INDIAN BANK

Corporate Office, No. 254 – 260, Avvai Shanmugam Salai, Royapettah, Chennai – 600 014

e-TENDER

FOR

PROPOSED CONSTRUCTION OF EXECUTIVE QUARTERS (Basement + Stilt + 5 floors)

AT No.75, MUSIRI SUBRAMANIAM SALAI (OLIVER ROAD), CHENNAI – 600 004.

VOLUME - IV

TECHNICAL SPECIFICATIONS

Tender ID: **CO:EST:TNDR:RPS:009:2025-26**

ARCHITECT	CLIENT	PMC
	Indian Bank	CAPITAL ENGINEERING CONSULTANCY

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CHAPTER A - BRIEF OF REQUIREMENT OF THE WORK:

1. General Scope of Work:

The scope of proposed work consists of the Construction of residential buildings including water supply, sanitary & plumbing, Internal & External Electrification, Elevator, CCTV, Solar Panel, telephone system, Data System, rain water harvesting system etc.

The work includes a number of specialized Civil and Plumbing/ Electrical/ Mechanical/ Elevator/ Electronic services/ ELV system etc. to be executed as integral part of the project

2. The following are the salient features of the Works:

a. Pile Foundations & other works like underground water tank.
b. Super structure
c. Internal and External water supply, sewerage
d. Electrical Installation (Internal & External)
e. LT Installation, DG Sets
f. Elevator
g. CCTV, EPABX/ Communication Systems
h. Solar Energy Systems.

3. Appointment of agencies for execution of works mentioned in Para 2:

Contractor shall submit credentials of the agencies proposed to be engaged by him/them for execution of sub heads e to i above of works mentioned in Para 2 above to the Client. Particular agency shall be approved by Client and only such agencies shall be allowed to execute the work on behalf of the contractor.

In addition to above, the contractor shall get the specialized works including the following works executed through a particular agency approved by Client and only such agencies shall be allowed to execute such works on behalf of the contractor.

1. Water proofing treatment works
2. UPVC door & windows
3. Aluminum door and windows, aluminum partition etc.
4. Aluminum composite panel & Structural glazing work
5. Anti-termite chemical treatment
6. LT switch gear
7. Elevator
8. Transformers

10. Diesel Generating sets

11. EPABX system

12. Firefighting

13. CCTV

Latest CPWD Specifications for Civil, Electrical and all other works with up to date correction slips for all sub heads of work as applicable, and Technical Specifications included in the tender documents, wherever applicable.

4. The work shall, in general, conform to the Latest CPWD Specifications for Civil, Electrical and all other works with up to date correction slips for all sub heads of work as applicable, and, Technical Specifications included in the tender documents, wherever applicable. Wherever any aspect of design/ construction/ material standards is not covered under the above mentioned specification, relevant standards shall be referred to in the order of precedence which shall be as follows. In the case of discrepancy between the Bill of Quantities, the Specifications and/ or the Drawings, the following order of preference shall be observed –

   a. Description of Bill of Quantities (BOQ)
   b. Particular specification and Specific Condition, if any
   c. Drawings
   d. CPWD Specifications
   e. Indian Standard Specifications of BIS/ NBC/ IRC/ MORTH/ BS/ ASTM/ DIN
   f. For items not covered by any of the above, the work shall be done, as per sound engineering practices and as directed by the Engineer-in-charge.

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CHAPTER B - TECHNICAL SPECIFICATIONS AND CONDITIONS- CIVIL WORKS

1. EARTH WORK: As per relevant CPWD specifications.

1. Irrespective of the stipulations in the relevant CPWD Specifications or elsewhere in the Contract, the excavated earth shall be disposed of by the contractor at his own cost to the place as directed by Engineer – in-charge and/or permitted by the local authority after obtaining written permission of the Engineer – in-charge and no payment will be made by the Client for disposal of this excavated earth.
2. The Contractor shall, at his own expense and without extra charges, make provision for all shoring, pumping, dredging or bailing out water, encountered from any sources such as rains, floods, springs, subsoil water table being high or due to any other cause whatsoever. The foundation trenches shall be kept free from water while all the works below ground level are in progress without any extra payment.
3. Filling in plinth shall be consolidated with water and compacted with pneumatic rammers, to achieve 90% relative density on testing. One test is to be carried out for 1000 sq.ms. of compacted area.

