

**Construction of Phase A works at Jawahar Navodaya Vidyalaya (JNV) at
Tufanganj, District Cooch Behar, West Bengal (WB)**

Tender No. WAP/CMU - II/NVS/JNV/Cooch Behar/2023/21

**VOLUME-II
Technical Specifications**

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1. TECHNICAL SPECIFICATIONS OF WORKS

1.1. General

- 1.1.1. 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) Schedule of Quantities (SoQ) and Drawings
 - e) Particular specification as applicable for respective works specified herein.
- 1.1.2. Error or omission, if any in the nomenclature, rate or unit of the items or work shall be corrected as per DSR-2021.
- 1.1.3. Measurement of work shall be done as per CPWD specifications and BIS codes, as applicable.
- 1.1.4. Actual quantities of completed and accepted work shall only be paid.
- 1.1.5. 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.
- 1.1.6. 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.
- 1.1.7. 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.
- 1.1.8. 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. However, any Royalty to be paid to the Government shall be paid by the contractor.
- 1.1.9. 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%

1.1.10. Material for installation

- 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 tender document. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.
- 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.
- The quantities of various items may vary from the quantities given in schedule of Quantity (SoQ)/ Bill of Quantity (BoQ). 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.
- 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.
- 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. The Employer shall not take back any spare quantity of cable whether in pieces or in sealed drums/ containers, if procured more than that required at site / approved by 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.

1.1.11. 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.

1.1.12. 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 Manufacturer's premises before dispatch to the site by the contractor.

1.1.13. 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, BIS recommendations, factory act, and workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements 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 recover the 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.

1.1.14. 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.

1.1.15. 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.

1.1.16. 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.

1.1.17. 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. Natural STP operation & maintenance manual should be provided to staff of NVS along with display board in Stainless steel should be install at site. Water testing results from NABL Lab should be provided by contractor after functioning of STP and one year O&M will be taken care by contractor.

- 1.1.18. 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.

1.1.19. 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.

1.1.20. 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.

1.1.21. 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 finalisation of bill.

1.1.22. 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 as required by Engineer-in-charge. 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.

1.1.23. Painting:

All equipment works shall be painted at the workshops/factory/manufacturing unit before dispatch to the site. Care shall be taken by the contractor while handling and installing the various equipment and components of the work to avoid damage to the finishes of equipment. 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.

1.1.24. Maintenance during defect liability period

Sufficient trained and experienced staff shall be made available to meet any exigency of work attends the complaint during the defect liability period from the handing over of the project.

- 1.1.25. 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**1.2.1 Technical specification for Hostel, Warden residence and Principal quarter are listed below:**

S.No.	ITEM NAME	HOSTEL DORMITORY	WARDEN RESIDENCE /TYPEIII & TYPE II QUARTERS	PRINCIPAL QUARTER & GUEST HOUSE
1	Foundation &Structure	As per structural requirements based on soil investigation report. The design shall vary as per soil conditions.		
2	Superstructure			
a)	Structure	RCC framed & Filler walls of Aerated Cement Concrete (ACC) / Cellular Concrete Block (CLC)/ Clay Brick work/Fly-ash brick		
b)	Internal Partition	Half brick thick masonry in ACC/CLC/ Fly ash Brick		
c)	Clear Ceiling height	3.00 M	3.00 Mt	
d)	Plinth Height	Plinth height of buildings shall be kept as 60cm from the adjoining ground level/plinthprotection level. Where plinth height becomes more then 60 cm special care shall be taken. If plinth height more than 1.20 mtrs., approval of the competent authority may be sought.		
3	Door & Window Frame			

a	Frame	
	Door Frame	Providing and fixing T-iron frames of 40*40*6 mm with 15*3 mm lugs 10 cm long embedded in cement concrete block 15*10*10 cm of C.C. 1:3:6 (As per DSR-2021 item no. 10.13.1)
	Window Frame & Ventilators	<p>Providing and fixing factory-made ISI marked steel glazed window (partly fixed and/or partly side hung/top hung) and side hung wire gauzed windows shutters with Z- section, window grills fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15*10*10cm of CC. 1:3:6(As per D.S.R.- 2021 item no. 10.11.1)</p> <p>Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.</p> <p>Providing and fixing anodized aluminum frame glazed window (partly fixed and/or partly side hung/top hung/ slide) and side hung/slide wire gauzed windows shutters with Z- section, window grills fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15*10*10cm of CC. 1:3:6</p>
b	Shutters	

	Main Doors	<p>i) Powder coated Aluminum Glazed Doors with fixed glazing on either side.</p> <p>ii) M.S. collapsible steel shutters (for safety measure) to main entrance lounge at GF.</p>	<p>(i) Factory made Machine pressed pre-laminated flush door exterior grade with teak wood lipping on edges. The lamination sheet used shall be decorative high pressure of plain / wood grain in gloss / matt/ suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS: 2046 Type S. The door shall be fixed to T Iron frame with SS Hinges.</p> <p>(ii) Safety door MS tubular box section styles and rails frame i/c Stainless steel Mosquito Proof Jali.</p>
	Other Doors	Single shutters with 35 mm thick factory-made exterior grade Non- Decorative type flush door shutter with teak wood lipping on edges & finished with one coat of wood primer followed by two or more coat of synthetic enamel paints. (As per D.S.R.-2021 item no. 9.21.1 & 9.23 for flush door)	
	Bath. WC. Toilets Doors	e) toilet door frames of solid pvc type & flush door shutters (non-decorative type) covering with pvc rigid foam sheet shall be used/ FRP door	

	Windows & Ventilators	Z- Section Double shutter one with frosted glass panes and other with stainlesssteel wire mesh shutter. All windows and ventilator shall be provided with 12 mm square guard bars at 10 to 12 cms. C/C spacing fixed in brick/ cement concrete block		
	Hardware & Fittings	Powder coated/anodized Aluminum/ SS fittings		
4	FLOORING			
a)	Living/Drawing Room. Bed Rooms. Dining & Family Lounge with matching grouting of joints	All flooring Kota stone combination with marble strip except WC/toilets area with matching grouting of joints	600 mm x 600 mm Vitrified Tile Flooring laid on 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry @ 3.3 kg/sqm including grouting the joints with white cement and matching pigments etc., complete.	600 mm x 600 mm Vitrified Tile Flooring laid on 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry @ 3.3 kg/sqm including grouting the joints with white cement and matching pigments etc., complete.
b)	Kitchen		Anti-skid Ceramic/ vitrified tiles of size not less than 300 mm* 300 mm with water absorption less than 0.08% laid with 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry 3.3kg/sqm including grouting the joints with white cement and matching pigments etc., Complete.	Anti-skid vitrified tiles of size not less than 300 mm * 300 mm with water absorption less than 0.08% laid with 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry @ 3.3kg/sqm including grouting the joints with white cement and matching pigments etc., Complete.
c)	Common circulation area	Kota stone slab flooring with marble strips (up to 50mm width) in required pattern including rubbing and polishing complete		
d)	Staircase	Kota stone in single length up to 1.05 meter of treads & risers		

e)	Toilets / Bathroom	Glazed ceramic anti-skid of size not less than 300*300 mm floor & 300*450 wall with matching grouting of joints		
f)	Skirting in rooms and other areas.	100 to 150 mm height skirting matching with floor materials		
g)	Kitchen Platform/ Dado	NA	(i) Platform- Granite Stone (ii) Dado over kitchen platform-Ist Quality Ceramic Glazed wall tiles of approved sizes from 600 height from platform	(i) Platform- Granite (ii) Dado over kitchen platform- Ist Quality Ceramic Glazed wall tiles of approved sizes from 600 height from platform
h)	Toilets/bathrooms/ WCDado	1st quality ceramic glazed wall tiles of size not less than 450mm * 300mm inside WC Area upto 900mm height & for remaining area of toilet block shall be upto 2100mm height.	1st quality ceramic glazed wall tiles of size not less than 450 mm * 300mm inside WC area upto 900mm height & for remaining area of toilet block shall be upto 2100mm height.	1st quality ceramic glazed wall tiles of size not less than 450mm * 300mm inside WC area up to 900mm height & for remaining area of toilet block shall be upto 2100mm Height
5 FINISHES				
a)	Internal Walls	(i) All walls to be painted with low VOC Acrylic washable distemper. (ii) Synthetic enamel paint on all woodworks and steel works	(i) All walls to be painted with low VOC Acrylic washable distemper. (ii) Synthetic enamel paint on all wood works and steel works.	(i) All walls to be painted with low VOC Acrylic washable distemper. (ii) Synthetic enamel paint on all wood works and steel works
b)	External Walls	Synthetic enamel paint on all wood work & steel work. Premium Acrylic Smooth exterior paint with Silicone additives or its equivalent/Texture Paint		
c)	Hand Rail	Stair Case Railing -SS/MS as per specification	Stair Case Railing -MS	NA
d)	Roof	RCC Slab brick with Coba treatment (Item No. 22.7.1 of DSR-21)/ bitumen paint (DSR-2021/12.15) on sloping RCC roof with galvanized sheet covering on top		

		with the help of MS box Section 25X25 mm		
e)	Toilets for Physically disabled person	One each for boys and girls (specification as per NBC)	NA	NA
f)	Underground water (UGT)	As per drawings/M30 grade concrete	As per drawings	As per drawings

