TCIL/CIVIL/PD(NE-1)/2024-25/EMRS/03 **Dated 20.06.2024**

"Construction of EMRS (Eklavya Model Residential School)at Dudhnoi, Goalpara in the state of Assam"

Comprising
School Buildings, Girls & Boys Hostels, Warden Residences, Type 1 & 2 Quarters including SiteDevelopment, Bulk Services and List of preferred makes of material

Tender Documents

VOLUME-IV

Technical Specifications

Telecommunications Consultants India Limited
H. No. 1421, NH-37 Tetelia, P.O- Gotanagar,
District- Kamrup Metro, Guwahati, Assam, PIN- 781033

Table of Contents

`

1. TECHNICAL SPECIFICATIONS OF WORKS

1.1. General

Unless otherwise specified, the Work will be executed strictly in accordance with the CPWD specification corrected up to date at the time of tenders, unless specified to contrary. The specifications to be generally followed will be the following specifications and codes:

a) CPWD specification

b) BIS specification

c) National building code

d) Bill/Schedule of Quantities (BOQ) and Drawings

e) Particular specification as applicable for respective works specified herein.

Error or omission, if any in the nomenclature, rate or unit of the items or work shall be corrected as per DSR 2018.

Measurement of work shall be done as per CPWD specifications and BIS codes, as applicable.

Actual quantities of completed and accepted work shall only be paid.

Nothing extra will be paid to the contractor for any lead or lift unless otherwise specified for any material required directly or indirectly under the contract.

Nothing extra will be paid to the contractor for diverting water in the channels or streams if it becomes necessary for the execution and completion of the work.

The contractor shall be responsible and liable for proper and complete execution of the entire work and ensure coordination and completion of Civil, Electrical, Plumbing, Mechanical/ Fire Fighting works, etc.

Any rock extracted during excavation from site shall be recovered and the same shall be used in the random rubble masonry or for stone pitching as much as possible.

The percentage of contract rates for the various items, wherein Supply, Installation, Testing, Commissioning (i.e. SITC) are involved in the Schedule of Quantities, shall be payable against the following stage of work:

Sl. No.	Stage of work	%age of Quoted Rate for Item
a)	On initial inspection of materials (as applicable) and delivery at Site in good condition	70%
b)	On completion of installation/ erection	20%
c)	On completion of Testing and Commissioning, as applicable	10%

Material for installation

a. The Contractor shall bring the various items & materials as per actual requirement at site at the time of execution of work. For any material brought prematurely at site without approval of Engineer-in-Charge, no payment shall be made for such material and the Employer shall not be responsible for its damage / deterioration. The make of material has been indicated in the attached Approved Make List of EMRS and must be followed strictly. The Engineer-in-charge shall reserve the right to instruct the contractor toremove the material which, in his opinion, is not as per specifications.

b. Quality of material: All materials and equipment for installation / work supplied by the Contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

c. The quantities of various items may vary from the quantities given in schedule of work. The Contractor shall bring the various items & materials as per actual requirement at site. Excess material more than the actual requirement shall not be accepted & paid by the Employer.

d. Before start of the work the Contractor is required to submit the shop drawings. The shop drawings shall be approved by the Engineer-in-Charge.

e. Before placing orders on the manufacturer for supply of cables, pole, fittings, pipes, etc., the contractor is required to get assessed the exact requirement of each size of the cable at site of work and get the same approved from the Engineer-in-charge.

However, it may be noted that the contractor shall have to arrange extra quantity of the cables, poles, fittings, pipes, etc. over and above that assessed by the contractor, before start of the work and approved by the Engineer-in-charge, if such additional quantity of the cables, poles, fittings, pipes, etc., is required at site, in order to make the installation as covered in Scope of this work and in order to make the installation operational. Such quantity shall be paid as per contractual provisions of the Agreement.

Completeness of work

All hardware items such as screws, thimbles, G.I. wires, etc. which are essentially required for completing an SoQ item as per specifications will be deemed to be included in the item even when the same have not been specifically mentioned. All hardware materials such as nuts/bolts/screws/ washers etc. to be used in the scheduled items shall be zinc/cadmium plated iron. Nothing extra on account of same shall be paid.

For items/equipment requiring initial inspection at manufacturer‟s works‟ the contractor will intimate the date of testing of equipment at the manufacturer‟s works before dispatch. The Employer also reserves the right to inspect the fabrication job at factory and the Contractor has to make the arrangement for the same. The Contractor shall give sufficient advance notice regarding the dates proposed for such tests/inspection to the Employer‟s representative(s) to facilitate his presence during testing/fabrication. The Engineer-in-charge at his discretion may waive off such testing/fabrication. The cost of the Engineer-in-charge‟s visit to the factory will be borne by the Contractor. Also, equipment may be inspected at the Manufacture‟s premises before dispatch to the site by the contractor.

Conformity with statutory Acts, Rules, Standards and Codes

a. All components shall conform to relevant Indian Standard Specifications, International Standards and shall bear the stamp of the testing laboratory wherever existing and amended to date.

b. In respect of all labor employed directly or indirectly on the work for the execution of the work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provision, B.I.S. recommendations, factory act, and workman‟s compensation act, CPWD code and instructions issued from time to time. Failure to provide such safetyrequirements would make the Contractor liable for penalty. In addition, the Engineer-in- Charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recoverthe cost incurred thereon from the Contractor.

c. The contractor shall provide necessary barriers, signals and other safety measures wherever necessary so as to avoid accident. He shall also indemnify the Employer against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian law and Regulations for any accident occurring due to any cause. The Employer shall not be responsible for any accident occurred or damage incurred or claims arising their form during the execution of work, the Contractor shall cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

Care of the Building

Care shall be taken by the contractor while handling and installing the various equipment and components of the work to avoid damage to the building. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove at his cost all unwanted and waste materials arising out for the installation from the site of work.

Performance Guarantee for Equipment Installation including Electrical works

The Contractor shall guarantee among other things, the following:

a) Quality, Strength and performance of the materials used.

b) Safe mechanical and electrical stress on all parts under all specified conditions of operation.

c) Satisfactory operation during the maintenance period.

Guarantee of Equipment Installation

All equipment/ installations shall be guaranteed for a period of 1 years from the date of taking over the installation by the Employer or for the period of the manufacturer‟s guarantee period whichever is greater against unsatisfactory performance and/or break down due to defective design, workmanship of material. The equipment or components, or any part thereof, so found defective during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Engineer-in-Charge. In case it is felt by the Employer that undue delay is being caused by the contractor in doing this, the same will be got done by the Employer at the risk and cost of the contractor. The decision of the Engineer-in-Charge in this regard shall be final.

Training, Operation & Maintenance

Training of Owner‟s staff for operation and maintenance of all equipment such as Transformer, CCTV system, all electrical Panels/Equipment‟s and any other equipment shall be arranged

by Contractor. In addition to this, the Contractor shall be required to hand over all installed equipment‟s manuals to the Owner.

The entire installation shall be at the risk and responsibility of the contractor until these are tested and handed over to the Employer. However, if there is any delay in construction from the Employer side, the installation may be taken over in parts, but the decision on the same shall rest with Engineer-in Charge which shall be a binding on the contractor.

Power Supply

Electrical power/Alternate source including backup power supply (as and when required) shall be arranged by the contractor for Construction, installation purpose at his own cost and payment for electricity charges shall be made by contractor. Electrical power supply required for testing of entire installation after completion shall be arranged by the Employer/Owner.

Data Manual and Drawings to be furnished by the Contractor

The Contractor would be required to submit the followings for approval before commencement of installation.

a. Technical submittal/ catalogue/ brochures of all equipment‟s installations to Engineering -In-Charge. Only after approval of such approval, the Contractor should place order for equipment and bring it to site.

b. Any other drawing/information not specifically/mentioned above but deemed to be necessary for the job by the contractor.

Completion Plan & Test Certificate for Equipment Installations including Electrical

The layout of all the installation for all services with proper dimensions, shall be finalized in consultation with the Engineer-in-Charge or his representative and the layout shall be got approved by the Engineer-in-Charge before start of the work.

Contractor shall submit completion plan/ Electrical drawings in triplicate before finalization of bill.

Verification of correctness of Equipment at Destination:

The materials shall be procured only from the manufacturers and their authorized dealers and documentary proof for such procurement and supply shall be produced by the contractor. The contractor shall have to produce all the relevant records to certify that the genuine equipment

from the manufacturers has been supplied and erected. The Employer reserves the right to send such materials to the manufacturers / authorized test laboratory to verify the genuineness and quality of the product. The Contractor shall submit all documentary details in fulfillment of this of invoices, test certificates; gate passes etc. to prove the genuineness of material/purchases from manufacturer or authorized dealers which are used at site as per agreement.

Painting:

All equipment works shall be painted at the works before dispatch to the site.

Maintenance during warranty period

Sufficient trained and experienced staff shall be made available to meet any exigency of work attends the complaint during the guarantee period of one year from the handing over of the installation.

The contractor shall ensure that all the skilled persons managed / deployed for executing the electrical work possess wireman license issued by approved authorities, otherwise he will not be permitted to execute the work. Also, consequences arising due to the default of the contractor to comply with this condition would be contractor‟s responsibility only.

1.2. CIVIL WORKS

The entire works shall be done as per CPWD specifications with up to date correction. However in the event of any discrepancy in the description of any item as given in the Schedule of quantities appended with the tender and the specifications relating to therelevant item as per CPWD specifications mentioned above the former shall prevail. If the specifications for any item are not available in the CPWD specifications cited above relevant IS specifications shall be followed. In case ISI specifications are also not available thedecision of the Engineer-in-charge given in written based on acceptable sound engineering practice and local usage shall be final and binding on the contractor.

1.0 The work shall be executed and measured as per metric dimensions given in the Schedule of quantities, drawings etc. (FPS units wherever indicated are for guidance only)

The following modifications, to the above specifications and some additional specifications shall however apply:-

i) All stone aggregate and stone ballast shall be of hard stone variety to be obtained from approved queries at or any other source to be got approved by the Engineer-in-charge.

ii) Sand to be used for cement concrete work mortar for masonry and plaster work shall be of standard quality. Sand shall be obtained from any source to be gotapproved by the Engineer-in-charge and screened as required. The same shallconsist of hard siliceous material. It shall be clean sand if the sand brought to site is dirty it must be washed clean in water and should conformto clause 3.1.5.1 of CPWD specifications 91-92 or latest edition for fine sand and clause 3.1.5.4 ofCPWD specification 91-92 for coarse sand except for grading purposes.

3.0 Wherever any reference to any Indian standard specification occurs in the documents relating to this contract the same shall be inclusive of all amendments issued there to or revisions thereof if any up to the date of receipt of tenders.

The rates for different items of works shall be for all heights and depth of the building accept where otherwise specified in the items of work.

i) The work will be carried out in accordance with the architect drawings and structural drawings., to be issued by the Engineer-in-charge. The structural and architectural drawings shall have to be properly noticed between Architectural and structural drawings, final decision in writing of the Engineer- in-charge shall be obtained by the contractor. For items where testing is required , sampleshall be prepared before starting the particular items of work for prior approval of the Engineer-in-charge and nothing extra shall be payable on this account.

5.0 Articles manufactured by reputed firms and approved by the Engineer-in-charge shall only be used. Only articles classified as "First quality" by the manufactures shall be used unless otherwise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of samples brought by the contractor shall be judged by the standards laid down in the relevant CPWD specifications. For items not covered by CPWD specifications relevant ISI standards shall apply.

6.0 The contractor shall give a performance test of installations as per specification before the work is finally accepted and nothing extra whatsoever shall be payable to contractor on this account.

7.0 The work shall be carried out in a manner complying in all aspects with the requirements of relevant bye-laws of the Municipal committee/development authorities and TCIL.

8.0 Other agencies doing work of electrification, external service other building work, horticulture work etc. for this project will also simultaneously execute the works and the contractor shall afford necessary facilities for the same. The contractor shall leave such necessary holes, openings etc., for laying/buying in the work pipes, cables, conduits, clamps, boxes and hooks for an clamps etc. as may be required for the electric and sanitary work etc. and nothing extra over the agreement rates shall be paid for the same.

9.0 Unless otherwise specified in the schedule of quantities the rates for all items of the work shall be considered as inclusive of pumping out or dewatering/bailing out water if required for which no extra payment will be made. This will include water encountered from any source such as rains, floods, and subsoil water table being high due to any other cause whatsoever.

10.0 Any cement slurry added over base surface or for continuation of concerning for better bond is added to have been in built in the item (unless otherwise/explicitly stated) and nothing extra shall be payable (or) extra cement considered with consumption on its account.

11.0 The rate for all items in which the use of cement is involved is inclusive of charges for curing.

The foundation trenches shall be kept free from water while all the works below ground level are in progress.

The fineness modulus of sand to be used in different works shall be as follows

i) Course sand Fineness modulus specified in the item like plain concrete, RCC work, flooring work etc. should lie between 2.5 to 3.5

ii) Fine sand Fineness modulus as specified in the items like finishing coat of cement plaster skirting cladding etc between 1.2 to 1.6.

iii) The coarse sand to be used at site shall be of light golden colour.

14.0 BRICK WORKS

Bricks shall generally conform to specification for brick class 75. Brick shall not absorb water more than 20% of their own dry weight after 24 hours immersion in cold water. Both the faces of wall of thickness more than 23 cm shall be kept in the proper plane. Wall of half bricks thickness or less shall be measured separately and paid in sqm. Half brick thickness shall be taken as 115 mm. Brick wall beyond half brick thickness shall be measured in multiple of half brick (i.e. 115 mm) which shall be deemed to be inclusive of mortar joints. When a fraction of half brick occurs due to architectural reasons or otherwise as per the requirements of the Department the same shall be measured as half brick work provided such fraction exceeds 2 cm fraction up to 2 cm thickness shall be made up in mortar and paid for as per specified thickness under brick work. Bricks shall be obtained from the source to be approved by Engineer-in-charge and shall be of best quality, well burnt, groundmoulded bricks available in the locality.

15.0 RCC WORK:

In respect of projected balconies, projected slabs at roof level and projected verandah the payment for the RCC work shall be made under the item of RCC slabs. The payment for centering and shuttering of such items shall similarly be paid under the item of centering and shuttering of RCC slab. Nothing extra shall be paid for the side shuttering at the edges of these projected balconies and projected verandahs. All the exposed edge shall however be finished as per specifications and nothing extra shall be paid for this.

In the item of RCC walls, railings and roofs etc. nothing extra shall be paid for making designs as per patterns given by Architects or for thickness of sections.

The rates for railing are inclusive of all the labour and the materials including of the item, portion of the railing which is embedded in the masonry or RCC shall not be included formeasurements.

16.0 PRECAST RCC

The compaction of the concrete shall be done by vibrations, table or external vibrator as approved by Engineer-in-charge. The rate quoted for the item shall include the element both for form work and mechanical vibration.

The water will be tested with regard to its suitability for use in RCC work and nothing extra will be paid for on this account.

The rate of item of reinforcement in RCC work includes all operations including straightening, cutting, bending, binding with annealed wire and placing in position at all the floors weight all leads and lifts complete.

17.0 FLOORING

The rate of items of flooring is inclusive of providing sunken flooring in bath rooms, kitchen etc. and nothing extra on this account is admissible.

WOOD WORK:

The contractor will be responsible for the watch and ward of shutters handed over to him by the Department for fixing in case these are stipulated for issue by the Distt. and nothing for the same will be paid. Timber as specified to be used for wood work shall be kiln seasoned in the relevant items in the schedule of quantities and shall conform to CPWD specifications 91-92 (Vol. I) or latest edition with correction slips up to date and will be of required variety obtained from approved sources.

Shutters of paneled doors shall be with kiln seasoned secondary species timber frames as per relevant specification of item and with panels of 12 mm thick second class teak wood 15 mm thick deodar wood both kiln seasoned or made of phenol form old dye glue processed nova teak or equivalent particle board 12 mm thick with or without commercial ply veneer faces on both sides as indicated in relevant items. The paneled shutters shall be kiln seasoned with species as specified in items (styles and rails) as per width shown in Architect drawings. Panels shall be embedded into frames to a minimum of 12mm with 1.5mm air gaps.

Permissible tolerance on wood work shall be as under:-

a) Door frames of 3 mm.

b) Door shutters.

   i) On width and height of 3mm.

   ii) On thickness of 1.2 mm

Transparent sheet glass conforming to IS 1761-1960 shall be used thickness being governed as under unless otherwise specified in the item.

Area of glazing	Thickness	Max. unsupported length	
For glazing area up to 0.2 sqm.	3 mm		60 cm

For glazing area from 0.2 sqm to 0.5 sqm	4 mm		120 cm
For glazing area more than 0.5 sqm	5.5 mm	120 cm	

Glazing for toilets and in fixed ventilators shall be of opaque type.