2. PLAIN CEMENT CONCRETE AND REINFORCED CEMENT CONCRETE WORK:

A. STONE AGGREGATE:

i. Stone aggregate used in the work shall be of hard broken stone to be obtained from approved source and shall conform to relevant provision in the Latest CPWD Specifications for works.

B. SAND/ M Sand

i. Sand/ M Sand to be used for the work shall be of as specified in CPWD Specifications 2019. Sand/ M Sand shall be obtained from the source to be got approved by the Engineer in charge and washed if required, with appropriate equipment to bring down the chemical, inorganic and organic impurities within the permissible limits as per the direction of the Engineer in charge. The same shall consist of hard siliceous materials.

Note: Where only one variety of sand is available the sand will be sieved for use in finishing work as directed by the Engineer – in – charge in order to obtain smooth surface and nothing extra will be paid on this account.

ii. Nothing extra shall be paid for screening or washing the sand/M Sand as prescribed above.

C. FLY ASH (GRIHA POINTS - IF REQUIRED)

Fly Ash conforming to grade 1 of IS 3812 (Part 1) may be used as part replacement of OPC provided uniform blending with cement is ensured in accordance with clauses 5.2 and 5.2.1 of I.S.456-2000 in the items of BMC and RMC. However this shall not override the provisions of the respective items.

D. CENTERING, SHUTTERING AND SCAFFOLDING:

i. All Scaffolding centering for RCC shall be with properly designed system and brought to site well in advance so that the progress of the work is not hampered for non-availability of the same.

ii. All shuttering for RCC work except soffits of slab shall be in water proof shuttering Ply (marine ply). Shuttering for slab and soffits shall be in water proof shuttering ply or in good quality mild steel plates free of dents, bends or warping and rusting as approved by the Engineer in charge.

iii. Contractor should deploy complete one set of shuttering materials for minimum one complete floor and the shuttering material for beam bottom shall be minimum for two complete floors.

iv. Scaffolding works for all levels for the facade works including aluminium works, brick facade works, painting works etc., complete are inclusive in the quoted rates. no additional charges shall be paid for scaffolding works

E. REINFORCEMENT:

i. TMT reinforcement steel shall be used as per design and conforming to IS: 1786 pertaining to Fe 500/Fe 500D grade of steel.

ii. TMT steel bars manufactured by main producers, as per list of makes, shall be allowed in the work. Contractor shall produce manufacturer Test Report for each dia and each lot Tests. Nothing extra will be paid for “straightening of bars” received from market in coils or with bends. All incidental charges of any kind whatsoever including cartage, storage, safe custody of materials, cutting and wastage etc. shall be borne by the contractor.

iii. The actual average sectional weight for dia up to 10 mm shall be arrived at from one meter long samples (minimum 3 from each dia) taken from each lot of steel. The discretion of the Engineer – in – charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute the single lot for this purpose.

iv. The weight of each lot of a particular diameter of 10mm and below shall be reckoned as the weight as per actual issue multiplied by a factor equal to the standard sectional weight of the particular diameter divided by the average sectional weight of the particular dia in a particular lot worked out as per above para. Adjustment for the steel shall be effected on the basis of the weight as modified above for quantity payable.

v. Measurement of all diameters of steel be on linear basis and will be converted into weight on the basis of standard sectional weight coefficients given in relevant CPWD specifications mentioned in schedule ‘F’ of General Conditions of Contract.

vi. Measurement of reinforcement shall be as per procedure described in the relevant CPWD specifications mentioned in schedule 'F' of General Conditions of Contract.

F. CEMENT

1. The contractor shall procure 43/ 53 grade ordinary Portland cement [grade as per design/ drawings/ decision of Engineer-in-charge] conforming to IS 8112 as required in the work, from approved manufacturers of cement having a production capacity not less than one million tonnes per annum as approved by the Engineer-in-charge. (Modified vide OM DG/MAN/270 dt. 1.5.2013)) The tenderers may also submit a list of names of cement manufacturers which they propose to use in the work. The tender accepting authority reserves right to accept or reject name(s) of cement manufacturer(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority does not accept the list of cement manufacturers, given by the tenderer, fully or partially**.** The supply of cement shall be taken in 50 kg. bags bearing manufacturer's name and ISI marking. Samples of cement arranged by the contractor shall be taken by the Engineer-in- charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the contractor does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer- in-charge to do so.