1.2.2 Technical Specification for School building, Kitchen and Dining are listed below:

S.No.	ITEM NAME	SCHOOL BUILDING	KITCHEN & DINING
1	Foundation & Structure	As per structural requirements based on soil investigation report. The design shall vary as per soil conditions.	
2	Superstructure		
a)	Structure	RCC framed & Filler walls of Aerated Cement Concrete (ACC) / Cellular Concrete Block (CLC)/ Clay Brick work/Fly-ash brick	
b)	Internal Partition	Half brick thick masonry in ACC/CLC/Fly-ash Brick	
c)	Clear Ceiling height	3.60M	3.60M
d)	Plinth Height	Plinth height of buildings shall be kept as 60 cm from the adjoining ground level/plinth protection level. Where plinth height becomes more than 60 cm special care shall be taken. If plinth height more than 1.20 mtr., approval of the competent authority may be sought.	
3	Door & Window Frame		
a	Frame		
	Door Frame	Providing and fixing T-iron frames of 40*40*6 mm with 15*3 mm lugs 10cm long embedded in cement concrete block 15*10*10 cm of C.C. 1:3:6 (As per D.S.R.- 2021 item no. 10.13.1)	
	Window Frame & Ventilators	Providing and fixing factory-made ISI marked steel glazed windows (partly fixed and/or partly side hung/top hung) with z- section, window grills fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (As per D.S.R.- 2021 item no. 10.11.1)	Providing and fixing factory-made ISI marked steel glazed windows (partly fixed and/or partly side hung/top hung) and side hung wire gauzed windows shutter with z- section, window grills fixing with 15x3

		<p>Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.</p> <p>Providing and fixing anodized aluminum frame glazed window (partly fixed and/or partly side hung/top hung/ slide) and side hung/slide wire gauzed windows shutters with Z- section, window grills fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15*10*10cm of CC. 1:3:6</p>	<p>mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (As per D.S.R.- 2021 itemno. 10.11.1)</p> <p>Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.</p> <p>Providing and fixing anodized aluminum frame glazed window (partly fixed and/or partly side hung/top hung/ slide) and side hung/slide wire gauzed windows shutters with Z- section, window grills fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15*10*10 cm of CC. 1:3:6</p>
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b	Shutters		
	Main Doors	<p>i) Powder coated Aluminum Glazed Doors with fixed glazing on either side and on the top below floor beams.</p> <p>ii) M.S. collapsible steel shutters (for safety measure) to main entrance (for safety measure only)</p>	<p>(i) Powder coated Aluminum Glazed Doors with fixed glazing on either side and on the top below floor beam</p> <p>(ii) M.S. collapsible steel shutters at main entrance (for safety measure) only</p>
	Other Doors	<p>Single shutters with 35 mm thick factory-made exterior grade Non-Decorative type flush door shutter with teakwood lipping on edges & finished with one coat of wood primer followed by two or more coat of synthetic enamel paints.</p> <p>(As per D.S.R.- 2021 item no. 9.21.1 & 9.23 for flush door)</p>	
	Bath. WC. Toilets Doors	<p>Factory made Machine pressed pre-laminated flush door exterior grade with teak wood lipping on edges.</p> <p>The lamination sheet used shall be decorative high pressure of plain / wood grain in gloss / matt/ suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS: 2046 Type S. The door shall be fixed to T Iron frame with SS Hinges.</p> <p>FRP doors (9.121 & 9.122)</p>	
	All Window/ ventilator Grills (except WC, Toilets, Baths)	Z-section single shutter with plain glass panes, windows and ventilator shall be provided with 12 mm square guard bars at 10 to 12 cm. C/C spacing.	Z- Section Double shutter one with frosted glass panes and other with stainless steel wire mesh shutter. All windows and ventilator shall be provided with 12 mm square guard bars at 10 to 12 cm. C/C spacing
	Windows/ ventilators Frame	MS/ Aluminum Z-section single shutter with Frosted Glass	
	Hardware & Fittings	Powder coated/anodized Aluminum/ SS fittings	
4	FLOORING		
a)	Main entrance hall, common circulation area	Mirror polished Kota stone with marble strip	

b)	Other	Classroom - (Kota stone slab flooring with marble strips (up to 50mm width) in required pattern including rubbing and polishing complete)	Dining Hall & Kitchen Area - (Kota stone slab flooring with marble strips (up to 50mm width) in required pattern including rubbing and polishing complete)
c)	Staircase/steps	Kota stone in single length up to 1.05 meter of treads & risers	
d)	Toilets / Bathroom	Glazed ceramic anti-skid of size not less than 300*300 mm with matching grouting of joints	
e)	Skirting in rooms and other areas.	100 to 150 mm height skirting matching with floor materials	
f)	(i) In toilets/WCs /Baths (including common circulation area of toilet block)	Glazed ceramic anti-skid of size not less than 300x300 mm with matching grouting of joints.	Glazed ceramic anti-skid of size not less than 300x300 mm with matching grouting of joints.
g)	Dado		
i	In Toilets / WCs / Baths (including common circulation area of toilet block)	1 st Quality Ceramic Glazed wall tiles of approved sizes from floor up to 900 mm height in toilet and remaining area of toilet block up to 2100mm height.	1 st Quality Ceramic Glazed wall tiles of approved sizes from floor upto 2.1 meter height except in WC, which shall be 900mm dado
ii	Counter/Pantry/Dining	At Laboratory platform: Granite stone with nosing	Kota stone for kitchen and pantry platform.
h)	Kitchen/Pantry	NA	1st Quality Ceramic Glazed wall tiles of approved sizes from floor up to 2.1-meter height
i)	Dining Area	NA	1st Quality Ceramic Glazed wall tiles of approved sizes from floor up to 1.20-meter height/ granite tiles

j)	Open Court Yard	Flag hoisting/Central court yard of school building. (i) Top Course: 60 mm thick thick factory made cement concrete interlocking paver block of M-30 grade made by block making machine with strong vibratory compaction etc., in required colour, pattern. 50mm thick compacted bed of coarse sand etc., (as per item no.16.68, DSR -2021) (ii) Based course : 7.50 cm thick CC (1:5:10) (iii) The top level of Court yard shall be 15 cm from formation level of School Building.	Kitchen back courtyard with Kota Stone slab flooring and front Dining courtyard with anti-skid vitrified tile 300 x 300 mm flooring/ 60 mm thick thick factory made cement concrete interlocking paver block of M-30 grade
5	ROOFING		Kitchen back side courtyard and Dinning Front Courtyard : Precoated GI profile sheet roofing
6	FINISHING		
a)	Internal Walls	(i) All walls and ceilings to be painted with low VOC Acrylic washable distemper. (ii) Synthetic enamel paint on all woodworks and steel works	(i) All walls and ceilings to be painted with low VOC Acrylic washable distemper. (ii) Synthetic enamel paint on all wood works and steel works
b)	External Walls	Synthetic enamel paint on all wood work & steel work. Premium Acrylic Smooth exterior paint with Silicone additives or its equivalent 1 mm thick cement-based putty on external face leaving CC tile cladding area.	Synthetic enamel paint on all wood work & steel work. Premium Acrylic Smooth exterior paint with Silicone additives or its equivalent
7	Railing	Staircase & Ramp Railing -SS 304 Grade (ii) Corridor in between Columns - 1350 mm height MS grill/railing as per approved drawings	Staircase & Ramp Railing –SS Grade 304
8	Roof Water Treatment	Brick Coba Treatment as per DSR-21, item No. 22.7.1/ Bitumen paint (DSR-2021/12.15) on sloping RCC roof with galvanized sheet covering on top with the	Brick Coba Treatment as per DSR- 2021, item No. 22.7.1./ bitumen

		hrlp of MS box Section 25X25 mm	paint (DSR 12.15) on sloping RCC roof with galvanized sheet covering on top with the hrlp of MS box Section 25X25 mm
9	Toilets for Physically disabled person	One each for boys and girls (Specification as per NBC)	N.A
10	Roof Water Tank	8,000 Liters over each toilet block for general use and 10,000 Liters for Fire in one toilet block only / or As per drawing	8000 Liters / or As per drawing
11	Cooking Platform	-	RCC as per design and drawings
12	Pantry	-	RCC as per design and drawings
13	Laboratories Counter/Platform	RCC as per design and drawings	NA
14	Ramp for Physically disabled person	One no. (specification as per NBC)	One no. (specification as per NBC) on each entrance
15	Staircase	Only Two Front Staircase shall run upto mummy. The back Staircase shall stop to FF Level.	MS Ladder shall be provided to reach the roof for maintenance purpose.