Factory made shutters as specified shall be obtained from factories to be approved by the Engineer-in-charge and shall conform to IS 2202 (Part-I) 1977. The contractor shall inform well in advance to the Engineer-in-charge the name and address of the factory where from the contractor intends to get the shutters manufactured. The contractor will place order for manufacture of shutters only after written approval of the Engineer-in-charge in this regard is given. The contractor is bound to abide by the decision of the Engineer-in-charge and he may recommend a another factory from the approved make list, in case the factory proposed by the contractor is not found competent to manufacture quality shutters.

The contractor will also arrange stage-wise inspection of the shutters at factory of the Engineer- in-charge or his authorized representative; contractor will have no claim if the shutters brought at site are rejected by Engineer-in-charge in part or in full lot due to bad workmanship/quality. Such shutters will not be measured and paid and the contractor shall remove the same from the site of work within 7 days after the written instructions in this regard are issued by Engineer-in- charge or his authorized representative.

The rate of T/angle iron from shall include the following:-

a) MS bill/tie of 16mm dia bar shall be welded to T-iron door frames to keep the frame vertical in correct position. The bill/tie shall be embedded in floorconcrete. No tie is necessary for window frames.

b) Each T-iron frame for doors shall have 4 nos. MS lugs 15x3 mm, 10cms longwelded to each vertical member of the frame.

c) MS plate 8x25mm, 100 mm long having threaded holes (no. of flats shall correspond to the no. of butt hinges to be fixed to door/window shutter) shall bewelded at appropriate places at the back of the T-iron frames for fixing the required but hinges to the frame with machine screws. MS flats 8x25mm; 50mmlong with threaded holes shall be welded to the back of the T-sections to receive the butt hinges for the cleats.

The MS flat cramps 15x6mm thick for holding arrangements are to be provided and added as per site conditions. The rate is inclusive of the cost of such clamps.

All welded steel work shall be tested for quality of weld as laid down in IS 822-970 before actual erection.

For all civil works, the work for all DSR items shall be executed strictly in accordance with

the CPWD specifications corrected up to date at the time of tenders, unless specified to contrary. The specifications for the non-scheduled items are mentioned below.

Single Bucket Dustbin

Single bucket dustbin with minimum dry waste carrying capacity of 40 kg weight and 70 L volume shall be fixed on stands, tilt able with open top and be made of 202 Grade Stainless Steel sheet of minimum thickness of 0.8mm and shall be corrosion resistant. Rates shall be inclusive of floor standing dustbin assembly with all accessories, stands, fittings and fixing. The Design shall be approved from Engineer-in-charge.

Flag Post

Supplying, installation and fixing Galvanized Iron high mast pole for National flags of height 6 meter. Pole shall be conical in shape of bottom & Top diameter- 20mm, Thickness - 1.0mm including holes and other accessories. Diameter of the base shall be 110mm and thickness of base plate shall be minimum 2mm. The rate shall be inclusive of National flag of required size as per IS code with hoisting arrangements and including mounted base, base plate and all other accessories.

Brick Tile Cladding

Material

1st class burnt clay brick tile shall be used. It shall be hard, sound durable and tough free from cracks, decay and weathering and defects like cavities cracks, flaws, holes, veins, patches of soft or loose materials etc. Thickness of tile shall be as approved by architect or Engineer-in-Charge. Before starting the work, the contractor shall get the samples of brick tile approved by Engineer-In-charge. Approved sample shall be kept in custody of Engineer-in-Charge andtile supplied and used on the work shall conform to sample with regard to soundness, colour, veining and general texture. Care shall have to be taken that corners of the tile are not damaged. No piece which has been damaged shall be used for that work.

Preparation of Surface and Laying

The tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:3 (1 cement: 3 coarse sand) or as specified. The average thickness of the bedding shall be 12 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable

the mason to place wooden plank across and squat on it. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The cladding shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished cladding shall not sound hollow when tapped with a wooden mallet.

Sampling and Testing

Sampling: For carrying out compressive strength, water absorption, efflorescence and dimensional tests, the samples of bricks shall be taken at random. The sample thus taken shall be stored in a dry place until tests are made.

Dimensional Tolerances: ± 1mm.

Compressive Strength: Should not less than 7.5N/mm^2 and less than 10N/mm^2

Water Absorption: The average water absorption of bricks tile when tested in accordance with the procedure laid down, shall be not more than 20% by weight.

Efflorescence: The rating of efflorescence of bricks tile when tested in accordance with the procedure laid down, shall be not more than moderate.

Outdoor Signages

Signages of different sizes and shapes shall be made using Stainless Steel sheet (Grade 304) conforming to IS 5522, of minimum 16G thickness. Letters of required size shall be constructed as three-dimensional letters from Stainless Steel sheets for outdoor signages, as may be specified in the design. All signages shall be fixed at required locations with Stainless Steel screws. Shop drawings shall be prepared by the Contractor before execution of work at his own cost and same shall be approved from Engineer-in-charge.

Indoor Signages

Signages of different sizes and shapes shall be made using Stainless Steel sheet (Grade 304) conforming to IS 5522, of minimum 20G thickness. Letters of required size shall be engraved/etched with approved colour on Stainless Steel sheet for indoor signages, as may be specified in the design. All signages shall be fixed at required locations with Stainless Steel screws. Shop drawings shall be prepared by the Contractor before execution of work at his own cost and same shall be approved from Engineer-in-charge.

Glass Reinforced Concrete (GRC)

Glass Reinforced Concrete Screens shall be made with frame of thickness 50mm and perforated designer screen element within thickness of 30mm as per approved design. The GRC screens shall be casted with a layering technique using power spray methodology and have minimum weight 3.5 kg per Sq.ft. The screens should be made from 53 grade white Portland cement, fine graded quartz, silica sand and alkali resistant glass fibre. Super plasticizers and UV resistant synthetic inorganic pigments should be used for pigmentation. The material casting should take place in FRP moulds. The GRC screens‟ flexural strength Limit of Proportionality should be at least 6 N/mm^2 & Modulus of Rupture should be at least 15 N/mm^2 for tests done on 28 days cured samples. The fixing of panels should be „Dry fixing‟ i.e., should be done with MS galvanized clamps, fixtures, screws and fasteners. All work, design, pattern and colour should be approved from Engineer-in-charge.

Expansion Joints

Expansion Joints in roofs, walls and floors shall be provided as per CPWD specifications 2019, Volume I sub-head 5.4.5 & 5.12

Cupboard Shutters

Providing and fixing Cupboard double leaf shutter/kitchen cabinet shutter with 1 mm thick pressed steel sheet door i/c 1.25mm thick pressed steel frame of minimum required section 75x25mm hinged with 3 Nos. steel butt hinges of 1.25mm thick sheet or 2 Nos.pivot hinge system at both side of frame i/c necessary fittings such as 2 Nos. M.S. tower bolts of size 150x10mm at top & bottom, 1 No. cupboard lock with lever handle i/c fixing with 3 Nos. lugs with rawl plugs, wooden plugs, screws/ Dash Fasteners etc. at both side of the frame complete as approved by Engineer-in-charge with priming coat of approved steel primer and spray painting with textured pattern synthetic enamel paint complete as per the direction of Engineer in charge. (Measurement shall be done of the elevational area of shutters i/c frame).

1.3. PLUMBING WORKS

General requirements

Scope of Work

a) The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

b) Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Drawings.

c) Without restricting to the generally of the foregoing, the sanitary installations shall include the following: -

Plumbing Works

a. Sanitary ware Installation
b. Water Supply System (Hot & Cold).
c. Under ground water tanks with all sleeves.
d. Sewerage & Storm water drainage system.

Specifications

Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender and as per BOQ, CPWD specifications with up to date amendments, relevant IS standards.

Execution of Work

a) The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, Mechanical, Electrical, Structural and Other specialized services drawings as shall be shared subsequently.

b) The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

Drawings

i. Plumbing drawings that shall be issued to Successful Bidder shall be diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

ii. Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

iii. Contractor shall verify all dimensions at site and bring to the notice of the Engineer-in-Charge all discrepancies or deviations noticed. Decision of the Engineer-in-Charge shall be final.

iv. Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

Inspection and Testing of Materials

Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings: -

i. Theodolite, Steel tapes
ii. Dumpy level
iii. Weighing machine
iv. Plumb bobs, Spirit levels, Hammers
v. Micrometers, Tachometers
vi. Thermometers, Stoves
vii. Hydraulic test machine
viii. Smoke test machine

All such equipment shall be tested for calibration at any NABL accredited laboratory, if required by the Engineer-in-Charge.

All Testing Equipment shall be preferably located in a special room meant for the purpose.

Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Engineer-in-Charge or kept at site in a sample room as prepared

by the Engineer-in-Charge. Any materials declared defective by Engineer-in-Charge shall be removed from the site within 48 hours.

Reference Drawings

The Contractor shall maintain one set of all drawings issued to him as reference drawings.

1.3.5.2.All corrections, deviations and changes made on the site shall be shown on these reference
drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Engineer-in-Charge.

Shop Drawings

The Contractor shall submit to the Engineer-in-Charge the shop drawings under following conditions: -

i. Showing any changes in layout in the plumbing drawings.

ii. Equipment layout, piping and wiring diagram.

iii. Manufacturer‟s or Contractor‟s fabrication drawings for any materials or equipment supplied by him.

The Contractor shall submit two copies of catalogues, manufacturer‟s drawings, equipment characteristics data or performance charts as required by the Engineer-in-Charge.

As built Drawings

On completion of work, Contractor shall submit two prints of “as built” drawings to the Engineer-in-Charge. These drawings shall have the following information.

(a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

(b) Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall.

(c) Run of all water supply lines with diameters, locations of control valves, access panels.

(d) Location of all mechanical equipment with layout and piping connections.

No completion certificate shall be issued unless the above drawings are submitted. Contractor shall provide two sets of catalogues, service manuals manufacturer‟s drawings, performance

data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

Testing

Piping and drainage works shall be tested as specified under the relevant clause(s) of the specifications.

Tests shall be performed in the presence of the Engineer-in-Charge.

All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

Contractor shall perform all such tests as may be necessary and required bythe local authorities to meet Municipal or other bye-laws in force.

Contractor shall provide all labour, equipment and materials for the performance of the tests.

Cutting of Water Proofing Membrane

No walls, terraces shall be cut for making and opening after water proofing has been done without written approval of Engineer-in-Charge.

Cutting of Structural Members

No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.

Grab Bar

Providing and fixing of 600mm wall mounted, Movable (horizontally and vertically) Stainless Steel 35mm diameter Handicap/ Disabled Grab Bar (U shape) including cutting & making good the walls.

Mirror

Providing and fixing 600 x 450 mm beveled edge mirror of superior glass (of approved quality) 5mm thickness, fixed with stainless steel studs, complete with cutting, making holes, studs, all fittings, screws, washers and making good the walls.

Toilet Paper Holder

The toilet paper holder shall be of PTMT as specified and of size and design as approved by the Engineer-in-Charge. It shall be fixed in position by means of PTMT screws and rawl plugs embedded in the wall.

Wash Basin

Wash basins shall be white glazed vitreous china of size as per manufactures, shape should be oval and type as specified in the Schedule of Quantities. Each Basin shall be fixed over counter. Placing of Basins over the counter without secure fixing shall not be accepted. Each Basin shall be provided with a 32mm dia waste with overflow, pop-up waste or rubber plug and chain as specified in the Schedule of Quantities, 32mm dia PTMT brass bottle trap with pipe to wall and flange. Each basin shall be provided with pillar tap fitting as specified in the Schedule of Quantities. Basins shall be fixed at proper heights as shown on drawings. If heightis not specified, the rim level shall be 79 cms or as directed by the Engineer-in-Charge.

uPVC Pipes and Fittings

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be

designed by external diameter and shall conform to IS:13592. The pipes shall be of Class-B pressure rating.

Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to IS : 14735

Laying & Jointing

The piping system must be clamped properly using rubber padded (internally) "coupled clamps", pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material.

The supports shall allow the repeated movements to take place without abrasion. Jointing for UPVC pipes shall be made by means of solvent cement for both horizontal and vertical lines. The type of joint shall be used as per site conditions / direction of the Engineer-in-Charge.

Traps

Floor traps where specified, shall be of siphon type full bore PVC having a minimum 50 mm deep seal.

Floor Trap Inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type of floor or manhole inlet fitting fabricated from UPVC without, with one, two or three inlet sockets welded on side to connect the waste pipe or joint between waste and inlet socket shall be with sealant compound/push-fit as per requirement of the system. Inlet shall be connected to a P or S trap, Floor trap inlet and the traps shall be set in cement concrete blocks where required in floors as specified without any extra charge.

Cleanout Plugs

Floor Clean Out Plug

Clean out plug for soil, waste or rain water pipes laid under floors shall be provided near pipe junctions bends, tees, "Y"s" and on straight runs at such intervals as required as per site conditions. Clean out plugs shall terminate flush with the floor levels. They shall be cast brass

suitable for the pipe dia. With screwed to a uPVC socket. The socket shall be joined to the pipe with drip seal/pipe seal.

Encasing in Cement Concrete

Encasing of pipes is required to provide stability to the line and prevent its damage during construction.

Soil and waste pipes under floor

Pipes laid in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 12mm size) 75mm in bed and all round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8m. All drainage pipes except when fixed above ground or in exposed locations shall be encased in cement concrete as specified above for soil and waste pipes. The bed and encasing thickness shall however be 150mm in bed and all round as shown on the drawing/specified in the BOQ.

Measurements

The pipes shall be measured net when fixed correct to a mm including all fittings along its length.

UPVC waste wipe and fittings from sanitary fixtures (up to 40 mm dia)

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from grooving‟s and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to IS: 4985:2000. The pipes shall be of 6 kg/cm^2 Class 3(PN) pressure rating and Fittings should be moulded type which conforming to IS 7834. Measurement of these pipes shall be measured net when fixed correct to a mm including all fittings along its length.

CPVC Ball Valves

Valves up to 50 mm dia. shall be quarter-turn (PVC Handle) shut off type Ball Valves with CPVC ball and body, spindle PTFE seating with high grade elastomer O-ring seals, tested to a hydraulic pressure of min of 10.3 kg , sq.cm. at 23-degree Celsius temperature. (Ball valves conforming to ASTM-D-2846 SDR-11)

Water supply pumps

Bore well Pumps

The pumps shall be vertical, submersible, multistage centrifugal, stainless steel (304) casing, stainless (304) impeller, stainless steel (316) shaft, ceramic bearings, tungsten carbide shaft protection bushes and mechanical seal driven suitable rated motor with 1500/2900 RPM, 415±10% Volts, 50 Cycles, AC 3 –phase Each pump shall be capable of operating within a performance pressure characteristics range sufficient below and above the required working pressure.

The Pumps shall conform to Indian standard IS: 8034. Pumps and motors shall be mounted ona common MS structural base plate. The pump shall be water cooled coupled to induction motor of suitable H.P and R.P.M specified in schedule of quantities. Pumping set shall be provided with a Gun Metal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping. The pump set shall be provided with gun metal gate valve of appropriate sizes on delivery & non-return valve of appropriate size and a pressure gauge with cock shall be provided on the delivery line.

Domestic Water Supply Pumps

Domestic water transfer pumps shall be Open well submersible monobloc pump, inline cast iron electrical driven pump, having Cast iron Base, Cast Iron impeller, stainless steel (316) shaft and mechanical seal directly coupled to motor suitable for operation on 400/440 volts driven by suitable kW as per manufacturer/pump performance chart, 2900 RPM, 220 Volts, 50 Cycles, AC 3 –phase TEFC vertical flange motor. Each pump shall be capable of operating with in a performance pressure characteristic range sufficient below and above the required working pressure.

Pumps shall be suitable for manual operation.

Pumps and motors shall be mounted on a common stand as per manufacturer

Each pump shall be provided with a totally enclosed water-cooled induction motor of H.P and R.P.M specified in schedule of quantities

Each pumping set shall be provided with a Gun Metal "Bourden" type pressure gauge mounted on delivery header with gunmetal isolation cock and connecting piping.

Appropriate vibration eliminating pads shall be provides with each pump.

The pump set shall be provided with gun metal gate valve of appropriate sizes on delivery. a non-return valve of appropriate size and a pressure gauge with cock shall be provided on the delivery line.

Suction and delivery lines of the pumps shall be provided with double flanged reinforced Neoprene flexible pipe connectors. Connectors shall be suitable for a working pressure of each pump as specified in Schedule of Quantities

System Description

The system shall be supplied as complete set including suction and discharge common manifolds, non-return valves, isolating valves, pressure transmitter on the discharge side and electrode at the suction tank.

Domestic Water Supply Pumps shall be suitable for manual operation.

Motor Design

The pump motor shall be a squirrel cage induction, housed in air filled water-tight enclosure. Oil filled motors are not acceptable. The stator windings shall be class `H' insulation (180°C or 317-8 grade 2) for submersible type.

