:- | | | | |
| | a) Painting of Rail 4 Pole structure with all iron parts with 2 coats of red oxide primer & 2 coats of Aluminium paints | Sets. | 7 | | |
| | b) Painting of Rail (D.P) for strut pole with all iron parts with 2 coats of red oxide primer & 2 coats of Aluminium paints | Sets. | 7 | | |
| | c) Painting of Rail (D.P) with all iron parts with 2 coats of red oxide primer & 2 coats of Aluminium paints | Sets. | 19 | | |
| | d) Painting of Rail (S.P) for strut pole with all iron parts with 2 coats of red oxide primer & 2 coats of Aluminium paints | Nos. | 21 | | |
| (xiv) | Supply & fixing of Barbed wire on 4&2 pole structures and supply & fixing of Danger | Sets. | 26 | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|---|-------|------|--|---------------------------------------|
| | Boards | | | | |
| (xv) | Raising arrangement of 33 kV grade, 3 Core x 120 sq. mm. XLPE insulated cable up to 6 Mtr. Height (approx.) through 4 Mtr. Long (approx.) GI pipe of 150 mm. diameter and fixing with the terminal structures, with supply of GI clamp, Nuts, Bolts & Washers with brick protection in between the said pipe & cable etc., including proper earthing connection. (Including supply of pipe). | Sets. | 2 | | |
| | GI shield wire 7/3.15mm dia.:- | | | | |
| (xvi) | a) Supply of GI shield wire. | Kgs. | 750 | | |
| | b) Stringing & sagging of GI Shield wire of span of about 50 Mtrs. | Sets. | 26 | | |
| | GI stay wire 7/2.5mm dia. with Guy insulator:- | | | | |
| (xvii) | a) Supply of stranded GI stay wire with Guy insulator. | sets. | 24 | | |
| | b) Installation and fixing of stranded GI stay wire with Guy insulator. | sets. | 24 | | |
| | Earthing of Rail Pole structure:- | | | | |
| | a) Supply of 50 x 6 mm G.I. strip | Mtr. | 600 | | |
| (xviii) | b) laying of 50 x 6 mm G.I. strip for earth electrode station to Rail Pole cable structure [4/2 Pole structure] bottom portion & Lightning Arrestor (LA) top portion, by welding & connection, with commissioning of the system | Mtr. | 600 | | |
| | Earthing stations:- | | | | |
| (xix) | a) Construction of Earth Electrode Station including supply and delivery of 50 mm. diameter 3 Mtr. long G.I. perforated pipe Earth Electrode as IS: 3043. | Sets. | 14 | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---|--|-------|------|--|---------------------------------------|
| | b)Construction of Spike Earthing Station including supply and delivery of GI Spike of 2150mm Length diameter 16mm Earth Electrode. | Nos. | 22 | | |
| (xx) | Supply and fixing of Cradle guard | Sets. | 2 | | |
| | | | | | |
| Part B-Electrical Installation at GC berth sub-station | | | | | |
| 1 | <u>HT 33KV VCB Panel:-</u> Design, fabricate, supply, installation, testing and commissioning of indoor HT 33kV VCB Panel 1250A, 3 phase, 50HZ, 25kA for 3sec. as per the Technical Specification (08 panel) . | | | | |
| (i) | Supply | Set | 1 | | |
| (ii) | Installation, testing and commissioning | Set | 1 | | |
| 2 | <u>HT 3.3KV VCB Panel:-</u> Design, fabricate, supply, installation, testing and commissioning of indoor HT 3.3kV VCB Panel 1250A, 3 phase, 50HZ, 25kA for 3sec. as per the Technical Specification (02 panel) . | | | | |
| (i) | Supply | Set | 1 | | |
| (ii) | Installation, testing and commissioning | Set | 1 | | |
| 3 | <u>6MVA Power Transformer:-</u> Design, Manufacture, supply, installation, testing and commissioning of following 33/3.3 kV oil filled indoor type transformers with On Load tap changer, RTCC Panel & marshalling box of make as per the Technical Specification. | | | | |
| (i) | Supply of 33/3.3 kV, 6MVA Power Transformer | No. | 1 | | |
| (ii) | Civil foundation | No. | 1 | | |

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|---|------|------|--|---------------------------------------|
| (iii) | Installation, testing and commissioning | No. | 1 | | |
| 4 | <u>3.3kV(UE) XLPE, HT Cable :-</u> Supply and laying of 1C x 1000 Sq.mm. HT Aluminum XLPE armoured cable as per Technical Specification. | | | | |
| (i) | Supply | Mtr | 240 | | |
| (ii) | Laying through RCC trench | Mtr | 240 | | |
| 5 | <u>3.3kV XLPE, HT Cable end termination:-</u> Supply of end termination kit for 1C x 1000 Sq.mm. HT Aluminum XLPE cable. | | | | |
| (i) | Supply of Indoor end termination kit | No. | 16 | | |
| (ii) | Installation, testing and commissioning | No. | 16 | | |
| 6 | <u>Battery Charger with batteries:-</u> Supply and Installation of Maintenance Free Lead Acid battery of 15Nos. Of 2Volts each for 30V, 60AH Battery Bank with Float cum-Boast Charger as per Technical specifications. | | | | |
| (i) | Supply | set | 1 | | |
| (ii) | Installation, testing and commissioning | set | 1 | | |
| 7 | Providing Earthing System with plate Earthing in accordance with BIS 3043 or latest amendment as per Technical Specification. | | | | |
| (i) | Supply | No. | 10 | | |
| (ii) | Installation, testing and commissioning | No. | 10 | | |
| 8 | Supply and laying of 50 mm x 6 mm Hot dip galvanized Earthing flat / strip as per Technical specification. | | | | |
| (i) | Supply | Mtr | 200 | | |
| (ii) | Laying | Mtr | 200 | | |

Annexure-III

| Sl. No. | Item Description | Unit | Qty. | Unit Rate (excluding GST) (in Rs.) | Amount (excluding GST) (in Rs.) |
|---------|---|------|------|--|---------------------------------------|
| 9 | <u>Structural items:</u> | | | | |
| (i) | Supply of GI Chequered Plates 8mm thick | T | 1 | | |
| (ii) | Supply of GI Angles (65x65x6)mm | T | 1 | | |
| (iii) | Supply of GI Channels (75x40x6)mm | T | 1 | | |
| (iv) | Fabrication, Installation and commissioning of above structural items | T | 3 | | |

Annexure-IV

Third Party Inspection (TPI) for the work of 'Supply, Installation, Testing and Commissioning of 33 kV Over Head Line & Under Ground Cable from Intake Substation to GC Berth Substation for strengthening of power supply arrangement of RMQC-3 of HDC, KoPT

PRICE SCHEDULE

| Sl. No. | Description of Work | Unit | Qty | Rate /Unit (Rs.) | Amount (Rs) | Applicable GST (%) |
|---------------|--|--------|-----|------------------|-------------|--------------------|
| | | | | In Figures | | |
| 1. | Charges for approval of Design, Data sheet, Drgs., QAP and FQAP submitted by the contractor as per scope of work of the tender, Technical Specifications and relevant Standards. | LS | 1 | | | |
| 2.. | Charges for inspection at Manufacturer's works and site as per scope of work, Technical Specifications and relevant Standards. | | | | | |
| | I. Manufacturer's Works | Manday | 14 | | | |
| | II. Site | Manday | 18 | | | |
| Total= | | | | | | Without GST |
| | | | | | | With GST |

Total Basic Price (in words): Indian Rupees_____ plus applicable GST.

Signature of the Bidder