1.2.3 Detail Scope and specifications of development works and campus boundary wall are listed below:

S.NO.	NAME OF WORK	DETAILS
1	Preparation of play fields:	
a)	Running track: 1 no. (As per drawing)	Leveling with good earth after filling/cutting of earth. The quantities of earth filling/cutting shall be worked out in detailed calculation basis as per initial level, contour plan. Finished level shall be 15 cm higher than the adjoining ground level so that water logging can be avoided.
b)	Multi-sport complex	(a) Leveling with good earth after filling/cutting of earth. The quantities of earth filling/cutting shall be worked out in detailed calculation basis as per initial level, contour plan. Finished level shall be 15 cm. higher than the adjoining ground level, so that, water logging can be avoided. b) CC court with pole, board, basket etc. (i) Base concreting CC 1:5:10) of 7.50 cm thick (ii) Top course Concreting (M-20 grade designed mix) of 10 cm thick. iii) Pole, board, Basket: As per SAI standard.
c)	Kho kho / Volley Ball court: 2 nos. (As per Drawing)	Leveling with good earth after filling/cutting of earth. The quantities of earth filling/cutting shall be worked out in detailed calculation basis as per initial level, contour plan. Finished level shall be 30 cm. higher than the adjoining ground level, so that, water logging can be avoided
2	Internal roads, paths and culverts:	
a)	Internal roads (Bituminous roads):	(i) Width: Shall be 3.50 mtrs. + 1 mtrs. Shoulder/side berm of each side. (ii) Road shall be constructed up to the all building units. (iii) Base Course 90mm to 45 mm / 63mm to 45mm (As per CPWD specification qty. of metal required for 10cm thick WBM = 1.28 cum/10 Sqm.) (iv) Top Course 2.5 cm premix carpet carpet surfacing with 2.25cum and 1.12 cum. Of stone chippings of 13.2mm and 11.2mm size respectively per 100 sqm. And 52 kg. and 56kg. of hot bitumen per cum. of stone chippings of 13.2mm and 11.2mm size respectively including a tack coat with hot straight run bitumen including consolidation with road roller of 6 to 9 ton capacity etc (v) Finished/top level of the roads i.e. tack coat using hot straight run bitumen of grade 80/100 including heating the bitumen, spraying the bitumen with mechanically operated spray unit fitted on bitumen boiler, cleaning and preparing the existing road surface as per specifications/ seal coat of premixed fine aggregate (passing 2.36mm and retained on 180 micron sieve) with bitumen using 128 Kg. of bitumen of grade 80 / 100 bitumen per cum of fine aggregate and 0.60 cum of fine aggregate per 100 sqm. of road surface including rolling

		and finishing with road roller all complete. (vi) Kerb stone (spec.as per DSR-21/16.69) both side of road.
b)	Pathways:	(i) 2.00 mtrs. width + 1 mtrs. shoulder/side berm each side of the pathways. (ii) Pathways shall be provided to connect the buildings/ permanent infrastructure to nearby internal roads. (iii) No pathways shall be provided on side of the roads. (iv) Top Course: 60 mm thick factory-made cement concrete interlocking paver block of M-30 grade made by block making machine with strong vibratory compaction etc. in required colour, pattern, 50 mm thick compacted bed of coarse sand etc. (as per item no. 16.68, DSR-2021) (v) Base course: 7.50 cm thick CC (1.5:10). (vi) Kerb stone on edge (50 mm thick, 250 mm height (for which shall be embedded underground): Factory Made kerb stone of M-25 grade cement concrete (as per item no. 16.69, DSR-2021). (vii) Finished/top level of the edge of the paths shall be 15 cm. higher than the adjoining ground level.
c)	Culverts	As per actual requirement/Hume Pipe
3	External water supply	
a)	Tube/open well i/c 2 Nos. submersible pump 7.5 HP (preferably Solar Powered) & cabling etc. complete	Shall be executed as per availability of underground water after examination by the local PHED or any other related Govt, agencies i.e. Central Ground Water Board, Local PHED etc. The yield of water source shall be 15000 LPH or more.
b)	Overhead Tank	Required in all building (As per Drawing)
c)	Under Ground Sump	100000 Itr. Capacity with 2 nos. centrifugal pumps including one standby.
d)	Pump house	i. Size - As per drawing ii. Plinth area- As per drawing. iii. Floor height - As per drawing. iv. Building shall be RCC framed structure with slope roof and shall be executed over Under Ground Water Tank. v. Flooring -CC vi. Internal Painting- White Wash vii. Door- Laminated Machine Pressed Flush Door viii. Window - Steel Glazed Door
e)	Water filtration plant (if required)	Shall be executed if required, after conducting necessary water test through local PHED or any other related Govt, agencies.

f)	GI/CI water supply distribution line	G 1 Pipes for intake from bore well and supply to OH Tanks, maximum dia -100/80 mm nominal size. Distribution line shall be designed as per the intake of the buildings. All pipes shall be CPVC only.
4	External Electrification:	
a)	Substation building	(i) Plinth area- As per drawing. (ii) Floor height - As per drawing. (iii) Building shall RCC framed structure with slop roof. (iv) Flooring -CC (v) Internal Painting- White Wash (vi) Door- Laminated Machine Pressed Flush Door (vii) Window - Steel Glazed Door
b)	LT Panel	Fabricated from CPRI approved workshop
c)	External wiring/cable connection using U.G. cables from sub-station to feeder pillar, building & pump house and necessary connection from DG set to infrastructures.	250KVA sub-station depending on the location of the School. However, capacity of sub-station may be confirmed after consultation with concern state electricity board.
5	External sewerage System	
a)	Septic Tank & Soak pit	(i) Proper planning shall be made before preparation of Preliminary estimate. (ii) Septic tank shall be designed as per the user and as per CPWD specification. (iii) Septic tank shall be RCC including walls as per IS dimension for 200v users for school, Girls Hostel and Boys' Hostel each (iv) Sufficient soak pit or dispersion channels shall be provided as per the soil condition
b)	Natural STP	Eco STP consisting of screening chamber, sewerage storage tank, V Notch chamber, Bio digester, wetland 1 & 2, Treated water collection chamber with treated water supply system shall be made as per drawings & specification. Treated water should be tested in NABL accredited lab.
c)	External sewerage line (RCC NP2/HDPE double wall corrugated (DWC) I.S 16098 (Part - 2) 3013 for soil / waste pipe	Proper planning shall be made before preparation of Preliminary Estimate.
6	7.5 H P. Sewerage Pump	Air Cool, mounted on trolley with 10m. Suction & 10m. del. Flexible pipe
7	25 KVA DG Set	(i) Including erection, installation, testing, commissioning etc. (ii) Essential connection to various building shall be provided as per latest NVS guideline/ order.

8	Retaining wall / Breast wall (if required)	Proper planning shall be made before preparation of Preliminary estimate
9	Strom Water Drain	(i) Proper planning shall be made after examining the levels of the campus very carefully before preparation of Preliminary estimate. Rain water pipe collect from the buildings shall be connected with the campus storm water drain. (ii) Road side drain shall be avoided. (iii) Level of out fall drains is always kept higher than the highest water level of Nallah/Natural drainage where water will be disposed off finally.
10	Rain water harvesting	Proper planning shall be made before preparation of Preliminary estimate
Campus Boundary Wall including Main Gate and Chowkidar Hut:		
1	Campus Boundary wall	(i) Boundary wall – As per drawing (ii) Height of boundary wall including fencing details with concertina wire over the wall – As per the drawing (iii) The campus boundary wall shall be of RCC column, plinth beam, top band and filler wall in brick work.
2	Chowkidar Hut/Sentry Booth	(i) Plinth area- As per drawing. (ii) Floor height - As per drawing. (iii) Building shall RCC framed structure with slope roof. (iv) Other specification as per Annexure-V of PAR-2021 for Type-I qtrs.
3	Main Gate - Depending upon layout two gates, one for school and other for residential area may be provided.	(i) Width & Height of Main Gate: As per drawing. (ii) Wicket Gate: As per drawing.

For all civil works, the work for all DSR-2021 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.

1.2.1. Single Bucket Dustbin

Single bucket dustbin with minimum dry waste carrying capacity of 40kg weight and 70 L volume shall be fixed on stands, tiltable 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/fixtures and fixing in totality. The Design shall be approved from Engineer-in-charge. Other specification as per BOQ.

1.2.2. 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. Other specification as per BOQ.

1.2.3. 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 and tile 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. Other specification as per BOQ.

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 epoxy 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: $\pm 1\text{mm}$.