The stator shall be heat shrunk fitted into the enclosure and shall not use bolts, pins or other fasteners that penetrate through the stator enclosure. The starter shall be equipped with a thermal switch embedded in series in the coils of the stator windings to protect the stator from wheel.

The motors shall be designed for continuous running duty type at 415 volts, 3 phase, 50 Hz power supply and capable of sustaining a minimum of 20 starts/stops per hour.

Between stator housing and pump, a tandem seal arrangement will be provided with an oil barrier. Both seals run in oil, allowing dry running without seal damage. Both seals shall be of the rubber bellows or metallic bellow type with positive drive between shaft and rotating seal face.

Electrical works

Electrical equipment shall be suitable for electrical voltage specified in the bill of quantities and as required by local authorities. Motors shall be for heavy duty TEFC compatible for the duties of the pumps. Motors shall be rated 10-15% above the proof terminal box. Each motor shall be provided with a weather proof terminal. Connections to all motors shall be made with waterproof flexible connections with suitable bushes and terminal lugs.

Starters for motors shall be fully automatic type with push buttons. Direct on line (DOL) for motor up-to 10 HP. Starters for motors above 10 H.P. shall be automatic star-delta starters. Motor control centre for the entire plant shall be dust and vermin proof construction fabricated from corrosion resistant M.S. sheets and comprising of:

- One incoming MCCB.
- Copper bus bar in separate chamber of ample capacity.
- One isolation MCB/ MCCB for each motor.
- One starter of required type for each motor.
- One set of ON/OFF indicating lamps for each motor.
- One voltmeter with selector switch on incoming main.
- One ampere meter for each motor.
- One single phasing preventer for each motor.
- All interconnecting colour coded wiring within the control center.

Any other devices and accessories necessary and required for a complete working system and as required by local authorities. All power and control cabling from MCC panel to all motors and controls shall be 1100 volts grade with numbers of the cores necessary and required conforming to relevant IS. Entire electrical installation shall be earthed in accordance with local electrical rules. Slotted tray running on wall shall be provided for taking cables from MCC to various motors.

Pipe colour code (Colour code to confirm to IS: 2379)

S.No.	Pipe Lines	Ground / Base Color	First Color Band	Second Color Band
1	Drinking Water (All cold-water lines after filter)	Sea Green	French Blue	Single Red
2	Treated Water (Soft Water)	Sea Green	Light Orange	
3	Domestic Hot Water	Sea Green	Light Grey	
4	Drainage	Black		

1.4. FIRE FIGHTING WORKS

Scope of Work

Without restricting to the generally of the foregoing, the Fire Fighting work shall include the following: -

a. Hydrant System

b. Fire Extinguishers

Fire Pump

a) The fire pump shall be single stage suction centrifugal type with split casing type and direct driven by electric motor as specified. The pump rating and performance shall conform to the equipment schedule and meet the TAC duty requirements.

b) Pump casing shall be of close-grained cast iron with bronze impeller. The shaft sleeve shall be brass or SS 304 and the trim shall be brass or bronze.

c) Pump shall be capable of delivering 150% of the rated capacity at 65% of the rated head and the no-delivery head shall be not more than 140% (150% in case of end suction type) of the rated delivery head. The pump casing shall withstand 1.5 times the no-delivery pressure or 2 times of the duty pressure whichever is higher.

d) The pump shall be electrically driven with direct flexible coupling.

e) The electric driven motor shall be squirrel cage induction conforming to IS 325 and rated for continuous duty (S1). Motor shall have not less than class F insulation and minimum enclosure of IP22. The starter shall be air cooled fully automatic star delta or auto transformer type. Starters shall conform to IS 8544 and rated for AC-3 duty conditions.

f) Drive rating shall be based on the largest of the following:

i) Rated pump discharge at rated head

ii) 150% of rated discharge @ 65% of rated head

iii) Maximum power absorbed by the pump in its operating range i.e. no-delivery to free discharge.

Accessories

The Fire Pumps shall be complete with the following accessories:

a) Suction and discharge eccentric reducers

b) Pump coupling guard

c) Common base frame, fabricated mild steel or cast iron.

Each pump shall have independent set of pressure switches. The pressure switch shall be snap action SP DT switch rated 10A @ 220 V operated through a stainless-steel diaphragm. The switch shall have a pointer for manual adjustment of set point, and all electrical connections shall be terminated in a screwed terminal connector. The entire unit shall be encased in a cold drawn steel (heavy gauge) enclosure. The diaphragm shall be designed for a maximum operating pressure of the system. Each pressure switch shall be provided with a pressure gauge in parallel as shown on the drawings and all gauges and pressure switches shall be mounted in an instrument panel with necessarycontrol piping and drainage facility.

System operation and control panels

a. The fire pump shall be started automatically on loss of pressure and the operation sequence of the booster and fire pumps shall be as follows:

    i. The Fire Pump shall start when the system pressure drops by 1.0 kg/cm2 and shall continue to run till manually switched off.

b. The motor starters (direct on line or star-delta) shall consist of electrically actuated contactors. The starter shall be complete with ON-OFF push buttons, timers and auxiliary contacts and shall be fully automatic. There shall be an indicating lamp with each of the pumps and an ammeter and selector switch with the fire pumps. Fire pump starting shall be annunciating through an electric siren.

c. The starter along with isolator shall be housed in a 14 SWG MS box duly rust inhibited through a process of degreasing and phosphating.

d. All cabling to and from the pumps to starter and control switch shall be carried out through armoured PVC cables of approved makes. Cables shall be laid in accordance with section "M V CABLING". The pump motors and panels shall be double earthed in accordance with IS 3043 or as shown on drawings and as approved.

Fire hydrants and hose reels

a. First-aid hose reel with 30 m long 25 mm dia high pressure double braided rubber hose (IS:444 marked) with 25 m dia Ball Valve.

b. The First Aid Hose shall conform to IS 884 and be wound on a heavy-duty circular hose reel with a bracket. The hose shall be permanently connected on one end to the Down comer through a 25m Ball Valve with necessary hose adapter and a gun metal nozzle at the other end.

Test & commissioning

1. The fire pump starting and stopping shall be tested by opening the test valve and record the following and the valves should be as furnished below:

i. System pressure at start-up : 2.0 kg/sqcm

ii. System pressure at stop : 3.5 kg/sqcm

iii. Time elapsed from start to stop : 2 Seconds

Mode of measurement

Fire pump with mounting frame, excluding concrete foundation shall be measured per unit. Instrument panel with pressure gauges, pressure switches, control piping etc. shall be measured as one unit. Control cabling from pressure gauge panel to the respective starters shall be measured in running meter and paid at unit rates.

Piping For Fire Fighting System

External

All External pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 using wrought GI steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwed type. Flanges shall be rated for 2.0 N/sqmm.

Black mild steel pipes, when laid underground, shall be protected against corrosion by two coats of hot bitumen and 2mm thick wrapping of pypkote. Fittings shall be weld able wrought iron, suitable for butt welding and 10% of the welded joints shall be radio graphicallytested and found in order. The welded joints shall be random selected for testing

in consultation with the Engineer-in-charge. All flanges shall be slip-on welded type to IS 6392 with a 3mm fibre-reinforced Teflon gasket and rated for 2.0 N/sq. mm.

Underground mains shall be laid not less than 750 mm below the ground level and shall be at least 2m away from the building face and supported on concrete pedestals at every 3.5m and held on with galvanised iron clamps. Concrete thrust anchors shall be provided at all bends and tees as shown on drawing and as directed. All excavation for pipe laying shall be carried out with sufficient width for making proper joints. Backfilling shall be done only after the piping is hydro-statically pressure tested. Piping shall be constantly kept clean till tested.

All valves shall be housed in brick masonry chambers over 150mm cement concrete (1:3:6) foundation. The brick walls of the chamber shall be plastered inside and outside with 20mm cement sand plaster 1:4 with a floating coat of neat cement. Chambers shall be 650 x 650 mm clear for depths up to 1200 mm and 1000 x 1000 mm for depths beyond. Each chambershall have a cast iron surface box approved by the Engineer in-charge.

Piping laid above ground shall be supported on cement concrete (1:2:4) pedestals raising the bottom of the pipe at least 150mm over the ground level and held to the pedestals with galvanised clamps. Pedestals shall be made at 3.0m centre to centre and as shown on drawings. Cement concrete 1:2:4 thrust anchors shall be provided at all tee-off points and change of direction as shown on drawings and as required. Pipes laid on walls and ceiling shall have galvanised steel brackets.

Internal

All internal pipes shall be, unless otherwise specified, heavy quality mild steel tubes complying to IS1239 using wrought steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwedtype. Flanges shall be rated for 2.0 N/sqmm.

Valves shall be suitable for external piping.

All pipes shall be of approved make and best quality without rust marks. Pipes and fittings shall be fixed in a manner as to provide easy accessibility for repair, maintenance and shall not cause obstruction in shafts, passages etc. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanship manner. Pipes shall be securely

fixed to walls and ceilings by suitable supports at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceiling and walls.

All pipes shall be adequately supported from ceiling or walls through structural supports fabricated from mild steel structural e.g. rods, channels, angels and flats generally as shown on drawings. Fasteners shall be shear type anchor fasteners in concrete walls and ceilings and wrought steel spikes of at least 75mm long in brick walls. All pipes supports shall be painted with 1 coats of red oxide primer and two coats of black enamel paint.

All low point loops in the piping shall be provided with 25mm Ball Valves with rising spindle for draining the system. All valves shall have screwed brass caps. Likewise 25mm gun metal air vents shall be provided at all high point loops to prevent air-locking.

All piping shall have flanged joints at about 25m intervals to facilitate easy maintenance.

Pipe Jointing

All pipes shall be provided with threaded joints up to 50mm diameter and welded joints for pipe above 50mm diameters. Hold tite shall be used for sealing.

All welded joints shall be tested by radiography test.

Joints between CI and GI pipes shall be made by providing a suitable flanged tail or socket piece and MS flange on the GI pipe. Flanges shall have appropriate number of holes and shall be fastened with nuts, bolts and 1.5mm thick compressed asbestos gasket.

a. Valves and other accessories

b. Gate Valves

i. Sluice / Gate valves shall be used for isolation of flow in pipe lines For sizes upto 65 mm, gate valves shall be outside screw rising spindle type and shall be as per IS: 778 Class-I and Class-II, as applicable. For sizes 80 mm to 300 mm, gate valve shall be as per IS: 780, PN=1.0 and shall be of inside screw and non-rising type and cast iron double flanged.

ii. Gate valves shall be provided with a hand wheel, draining arrangement of seat valve and locking facility (as required). Gate valves shall have back setting bush to facilitate gland renewal during full open condition.

iii. The Body, bonnet, Stuffing Box, cap and hand wheel shall be of cast iron to IS:210, grade FG 200 / 260. The non-rising spindle shall be of solid forged high tensile brass or carbon

steel to AISI 304 construction. The Bodyseating and wedge ring shall be of solid leaded gun metal. The Bonnet gasket shall be of high quality rubber.

iv. The Valve shall be PN 1.0 rated but shall withstand tests of up to 20 kg / cm2. The ends shall be flanged. The batch number of the valve shall be punched on the top of the flange. The spindle shall be removable type, and shall be easily rotated.

c. Pressure Switch

i. The Pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. It shall be suitable for line pressures up to 15 kg / cm2. The scale range for cut in and cut outshall be from 0 to 10 kg / cm2.

ii. The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP: 66 water and environment protection.

iii. The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel. The switch shall be snap acting type with 1 number N O / N C contact.

d. Pressure Vessel

i. The Pressure Vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water; the remaining being filled with air which will be under compression when the system is in normal operation.

ii. Pressure vessel shall be fabricated from 8-10 mm thick MS plate with dished ends and suitable supporting legs. It shall be provided with a 50 mm dia flanged connections from pump, one 25 mm drain with ball valve, one water level gauge and 25 mm sockets for pressure switches. The pressure vessel shall be hydraulically tested as required.

iii. The Pressure Vessel shall be for Hydrant Systems. The Pressure Switches shall be mounted on the drain end of each Vessel. The Vessel shall also be provided with an air release valve mounted at the top.

e. Pressure Gauge

The Pressure Gauge shall be constructed of die cast aluminum and stove enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourden tube type Pressure Gauge with a scale range from 0 to 16 Kg / cm^2 and shall be constructed as per IS:

3624. Each Pressure Gauge shall have a siphon tube connection. The Shut off arrangement shall be by Ball Valve.

f. Ball Valve

The Ball Valve shall be made from die cast brass and tested to 14 Kg/cm^2 pressure.

i. The valve shall be internally threaded to receive pipe connections.

ii. The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body- bonnet gasket and gland packing shall be of Teflon.

iii. The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of `open' and `closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping up to 14 Kg / cm2 pressure.

iv. The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree. The lever shall be operated smoothly and without application of any unnecessary force.

g. Non Return Valve

i. Non-return valves shall be cast iron spring action swing check type. An arrow mark in the direction of flow shall be marked on the body of the valve. The valve shall bear IS: 531 certification.

ii. The Valve shall be of cast iron body and cover. The internal flap in the direction of water shall be of cast iron and hinged by a hinge pin of high tensile brass or stainless steel. Cast iron parts shall be conform to IS: 210, grade 200 / 260 type.

iii. The gasket shall be of high-quality rubber and flap seat ring of leaded gun metal to BS 1400 LG 2C. At high pressure of water flow the flapper shall seat tightly to the seat. The Valve shall be capable of handling pressure up to 15 kg / cm2.

h. Butterfly Valve

i. The Butterfly Valve shall be suitable for waterworks and tested to minimum of 16 kg / sq cm pressure. The Valves shall fulfill the requirements of AWWA (American Water WorksAssociation) C 504, API 609 and MSS-SP-67.

ii. The body shall be of cast iron to IS: 210 in circular shape and of high strength to take the minimum water pressure of 10 kg / cm2. The disc shall be heavy duty cast iron with anti-corrosive epoxy or nickel coating.

iii. The valve seat shall be of high-grade elastomer or nitrile rubber. The Valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be of EN 8 grade carbon steel.

iv. The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakage.

v. The Valves shall be supplied with manual gear operated opening / closing system by lever.

i. Pipe supports

All pipes whether horizontal or vertical shall be suitably supported using galvanized mild steel clamps/clevis hanger manufactured by M/s Hira Walraven Installation Systems Pvt Ltd or equivalent product of good quality as approved by engineer in-charge.

j. Vertical Pipes

The pipes running vertical shaft shall be supported by galvanised mild steel rigid clamps fixed to wall with anchor bolts and studs.

When the horizontal distance between the centre line of two adjacent pipes is less than 300 mm a powder coated HIRA WALRAVEN/or equivalent rail shall be fixed to wall the pipes independently clamped to the rail with `U' bolt clamps.

k. Horizontal Pipes

Pipes running horizontal shall be supported from structural beam/slab by using appropriate galvanised M.S. pipe clevis hangers.

The spacing of supports shall be as follows:

GI Pipes/MS Pipes		CI Spun Pipes	
Internal Dia (mm)	Spacing (mm)	Internal dia (mm)	Spacing (mm)
15	1800	75-150	2700

20,25	2400	200-250	3000
32	2700	300	3600
40-50	3000		
65-80	3600		
100	4000		
150	4500		

Supports for horizontal piping longer than 15m in a stretch shall be provided with swivel clamps. Otherwise, the clamps shall be universal clamps or rigid clamps as required by the project engineer.

Fixing of clamps/rails etc.

All clamps, rails and accessories shall be fixed to the structure (beam, slab, walls etc.) by using approved good quality anchor fasteners of appropriate size.

l. Painting

All exposed piping for firefighting shall be distinctly painted `Fire red' shade 536 to IS:5-2007. Pipes shall first receive two coats of red oxide primer uniformly applied and two coats of oil paint applied thereafter. All pipes support shall be painted black as specified for support & clamps.

Painting Schedule

All equipment and piping shall be painted in accordance with the following colour code:

Equipment	Colour	Distinguishing Mark
a) Pump motors	Fire Red Shade No.536 to IS: 5 -2007	
b) Internal piping	"	
c) Landing valves & Hose reel cabinets	"	
d) External Hydrants	"	

e)	Fire brigade connection	"
f)	Priming tank	"
g)	Air vessel	"
h)	Electric panels	Black & Red
i)	Fire Alarm Panel	Black & Red
j)	Repeater panel	Black & Red
k)	Break Glass Unit	Fire Red
l)	Hooters/Speakers	Fire Red
m)	Sprinkler pipes	Fire Red

All surfaces to be painted shall be thoroughly cleaned with wire brush to remove completely rust and other extraneous substances. Over the cleaned surfaces one coat of red oxide primer shall be applied completely covering the exposed surfaces. Finishing coat of enamel paint shall be applied one day after the prime coat, after ensuring that the paint is dry. The second coat shall be done before the installation is handed over and after approval to do so from the Engineer-in-charge.