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. Other specification as per BOQ.

1.2.4. Tree Transplantation

- A. Roots must be trimmed before transplanting. Set up temporary supports before trimming. Perform excavation and trimming in stages. The root-cutting diameter should be 10 cm less than the planned root ball. The roots should be trimmed one after another, in a circular pattern with the trunk as the core. The wounds of the exposed roots must be smoothened. Root trimming is normally performed in spring, before new shoots start to grow, but can also be performed in summer when the part above the ground stops growing or before the leaf falling season in autumn.
- B. Digging up trees
 - a. The diameter of the excavated root system or soil ball should be five times the diameter of the base of the tree trunk, but not less than 40 cm. The depth of the excavation should be $\frac{2}{3}$ of the soil ball's diameter, but not shallower than 25 cm. The depth of the soil ball should include multiple root systems. For slow growing plants or big trees being transplanted in the non-growing season (i.e., weakly growing trees or transplantation during inappropriate season), the size of the soil ball should be increased accordingly.
 - b. When encountering thick roots, cut them with a hand saw instead of digging through, keep the wounds

smooth and apply healing agents to prevent infection.

- c. Wrap the soil ball with biodegradable materials, and then with large mesh wire netting to maintain its stability.

C. Wrapping and transporting

- a. After being excavated, the tree trunk should be wrapped with protective materials (e.g., sackcloth, canvas). During transporting the tree to the new destination, cushions should be placed between the tree and the body of the vehicle, to avoid damaging the branches. Fasten the tree with ropes for safety's sake, regardless of how far it is being transported.
- b. Be gentle while loading, unloading, and handling, and avoid dragging while transporting. Ensure there are no damage to the soil ball, and no scratching and splitting of the root system. The tree should be kept intact without injuries to its root system, trunk and crown.
- c. Keep the trees being transported properly moistened, sheltered and protected from wind, strong sunlight, rain, cold weather and theft.
- d. While transporting, loading and unloading, follow traffic safety guidelines, with warning signs erected to alert passing vehicles and pedestrians.

D. Tree planting

- a. Mark the planting site with the Engineer in advance. Start digging only after confirmation. The size of the excavation should be double that of the soil ball, or at least 30 cm wider than its diameter, while the hole should be 15-20 cm deeper than the root ball. After digging, apply organic or other types of fertilizers to the base of the hole to facilitate root growth, and replace the existing soil with new soil. There should not be any rocks or impurities larger than 1 cm in diameter in the soil.
- b. The transplantation process including excavation, transporting and planting should be completed within the same day. When encountering adverse weather, apply temporary measures to protect the soil ball and the planting hole, install sheltering facilities and, if necessary, water the tree to prevent injury or withering.
- c. Before planting, place a ventilation bag on each of the four sides of the hole (Dimensions of ventilation bag: 12-15 centimetres in diameter, 1 metre in length; fillings comprising perlite, with a diameter of more than 1 centimetre). While planting, remove the wrapping materials around the soil ball, gently put the tree into the hole, and keep the trunk upright. Refill the soil surrounding the root ball, water the tree three times, compact the soil with wooden stick to enhance contact with the root system, & build

a “soil wall” around the tree to retain water.

- d. Install supporting structures immediately after planting, to prevent tree leaning. Structures of less than 20 centimeters in diameter should be made up of materials of at least 5 centimeters in diameter, while structures of over 20 centimeters in diameter should be made up of materials of at least 10 centimeters in diameter, and they should be firmly pressed at least 4 inches into the soil. Protect the parts where the trunk is in contact with the structures with thick soft materials (such as plastic or fabrics), to avoid injuries to the bark. Fasten the tree with ropes.
- e. Water the tree immediately after transplanting, and water again after 2~3 days, and then again after one week. Keep it well watered each time, to ensure sufficient water at the base of the soil ball. Meanwhile, wrap the main trunk and the first and second main branches with straw ropes or soft moist materials. Other specification as per BOQ.

1.2.5. 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 3-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.

1.2.6. 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. Other specification as/BOQ.

1.2.7. 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. Other specification as per BOQ.

1.2.8. Expansion Joints

Expansion Joints in roofs, walls and floors shall be provided as per CPWD specifications 2021, Volume I sub-head 5.4.5 & 5.12

1.2.9. 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). Other specification as per BOQ.

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. Underground water tanks with all sleeves.
- d. Sewerage & Storm water drainage system.

1.3.1. 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 upto date amendments, relevant IS standards and in case of its absence as per British Standard Code of Practice.

1.3.2. 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.

1.3.3. 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.

1.3.4. Inspection and Testing of Materials

- 1.3.4.1. 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.

1.3.4.2. 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

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

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

1.3.4.5. 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 Engineer-in-Charge shall be removed from the site within 48 hours.

1.3.5. Reference Drawings

1.3.5.1. 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.

1.3.6. Shop Drawings

1.3.6.1. 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. Manufacturers or Contractor's fabrication drawings for any materials or equipment supplied by him.

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

1.3.7. As built Drawings

1.3.7.1. 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 upto 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.

1.3.7.2. 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.

1.3.8. 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 by the 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.

1.3.9. 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.

1.3.10. Cutting of Structural Members

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

Water Supply System

1.3.11. 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.

1.3.12. Mirror

Providing and fixing beveled edge mirror of superior glass (of approved quality) desired thickness, fixed with stainless steel studs, complete with cutting, making holes, studs, all fittings, screws, washers and making good the walls as specified BoQ.

1.3.13. Water supply pumps

1.3.13.1. Borewell 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 suitable RPM, $415 \pm 10\%$ Volts, 50 Cycles, AC3 – phase. Each pump shall be capable of operating within a performance pressure characteristic range sufficient below and above the required working pressure.

The Pumps shall conform to Indian standard IS: 8034. Pumps and motors shall be mounts on a 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 provides 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.

1.3.13.2. Domestic Water Supply Pumps

Domestic water transfer pumps shall be multistage, vertical stainless steel pumps, having stainless steel casing, stainless steel pump foot and diffusers, stainless impeller, stainless steel shaft, ceramic bearings, tungsten carbide shaft protection bushes and mechanical seal driven by suitable kW, RPM, 400/440 Volts, 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 mounts on a common MS structural base plate. Each pump shall be provides with a totally enclosed fan cooled

induction motor of H.P and R.P.M specified in schedule of quantities Each pumping set shall be provides with a Gun Metal “Bourden” type pressure gauge 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

1.3.13.3. Sump pumps

Pump shall be integral with submersible motor on a common shaft. The pumps shall be as specified in the BoQ.

The pump set shall be installed in vertical position in sumps with level controller cum operated float switches.

Pump casings shall be aluminum and impellers of SS. All pumps shall have combination ball and roller bearings and shaft seals should be mechanical. Motor shall be submersible and shall be rated for minimum HP specified or the BHP absorbed in the operating range of the pump.

1.3.14. 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.

1.3.14.1. Submersible Pump

These shall be fully submersible with a fully submersible motor. The pumps shall be provided with an automatic level controller and all interconnecting power and control cabling which shall cause the pumps to operate when the water level in the sump rises to a preset level and stop when the preset low level is reached.

Pumps for drainage shall be single stage, single entry.

Pump shall be C.I. casing and C.I. two vane open type with a dynamically balanced impeller connected to a common shaft of the motor. The vane for sewage pump will be open type, while for drainage pump, etc. it will be of semi open type. The MOC of the sump shall be in accordance to schedule of quantity.

Stuffing box shall be provided with mechanical seals.

Each pump shall be provided with a suitably rated induction motor suitable for 415 volts, 3 phase, 50

Hz A.C. power supply. Each pump shall be provided with in built liquid level controller for operating the pump between predetermined levels.

The pumping set shall be for stationary application and shall be provided with pump connector unit. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation.

Pump shall be provided with all accessories and devices necessary and required for the pump to make it a complete working system.

Sump pump shall be complete with level controllers, power and control switch gear, Auto/off/Manual switches, pumps priority selections and control and power cabling upto motor and controller/probes etc. (Including earthing). Level control shall be such that one pump starts on required level, 2nd pump cuts in at high level and alarms is given at extra high level. All level controllers shall be provided with remote level indications.

1.3.14.2. 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 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 as specified in the BoQ. 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.

1.4. FIRE FIGHTING WORKS

Scope of Work

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

Fire Fighting Works

- a. Hydrant System
- b. Fire Extinguishers

1.4.1. 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 in schedule of quantities. 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.Other specification as per BOQ.

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 SPDT 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 necessary control piping and drainage facility. For other specifications BOQ items shall be followed.

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 annunciate 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. Other specification as per BOQ.

1.4.2. Fire hydrants and hose reels

- a. Hydrants shall be provides internally as shown on the drawings. Internal hydrants shall be providing at each landing of and escape staircase and additionally depending on the floor area as shown on drawings. Landing valve shall be single headed gunmetal valve with 63 mm dia outlets and 80mm inlet conforming to IS 5290. Landing valve shall have flanged inlet and instantaneous type outlets and mounted at 1.0m above the floor level. Instantaneous outlets for the hydrants shall be of standard pattern approved and suitable for 63mm dia fire brigade hoses. Wherever necessary, pressure reducing orifices plate and shall be provided so as to limit the pressure to 3.5 kg/sqcm or any other rating as required by the Local Fire Authority.
- b. Each landing valve shall have a hose reel cabinet as shown on drawings.
 - i. Landing valve with single 63 mm dia outlet and 80 mm dia inlet.
 - ii. 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.
 - iii. 2 Nos. 15.0-Meter-long 63 mm dia Reinforced Rubber Lined (RRL) hoses with gun metal I.S. markedinstantaneous couplings.

- iv. One-gun metal branch pipe.
- c. 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 Wet Riser through a 25m Ball Valve with necessary hose adapter and a gun metal nozzle at the other end.
- d. Hoses shall be in two lengths of 15.0 m each, of RRL type with instantaneous couplings, neatly rolled into bundles and held in position with steel brackets. Hoses shall be tested and certified by the manufacturer, to withstand an internal water pressure of not less than 35 kg / sqcm without bursting. The hose shall also withstand a working pressure of 7 kg / sqcm without leakage.
- e. The hose cabinet shall be fabricated from 2mm mild steel sheet duly rust inhibited through a process of degreasing and phosphating. The cabinet shall have double flap hinged doors with 4mm clear glass and shall have necessary openings for riser main and brackets for all internals. The cabinet shall receive two coats of red oxide primer both inside and outside before two after coats of final paint of approved colour shade.
- f. The fire brigade connection shall consist of two / three/four headed as specified in BOQ 63mm dia gun metal outlets with built-in check valve and drain plugs connected to a 150mm dia outlet connection to the water reservoir or to the hydrant main. The fire brigade collecting head shall conform to IS 904. Other specification as per BOQ.

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.

1.4.3. Piping for Fire Fighting System

External

- 1.4.3.1. 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.
- 1.4.3.2. 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 graphically tested 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.
- 1.4.3.3. 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.
- 1.4.3.4. 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 upto 1200 mm and 1000 x 1000 mm for depths beyond or as specified in the BoQ. Each chamber shall have a cast iron surface box approved by the Engineer in-charge.
- 1.4.3.5. 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. Other specification as per BOQ.

Internal

- 1.4.3.6. All internal pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 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 screwed type. Flanges shall be rated for 2.0 N/sqmm.

1.4.3.7. Valves shall be suitable for external piping.

1.4.3.8. 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.

1.4.3.9. 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 support shall be painted with 1 coats of red oxide primer and two coats of black enamel paint.

1.4.3.10. 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.

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

Pipe Jointing

1.4.3.12. 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.

1.4.3.13. All welded joints shall be tested by radiography test.

1.4.3.14. 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 Body seating 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 upto 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 upto 15 kg / cm². The scale range for cut in and cut out shall 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 / cm² 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/cm² 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 upto 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 certifications.
- 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 upto 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 fulfil the requirements of AWWA (American Water Works Association) 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

waterpressure 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 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 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. Other specification as per BOQ.

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.

1. 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

1.4.3.15. 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

1.4.3.16. 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.

1.4.3.17. 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

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

1.4.3.19. All pipes & fittings

1.4.3.20. Bituminous coating

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

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

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

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

1.4.4. PORTABLE FIRE EXTINGUISHERS & EXIT SIGNAGES

1.4.4.1. 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.

- ABC Dry powder extinguisher
- Carbon-dioxide extinguisher

1.4.4.2. 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.

1.4.4.3. Extinguishers

Carbon dioxide type

- The extinguishers shall be rated for 4.5 and 9 kg by weight or carbon dioxide, unless stated otherwise. The contents shall be with a filling ratio not exceeding 0.667.
- The body shall be steel cylinder made according to IS:2872 and approved by the chief controller of explosives.
- 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 syphon 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.
- The discharge system shall be designed to expel 95% of the contents in continuous discharge as follows:

Capacity (kg)	Time (Sec.)
4.5	10 - 24
9.0	15 - 36

ABC Dry Powder type

- The capacities envisaged are 2 kg & 6 kg. The filling pressure shall be 0.95 +/- 0.055 N/sqmm.
- The body shall be cylindrical in shape and made of cold rolled carbon steel grade D/DD or hot rolled steel plate with radiographically tested welded construction. Plate thickness shall conform to IS:11108.
- 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

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

1.4.4.4. General requirements

- 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.
- All extinguishers shall have a structurally designed galvanised 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	Swing check 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

S.No.	IS Code No.	Description
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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 2020, 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

1.4.5. Switchgears & Switchboards Standards and codes

	<u>Specification for low voltage switchgear and control gear</u>	
	• 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
	<u>Electrical relays for power system protection</u>	

	General introduction and list of parts	IS 3231 Part-0 : 1986
	<ul style="list-style-type: none"> General requirement 	
	<ul style="list-style-type: none"> ➤ Contact performance 	IS 3231 Part-1 : Sec-1 : 1986
	<ul style="list-style-type: none"> ➤ Insulation tests 	IS 3231 Part-1 : Sec-2 : 1986
	<ul style="list-style-type: none"> ➤ High frequency disturbance test for static relay 	IS 3231 Part-1 : Sec-3 : 1986
	<ul style="list-style-type: none"> Requirements for principal families 	
	<ul style="list-style-type: none"> ➤ All or nothing relays 	IS 3231 Part-2 : Sec-1 : 1987
	<ul style="list-style-type: none"> ➤ General requirement for measuring relay 	IS 3231 Part-2 : Sec-2 : 1987
	<ul style="list-style-type: none"> ➤ General requirements for thermal relay 	IS 3231 Part-2 : Sec-3 : 1987
	<ul style="list-style-type: none"> Requirements for particular group or relays : Biased (percentage) differential relay 	IS 3231 Part-3 : Sec-3 : 1987
	<ul style="list-style-type: none"> 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 :	
	<ul style="list-style-type: none"> Requirements for type tested and partially type tested assemblies 	IS 8623 : Part 1 : 1993
	<ul style="list-style-type: none"> Particular requirements for bus bar trucking system (bus way) 	IS 8623 : Part 2 : 1993
	<ul style="list-style-type: none"> 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	
	<ul style="list-style-type: none"> General 	IS 10118 Part-1 : 1982
	<ul style="list-style-type: none"> Selection 	IS 10118 Part-2 : 1982
	<ul style="list-style-type: none"> 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
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1.4.5.1. 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 Ics - 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. Other specification as per BOQ.

1.4.5.2. 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 sleeving of 1.1 kV grade and bus bar joints provided with clip-on shrouds.
- Bus Bar supports Non-breakable, non-hygrosopic 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. Other specification as per BOQ.

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 . Other specification as per BOQ.

1.4.5.3. 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

1.4.5.4. 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.

1.4.5.5. 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. Terminals of 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.

1.4.5.6. Potential transformer

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

1.4.5.7. 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.

1.4.5.8. 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.

1.4.5.9. 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.

1.4.5.10. 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. Other specification as per BOQ.

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 $\pm 2\%$ for AC. Input variation of $230\text{ V} \pm 10\%$, frequency variation of $50\text{ Hz} \pm 5\%$ 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 $\pm 2\%$ of the set value for AC input voltage variation of $230\text{ V} \pm 10\%$, frequency variation of $\pm 5\%$ 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.

1.4.6. Technical Specification of 11KV 200Amp. (3-Pole/2-Pole) Air Break Switch

1.4.6.1. Scope

This specification covers manufacturing, testing and supply of 11KV 200Amp. 50Hz Air Break switches for outdoor installation in horizontal configuration. The switches are suitable for operation under off-load conditions only and are intended for use on Distribution Sub-stations and tapping sectionalizing points of 11 KV lines.

1.4.6.2. Description of the materials

The 11KV A.B. Switch sets shall confirm to the following parameters: -

- | | |
|--------------------------------------|--------------------------|
| a) Number of poles | 3 |
| b) Number of Post insulator per pole | 2nos. 12KVpostinsulator. |
| c) Nominal system voltage | 11KV |
| d) Highest system voltage | 12KV |
| e) Rated frequency | 50Hz |
| f) System earthing | effectively earthed. |
| g) Rated nominal current | 200 amps |
| h) Altitude of installation | Not exceeding 1000M |

The post insulators used in the A.B. Switches shall have the following ratings:-

- | | |
|--|-------------|
| a) Power frequency withstand voltage (dry) | 25KV (RMS) |
| b) Power frequency withstand voltage (wet) | 35KV (RMS). |
| c) Implies withstand voltage(dry) | 75KV |
| d) Power frequency puncture withstand | 1.3 |

1.4.6.3. Standards

The AB Switch Set shall conform to the following standards: -

- i) IS-9920 (Part-I to V)
- j) IS-2544/1973 (for porcelain post insulators)
- k) IS-2633, (for galvanization of ferrous parts.) or its latest amendments if any.