Testing & commissioning

All piping after installation shall be tested for a hydrostatic test pressure of 10.5 kg/sqcm or 1.5 times the working pressure (whichever is less) maintained for 24 hours. All joints and valves shall be checked for leaks and rectified and retested. During testing all valves except drain & air valves shall be kept fully open.

Mode of measurement

All external piping shall be measured along the centre line of the pipe and paid per unit length and shall include:

- All pipes & fittings

- Bituminous coating

All internal piping shall be measured similarly but shall include for the pipe supports and clamps.

All valves, air valves, drain valves together with flanges or tail pieces shall be measured per unit.

All excavation and concrete supports and thrust blocks shall be measured as per drawing and paid for per cum.

The cost of pipe supports described above form part of the rate quoted for piping and no extra shall be payable on the account.

PORTABLE FIRE EXTINGUISHERS & EXIT SIGNAGES

Scope

The scope of work covers the supply and installation of portable fire extinguishers. The following types are envisaged in these specifications and provided as shown in the schedule of portable fire extinguishers.

- Dry powder extinguisher
- Carbon-dioxide extinguisher
- Mono ammonia phosphate extinguisher
- Water expelling type.

Standards

The following standards and rules and regulations shall be applicable:

Fire protection manual of the tariff advisory committee, Fire Insurance Association of India

IS:2176 : Portable fire extinguisher Dry power type

IS:2878 : Portable fire extinguisher carbon-dioxide type

Local Fire Brigade/Authority standards mean the latest.

Extinguishers

(i) Carbon dioxide type

a. The extinguishers shall be rated for 2.0 and 4.5 kg by weight or carbon dioxide, unless stated otherwise. The contents shall be with a filling ratio not exceeding 0.667.

b. The body shall be steel cylinder made according to IS:2872 and approved by the chief controller of explosives.

c. The discharge head shall be simple and safe to operate conforming to IS:3224 with a safety release to IS:5903 set to 18.0 to 20.0 N/sqmm. A siphon tube of copper or PVC shall be fitted. A non-conducting discharge horn and a high pressure hose (27.5 N/sqmm pressure) shall be fitted with each extinguisher.

d. The discharge system shall be designed to expel 95% of the contents in continuous discharge as follows:

Capacity (kg)	**Time (Sec.)**
2.0	8 - 18
3.0	10 - 20
4.5	10 – 24

(ii) Mono ammonium phosphate type

a. The capacities envisaged are 2 kg & 6 kg. The filling pressure shall be 0.95 +/- 0.055 N/sqmm.

b. The body shall be cylindrical in shape and made of cold rolled carbon steel grade D/DD or hot rolled steel plate with radio graphically tested welded construction. Plate thickness shallc onform to IS:11108.

c. Discharge valve mechanism shall be a simple and safe squeeze grip valve. 4.5 kg and above capacity shall have a high pressure (0.5 N/sqmm) hose and non-conducting horn and shall also be provided with a pressure gauge. 95% of the contents shall be discharged as follows:

Capacity (kg)	**Time (sec)**	**Throw (m)**
2.00	8 - 16	2
6.00	15 - 24	4

d. The internal and external components and surface shall be treated for anti-corrosion as for dry powder type extinguishers.

General requirements

a. All extinguishers shall be standard products approved by the Tariff Advisory Committee and Local Fire Authority and manufactured and tested strictly in accordance with the relevant Indian Standard. All markings and test results shall be stamped in the appropriate colour markings accordingly to the Indian Standards.

b. All extinguishers shall have a structurally designed galvanized steel handle and also a suitable wall mounting bracket.

List of Standard Codes

S.No.	**IS Code No.**	Description
1.	IS:780:1984	Specification for sluice valve for water works purposes (6th rev.) (50 to 300 mm size) (amendment 3)
2.	IS:13095:1991	Butterfly valves for general purposes
3.	IS:5312 (part 1) : 2004	Swingcheck type reflux valves (non-return valve): part 1 single door pattern
4.	IS:884:1985	Fire aid hose reel for fire fighting
5.	IS:901:1988	Coupling double male and female instantaneous pattern for fire Fighting
6.	IS:903:1993	Fire hose delivery coupling, branch pipe, nozzles and nozzles Spanner
7.	NBC-2016 Part IV	National building code of India 2016
8.		Central public works division (CPWD) Part-V, wet riser system for firefighting 2006, Govt. of India
9.	IS:3844-1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises
10.	IS:2190:2010	Code of practice for selection and maintenance of first-aid fire Extinguisher
11	IS:6382:1984	Code of practice for design and installation of fixed system carbon dioxide fire extinguishing system
12.	SP:35 (s&t)-1987	Hand book on water supply & drainage by bureau of Indian Standards
14.	IS:933-1989	Specifications for portable chemical from fire extinguisher
15.	IS:2171-1999	Specifications for portable fire extinguishers, dry power

1.5. ELECTRICAL WORKS

Switchgears & Switch boards

Standards and codes

	Specification for low voltage switchgear and control gear	
	• General Rules	IS 13947 Part-1 : 1993
	• Circuit breaker	IS 13947 Part-2 : 1993 IEC-62271
	• Switches, disconnectors, switch disconnectors and fuse combination units	IS 13947 Part-3 : 1993
	• Low voltage switchgear and control gear Specification - Control circuit devices and switching elements	IS 8623
	➢ Electro mechanical control circuit Devices	IS 13947 Part-5 : Sec-1 : 2004
	➢ Proximity switches	IS 13947 Part-5 : Sec-2 : 2004
	Guide for uniform system of marking and identification of conductors and apparatus terminals	IS 113553 : 1985
	Electrical relays for power system protection	
	General introduction and list of parts	IS 3231 Part-0 : 1986
	• General requirement	
	➢ Contact performance	IS 3231 Part-1 : Sec-1 : 1986
	➢ Insulation tests	IS 3231 Part-1 : Sec-2 : 1986
	➢ High frequency disturbance test for static relay	IS 3231 Part-1 : Sec-3 : 1986
	• Requirements for principal families	
	➢ All or nothing relays	IS 3231 Part-2 : Sec-1 : 1987
	➢ General requirement for measuring Relay	IS 3231 Part-2 : Sec-2 : 1987
	➢ General requirements for thermal relay	IS 3231 Part-2 : Sec-3 : 1987

	• Requirements for particular group or relays : Biased (percentage) differential relay	IS 3231 Part-3 : Sec-3 : 1987
	• Requirements for particular group or relays : Directional relays and power Relays	IS 3231 Part-4 : Sec-3 : 1987
	Specification for low voltage switchgear and control gear assemblies :	
	• Requirements for type tested and partially type tested assemblies	IS 8623 : Part 1 : 1993
	• Particular requirements for bus bar trucking system (bus way)	IS 8623 : Part 2 : 1993
	• Particular requirements for equipment where unskilled person have access for their use	IS 8623 : Part 3 : 1993
	Code of practice for selection, installation, and maintenance of switchgear and control gear	
	• General	IS 10118 Part-1 : 1982
	• Selection	IS 10118 Part-2 : 1982
	• Installation	IS 10118 Part-3 : 1982
	General requirement for switchgear and control gear for voltage not exceeding 1000 volt AC or 1200 volt DC	IS 4237 : 1982

Switchgear

A. Molded case Circuit Breakers (MCCB)

- Type Molded case circuit breaker
- Operating voltage 415/690-volt 3 phase 50 Hz
- Insulation Voltage - 690 volts
- Current rating - as per Schedule of Quantities
- Fault Level withstand Ices - As per Schedule of Quantities
- Icu - 100% Ics

- Icw - 100% Ics
- Isolation function - as per IEC 60947-2 Section 7.12
- Insulation - class II insulation between the front panel and internal power circuits
- Cubicle mounting - Fixed unless otherwise specified
- Operating mechanism - Trip free
- Independent Manual spring closing (IMS) or motor wound spring closing mechanism (MWS) as per Schedule of Quantities
- No of Poles - 3 or 4 as required
- All current carrying parts - Silver plated
- Arcing contacts shall be provided to protect the main contacts and shall be separate from the main contacts and easily replaceable.
- Arc chutes shall be provided for each pole, and shall be suitable for being lifted out for the inspection of the main and the arcing contacts.
- Common Operating handle required for three phase MCCBs for simultaneous operation and tripping of all the three phases.
- Indications and Operations integral with ACB on front
    a. Mechanical ON/OFF/ Tripped indication
    b. Operating handle
    c. Mechanical trip push button
- Accessories - Following accessories shall be provided as required
    i. Under voltage trip
    ii. Shunt trip
    iii. Alarm switch
    iv. Auxiliary switch
- Circuit Breaker Interlocking - Interlocks shall be provided to ensure the following:
    i. Handle interlock to prevent unnecessary manipulations of the breaker.

ii. Door interlock to prevent door being opened when the breaker is in ON position.

iii. DE interlocking device to open the door even if the breaker is in ON position.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

- Protection Microprocessor based releases and/or thermal magnetic releases shall be provided for the Circuit Breakers as stipulated in the Schedule of Quantities
- Electrical endurance Upton 250 amps minimum 10,000 operations
- For 400 amps & above minimum 4,000 operations
- Type test certificates Submit Certificates from a recognized test house for the Circuit Breakers offered.

Switchboard

- Supply System Three phase 4 wire, 415-volt, 50 Hz, Indian TN-S system.
- Short circuit level withstands as per Schedule of Quantities.
- Ingress protection IP 42 as applicable.
- Metal based neoprene gaskets between all adjacent units and beneath all doors and covers shall be provided to render the joints dust and vermin proof.
- Pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.

Panel Compartmentation

- Compartment Tier 3A as per IEC 6043 (Part-I) unless otherwise stated in Schedule of Quantities.
- Circuit Breaker Metering Separate segregated compartment shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus bars and connections.
- Control wiring compartment a horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Panel Configuration

- Panel configuration - MCCB's arranged multi-tier formation.
- Air Circuit Breakers - Single or double tier formation.
- Spare Space provision - The Switchboards shall have a provision of 25% spare space to accommodate possible future additional switch gear.
- Extensible shall be extensible on both sides.

Panel Construction

- Metal clad totally enclosed,
- Dead front
- Floor mounted
- Free standing type
- Modular extensible design
- Suitable for indoor mounting.

Switchboard cubicles, doors and covers - Fabrication with CRCA Sheet Steel

Cubicles - Thickness shall be 3.0 mm for load bearing compartments and 2.0 mm for non-load bearing compartments, folded and braced to ensure rigid support for all components.

Doors/ covers - Thickness not less than 1.6 mm & should be properly earthed.

Joints - Seam welded

Welding slag - Ground off

Welding pits - Wiped smooth with plumber metal.

Switchboard frames Fabrication

With electro galvanized MS sheets „U" Channel switchboard frames of 2.5 mm thick

All joints should be neatly formed and finished flush with adjacent surfaces, No joints shall be located in corners. Bare edges shall be round/covered.

Structural members and bracings where ever required shall be welded or bolted to the frame. The frame shall be of modular design and extensible.

Cable compartment Rear Access switchboards

All cabling from rear, Front access switchboard, Separate vertical cable accessible from front only.

Adequate space shall be provided for ease of installation and maintenance with safety for working without coming into contact with any live parts.

The cable chambers shall be complete with

- Adequate support for cables.
- Tinned brass cable sockets,
- Tinned brass compression glands,
- 3 mm thick gland plates,
- Supporting clamps and brackets etc. for termination of 1,100-volt grade aluminum conductor XLPE cables.
- Door handles Good quality door handles fitted with toggles to operate rods to latch with suitable slots in both top and bottom of switchboards shall be provided. Latching rods and associated brackets shall be cadmium plated.
- Operating handles all operating device shall be located in front of switchgear only.
- Fixing Screws Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in switchboards.
- Dimensional Limitations
    i. Base channel 75 mm x 5 mm thick shall be provided at the bottom.
    ii. Minimum 200 mm blank space between the floor of switchboard and bottom most unit shall be provided.
    iii. Overall height shall be limited to 2,300 mm unless otherwise stipulated.
    iv. Height of the operating handle, push buttons etc. shall be restricted between 300 mm and 1,700 mm from finished floor level.

Switchboard Bus Bars, Interconnections etc rating

- Rating of Bus Bars, interconnections and to feeders these shall be designed as per requirements in Schedule of Quantities to-Carry full load current for phase and neutral bus bars Withstand the stresses of fault level. For aluminum & copper current density shall be of minimum cross section of 0.6 & 1.0 amp per sq. mm respectively.

Switchboard Bus Bars

- Bus Bar material High conductivity, high strength aluminum alloy, complying with requirements of grade E 91E of IS 5082 – 1981

  Alternatively, Electrical grade 99.99% pure copper as per Schedule of Quantities

- Bus Bar Insulation Heat shrunk PVC sleeking of 1.1 kV grade and bus bar joints provided with clip-on shrouds.

- Bus Bar supports Non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature of - 25°C to 130°C (degree of protection IP 65 IEC 60529) at regular intervals, to withstand the forces arising from a fault level as stipulated in schedule of quantities.

- Colour coding- all bus bars shall be colour coded.

- Auxiliary Bus Electrolytic Copper Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These shall be insulated, adequately supported and sized to suit specific requirement.

Switchboard Interconnections

- Interconnection material Unit ratings up to 100 amps,

- FRLS PVC insulated copper conductor wires with crimped terminations.

- Rating of 100 amps and above solid copper/aluminum connections PVC sleeved

- Interconnection jointing all connections, tapings etc.

- Shall be made to ensure minimum contact resistance.

- Shall be firmly bolted and clamped with even tension before assembly.

- Joint surfaces shall be filed or finished to remove burrs, dents and oxides and

  Silvered to maintain good continuity at all joints.

All screws, bolts, washers shall be cadmium plated.

Approved spring washers shall be used with cadmium plated high tensile steel bolts with BSF threads.

- Instrument and control wiring all wiring for relays and meters shall be with ZHFR PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. All power circuit wiring shall be minimum 2.5 sqmm and control

circuit wiring shall be of minimum 1.5 sqmm and for CT & PT minimum 4sqmm copper cable shall be considered.

Earthing

Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors / frames shall be connected to earth through adequately sized flexible braids.

Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 5°C operation interlocked with switchgear.

- Sheet Steel Treatment and Painting Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute Sulphur acid and a recognized phosphating process after which a coat of primer paint comp actively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50-micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.
- Labels Suitable engraved white on black metal identification labels shall be provided for each switchgear cubicle in front and back identifying the circuit, switchgear type, rating and duty.

Testing at manufacturers works

Following testing must be completed before dispatch of equipment at site, if required Engineer-In-Charge may call for factory inspection to ensure all testing are completed.

- All wiring checks and connections
- Relay adjustment
- Interlock function check
- Continuity checks of wiring, fuses
- Insulation resistance test
- Trip test

- High voltage test
- Testing and commissioning
- Assembly of various sections of panels
- Grounding the units
- Bus bar termination on switchgear
- Insulation test with 500 volts megger. The insulation resistance should be more than 100 mega ohms
- Local Authority Requirements. All requirements by the local Authority including those listed below shall be complied with
- Provision for Gas nozzles within each cubicle
- Danger Notice Plate
- Rubber floor mat of minimum 6 mm thickness and 1 m width provided for the full length of the switchboard.
- A dry chemical type fire extinguisher of required capacity with approved label

Relays, CTs, PTs, Meters, Indicating Lamps etc.

General

This section covers specifications for Protection and Control Relays for breakers, Instrument Transformers, Measuring Instruments, Push Buttons, and Indicating Lamps etc. required in LT and HT switchboards.

Standards and codes

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition, the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 2016, National Electrical Code (SP30 : 2011), Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

Application guide for Current Transformers	IS 2705
Application guide for Voltage Transformers	IS 3156

Instrument Transformers (Current & Voltage Transformers)	IEC 61869
Application guide for Relays	IS 3842
Electromagnetic Relays	IS 5051
Microprocessor Relays	IEC 60255

Protection and control relays

The Circuit Breaker shall have protection and control relays as specified in the bill of quantities. Relays shall be approved types complying to relevant ISS and having approved characteristic. Relays shall be flush mounted in dust proof cases. Relays shall be arranged so that adjustments, testing and replacement can be affected with minimum of time and labour.

In case of C.T. operated thermal overload and magnetic instantaneous short circuit release. The overload releases shall be such that each phase can be individually set depending on the phase unbalanced currents. The releases shall have inverse time current characteristics and the magnetic release shall be time delayed with a minimum setting of 25 ms varying up to 300 ms for discrimination without effecting the breaking current capacity of the ACB.