1.4.6.4. Insulator make

12KV post insulators complete with post and cap duly cemented to be used in the AB Switch Set conforming to IS-2544/1973.

The bidder shall furnish the type test certificate of the post insulators from their manufacturer for reference and scrutiny.

The bidder shall mention make, type of insulation materials, metal fittings, Creepage distance, protected Creepage distance, tensile Strength, compressing strength, torsion strength and cantilever strength.

1.4.6.5. Climatic condition

The A.B. Switch set shall be suitable for operation under the following climatic conditions.

Maximum ambient air temperature	45 °C
Maximum daily average air temperature	35 °C
Maximum yearly average ambient air temperature	30 °C
Maximum temperature attainable by a body exposed to the Sun	50 °C
Minimum ambient air temperature	0 °C
Maximum relative humidity	100%
Minimum number of rainy days per annum	70
Average number of rainy days per annum	120
Average annual rainfall	150 cm
Number of months of tropical monsoon conditions	4
Degree of exposure to atmospheric pollution	Normally
Atmosphere.	Polluted

1.4.6.6. Other technical details

- General: - The 11KV A.B. Switch Set shall be the gang operated rotating single air break type having 2 post insulators per phase. The operating mechanism shall be suitable for manual operation from the ground level and shall be so designed that all the three phases shall open or close simultaneously. The Switches shall be robust in construction, easy in operation and shall be protected against over travel or staining that might adversely affect any of its parts. The required base M.S. Channel (hot dip galvanized) phase coupling rod, operation rod with intermediate guide braided with flexible electrolytic copper, tail piece of required current carrying capacity and operation mechanism with “ON” & “OFF” positions shall be provided. The operation rod shall be medium gage of 32mm diameter nominal bore G.I. pipe single length 6 meters. The phase coupling rod for gang operation shall be of medium gauge 25 mm dia. nominal bore G.I pipe. The Rating post insulators shall be provide with suitable bearing mounted on a base channel with 8mm dia thrust collar and 6mm split pin made out of stainless steel. The operating down rod shall be

coupled to the spindle (minimum) dia – 32mm for gang operation through another suitable bearing by two numbers 10mm dia stainless steel bolts with double nuts. All the bearings shall be provided with grease nipple. All metal (ferrous) parts shall be galvanized and polished. The pipe shall be galvanized in accordance with IS-4736/1968. The post insulators should be fixed with the base channel using Galvanized Nuts and Bolts.

- Mounting: - The A.B. Switches shall be suitable for horizontal mounting in double pole sub-station structures. MS Galvanized base Channel & base support channel should be of min. size 75x40x6 mm.
- Switching Blades: - It shall be made out of electrolytic copper with silver plated. The approximate size shall be 220mm X 50 X 6 mm. The Switch shall have such a spring mechanism so as to ensure that the speed of the opening of contact is independent of speed of manual operation.
- Fixed Contacts: - The fixed Jaw type female contacts shall be made of electrolytic copper (minimum 95% copper composition) duly silver coated controlled by stainless steel high pressure spring housed in robust G.I. Cover. It is essential that provision shall be made in fixed female contacts to take the shock arising from the closing of moving contact blade without the same being transmitted to the post insulator. The arrangement made in this regard shall be specifically shown in the drawing.
- Arcing Horn: - As the switches are generally meant for isolating transmission line and distribution transformers, suitable arcing horns shall be provided for breaking the charging current horn shall be made of 10mm dia. G.I. Rod with spring assisted operation.
- Terminal Connectors: - Terminal connectors shall be robust in design. The size of fixed connector shall be (80 X 50 X 6 mm) and size of movable connector shall be of (80 X 50) X (80 X 50) X 6 mm of copper casting with uniform machine finishing duly silver plated made out of minimum 95% copper composition with 2 nos. 12mm dia holes provided with suitable brass bolts and double nuts, flat washers & 2nos. bimetallic solder less sockets suitable upto 80 mm² conductor.
- Spacing: - The minimum clearance between phases to the switch shall be 760mm. The operation down rod shall be at a transverse distance of 300mm from the outer limb of the switch. The centre spacing between two post insulators of the same phase shall be 380mm. In the open position of the A.B. switches the moving blade shall rotate through 90°. This shall be exhibited in the drawing.

- Sample, Drawing & Literatures: - Sample of each items 11KV 200 amps. A.B. Switch shall be furnished and three copies of drawings item similar to the sample shall be furnished along with the tender.
- The details of construction and materials of different parts of the A.B. Switch shall clearly be indicate in the tender and illustrative pamphlet / literature for the same shall be submitted along with the tender.

1.4.6.7. Test & Test Certificate

- Type Test: - Certificate for the following type tests conducted (within five years proceeding to the date of opening of the tender)on a prototype set of A.B. Switch in a NABL approved test house/CPRI shall have to be submitted along with offer.
- Dielectric Test (impulse and one minute were power frequency withstand voltage test.)
 - i. Temperature rise test (for contracts and terminals)
 - ii. Shorts Time current and peak withstand current test.
 - iii. Mainly active load breaking capacity test.
 - iv. Transformer off-load breaking capacity test.
 - v. Line charging breaking capacity test.
 - vi. Cable charging breaking test.
 - vii. Operation and mechanical endurance test.
 - viii. Mechanical strength test for post insulator, as per IS-2444/1937 shall be furnished.
 - ix. Test for galvanization of metal (ferrous) parts.

1.4.6.8. Routine /Acceptance Test

The inspection may be carried out by the Purchaser at any stage of manufacture. The successful bidder shall grant free access to the Purchaser's representative at a reasonable time when the work is in progress. The following routine tests shall have to be conducted on each set and results are to be furnished for consideration of deputing inspecting officer for inspection and conduction testing of the materials at the works of the manufacturer. The supplier shall give fifteen days advance intimation to the Purchaser to enable him to depute his representative for witnessing the tests.

- a. Power frequency voltage dry test.
- b. Measurement of resistance of main circuit.

- c. Tests to prove satisfactory operation.
- d. Dimension Check
- e. Galvanization test.
- f. Operational test.

1.4.6.9. Guaranteed Technical Particulars

The bidder shall furnish the guaranteed technical particular duly filled in the format along with the tender.

1.4.6.10. Completeness of Equipment

All fittings, accessories of apparatus which may not have been specifically mentioned in this specification but which are usual or necessary in equipment of similar plant shall be deemed to be included in the specification and shall be supplied by the Tender without extra charge. All plant and equipment shall be completed in all details whether such details are mentioned in the specification or not.

1.4.7. 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 Sambalpur, Odisha as under: -

- (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 Tenderer in the "Schedule of Deviations" with full justification.

Rating and general particulars

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 Indian

Standards 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 be 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 be 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 arcing switch or an air 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 relieving 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 $\pm 10\%$

Terminal

Cable Box on HV & LV Sides for Cable Termination

Short circuit level

Designed maximum fault level of 11 kV and 18.24 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 position of 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 should have 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 angle of 3° to 9° 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 per IS: 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 heater 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 data 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 of windings 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 load voltage 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 withstands 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 center line and position of center 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.
- iv. 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:

Tenderers 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

Tenderer shall furnish documents in support, delivery, of similar equipment indicating thereon names of 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 four 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 inseting 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

1.4.8. 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 $\pm 10\%$ 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-circuitprotection, 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 currentharmonics (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 bypass as 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

	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 equipment 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	0° to 40° C (Continuous)
2.2	Storage temperature	-10 ° to 50 ° 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:	
a)	Lowest input Volts to Highest Input Volts	Not less than 90% under specified conditions
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 $\pm 1\%$
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 underfollowing conditions	$\pm 1\%$
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	$\pm 1\%$
a)	At balance load	
b)	At 100% load step (Dynamic Regulation)	$\pm 1\%$
5.6	Voltage adjustment- Manual	Required

5.7	Output frequency	50Hz
5.8	Frequency regulation	$\pm 0.2 \%$
5.9	THD at Output	$\leq 2\%$ for liner load & $\leq 5\%$ for non- linear load.
5.10	Phase displacement (a) in balance load	$120^\circ, \pm 1\%$
5.11	(b) in 100% unbalanced load	$120^\circ, \pm 2\%$
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	$\leq 20 \text{ ms}$
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	Load Events & 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	$\pm 1\%$
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 blockdiagrams.
- b) Detailed installation drawings, including all terminallocations 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 bemonitored by thermal sensors.

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

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 an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions.

This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass sources, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

The Static bypass switch must automatically assume 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 milliseconds & 1000% for 5 cycles (1000 milliseconds)

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 push button –alarm silence switch

1.4.9. 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

1.4.10. Technical Specifications for CCTV

Technical Specification of Dome/Bullet Camera

S.No	Features	Specifications
1	Form Factor	DOME/BULLET
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 fourth stream 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

Note: All other specifications shall be as per BOQ/Manufacturer's specifications

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 capacity of 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/10GSFP+ 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 QueueScheduling	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
27		SNMP (v1, v2c, v3) , RMON (1,2,3 & 9 Groups), Software Upgrade
28		Configuration Export/Import , Port Mirroring ,
29		LLDP (IEEE802.1AB)
30		LLDP-MED (IEEE802.1AB)
31		CDP Aware ,sFlow ,IPv6 Management , NTP
32	Device Management	Topology View , Floor View ,Map View , Dashboard ,Traffic Monitoring , Cable Diagnostics
33	Operating Temperature	0°C to 40°C
34	Operating Humidity	10 to 90% RH
35	Storage Temperature	-20 to 70°C
36	Storage Humidity	10 to 90% RH
37	AC Input	100V-240V
38	Certifications	EN61000-4-5 (for RJ45 Port, Surge 6KV) ,CE/FCC Class A

1.4.11. 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 assembliesIEC
60529	Degree of protection provided by enclosure
IS 4540	Mono crystalline semiconductor rectifier assemblies and equipmentIS
3136	Polycrystalline semiconductor rectifier equipment
IS 2147	Degree of protection provided by enclosure for low voltageIEC
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

1.6 LIST OF MAKE FOR CIVIL WORKS

Acceptable makes of materials to be used in the work are as follows. In case of non-availability of these makes, after the approval of WAPCOS, the Contractor can use the alternative makes only BIS marked materials of equivalent reputed brand. Non BIS marked materials may be permitted by the WAPCOS only when BIS marked materials are not manufactured. If any make / brand of the “Material / Article” is not mentioned in following make list, then standard top 5 Manufacturers/ Agencies /Brand Make for that “Material / Agency” will be considered for approval by WAPCOS

S.N	Material /Article	Confirming IS Code	Manufacturers/ Agencies /Brand Make
1.	Cement (OPC 43 grade) /PPC	IS : 8112: 1989/ IS : 1489 (Part-1) 2015	A.C.C., Jaypee Cement, Ultratech, Shri Cement, Gujarat Ambuja Cement, Star Cement, Cement Corporation of India, Dalmia InfraPro (Dalmia Bharat Cement),
2.	Steel Reinforcement	IS 1786:2008	Thermo Mechanically treated bars Fe-500 Grade conforming to IS 1786:2008 from approved brands i.e. SAIL, Tisco, RINL, JSW Steel Ltd, JINDAL, Shyam Steel
3.	Structural Steel	IS 2062:2011	SAIL, Tisco, RINL, JSW Steel Ltd, JINDAL, Shyam Steel
4.	Stainless Steel	-	Jindal SS Ltd (JSL), Salem (SAIL), SAIL (SAIL), Shyam Steel
5.	Corrugated GI Sheets	IS 277:2003	TATA SAIL, JSW, JSPL, BHUSAN
6.	Colour coated profile sheet	-	TATA KOMDA; JINDAL
7.	Aluminium extruded sections	IS 733: 1983 & IS 1285:2002	Jindal, Hindalco, Indian Aluminium Co. NALCO
8.	Aluminium plain sheets	IS 733: 1983 & IS 1285:2002	Jindal, Hindalco, Indian Aluminium Co. NALCO
9.	Factory made Machine pressed laminated flush door shutter	IS 2202 (Part 1): 1999 And relevant IS Code	Century, Greenply, Kitply, Duroply Merino
10.	Block Board	IS 1659:2004	Century, Greenply, Kitply, Duroply Merino
11.	Flush Door Shutter	IS 2202 (Part 1): 1999	Century, Greenply, Kitply, Duroply Merino
12.	Boiling Water proof plywood, Block board, Commercial Plywood	IS 303:1989	Century, Greenply, Kitply, Duroply Merino
13.	Aluminium door & window fittings	Relevant IS Code	Jyoti, Argent, Everest
14.	PVC rigid foam sheet	-	Rajshri or equivalent
15.	Hydraulic Floor Spring	IS 6315:1992	Dorma, Hardwin, Ozone, Dorset
16.	Door Closure	IS :3564	Dorma, Hardwin, Ozone, Dorset
17.	Float Glass	-	Saint Gobain (Saint Gobain India Pvt. Ltd.) Modiguard (Gujarat Guardian Ltd.) Asahi (Asahi India Glass Ltd.)
18.	SWR uPVC pipe & fitting	IS 4985:2000 & IS 14233:1999	Supreme, Finolex, Prince Astral, Prakash, Ashirwad

S.N	Material /Article	Confirming IS Code	Manufacturers/ Agencies /Brand Make
19.	CPVC Pipe & fittings	IS 16088:2012, IS 15778:2007	Supreme, Finolex, Prince Astral, Prakash, Ashirwad
20.	Ceramic glazed wall tiles	IS 13712:1993	Kajaria, Orientbell, Somany, NITCO, HR-Johnson
21.	Vitrified Tiles	IS 15622:2006	Kajaria, Orientbell, Somany, NITCO, HR-Johnson
22.	Bitumen VG-30, VG-10 Etc.	IS 73:2013	As per particular Specification of IOCL, BPCL, HPCL.
23.	Admixtures	IS9103:1999	FOSROC, SIKKA, CICO Technologies Ltd. Pidilite
24.	Mild steel tubes	IS 1239:1990	As per IS Code
25.	1 st quality acrylic distemper (Ready Mix)		Bison (Lewis Berger), Beauty (NEROLAC), Tractor Uno (Asian Paints)
26.	Premium Acrylic smooth exterior Paint with silicon additives		ULTIMA (Asian Paint), Premium Exterior Emulsion (Dulux), Weather coat long life 7 (Berger)
27.	Paints	IS : 101 : 1986	Lewis Berger, Asian Paints, Nerolac, Dulux
28.	Steel/Wood Primer Paints	IS : 14177 : 1994	Lewis Berger, Asian Paints, Nerolac, Dulux
29.	Factory Made C.C. Interlocking Paver Blocks	IS : 15658 : 2006	NITCO, KK, NTC
30.	Bitumen 85/25	IS : 702 : 1988	HPCL, IOCL
31.	Water Proofing Compound	IS : 2645: 2003	FOSROC, Dr. FIXIT, BASF,CICO, SIKKA
32.	Crystalline Waterproofing Compound	IS : 2645: 2003	FOSROC, Dr. FIXIT, BASF, SIKKA
33.	G.I. Pipes	IS : 1239	TATA, Jindal Hissar
34.	PVC Water Storage Tanks	IS : 12701 : 1996	Sintex, Plasto
35.	P.T.M.T. Accessories	IS : 9763	Prayag, Prakash
36.	Mirror		Saint Gobain (Saint Gobain India Pvt. Ltd.), Modiguard (Gujarat Guardian Ltd.) Asahi (Asahi India Glass Ltd.), Atul (Autl Glass Industries Ltd.)
37.	Stainless Steel Sink	IS : 13983 : 1994	Hindware, NIRALI, CERA, JAYNA
38.	Sanitary ware /Chinaware	As per IS Code	Cera, Parryware, Hindware, Jaquar
39.	C.P. Fittings and accessories for bathroom/toilets	IS: 7784 : 1993	Jaquar, Gem, Parko, Hindware, Cera, Parryware
40.	RCC Pipes	Confirming to IS Specification	Indian Hume Pipes (Indian Hume Pipe Ltd.) Jain & Co (Jain Spun Pipes Co)
41.	SFRC Cover and grating	IS 12592 (2002)	KK (KK Manhole and gratings Co Pvt Ltd)
42.	CI Manhole Cover	IS 1726 (1991)	RPFM (M/s Raj Pattern Makers & Founders Pvt Ltd.) BIC Bengal Iron Corporation), Neco (Jayaswal Neco Ltd.)
43.	Foot Rest (for Manhole)		KGM (KGM Exports), Accurate Buildcon (Accurate Buildconcompany) Neco (Jayaswal Neco Ltd)

S.N	Material /Article	Confirming IS Code	Manufacturers/ Agencies /Brand Make
44.	Water stops		Hydrotite (Sika India), Dr. FIXIT (Pidilite Industries), Ferrous Crete (Ferrous Crete (India) Pvt. Ltd.)
45.	Aluminium doors/windows sections	IS 733 & IS 1285	Hindalco (Hindalco Industries Ltd.) Jindal (Jindal Aluminium Ltd)
46.	Glass Reinforced Concrete (GRC) jail		Terrafirma (terrafirma GRC Industries), Ecovision (Ecovision Industries Pvt Ltd.). Mahesh GRC (Mahesh Prefab Pvt Ltd.)
47.	SS Doors & Windows Hardware & Fittings		JINDAL, Dorma, KICH, Godrej, Ozone
48.	Wall Putty		Dalmia, JK, Birla, Asian
49.	Factory Made steel Glazed/ Gauged windows and ventilators	IS : 1038-1983	SKS Steel Industries (Havlox)/Madhu Industries /Multiwin
50.	Solar Lighting System	ECBC-2017	WIPRO/Anchor-Panasonic/Philips/TATA BP solar
51.	CP Fittings	IS : 8931	Jaquar, Kohler, Marc (Premium Quality), Hindware
52.	Tubular Profile steel door/ windows; Steel windows; Pressed steel door frames		TATA/APL Apollo/ Jindal/ Classic Engineers & fabricators
53.	Pre painted / powder coated CRC Windows		APL Apollo/ Jindal/ Classic Engineers & fabricators/ JK Enterprises/ NCL Alltek & Seccolor Ltd.