Current transformer

Separate sets of CTs shall be provided for metering and protection. C/Ts shall confirm to IS 2705 (part -I, II and III) in all respects. All C/Ts used for medium voltage application shall be rated for 1.1 kV. C/Ts shall have rated primary current, rated burden and class of accuracy as specified in Bill of Quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 and for protection class 5P10. C/Ts shall be capable of withstanding magnetic and thermal stresses due to short circuit faults on the bus. Terminalsof C/Ts shall be paired permanently for easy identification of poles. C/Ts shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each C/T shall be provided with rating plate indicating:

i. Name and make
ii. Serial number
iii. Transformation ratio
iv. Rated burden
v. Rated voltage
vi. Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor FRLS PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Potential transformer

PTs shall confirm to IS 3156 (Part-I, II and III) in all respects.

Measuring instruments

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 0.5 for ammeters. Meters shall be suitable for continuous operation between -5 degree C and +50 degree C above ambient temperature. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mold. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Suitable selector switches shall be provided for ammeters and volt meters used in three phase system. The rating type and quantity of meters, instruments and protective device shall be as per Schedule of Quantities /drawings.

Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248.

Ammeters shall normally be suitable for 5 A secondary of current transformers. Ammeters shall be capable of carrying substantial over loads during fault conditions.

Voltmeters

Voltmeters shall be moving iron type range of 3 phase 415-volt voltmeters shall be 0-500. Volt meters shall be provided with protection fuse.

Watt meter

Wattmeter shall be of 3 phase electro dynamic type and shall be provided with a maximum demand indicator if required.

Power factor meter

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be +40.

Energy and reactive power meters

Trajectory meters shall be two elements, integrating type, kWh, kVA, kVArh meters. Meters shall confirm to IEC 170 in all respects. Energy meters, kVA, and kVArh meters shall be provided with integrating registers. The registers shall be able to record energy conception of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

Indicating lamps

Neon type indicating lamps shall be provided for indication of phases and Breaker position as required in the bill of quantities. Lamps shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors.

Push buttons

Push buttons shall be of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking. Contacts shall be of adequate strength and have a positive whipping action when in operation.

Battery and Battery Charger

General

This section covers specifications for lead acid batteries and float cum boost battery chargers. DC is considered as unearthed system.

Standards and codes

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition, the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 2016, National Electrical Code (SP30 : 2011), Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

Electrical vocabulary secondary cells and batteries	IS 1885
Lead Acid SMF VRLA Batteries	JIS C8702
Stationary valve regulated lead acid	IS 15549:2005

Water for storage batteries	IS 1069
Sulfuric Acid for storage batteries	IS 266
General requirements for tests for lead acid storage batteries	IS 8320
Rubber and Plastic containers for batteries	IS 1146
Synthetic Separators	IS 6071
High performance planet cells	BS 6290 (Part II)
IE recommendations for sizing of large lead acid storage batteries	IEEE 485
Design and installation of storage batteries	IEEE 484
Stationary lead acid batteries	IEC – 896 (Part I)

Battery

The battery shall be sealed maintenance free / valve regulated led acid (SMF/VRLA) battery. The batteries shall be manufactured using "absorbent glass matt" technology in which the electrolyte is in absorb condition, held within the pores of the glass matt separator. The separator is packed tightly between the positive and negative plates. "Led Calcium Tin Alloy" shall be used in the plate grid structure to eliminate harmful effect of early gassing. The container and the lid of the battery shall be of high-grade polypropylene. The vent plugs shall be provided with self-resealing relief valves. The battery shall be rated for minimum 100 AH at 24-volt DC unearthed system. The battery sizing calculation to be carried out by vendor during detailed engineering stage and to be submitted to Electrical consultant for verification and approval.

Battery Charger

General

The battery charger shall be float cum boost type, thermistors controlled. The charger shall have selector switch for auto float – boost/manual, float /manual boost mode of operation. During auto float – boost mode, automatic changeover shall take place from float mode to boost mode and vice versa. This means that when the batteries are fully charged the charging shall automatically change from boost charge to trickle charge.

Construction feature

The float cum boost charger and DC distribution board shall be housed in sheet steel cubicle of angle iron frame work with panels of 2.0 mm thickness, louvers for ventilation, glands plate will be provided

for cable entry from front bottom. The cubicle shall be painted in siemens grey shade. Four wheels/2 nose channels shall be provided at the base.

Performance

The DC output voltage of float /boost charger shall be stabilized within ± 2% for AC. Input variation of 230 V ± 10%, frequency variation of 50 Hz ±5% and DC load variation of 0-100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response IGBT. The ripple content in output will be within 3% of DC output nominal voltage.

There shall be provision to select auto float/manual float /manual boost modes. During auto float mode the battery charging shall automatically changeover from boost mode to flat mode and vice versa. During manual float/boost modes it shall be possible to set the output volts by separate potentiometers. The battery charger shall have automatic output current limiting feature.

Components

The battery charger shall essentially comprise of the following

- 1 no. double pole ON/OFF MCB at AC input
- 1 no. pilot lamp to indicate charger ON.
- 1 no. main transformer: Double wound, naturally air cooled, having copper windings.
- 1 no. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.
- 1 set solid state constant potential controller to stabilize the DC output voltage of the float cum boost charger at ±2% of the set value for AC input voltage variation of 230 V ± 10%, frequency variation of ±5% from 50 Hz and simultaneous load variation of 0-100% and also complete with current limiting circuit to drop the float charger output voltage upon overloads to enable the battery to take over.
- 1 no. electronic controller to automatically changeover battery charging from boost

  to float and vice versa 1 no. DC ammeter and toggle switch to read charger output current and battery charge/discharge current.
- 1 no. moving coil DC voltmeter to read the DC output voltage.
- 2 set potentiometers to adjust the output voltage during manual/auto float and boost modes.
- 1 no. double pole ON/OFF MCB at charger output. DC distribution board.

- Alarm annunciation

Visual and audible alarm with manual accept/ reset facility shall be provided for the following:

i. AC mains fail
ii. Charger fails
iii. Load / output over volt
iv. Potential free contact for BMS connectivity for maintaining battery status.

11 kV HT Panel

General

The technical specifications cover the equipment to be supplied for an 11 kV Single VCB Switchboards (Indoor Type) suitable for 11 kV 3 phase Earthed System. 50 Hz AC supply with a fault level of 350 MVA at 11kV. The equipment shall be suitable for continuous operation at the stipulated ambient conditions.

Standards and codes

The following Indian Standards Specifications and Codes of Practice shall apply to the equipment covered by this Contract. In addition, the relevant clauses of the Indian Electricity Act 2003 and Indian Electricity Rule 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government Regulations. Necessary Test Certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

11,000-volt Circuit Breaker	IS 13118; 1991
Metal Enclosed Switchgear and Control gear for voltages above 1000 volts	IS 3427:1969
Electrical Relays for Power System Protection	IS 3231:1986
Voltage Transformers	IS 3156: 978
Current Transformers	IS 2705: 1981

Rubber Mats for Electrical Works	IS 5424: 983
Danger Notice Plate	IS 2551: 982

11,000 volt circuit breakers

Technical Parameters

The 11,000-volt circuit breakers shall be triple pole Vacuum type suitable for indoor mounting and shall comply with the requirements of the relevant Indian Standards. The Circuit Breakers shall be suitable for operation at 11,000 volts 3 phase 50 Hz supply system and shall have a certified symmetrical breaking capacity of 350 MVA at 11000 volts or as stipulated in schedule of Quantities.

The Circuit Breakers Shall be Vacuum Type and Shall Consist of Three Identical single pole Vacuum interrupter units which shall comprise of a pair of butt contacts enclosed within a Sealed ceramic body with SS end plates. The moving contacts shall be sealed into the Enclosure via a SS steel bellow which shall permit axial movement of the contact. The contact Arrangement shall be surrounded by SS sputter shield to prevent condensation of metal on the inside of the insulating envelop and also to provide good voltage grading across the gap and the outer envelope. The contact material and the contact geometry shall be suitable for the purpose so as to attain current chopping at minimum current to prevent build-up of unduly High over voltages and to prevent the arc to cause localized high spots on the contact.

The Circuits Breaker shall be suitable for switching Duty of Transformer.

Circuit breaker constructional features

The 11,000 volt circuit breaker shall be flush front, metal clad, truck mounted, Fix type and fully interlocked. The truck that carries the Circuit Breaker shall be of rigid fabricated construction. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

All electrical connections on the truck shall be brought to secondary plugs which engage similar sockets in the housing.

The Circuit Breakers shall be of the double break type. Interphase barriers and tank lining of insulating material shall be provided.

All current carrying parts in the Circuit Breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts.

Isolating contacts of the spring loaded self-aligning pattern shall be provided for the Circuit Breaker. Suitable arc control devices shall be mounted around the fixed contacts.

Terminal insulators of synthetic resin bonded paper shall be provided suitable for the specified short circuit level

Sheet steel barriers shall be provided between

Instrument Panel and Potential Transformer

Instrument Panel and Current Transformers

Bus bar chamber and Circuit Breaker compartments

Circuit breaker operating mechanism

The Circuit Breaker shall be trip free and equipped with a motor power operated closing mechanism. The operating mechanism shall be such that the Circuit Breaker is at all times free to open immediately the trip coil is energized. Mechanical ON/OFF position indication shall be provided on the front of the circuit breaker.

The operating mechanism shall be mounted on the front panel of the truck. The operating handle and the mechanical trip push button shall be at the front of and integral with the Circuit Breaker.

The operating mechanism shall provide four distinct and separate positions of the Circuit Breaker on the cradle

Service

Test

Isolated

Maintenance

Circuit breaker interlocking

Each Circuit Breaker shall be provided with the following mechanical safety interlocks to ensure protection to the equipment and the operator.

- The Circuit Breaker cannot be closed unless it is in the 'PLUGGED IN' position.
- The Circuit Breaker cannot be withdrawn from or pushed into the housing unless the main contacts are open.
- The Circuit Breaker cannot be put into service without making the secondary connections between the truck and housing.

A. The cover of the draw out voltage transformer cannot be opened unless the transformer is Isolated.

Circuit breaker auxiliary contacts

The Circuit Breaker shall have a minimum of 6 Normally open (N.O) and 6 Normally close (N.C) auxiliarycontacts rated at 5 amps. These contacts shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is lowered.

Protective relays

The Circuit Breaker shall have over current, earth fault protection and auxiliary relay devices as specified in the Schedule of Quantities. These relays shall be mounted flush on a separate compartment with access from the rear for wiring and maintenance.

Potential and instrument transformers

A draw out type cast resin voltage transformer shall be mounted in the panel and connected to the line. The tank shall be arranged for horizontal isolation.

The Circuit Breaker shall have the required current transformers as specified in the Schedule of Quantities for metering and protection mounted outside the Circuit Breaker compartment but within the free-standing cubicle. The transformers shall comply to the relevant Indian Standards. All current transformers for metering shall be Accuracy Class 0.5 and of capacity and ratio as required. Separate sets of current transformers shall be provided for metering and protection.

Instrumentation

Instruments and indicating lamps as required in the Schedule of Quantities shall not be mounted on the Circuit Breaker compartment door. A separate adequate compartment shall be provided. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel.

Square pattern flush mounting meters and selector switches of the three way and OFF pattern complying with the requirements of the relevant Indian Standards shall be used.

The current transformers for metering and protection shall be mounted on the solid bus bars with proper supports. Neon type indicating lamps shall be provided for phase and other operational indications.

Type test certificates

The Contractor shall submit type test certificates of the Circuit Breakers complying to the relevant Indian Standards from a recognized Test House.

11kV switchgear panel

General

The switchgear panels shall be suitable for operation at 11,000-volt 3 phase 50 Hz supply system with a short circuit withstand of 350 MVA at 11,000 volts and a corresponding short time rating for 3 second. The Switchgear panels shall comply with the requirements of the latest edition with up-to-date amendments of the relevant Indian Standards Specifications, Indian Electricity Rules and Regulations.

Switchgear Configuration

The panel shall be configured with 11,000-volt Circuit Breakers, associated metering and protective devices and other equipment as called for in the Bill of Quantities. Each 11,000-volt Circuit Breaker shall be housed in an individual panel in single tier formation.

Equipment Specifications

All equipment used to configure the Switchgear Panel shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and the detailed technical specifications as included in this tender document.

Constructional Features

The 11,000 volts Switchgear Panel shall be totally enclosed, dead front, metal clad, cubicle pattern, floor mounting, extensible on both sides and suitable for indoor use.

The Switchgear Panel shall be totally enclosed and completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the jointsdust and vermin proof. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.

The Switchgear Panels shall be fabricated with CRCA Sheet Steel of Thickness shall be 3.0 mm for load bearing compartments and 2.0 mm for non load bearing compartments, folded and braced to ensure rigid support for all components. The doors and covers shall be constructed from CRCA Sheet Steel of thickness not less than 1.6 mm. Joints of any kind in sheet steel shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned. Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in the construction of the Switchgear Panels.

Switchgear Panel Limitations

A base channel of 75 mm x 5 mm thick shall be provided at the bottom. The Switchgear Panel height shall normally be restricted to a maximum of 2,300 mm.

Switchgear Panel Compartmentalization

The Switchgear Panels shall be divided into distinct separate compartments comprising A completely Enclosed Ventilated Dust and Vermin Proof Bus Bar Compartment for the Vertical and Horizontal Bus Bars. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides. Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, protective relays, control fuses etc. as required. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts. A horizontal wire way with screwed covers shall be provided at the top to take interconnecting control wiring between vertical sections. Cable compartment shall be of adequate size for easy termination of all incoming and outgoing cables. Adequate and proper supports shall be provided in the compartment for supporting the cables.

Switchgear Panel Bus bars

The main horizontal and vertical interconnection bus bars shall be Aluminum Bus Barr and of rectangular cross sections suitable for full rated current. The current density for Aluminum shall be minimum 0.6 amps per sq. mm. and suitable to withstand the electromagnetic and thermal stresses of a 350 MVA fault level at 11,000 volts for 21KA for 3 second. The bus bars and interconnections shall be insulated with fiber glass sleeves. The bus bars shall be extensible on either side of the Panels. The Bus Bars Shall be Supported on Non-Breakable, non-hygroscopic insulated supports at regular intervals to withstand the stresses of a 350 MVA fault level. All bus bars and interconnections shall be colour coded. The main horizontal bus bars shall run through the entire length of the Switchgear Panels.

Switchgear Panel Interconnections

All interconnections shall be with solid electrolytic copper of adequate size to carry the full rated current and fiber glass insulated.

Switchgear Panel Interlocks

Each group of bus bars and feeder connections shall be fitted with automatically operated safety shutters with positive opening and closing when the Circuit Breaker is raised or lowered. Facility shall be provided for hand operation of the shutters and latching in either open or closed position. Padlocking provision of the shutter in the closed position shall be included for maintenance purposes.

Instruments and Protection Relays

Instruments, indicating lamps and all protection and control relays shall not be mounted on the Circuit Breaker compartment door. A separate adequate compartment shall be provided. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel. Neon type indicating lamps shall be provided for phase and other operational indications. The current transformers for metering and protection shall be mounted on the solid copper bus bars with proper supports.

Switchgear Panel Internal Wiring

- All wiring for relays and metering shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. All power circuit wiring shall be minimum 2.5 sqmm and control circuit wiring shall be of minimum 1.5 sqmm and for CT & PT minimum 4sqmm copper cable shall be considered.

All control circuits shall be provided with 10 kA MCB's Instrument testing plugs shall be provided for testing the meters.

Cable Terminations

Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the location of the incoming and outgoing cables.

The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located in the cable chamber at the rear of the Panels.

Space Heaters

The Switchgear Panel shall have in each panel thermostatically controlled space heaters with a controlling 16-amp 230-volt socket outlet with MCB to eliminate condensation.

Earthing

Two main earth bars of copper as required shall be provided throughout the length of the Switchgear Panels with a provision to make connections on both sides to the sub-station earths.

Designation Labels

Suitably engraved white on black name plates and identification labels of metal for all Panels and circuits shall be provided. These shall indicate the feeder number and the designation

Sheet Steel Treatment and Painting

Sheet steel materials used in the construction of the Switchgear Panels should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute Sulphur acid and a recognized Phosphating process. The sheet steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

All sheet steel work shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stove and the paint thickness shall be not less than 50 microns.

The circuit breakers shall be provided with following

a. Auxiliary switch with 6NO + 6NC contacts.
b. Mechanical operation counter
c. Spring charging handle
d. Recharging in/out handle
e. Foundation bolts
f. Maintenance manual
g. Instruction manual
h. Circuit breaker ON/OFF Indicator
i. Spring charge/ trip circuit healthy indicator

Auxiliary supply

a) The tipping shall be at 24 V DC through a power pack unit
b) Space heater, Indication and other auxiliary supply shall be through to 230 V AC

Factory & Site Test

Acceptance tests shall be carried out according to contractual standards, for each Switchgear, with all the panels of the same Switchgear assembled together.

a) Preliminary, at manufacturer-premises before delivery:

b) Visual: general compliance with the contractual documents and with good execution;

c) Mechanical operation of doors, shutters, switching devices;

d) Ratio and polarity of measuring transformers (to be tested at transformer‟s manufacturer‟s place and will be witnessed by Client).

e) Electrical insulation, of main and auxiliary circuits by megger and HV;

f) Pick-up and drop-off test of auxiliary relays;

g) Functional test of control circuits;

h) Simulation and operation of protection relays at set points.)

i) HV Testing

j) Mechanical Endurance Test

k) Functional test of control circuit

Technical Specifications for Transformer

This specification is intended to cover design manufacture assembly, testing at manufacturer‟s works, supply and delivery of three phases, 50 Hz, 11/0.433 kV Delta/Star, Vector Group Dyn11 two windings copper wound outdoor type oil immersed naturally air-cooled Transformer is per detail furnished here after.