1.7 LIST OF MAKE FOR ELECTRICAL WORKS

Acceptable makes of materials to be used in the work are as follows. In case of non-availability of these makes, after the approval of WAPCOS, the Contractor can use the alternative makes only BIS marked materials of equivalent reputed brand. Non BIS marked materials may be permitted by the WAPCOS only when BIS marked materials are not manufactured. If any make / brand of the “Material / Article” is not mentioned in following make list, then standard top 5 Manufacturers/ Agencies /Brand Make for that “Material / Agency” will be considered for approval by WAPCOS.

S.NO.	Material /Article	Manufacturers/ Agencies /Brand Make
1.	DG Engine	Ashok Leyland/Cummins/Cater pillar/KOEL Mahindra & Mahindra/Escorts
2.	DG Alternator	Kirloskar/KEL/Crompton Greaves (AL. Series)/KEC/ Stamford
3.	Battery (Lead Acid / Mntc. Free)	Amara Raja/Exide/Crompton Greaves/Prestolite/Pace Setter/Standard/
4.	HV Switchgear	Crompton/Kirloskar/Voltas/C&S Electric
5.	LT Switchgear	L&T/Schneider Electric/Siemens/Legrand/Havells
6.	Vaccum Circuit Breaker	GE/Siemens/C&S Electric
7.	Transformer (Oil filled / Dry Type)	ABB/ Crompton Greaves/

S.NO.	Material /Article	Manufacturers/ Agencies /Brand Make
		Kirloskar/ Siemens /Alstom/ Uttam
8.	HT Panels	ABB/ Siemens/ L&T/Schneider/Kirloskar
9.	Air Circuit Breaker	L&T/Schneider Electric/Siemens/Havells
10.	MCCB (ICS=ICU)	L&T/Schneider Electric/Siemens/Legrand/Havells
11.	MV/LT Panels	TTA/CPRI Fabricators with panels cleared by CPRI. Note: Contractor shall take prior approval of make of Panels before procurement.
12.	SDF Units	L&T/Schneider Electric/Siemens/Legrand/Havells
13.	Power Contractors	L&T/Schneider Electric/Siemens/BCH/GE/Power Controls
14.	Change Over Switch	L&T/HPL/Havells/Standard/Control & Switch Gears
15.	Air Brake Switch	National/Kiran/Pactil/Atlas/Power grid switchgears
16.	Pin and Disc Insulator	Jayshree/WS/IEC/BHEL/Bharat Industries
17.	11 KV Horn Gap Arrestor	Sahal/Pactil/GEC/SEW
18.	Lightning Arrestor	Atlas/GE/Elaro/Lamco/International Oblum/ Elpro
19.	Drop out Fuses	National /Kiran/Pactil
20.	GI/MS Pipe (ISI Maked)	ATC/ATL/BST/GSI/ITC/ITS/ IIA/JST/Jindal/TTA/ Tata/Zenith
21.	APFC Relay	L&T/Schneider Electric/Neptune Ducati/Syntron/Trinity Electronics
22.	IDMT Relay	AVKC/SEGC
23.	C.T./P.T.	AE/MP/Marshall/Pactil/Kappa/L&T/Ashmor/Waco/Meco/ Gilbert/ Trio/Indotech/Indo coil
24.	Selector Switch	L&T/Kaycee/IMP/Vaishno/Seizer/rass control
25.	Indicating Lamp (LED Type) and Push But	Vaishno/Siemens/L&T/AE/IMP/Rass
26.	Power Capacitors (MPP/APP)	Khatau/Junkar/L&T/ EPCOS(Siemens)/ABB/Crompton/Schneider Electric / Neptune Ducati
27.	Digital Panel Meters i/c Multi-Function Meter	Conzerv/Schneider Electric/AE/Digitron/IMP/Meco/ Rishabh/Univeral/HPL/L&T/ABB
28.	Ammeter/ Voltmeter	AE/Univeral/Rishabh/Kaycee/Meco/Enercom
29.	Cold shrink HT/LT Cable Joint Kit	Denson/3M(M-Seal)/Paychem
30.	Rubber Matting (ISI Marked)	Jyoti Rubber Udyog/Raychem/Padmini/Dozz
31.	AVM Pads	Dunlop/Poly Bond
32.	MCB/Isolator/ELCB/RCCB/Distribution Board	Crompton/Havells/MDS Legrand/L&T/ Schneider Electric/Siemens/Polycab/C&S/(Make of DBs and circuit breakers shall be same)
33.	TPN Switches & HRC Fuses	Crompton/Havells/MDS Legrand/L&T/ Schneider Electric/Siemens/Polycab/C&S/(Make of DBs and circuit breakers shall be same)

S.NO.	Material /Article	Manufacturers/ Agencies /Brand Make
34.	PVC Conduits (ISI Marked) Colour: Ivory/Grey	AKG/Polycab/Avon Plast/Precision/finolex/Astral
35.	Steel Conduits (ISI Marked)	BEC/Bharat/Gupta/AKG/RMCON/Steel Krafts
36.	Piano/Modular Switches and Sockets	Legrand/Havells/Polycab/Schneider/Anchor
37.	Cable Tray	MEM/Bharti/Ratan/Slotco/Profab
38.	Cable Glands	MCI, Comet/Jainson/Dowells
39.	Thimbles/Lugs	Jainson/Dowells/Ascon
40.	1.1 KV/11 KV grade AI. Condr., XLPE insulated armoured cables (ISI Marked)	Finolex/Havells/Polycab/KEI/Batra Henlay
41.	Fire Survival cable	Finolex/Havells/Polycab/KEI/Batra Henlay
42.	Wires (PVC insulated copper conductor cable FRLS – ISI marked)/ Telephone Cables/Submersible cables/ Co- axial/TV cables	Finolex/Havells/Polycab/KEI/Batra Henlay
43.	Fans and Exhaust fans (All Types)	Khaitan / Havells/Crompton/Orient/ Bajaj/Usha/Polycab
44.	LED Luminaries i/c street light fittings (ISI Marked)	Khaitan / Havells/Crompton/Orient /Bajaj/Usha/Polycab
45.	LAN Cables	Panduit/Legrand/Schneider/Polycab
46.	Centrifugal Pump	BE Power/Beacon/Crompton/ Kirloskar/KSB
47.	Submersible Pump	BE Power/Beacon/Crompton/ Kirloskar/KSB
48.	Motors	Crompton Greaves/Schneider Electric/Kkirloskar/ Siemens
49.	Motor Starter	L&T/Siemens/BCH/GE Power Control/Schneider Electric
50.	Fresh Air Fans	Khaitan/Havells/Crompton/Orient/Bajaj/Usha/Pol ycab
51.	Single Phase Preventer / Overload Unit	L&T/ Minilec/Siemens
52.	Timers	L&T/ Minilec/Siemens/AE
53.	Gate Valve/Foot Valve/NRV/Butter Fly Valve	Advance/Audco/Johnson Controls/Zoloto/Annapurna /Fountain/Kirloskar/Leader/Sant/Trishul/Kartar/I nter Valve
54.	Single/Double Headed GM Landing valve	New Age (Mumbai)/Safex/Ceasefire/Padmini/Life guard
55.	Hydrant Valve	New Age (Mumbai)/Safex/Ceasefire/Kalpana/L&T valves Ltd. /Life guard
56.	Sprinkler/ Hose reel & Hose Pipe (ISI marked)	Safex/Agni/Newage/Ceasefire/Fire Guard/Omex
57.	Fire Extinguisher (ISI marked)	Minimax/Lifeguard/Safeguard/Safex/Omex
58.	Water Purifier	Eureka Forbes/Kent/ion Exchange /LG
59.	Inverter System	Sukam/Microtek/Luminous
60.	Electrical Water Storage Heater	Racold/Crompton/Havells/Bajaj/Polycab