The transformer offered be complete with all parts and accessories which are necessary or usual for their efficient and satisfactory operation. Such parts and accessories be deemed to be within the scope of this specification whether specifically mentioned or not. Main tank body may be delivered in unpacked condition, but delicate parts like indicating meter, radiator, and conservator. Pressure Relief Valve, equalizer pipe, be packed to avoid damage due to transport, shipment. The equipment and work conform to General Specifications for electrical works of CPWD (Part– I, II, IV) as amended up to date, BSI /IEC and relevant Indian Electricity rules, Indian Electricity Act 2003 and other relevant regulations with statutory regulation and safety codes that is related to the work.

Location

The equipment supplied be suitable for satisfactory performance for the rated capacity at all weather conditions in summer, monsoon, and winter at referred locations under district Kaimur (Bihar) & District Ranchi & Sahibganj in Jharkhand as applicable with reference to NIT : -

(a) Altitude: less than 1,000 mtr.

(b) Max. ambient air temp: 50°C

(c) Max. daily average ambient air temp: 40°C

(d) Max. yearly weighted average ambient temp: 32°C

(e) Min. yearly weighted average ambient temp: -5°C

(f) Temp. rise at the above conditions:

(g) By resistance method: 55°C (Max. temp. being 95°C)

(h) By Thermometer: 50°

(i) By Maximum Humidity : 79%

(j) Seismic Zone : III

System details

11 kV system is Non- Effectively Earthed, whereas 433 V Systems is to the effectively earthed at Neutral Point of the Star Connected Windings of the Transformer.

Applicable standards

Unless otherwise stated, transformer be designed, constructed, and tested in accordance with provisions contained in latest revisions of following Indian standards and Rule

- IS 1180 (part 1): 2014 (Level 2)
- REC Manual 10/1976.
- C B.I.P Manual on Transformer Technical Report 1: Section A.D: (Revised: 1987)
- C.B.I.P Technical Report No 72 (June 1989)
- C.B.I.P Publication 295 - 2007

- Indian Electricity Rules, 1953 (Amended up to date)
- other applicable Indian Standards.

Deviations from specifications

The deviations from the purchaser‟s specification to improve utility, performance and efficiency of equipment or to secure overall economy be considered if such deviations(s) is (are) mentioned by the bidder in the "Schedule of Deviations" with full justification.

Rating and general particulars

Type

Core Type, Three Phase. Oil immersed step-down two winding copper wound transformer for outdoor installation.

Standard Rating

Off Circuit Tap Changer as Mentioned in the Schedule of Quantities.

Continuous Maximum Rating and Temperature rise

As regards maximum rating and temperature rise, all transformers comply with the appropriate requirement of Indian Standards

To consideration of maximum temperature rise of oil and winding the following ambient temperature are assumed.

Cooling medium	:	Air
Maximum Ambient Air temperature	:	50°C
Maximum daily average ambient Air temperature	:	40°C
Maximum yearly weighted average temperature	:	32°C.

With the Above Ambient Temperature Condition Allowable Maximum Temperature Rise be As Mentioned Below

Type of Cooling	Oil in °C	Winding in °C
ONAN	40	45

No load voltage ratio

The No Load Voltage Ratio Corresponding to Principal (Normal) Tapping be 11000/433 Volts

Winding Connections and Vector Group etc.

i.	Number of phases	:	Three
ii.	Frequency	:	50 HZ
iii	Type of Cooling	:	ONAN
iv.	Winding connections	:	The primary winding (HV) be connected in delta and secondary winding (LV) be connected in star.
v.	Vector Group	:	Windings be connected as per Vector symbol Dyn11 of IndianStandards to produce a punitive displacement of 30 Deg. from the primary to the secondary vectors of the same phase assuming vector rotation counterclockwise.
vi.	Neutral Earthing	:	The neutral point of the secondary (LV) winding be brought out to a separate insulated terminal and he solidly earthed.

Taps

Transformer be provided with off load taps ranging from +5% to -10% in steps of 2.5% each on H.V winding for H.V. variation. The tap changing switch be in a convenient position so that it can he Operated from Ground level. The Control Box be Provided with Tap Position Indication & Locking Arrangement.

Technical Specification of Off Load Tap Changer to be supplied with 250 kVA 11kV/433 V Transformer

- The Off-load tap changer be designed suitable for local manual as well as local electrical operation
- An oil immersed tap selector and arching switch or are suppressing tap selector, provided with reactor or resistor for reduction of make and break arcing voltages and short circuits
- Control and protection devices.
- Manual/Electrical operating device.

A suitable pressure reliving arrangement should be provided to take care to sudden pressure rise in compartment.

The manual operating device be so located on transformer that it can be operated by a man standing at the level of transformer track. It is strong and robust in construction.

Impedance Value

The percentage impedance be as follows

S No.	Rating	Voltage Ratio	% Impedance
1.	250 kVA	11 kV/433 V	4.5 or as per manufacturer‟s Data

The impedance value refers to the (normal) principal tapping are subject to a tolerance of ±10%

Terminal

Cable Box on HV & LV Sides for Cable Termination

Short circuit level

Designed maximum fault level of 11 kV and 21 kA for 3sec or as per IS

Insulation level

Insulation Level be as per IS

Cores

The Cores be constructed from high grade cold rolled non-aging grain-oriented silicon steel laminations having magnate coating as insulation. The core thickness shall be 27 microns

Successful bidder will offer the Core for inspection and/or approval by the purchaser during the manufacturing stage. Manufacturer‟s Call notice for the purpose should be accompanied with the following as applicable as a proof towards use of Prime Core materials:

i. Invoice of supplier

ii. Mill‟s Test Certificate

iii. Packing Lists

iv. Bill of Lading

v. Bill of entry Certificate to Customs

Core materials be procured either from the core manufacturer or through their accredited marketing organization of repute.

Tendered should preferably have in-house Core cutting facility for proper monitoring and Control on quality.

The materials used for insulation have high interred lamination resistance and rust inhibiting property. It not deteriorates by aging from hottest operating temperature and clamping pressure of the core or disintegrate due to core vibration. It not has any tendency to absorb moisture or to react with insulating oil.

The assembled core be securely clamped on the limbs and yoke with uniform pressure to minimize noise emission from it.

The top main core clamping structure be connected to the tank body by a copper strip. The bottom clamping structure be earthed by one or more of the following methods (i) by connecting through vertical tie rods to the top structure (ii) by direct metal to metal contact with the tank base by the weight of the core and winding (iii) by a connection to the top structure on the same side of core as the main earth connection to the tank.

All parts of the cores be robust design capable of withstanding any shock, to which they may be subjected during lifting, transport, installation, and service.

Adequate lifting lugs be provided to enable the core and winding to be lifted.

Adequate provision be made to prevent movement of the core and winding relative to the tank during transport and installation or while in service.

The supporting framework of the cores be so designed as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.

The insulation structure for the core to bolts and core to clamp plates be such as to withstand a voltage of 2000 V AC at 50HZ for one minute.

Flux density of core

Flux Density at rated voltage and frequency shall not exceed 1.69 tesla or as per latest Indian Standards.

The No load current shall not exceed 1.5 % of the full load current. The no load current shall not exceed 3 % of the full load current in L. V. Winding when the applied voltage is 112.5%

Winding

- All windings shall be electrolytic copper (99.9% purity) be fully insulated.
- Transformer be designed to withstand the impulse and power frequency test voltages
- The windings be designed to reduce to a minimum the out of balance forces in the transformer at all voltage ratios.
- The insulation of transformer winding and connections be free from insulating material liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inactive to transformer oil during service.

- The stacks of windings receive adequate shrinkage treatment before final assembly. Adjustable device be provided for taking up any possible shrinkage of coils in service.
- All the insulating material to be used in the transformer preferably be of class - A insulation as specified in Indian Standards, the test certificate of the materials be made available by the transformer manufacturer on request during inspection and testing
- The coil clamping arrangement and the finished dimensions of any oil ducts be such that it will not impede the free circulation of oil through the ducts.
- The windings and connections of transformer be braced to withstand shocks which may occur during transport or due to switching short circuit and other transient conditions during service.
- Coil clamping rings, if provided, be of steel or suitable insulating material. Axially laminated material other than Bakelite paper not be used.

Inter earthing arrangements:

General:

All metal parts of the transformer except for the individual core laminations, core bolts and associated individual clamping plates be maintained at fixed potential.

Earthing of core clamping structure:

Core clamping structure be earthed as specified in clamping section above.

Earthing of coil clamping rings:

Where coil clamping rings are of metal at earth potential each ring be connected to the adjacent core clamping structure on the same side of transformer as the main earth connection.

The Total number of earth electrodes shall be 4 (2 for neutral and 2 for connection to a common earth bus for body earthing) in two different places

Tanks

Tank Pressure be as per Manufacturer Standard and comply the latest IS Standard

Construction:

The Transformer tank and cover be fabricated from good commercial grade low carbon steel suitable for welding and of adequate thickness. The tanks of all transformers be complete with all accessories and be designed so as to allow the complete transformer in the tank and filled with oil, to be lifted by crane or jacks, transported by- rail, road without overstraining any joint and without causing subsequent leakage of oil.

The main tank body be capable of withstanding vacuum gauge pressure 68 kN/sq. m (500 mm. of Hg). The under carriage of the tank be made of channel of suitable size and design.

The base of each tank be so designed that it be possible to move the complete transformer unit by skidding in any direction without injury when using plate or rails. Where the base is at a channel construction. It be designed to prevent retention of water.

Tank stiffeners be deigned to prevent retention of water. Wherever possible the transformer tank and its accessories be designed without pockets wherein gas may accumulate. Where pockets cannot be avoided, pipes be provided to vent the gas into the main expansion pipe

All joints other than those which may have to be broken be welded when required they be double welded. All bolted joints to the tank be fitted with suitable oil tight gaskets which give satisfactory service under the operating conditions and guaranteed temperature rise conditions. Special attention be given to the methods of making hot oil tight joints between the tank and the cover as also between the cover and busing and all other outlets to ensure that the joints can be remade at site satisfactorily.

Tank cover

Each tank cover be of adequate strength and not distort when lifted. Inspection openings be provided as necessary to give easy access to bushings or changing ratio or testing the earth connection. Each inspection opening be of ample size for the purpose for which it is provided.

The tank cover and inspection cover be provided with suitable lifting arrangement.

The tank cover be fitted with pockets for thermometer and for the bulbs of oil and winding temperature indicators. The thermometer pocket be fitted with a captive screwed top to prevent the ingress of water. Protection be provided, where necessary for each capillary tube. The pocket be in the positionof maximum oil temperature and it be possible to remove the instrument bulbs without lowering the oil in the tank. Turrets should provide on tank cover to house the bushing. The tuners of both HV & LV bushings should be connected through pipes with main tank pipe to drive out trapped air or shouldhave air release plug to drive out trapped air.

Conservator vessels

The conservator should be normal type to prevent direct contact of Transformer oil with atmospheric air for retarding oxidation and contamination of oil. The air cell be made from suitable material with inner coating resistant to transformer oil & outer coating resistant to ozone & weathering.

The conservator be provided with necessary valves to drive out the air in the space between conservator wall & air cell during filling of oil drain valves for complete draining of oil and cut off valves etc.

The conservator completes with necessary valves be provided in such a position as not to obstruct the electrical connections to the transformer from H.V& LV. SIDE.

The conservator to have a capacity to meet the requirement of expansion of the total cold oil volume in the Transformer & cooling equipment.

The conservator be designed so that it can drain oil completely by means of the drain valve provided when mounted. One end of the conservator be bolted into position so that it can be removed for cleaning purpose.

Oil Gauges

Normally one Magnetic type oil gauge be provided. The oil level at 30°C be marked on the gauge

Connection

The oil connection from the transformer tank to the conservator vessel be arranged at a raising angel of 3° to 9°C to the horizontal and consist of pipe with inside diameter 50 mm/80 mm as per capacity of the transformer and as per IS : 3639. Two valves be provided between the conservator and transformer main tank to cut off the oil supply to the transformer after providing a straight run of pipe for at least a length of five times the internal diameter of the pipe on the tank side of the gas and oil actuated relay and at least three times the internal diameter of the pipe on the conservator side of the gas and oil actuated relay. The valves should be fitted on both sides of the Gas and Oil actuated Relay.

Breather

Conservator vessel be fitted with a glass container type breather in which silica gel is dehydrating agent and so designed that:

i. The passage of air through the silica gel

ii. The external atmosphere is not continuously in contact with the silica gel

iii. The moisture absorption indicated by a change in colour of the tinted crystals can be easily observed from the distance.

iv. breather be mounted at approximately 1400 mm above ground level and be connected to the air cell of the conservator through pipe for the purpose of breathing during contraction or expansion of the air cell

Bushings

Pollution free type insulator should be used for the bushings. The bushing should be located on suitable turrets (with air release plugs). Adjustable arcing horns should be provided on the Bushings;Bushings of identical voltage rating be interchangeable. All bushings be equipped with suitable terminals of approved type size and be suitable for bimetallic connections

The bushings have high factor of safety against leakage to ground and so located as to provide adequate electrical clearance between bushing and grounded parts.

Both HV & LV Bushing should be suitable for use in heavily polluted atmosphere as per IS 2099 & IS 3347. 3 Nos. H.V Bushings & 4 Nos. L.V. Bushing should be supplied with the transformer.

Filter, drain valves, sampling devices and air release plugs

Each transformer be fitted with the following

- A drain valves as specified below be fitted to each conservator for diameter up to 650 mm: Size of the valve 15 mm: for diameter above 650 mm: Size of the valve 25 mm.
- Suitable oil sampling device be provided at the top and bottom of the main tank. The sampling device is not fitted on the filter valves specified under (ii) above
- One 15 mm air release plug on the main tank of the transformer
- All other valves opening to atmosphere be fitted with blank flanges.

Radiator

General

Radiators be so designed as to avoid pockets in which moisture may collect and withstand the pressure tests. The radiator tubes / fins be seamless, made of mild steel having minimum wall thickness of approx. 1.0 mm and a clean bright internal surface free from dust and scale They be suitably braced to protect them from mechanical shocks, normally met in transportation and to damp the modes of vibration transmitted by the active part of the transformer in service. Each cooler unit have a lifting eye.

The butterfly or similar metal valves be provided for isolating detachable radiator assembly. One cock each at the bottom of radiator stack be provided for draining oil from radiator stacks.

Air release plug each at the top of radiator stack be provided for release of locked air from radiator stack. Removable blanking plates be provided to permit the blanking off main oil connection of each cooler. Radiator fixing bands in top & bottom of radiators to be provided to minimize the vibration of the same.

Lifting and haulage facilities

Each tank be provided with

(i) Lifting lugs suitable for lifting of transformer complete with oil.

a. A minimum of four jacking lugs, in accessible positions to enable the transformer to complete with oil to be raised or lowered using hydraulic or screw jacks. The minimum height of the lugs above the base

b. Transformer up to and including 10 tonnes weight -300 mm.

c. Transformer above 10 tonnes weight – 500 mm

(ii) Suitable haulage holes be provided

Insulating oil

The transformer and all associated oil filled equipment be supplied complete with insulating new oil required for first filling including 10% extra oil for future use during commissioning. The transformer tank be dispatched filled oil and the balance oil be supplied in non-returnable sealed drums along with the Transformers.

The insulating oil conform to the requirement of IS: 335: 1993.

Pressure relief device

Pressure relief device be provided with A/T Contact of sufficient sizes for rapid release of any pressure that may be generated within the tank, and which might result in damage to the equipment. The device operates at a static pressure of less than the hydraulic test pressure for transformer tank. Means be provided to prevent ingress of rain. It shall be mounted on the cover of the main tank and be designed to prevent gas accumulation. Spring loaded setting type Pressure Relief Valve having suitable opening Port hole according to the capacity of the Transformers should be provided. The Pressure Relief Valve should have provision of visual indication for opening of the valve.

Axis and wheels

The Transformer be provided with flanged bidirectional wheels as mentioned below

Transformer rating in kVA Type

Flanged wheel suitable for use on a 1,435 mm / 1676 mm gauge track.

The wheels be suitable for being turned through an angle of 90°C and locked in that position when the tank is jacked up. All wheels be detachable and be made of Cast iron or Steel. Suitable locking arrangement be provided to prevent the accidental movement of the transformer.

Painting

Before painting or filling with oil all metallic parts be completely cleaned and free from rust, scale and grease and all external surface cavities on castings be filed by metal deposition

The interior of al transformer tank and other oil filled chambers and internal structure steel work be thoroughly cleaned of all scale and rust by sand blasting or other approved method. These surfaces be painted with hot Oil resisting varnish or paint. Unexposed weld need not be painted.

Except for nuts, bolts, and washers, which may have to be removed for maintenance purposes all external surface receives a minimum of three coats of paint.

The primary coat be applied immediately after cleaning. The second coat be of oil paint of weather resisting nature and preferably of a shade or colour easily distinguishable from the primary and final coats be applied after the primary coats have been touched up where necessary. The final coat be of a glossy oil and weather resisting non-fading paint of Dark Admiralty Grey shade no. 632 of IS:5. Primer paint be ready-made zinc chrome as per IS: 104: intermediate and final costs of paint be as perIS: 2932.

All interior surfaces of mechanism chambers and kiosks except those which have received anti-corrosion treatment receive three coats of paint applied to the thoroughly cleaned metal surface as per procedure mentioned above. The final coat be of a light-coloured anti-condensation mixture.

Any damage to paint work incurred during delivery be made good by the manufacturer by thoroughly cleaning the damage portion and applying the full number of coats of paint that had been applied before the damage caused.

Earthing terminal

Two earthing terminals capable of carrying the full amount of lower voltage short circuit current of transformer continuously for a period of 5 second provisions be made at positions close to each of the bottom two corners of the tank for bolting the earthing terminals to the tank structure to suit local conditions.

Temperature indicating devices

Oil temperature indicator with one electrical contact be provided with anti-vibration mounting. The oil temperature indicator be housed in the marring box.

The winding temperature indicator with two electrical contacts for alarm and trip purposes be provided with anti-vibration mounting. The winding temperature indicator be housed in the marring box.

The oil and winding temperature indicator should be of renowned make preferably of "Perfect Control". The scale on the dial of the thermometer should be 0°C to 150°C. The angular displacement of thermometer should be 270.

The tripping contracts of indicator be adjustable to close the winding temperature indicator between 60°C and 120°C. The alarm contacts of indicator be adjustable to close between 30°C & 50°C.

All contacts be adjustable on a scale and be accessible on removal of the cover. The Temperature indicators be so designed that it shall be possible to check the operation of contacts and associated equipment.

For measuring winding temperature, a hearer coil fed from a C.T. (Current transformer) must be provided on the pocket for winding temperature indicator bulb. The connection from C.T. to heater should be through a link arrangement on tank cover suitably housed in a weatherproof box so that C.T. current and heated coil resistance can be checked.

Rating diagram

The following plates shall be fixed to the transformer tank at a suitable height so that the particulars could be read by standing at ground level.

- A rating plate bearing the date specified in the relevant clause of IS: 2026 including figures of temperature rise of oil and winding and high voltage test values.
- A diagram plate showing the internal numbering of taps, tapping switch connection ofwindings and the voltages vector relationship in accordance with IS:2026 and in addition a plan view of the transformer giving the correct physical relationship of the terminals. No loadvoltage be indicated for each tap. the losses should be mentioned with impedances

The centre of gravity

The centre of gravity of the assembled transformer shall be low and as near the vertical centre line as possible. The transformer shall be stable with or without oil. If the centre of gravity is eccentric relative to track either with or without oil, its location shall be shown on the outline drawing

Operation

The transformer shall be suitable for operating in Board‟s Sub independently or in parallel with one or more transformers.

Duty under fault conditions

It is to be assumed that normal voltage will be maintained on one side of the transformer when there is a short circuit between phases or to earth on the other side.

The transformer may be directly connected to an underground or overhead line and may be switched into and out of service together with or without its associated incoming / outgoing line.

The thermal ability to withstand short circuit be 21kA for 3 sec without injury for 3 phase dead short circuit at the terminal.

Rated voltage of operating device

Rated voltage for indicating and operative device be 24 volts DC /230 volts AC with variations as specified in the relevant IS.

Foundation

The Contractor shall furnish foundation plan of the transformer showing the fixing arrangement of the transformer so that the purchase may be able to finalize the foundation drawing.

Tests and inspection

Routing Test

All transformer shall be subjected to the following routing tests at the manufacturers work. The test be carried out in accordance with the details specified in IS: 1180 Part 1 (Level 2)

i. Measurement of winding resistance

ii. Measurement of voltage ratio and check of polarity, voltage vector relationship

iii. Measurement of impedance voltage / short circuit impedance

iv. Measurement of load loss

v. Measurement of no-load loss and no-load current

vi. Measurement of insulation resistance.

vii No Load and Load Losses

viii Impedance Voltage

ix. Induced over voltage withstand test.

x. Separate source voltage withstand test.

xi. Heat Run Test/Temperature rise test (Test not to be Conducted, Only calculation Certificate Should be Provided By Manufacturers)

xii Measurement of unbalance current and magnetizing current test at 110% rated voltage and frequency

xiii Testing of neutral CT in accordance with provisions in the relevant IS.

xiv Oil BDV Test

xv HV Test

xvi Insulation Test

xvii Continuity Test

Type and special tests.

In addition to routing tests mentioned above the transformer shall be subjected to all kinds of type and acceptance tests in accordance with relevant ISS (IS: 2026)

If type tests have successfully been carried out earlier in compliance with the provisions made in the relevant IS from a recognized institution then the copy of the same in triplicate be furnished along with the tender papers in respect of each of kind of transformer.

If Type tests have not yet been carried out, then the manufacturer have to do so at their own cost. Owner if feels, may depute their representative to witness the said Type Tests etc. The manufacturer arranges all facilities for such inspection and tests free of cost.

Inspection and testing

Inspection & Testing as already mentioned the equipment be subjected to routine and other acceptance tests as per provisions in the relevant IS.

The Engineer-In-Charge reserves the right to send its Engineers if so desires to witness manufacturing process and to reject either raw materials or finished products found to be not complying with the requirement of the specification and also have the right to select any/all equipment from the lot offered for tests.

The manufacturer shall give at least (21) twenty one days‟ advance notice regarding readiness of such inspection and testing and submit six set of the works test certificates of the material / equipment offered for inspection and testing indicating probable date of inspection and testing.

The supplier shall arrange all possible facilities for such inspection and testing at any lane during manufacture free of cost.

Test certificates

Seven copies of the approved Test certificates as mentioned above are to be furnished to the Owner before dispatch of the equipment.

Drawing and manuals

The following drawings and details shall be furnished in triplicate along with the tender:

i. General Arrangement outline drawing with plan, elevation and end views showing various dimensions of transformer and its vital component including height of the bottom most portion of bushing from the bottom of base channel and also

indicating thereon physical centre line and position of centre of gravity.

ii. Three copies of sketches for height of crane hook above ground for lifting and undertaking core, shipping dimensions, complete lists of fittings and devices, net weights of core, winding, tank, radiator, oil, conservator and total weight, fixing arrangement of transformer in foundation.

iii. Installation, operation, and maintenance manual.

The following drawings and manuals in six sets shall be submitted for approval within 15 (fifteen) days from date of placement of LOI / ORDER.

i. Cross sectional details with plan, elevation and views showing all internal clearances.

ii. Drawing of Name & rating plate

iii. Drawing of diagram

iv. Installation, operation and maintenance manual of transformer, associated equipment like temperature indication, oil level indicator etc.

The manual clearly indicates the installation method, check-ups and tests to be carried out before and after commissioning of the transformer.

Guaranteed technical particulars:

Bidders shall furnish guaranteed technical particulars of equipment offered as per Schedule „B" Performance Guarantee shall be based on guaranteed technical particulars.

Short circuit calculations

Manufacturer shall submit theoretical calculations in support of the ability to withstand short circuit on consideration of highest value that may attain in triplicate within 15 (fifteen) days from the date of placement of L.O.I./Order.

Performance certificates

Copies of performance certificates of similar Equipment supplied to various organizations have to be furnished along with Tender

Credentials

Bidder shall furnish documents in support, delivery, of similar equipment indicating thereon namesof the organization quantity ordered, quality supplied along with tender.

Deviations

All deviations from the specifications shall be recorded in the "Deviation Sheet" with reference to respective clauses of the Specification by drawing Specification for the same. Unless deviations are recorded in the Deviation Sheet and submitted with the offer, it will be taken for granted that the offer is made in conformity with Specification.

Spare parts

The Contractor shall submit a recommended list of spare parts for five years of operation along with item wise price for each item of spares.

Validity period

Validity period of the offer be reckoned from the date of opening of tender provided it is technically and commercially complete one. Otherwise, it will be counted from the date of receipt of complete information.

Transformer fitting & accessories /Spares

All screw threads and nuts shall be made as per ISS and all valves shall be of standard tested quality and leak proof.

The following fittings and accessories shall be supplied with each transformer

1. Outdoor type bushing – HV-3 Nos. and LV-4 Nos.
2. Normal Type Conservator
3. Conservator drain valve

4. Dial type oil level indicator complete with alarm contact.
5. Silicate breather with oil seal and connecting pipe. The breath shall be accessible for inspection from ground.
6. Access / inspection holes with bolted cover for access to inner ends of bushing
7. Cover lifting eyes
8. Lifting eyes for core frame with windings
9. Off load tap changing arrangement
10. Air release plugs on top of cover and hushing turrets.
11. Upper filter valve and bottom filter valve.
12. Drain valve
13. Top and bottom oil sampling devices. Provision for oil sample collection during process of filtration should be made.
14. Lifting lugs
15. Jacking pads with handling holes at tour corners.
16 Transport lugs.
17. Undercarriage base channel.
18 Tank earthing terminal - 2 Nos
19. Dial thermometer for winding temperature with alarm contacts and trip contacts.
20. Dial thermometer for oil temperature with alarm contacts.
21. An additional pocket for insetting thermometer for oil temperature indication
22. Weatherproof control cabinet for Marshalling terminal connections from protective and indicative devices. The cabinet be provided with incandescent filament lighting, plugs tic.
23. Neutral C.T. in LV side of Power Transformer.
24. Rating plate as per ISS
25. Diagram Plate
26. LT cable box with extended bus bar for terminations

Technical Specifications for UPS

(Nominal output active power at PF=1) True Online UPS having IGBT based rectifier & with Inbuilt Isolation Transformer compatible for parallel redundant configuration designed for having no single point of failure even for communication. UPS should be CE marked, 3 Phase 415V (+10% -15%), 50 Hertz ±10% input & 3 phase 415V, 50Hz output with selection for 380/400/415V AC. UPSs operating in parallel redundancy load need to share load equally during normal mode and also to be capable of handling Electronic short-circuit protection, current limit to: 2.7 times In for 200 ms between phase and phase and 4.0 times In for 200 ms between phase and N/PE and also overload of 125% for 10 Mins & that of 150% for 1 min. IGBT Based rectifier should be capable of restricting input current harmonics (THDi) to < 3 % and maintaining the Input power factor ≥ 0.99 above 25% of load . Scalability should be feasible & for that each UPS should have its own built in static bypassas well as manual bypass arrangement. Static switch should be fully rated for continuous duty & whereas built in manual bypass should be of make before break type. AHMI comprising of LCD features of web-enabled Monitoring and Management through SNMP protocols for multi-OS environments should be integral part of the UPS.

	General
	Scope
1	These specifications describe requirements for an Uninterruptible Power System (UPS) consisting of single modules UPS units connected in parallel, redundant mode/stand alone with manual bypass switch. The UPS shall automatically maintain AC power within specified tolerance to the critical load, without interruption, during failure or deterioration of the mains power supply. Each UPS shall be complete with 12-plus operation IGBT based PWM design inverter and IGBT based charger, built-in-static bypass switches and built in communication ports and LCD display based keypads. Each unit shall be designed for three phase and neutral input and output. The UPS shall be expandable by paralleling additional modules of the same rating, to provide for module redundancy or load growth requirements. It shall include all equipments to properly interface the AC power sources to the intended load and be designed for unattended operation.
1.2	**Technical specification**

Sl. No.	Description	Parameters required
1	**Capacity**	As per BOQ
2	**Environment Characteristics**	
2.1	**Working temperature**	0º to 40º C (Continuous)
2.2	**Storage temperature**	-10 º to 50 º C
2.3	**Humidity**	95% non-condensing
2.4	**Standards**	EN50091-2/IEC 62040-2
3	**General Characteristics**	
3.1	Overall Efficiency of the UPS under following conditions:	Not less than 90% under specified conditions
a)	Lowest input Volts to Highest Input Volts	
b)	Lowest Input Frequency to Highest Input Volts	
c)	AC/AC total efficiency @ 75% load	
d)	AC/AC total efficiency @ 100% load	
3.2	Noise level @ 1 Mtr. Distance	< 70db
3.3	Conversion technology	True-Online & Double conversion
3.4	Configuration	Compatible to Single, Parallel, Dual Bus arrangement.
3.5	No. of systems that can be paralleled	3 or more
4	**Input Electrical Characteristics**	
4.1	Type of rectifier	SCR Based –Power Factor Corrected
4.2	Input Voltage (3 phase)	360-460V
4.3	Input Frequency	50 Hz to ± 1%
4.4	Input Power factor @ 50 to 100% load	0.98 or better

4.5	Input voltage band	360 to 460 V
4.6	**Input Current harmonic distortion (THD)**	Less than 3%
5.1		IGBT based PWM design
5.2	Output Voltage (3 phase)	380V/400V/415V (user selectable)
5.3	Output waveform	Sinusoidal

5.4	Static output voltage variation under following conditions	± 1%
a)	No load to Full load/full load to No load	
b)	0.5 lag to unity p.f	
c)	Minimum to Maximum DC input volts	
d)	Input Frequency from 46 to 54 Hz	
e)	Full Input Voltage range	
5.5	Output Voltage variation	
a)	At balance load	± 1%
b)	At 100% load step (Dynamic Regulation)	± 1%
5.6	Voltage adjustment- Manual	Required
5.7	Output frequency	50Hz
5.8	Frequency regulation	± 0.2 %
5.9	THD at Output	≤ 2% for liner load & ≤ 5%for non- linear load.
5.10	Phase displacement (a) in balance load	120º, ± 1%
5.11	(b) in 100% unbalanced load	120º, ± 2%
5.12	Overload capacity	
	At 110%	For 60 minutes
	At 125%	For 10 minutes
	At 150%	For 1 minutes
5.13	Crest Factor	3:1
5.14	Voltage Transient Recovery Time	≤ 20 ms
6	**Static bypass arrangement**	**To be provided**
7	**Battery details**	
7.1	Type of batteries	SMF battery

7.2	Back-up	30 minutes
7.3	AH of the battery	By Vendor
7.4	Life of battery	> 3 years
7.5	Battery temperature sensor	By Vendor
7.6	No. of Batteries provided	By Vendor
7.7	Battery Monitoring in YPS	By Vendor
7.8	Battery mounting	By Vendor
7.9	Dimensions of battery cabinet (LXBXH)	By Vendor
7.10	Weight of battery cabinet	By Vendor
7.11	Base Frames for UPS & battery racks	By Vendor
8	**Communication**	
8.1	BMS compatibility	Required
8.2	SNMP	Required
8.3	Oast Evebts & Trend Analysis	Required
8.4	Life Cycle Monitoring of Fans , DC/AC Capacitors, Batteries	Required
9	**Charger**	
9.1	Type	**SMPS**
9.2	Nominal Voltage Regulation	±1%
9.3	Ripple (without batteries)	<1%
9.4	Charging Method	Constant Voltage Constant Current
10	**General :**	
	Indicate the make, capacity & other technical characteristics of the devices used.	
	Input reverse phase sequence protection is to be provided. UPS should work on main mode in case of input reverse phase sequence.	

	Built in Galvanic Isolation (Neutral Isolation) through double-wound transformer at output.

Mode of Operation

The UPS shall be designed to operate as Double conversion True ON LINE VFI as per IEC 62040-3:-

a)	**Normal-**	The critical AC load is continuously supplied by the UPS Inverter. The rectifier/Charger derives power from AC input source and supplies DC power to the Inverter while simultaneously charging power reserve battery.
b)	**Emergency-**	Upon failure of AC Input power, the critical AC load is supplied by the inverter which without any switching obtains power from the batteries. There shall be no interruption in power to the critical load upon failure or restoration of AC input source.
c)	**Recharge-**	Upon restoration of AC input power during the emergency mode of operation, the rectifier/charger shall automatically restart, walk-in and gradually assume the inverter and battery recharge loads.
d)	**Bypass-**	UPS must have for static bypass switch in addition to manually operated maintenance bypass switch. Manual switch should be incorporated into UPS cabinet that will connect the load to AC power source bypassing the rectifier/charger, inverter and static transfer switch.
e)	**Off-Battery-**	If the battery system only is taken out of service for maintenance, it is disconnected from the rectifier/charger and inverters by means of (an) external disconnect breaker(s). The UPS shall

continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

f) SNMP (Simple Network Management Protocol) - Web enabled Adopter card with smart software for server shutdown shall be Provided by UPS vendor.

g) Parallel Operation All the UPS shall work in synchronization mode & share the entire load equally by each UPS. In case of failure of any UPS the same, shall be disconnected automatically from the system and the load shall be transferred to the other healthy UPSs equally and there should be no interruption of supply during this transferring operation.

Maintenance Free Battery Requirements

Battery banks connected to different KVA UPS shall be designed to provide 30 minutes back-up at full load. The UPS module should be automatically disconnected when the battery reaches to the minimum discharge voltage level or when signaled by other control functions.

During normal operation batteries shall be continuously float charged & the charging current is electronically controlled for the limiting purpose.

UPS Delivery submittals

The specified UPS shall be supplied with one (a) user manual to include details of

a)	Functional description of the equipment with block diagrams.
b)	Detailed installation drawings, including all terminal locations for power and control connections for both the UPS and battery system.
c)	Safety precautions.
d)	Step-by-step operating procedures
e)	General maintenance guidelines
f)	The UPS & Battery's shall be supplied with a record of pre-shipment final factory test report. & Certificate shall be provided by manufacturer

Construction and Mounting

The UPS unit comprised of Input Isolator, Rectifier/Charger, Inverter, Static transfer switch, Maintenance Bypass switch and static bypass input switch shall be housed in a free standing steel enclosure with key lockable doors. Front/rear access shall be required for expedient servicing, adjustments and installation. The enclosure will be built to comply with IP 20. The UPS shall be constructed of replaceable sub-assemblies. Printed circuit assemblies shall be plug-in type.

Cooling

Cooling of the UPS shall be by forced air ventilation. Low velocity fan shall be used to minimize audible noise output. Fan power shall be provided by the UPS output. Temperature shall be monitored by thermal censors.

Cable Entry.

Standard cable entry for the UPS module shall be from the bottom/top as required through detachable gland plate.

Static Transfer Switch

General

A static transfer switches and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be naturally commutated high-speed static (SCR type) devices rated to conduct full load current continuously and shall have naturally commutated high-speed static antiparallel SCR"s in the output of the inverter circuit as well as in the static bypass line to enable the critical load to be connected to the inverter output or bypass power sources. The static transfer switch control logic shall contain andautomatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transferof the load to an alternate bypass sources, without exceeding the transient limits specifiedherein, when an overload or malfunction occurs within the UPS, or for bypassing the UPSfor maintenance.

The Static bypass switch must automatically assumes the critical load to mains supply without interruption after logic senses one of the following conditions:-

- Inverter overload beyond
- Battery run time expired and bypass available
- Inverter failure
- Battery circuit breaker open
- Fatal error in control system.

The short circuit withstanding capability of static Bypass path should be 1430% for 20 millisecond & 1000% for 5 cycles (1000 millisecs)

Uninterrupted Transfer

The transfer control logic shall automatically turn on the static transfer switch, transferring the critical ac load to the bypass sources, after the transfer logic senses any of the following conditions.

- Inverter overload capacity exceeded
- Critical AC load over voltage or under –voltage.
- UPS fault condition.

The transfer control logic shall inhibit and automatic transfer of the critical load to the bypass sources if any of the following conditions are present.

Uninterrupted Retransfer

Retransfer of the critical AC load from the bypass sources to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

- Bypass out of synchronization range with inverter output
- Inverter/bypass voltage different exceeding pre-set limits.
- Overload condition exists in excess of inverter full load rating
- UPS fault conditions present.

Maintenance Bypass Isolator

General

A manually operated maintenance bypass isolator shall be incorporated into the UPS cabinet to directly connect the critical load to the input AC power sources, bypassing the rectifier/charger, inverter and static transfer switch.

Maintenances Capability

Without the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery and static transfer switch.

Display and Controls

Monitory & controlling – The UPS shall be provided with a microprocessor based unit status display & controls section designed for convenient and reliable user operation. A system power flow diagram, a percentage load and battery time remaining display shall be provided as part the monitoring and controls sections which depict a single-line diagram of the UPS illuminated visual indicators. Shall be of long life LED type. All of the operator controls and monitors shall be located on the front of the UPS cabinets

The following parameters shall be displayed.

Display Parameter

- DC Voltage
- Battery voltage
- Battery charger & discharge current
- Input voltage and frequency
- Output AC voltage line-to-line and line to neutral and 1% load used of nominal
- Output frequency
- Active Power (KW) Apparent Power (KVA)
- Temperature- Ambient, battery, inverter and transformer

Warning and Alarm Messages

- Normal Operation, Input breaker open
- Output breaker open
- Battery breaker open
- Bypass absent, Bypass over limits.
- Bypass under limits, Bypass freq. over limit
- Bypass inhibit

- Load on bypass
- Rectifier off or failed
- Inverter off or failed
- UPS unsynchronized
- D.C. Volts over voltage
- D.C. under voltage and end of discharge pre-alarm
- DC Bus over volts Battery Low
- Emergency stop
- UPS Overload

Controls

Four pushbuttons shall be located on the operator control panel.

- Enter
- Escape
- UP
- Down

The push buttons shall permit the operator either to select options from a menu for display on the LCD winder or to change the value of some parameters. One pushbuttons –alarm silence switch

1.5.7. **Technical Specifications for Computer Jack RJ 45**

RJ45 Jack of Category 6, for the establishing of transmission channels of class E with up to 4 plugged connections, complies with Category 6 requirements of the standards ISO/IEC 11801:2nd edition, EN 50173-1, DIN EN 50173-1: 2002 as well as ANSI/TIA/EIA 568-B.2-1, de-embedded tested in acc. with IEC 60603-7 (603-7), interoperable and backwards compatible with Cat.5e and Cat.5.
Suitable for 10GBase-T applications in acc. with IEEE 802.3an up to 500 MHz and 55 m.
Compatible with RJ standard plugs (RJ11, RJ12, RJ45), PCB- and tool based connection of installation cables AWG 24 – 22 (0.5 mm – 0.65 mm) and flexible cables AWG 26/7 – AWG 22/7.
IDC termination should feature nil crossover in acc. with EIA/TIA 568-A/B, gold-plated bronze contacts for >750 mating cycles, >200 insertion cycle

Material: RoHS complied

Housing material: Polycarbonate (UL-94-V0)

Should be available with or without dust protection feature

Should be 3P certified

Technical Specifications for CCTV

Technical Specification of Dome Camera

S.No	Features	Specifications
1	Form Factor	DOME
2	Certification	UL,CE,FCC
3	Housing	IP67 and IK10 or better
4	System Compatibility	ONVIF profile S ,G & T
5	Max Resolution	5MP(2592 X 1944)
6	Lens	2.7mm to 12 mm motorized varifocal length
7	Focus	Auto focus
8	Image Sensor	1/2.8" or larger
9	H-FOV	99 ~ 30°
10	Min illumination	0.01 Lux @ (F1.2,AGC ON), 0 Lux with IR
11	Shutter Speed	1/5 s ~ 1 / 100,000 s
12	Video Compression	H.265+ ,H.265 ,H.264+ H.264
13	Video bit Rate	256 Kbps to 8 Mbps
14	Noise Reduction	2D / 3D DNR
15	Video Streams	Quad stream , Each stream should support H.265+ compression
16	IP filter	Should support IP filter for security purpose
17	Frame rate	Main stream upto 5MP@25fps , sub stream upto 2MP@25fps , third and fourthstream upto VGA@25fps
18	ROI	Should Support ROI for Better bandwidth consumption
19	BLC	Support

20	Day & Night	IR cut filter with auto switch
21	Day / Night Switch	Auto / Schedule / Triggered by Alarm In
22	Edge analytics	Motion Detection, Perimeter Intrusion, Line Crossing, Stationary Object, Pedestrian detection, Face detection (deep learning) ,Cross counting
23	Image setting	Flip, Rotation, Corridor mode, Saturation, Brightness, Contrast, Hue, Sharpness adjustable
24	Rotate Mode	Yes
25	WDR	120 dB WDR
26	Alarm	1 input, 1 output
27	Audio	1 input, 1 output
28	SD Card support	upto 128 GB
29	Protocols	TCP/IP,HTTP,DHCP,DNS,DDNS,RTP/RTSP,PPPoE,SMTP,NTP,UPnP,SNMP,HTTPS,FTP,
30	Video output	1 X BNC
31	Reset button	Available
32	Security	Flash-prevention, dual stream, heartbeat, password protection, privacy mask, IP address filtering
33	Digital Zoom	Should have the capability to digitally zoomed in web browser by selecting the area using mouse
34	Factory Default	Should have the option of setting the configuration to factory default except network settings.
35	Privacy Zones	Min 4 Nos of selectable privacy Zones
36	User accounts	Should support 1 admin and 6 user accounts
37	Firmware upgrade	Firmware upgrade shall be done through web browser
38	Remote Update	Camera IP and firmware should be upgradable through the device search tool/Software without directly logging in to the camera. Firmware should also be upgradable through web browser
39	Defog	Should support Defog mode
40	IR Distance	Min IR distance 40 meters
41	Vandal resistant	IK10

42	Operating Temperature	-30°C ~ 60°C Humidity 95% or less (non-condensing)
43	General	OEM should not be blacklisted nationally or internationally

Technical Specification of 32 Channel NVR

S.No	Features	Descriptions
1	Channels	32 IP Cameras
2	Certifications	UL,CE,FCC
3	Compatibility	ONVIF profile S & G
4	Power Supply	Power adaptor must be supplied with NVR
5	Smart Phone Support	iOS, Android
6	Remote Viewing & Monitoring	Smart phone and Desktop client software
7	Recording Bandwidth	Max 320Mbps
8	Recording Mode Supportable	Normal , Motion , Alarm
9	Instant play back	Supported
10	Email	E-mail alert on video loss
11	Firmware Upgrade	Firmware upgrade through USB/web browser
12	Compression Support	H.265 , H.264
13	HDD	Support 2 SATA HDD , Each HDD capacityof upto 8 TB
14	Users	Support 6 user accounts and one admin
15	Digital Zoom on live view	Support digital Zoom on live view
16	Digital zoom on playback	Support digital zoom on playback
17	PTZ Support	Support PTZ Cameras with Pan , tilt and Zoom functionality
18	Analytics	Edge analytics of proposed cameras should be integrated with NVR .
19	Recording Resolution	8MP (4K), 5MP, 3MP ,2MP(1080P), 1.3MP (960P), 1.0MP (720P)
20	Recording backup USB	Support recording download by directly connecting USB pen drive to NVR
21	Recording backup web browser	Support downloading of recording through web browser on workstation/PC .
22	Display Split	1/4/6/8/9/10/13/14/16
23	Output Interface	1 HDMI (up to 4K), 1 VGA
24	Display Resolution	1024*768,1280*720,1280*1024,1440*900, 1920*1080,1680*1050,1600*1200,1900*1200, 2560*1440,3840*2160
25	Alarm Input/out	16ch in / 1ch out

26	Ethernet	RJ-45 port (1000M)
27	RS485	Supported
28	Line In	Yes
29	USB	1x3.0 USB for backup / upgrade, 2x 2.0 USB for mouse

Technical Specification of 24 Port PoE Switch

S.No	Features	Specifications
1	Port Configuration	24 Nos of 10M/100M/1G RJ45 Port ,4 Nos of1G/10G SFP+ Port , 1 Nos of DB9 Console Port .
2	PoE Function	IEEE802.3at (PoE+ 30W) ,IEEE802.3af (PoE 15.4W)
3	PoE Port	24
4	Available PoE Power	370W
5	Switching Bandwidth	128 Gbps
6	Forwarding Performance	95.232 Mpps
7	MAC Address	32 K
8	Jumbo Frames	10056 Bytes
9	Spanning Tree	IEEE802.1D (STP),IEEE802.1W (RSTP),IEEE802.1S (MSTP)
10	VLAN	802.1Q VLAN , Port-Based ,Private VLAN , Voice VLAN ,Guest VLAN, Q-in-Q , 802.1v Protocol VLAN , MAC-Based VLAN ,IP Subnet-Based VLAN
		4K VLAN Entries
11	IEEE 802.3ad LACP	Dynamic Trunk , Static Trunk

12		GARP/GVRP , IGMP Snooping , MLD Snooping ,Multicast VLAN Registration (MVR)
16	L3 Features	Static Route , DHCP Server
17	Class of Service	Port Based , 802.1p ,DSCP, TCP/UDP Port
18	Rate Limiting	Ingress , Egress
19	Priority Queue Scheduling	WRR , Strict Priority
20	Hardware Queues	8
21	ACLs	L2/L3/L4 , IPv6 Support
22	Security	Port Security(MAC-based) , IP Source Guard ,Storm Control ,RADIUS Authentication 802.1x , TACACS+ Authentication ,HTTPs and SSL (Secured Web) ,BPDU Guard ,STP Root Guard ,DHCP Snooping,Loop Protection
23	DHCP	Client , Relay , Option 66 , Option 67 , Option 82
24	Event/Error Log	Syslog , SMTP (RFC821)
25	Management Access Filtering	SNMP , Web , Telnet , SSH
26	PoE Management	Scheduling ,Auto-Checking ,Power Delay
29		SNMP (v1, v2c, v3) , RMON (1,2,3 & 9 Groups) , Software Upgrade
32		Configuration Export/Import , Port Mirroring ,
34		LLDP (IEEE802.1AB)
35		LLDP-MED (IEEE802.1AB)
36		CDP Aware ,sFlow ,IPv6 Management , NTP
40	Device Management	Topology View , Floor View ,Map View , Dashboard ,Traffic Monitoring , Cable Diagnostics

41	Operating Temperature	0°C to 40°C
42	Operating Humidity	10 to 90% RH
43	Storage Temperature	-20 to 70°C
44	Storage Humidity	10 to 90% RH
45	AC Input	100V-240V
46	Certifications	EN61000-4-5 (for RJ45 Port, Surge 6KV) ,CE/FCC Class A

Technical Specifications for Octagonal Pole

This specification is intended to cover design manufacture assembly, testing at manufacturer‟s works, supply and delivery of Octagonal Poles as per ISO 9001, ISO 14001 and OSHAS 18001 certified factory taking care of all aspects of design, quality, environment and safety. The Contractor should ensure that manufacturer of Octagonal Poles must have minimum 12 years of manufacturing experience.

The poles have to be manufactured by CNC Controlled plasma sheet cutting and bending machine and fully Automated Submerged arc welding machine for longitudinal welding of shaft and welding to be carried out by experienced and certified welders.

Pole should be tested as per BSEN 40-2-1 & 3 for steel test and test certificate shall be submitted showing silicon content less than 0.04%.

Poles, bracket, foundation bolts, and fixture should be of one make. Test certificate of steel manufacturer and Pole manufacturer specifying grade of steel used for Poles.

The Octagonal Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN 40-2- 1 & 3.

Pole Shaft - The pole shaft shall be made from sheet steel confirming to BSEN 10025 having yield strength of 355 N/sqmm and silicon content less than 0.04%. The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be

any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process.

Octagonal pole shafts shall be provided with the rigid flange plate manufacture from MS FE410 confirming to IS: 2062 of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified MMAW process approved by Third Party Inspection agency.

Door opening: The octagonal Poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Welding: The welding shall be carried out confirming to approve procedures duly qualified by third party inspection agency. The welders shall also be qualified for welding the octagonal shafts.

Pole sections: The Octagonal Poles shall be in single section (up to 12 Mtrs). There shall not be any circumferential weld joint.

Galvanization: The poles shall be hot dip galvanized as per BSEN ISO 1461 standard with average coating thickness of 70 microns. The galvanizing shall be done in single dipping.

Fixing Type: The Octagonal Poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.

Top Mountings: The galvanized mounting bracket shall be supplied along with the Octagonal Poles for installation of the luminaries.

Pole Testing Facility: The Manufacturing unit shall have in house pole testing facility for validation for structure design data. The Pole testing facility shall be as per BSEN 40 – 2 1 & 3.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below

IEC 60146	Semiconductor converters
IS 13947	Low voltage switchgear and control gear
IS 8623	Low voltage switchgear and control gear assemblies
IEC 60529	Degree of protection provided by enclosure
IS 4540	Mono crystalline semiconductor rectifier assemblies and equipment
IS 3136	Polycrystalline semiconductor rectifier equipment
IS 2147	Degree of protection provided by enclosure for low voltage
IEC 60747	Semiconductors devices
IEC 62485	Safety requirements for secondary batteries and battery installations
IEEE 946	IEEE recommended practice for the design of DC auxiliary
IEC 60947	Low voltage switchgear and control gear
IEC 61439	Low voltage switchgear and control gear assemblies