2. The cement shall be brought at site in bulk supply of approximately 50 tonnes or as decided by the Engineer- in- charge. The cement godown of the capacity to store a minimum of 500 bags of cement shall be constructed by the contractor at site of work for which no extra payment shall be made.

3. Double lock provision shall be made to the door of the cement godown. The keys of one lock shall remain with the Engineer-in-Charge or his authorized representative and the keys of the other lock shall remain with the contractor. The contractor shall be responsible for the watch and ward and safety of the cement godown. The contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at any time.

4. The cement shall be got tested by the Engineer-in-charge and shall be used on the work only after satisfactory test results have been received. The contractor shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the contractor/Department in the manner indicated below: (a) By the contractor, if the results show that the cement does not conform to relevant BIS codes. (b) By the Department, if the results show that the cement conforms to relevant BIS codes.

5. The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions laid

therein. In case the cement consumption is less than theoretical consumption including permissible variation, recovery at the rate so prescribed shall be made. In case of excess consumption no adjustment need to made.

6. The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the Engineer-in- charge.

7. The damaged cement shall be removed from the site immediately by the contractor on receipt of a notice in writing from the Engineer-in-charge. If he does not do so within 3 days of receipt of such notice, the Engineer-in charge shall get it remove at the cost of the contractor. Engineer –in- charge may change the brand of Cement depending upon availability in local market, if needed. Instructions in this respect can be issued by them at regular intervals.

G. CONCRETE MIX DESIGN

The mix design shall be for MODERATE exposure and GOOD degree of quality control, unless otherwise specified.

H. CONCRETE BATCHING PLANT (DESIGN MIX)

i. The Concrete Batching Plant of suitable capacity to be installed, as per requirement at site, within a period of 30 days from award of work. The contractor shall install batching plants (within 50 meters distance from the site of work) supplying Concrete at site. The batching plant proposed to be engaged by the contractor shall fulfill the following requirements.

1. It shall be fully computerized.

2. Facility to pump concrete upto the highest point of the building.

3. It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.

4. It should have sufficient capacity to meet the requirement as per schedule.

In case of failure of Batching Plant, RMC may be allowed with a written permission of the Engineer in Charge

- Approved admixtures conforming to IS.9103 shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of BS 5075. The total amount of chloride content in the admixture mixed Concrete shall satisfy the requirement of IS 456-2000.
- The concrete mix design with water reducing admixture will be carried out by the contractor through the Laboratories/ Test house as approved by Engineer-in- charge.
- The various ingredients for mix design/ laboratory tests shall be sent to the lab test house through the Engineer and the sample of such ingredients sent shall be preserved at site by the department till completion of work or change in

Design Mix whichever is earlier. The sample shall be taken from the approved materials which are proposed to be used in the work.

- The batching and mixing plant shall be fully automatic.
- The contractor has to arrange to erect batching plant (if required) for the design mix concrete on his own at site but without affecting the overall completion time of the total building.
- The concrete shall be transported to the site in specially made Transit Mixers & shall have suitable retarders so that it should not set before placing in position. It should have sufficient flow so that at height the concrete shall be placed by pumping only.
- Each Transit Mixer reaching site shall invariably have manufacturer's certificate containing details like truck number Grade of mix, time of leaving the plant, time of reaching a site etc. A copy of the same shall be handed over to E- in – C or his authorized representative.
- However samples for testing etc. shall be taken as per the mandatory tests prescribed in latest CPWD specifications.
- All cubes shall be tested for 7 days and 28 days tests in conformity with the relevant CPWD specifications.
- In respect of projected balconies, projected slabs at roof level and projected verandah, the payment for the RCC work shall be made under the items of RCC slabs. Nothing extra shall be paid for the side shuttering at the edges of these projected balconies and projected verandah. All the exposed edge shall however be finished as per specifications and nothing extra shall be paid for this.
- In the items of RCC walls, railings and roofs etc. nothing extra shall be paid for making designs as per patterns given by Engineer-in-charges or for thickness of sections.
- The water will be tested every 3 month with regard to its suitability for use in CC/RCC work and nothing extra will be paid for on this account.
- To receive anchor bolt / foundation for machines to be installed at later date, pocket of size minimum 110x100x300 mm shall be kept while concerting of RCC/ CC members and shall be filled with CC 1:1:2 with plasticizer and as per the direction of Engineer in charge.

I. READY MIX CONCRETE (RMC)

i. The contractor shall engage Ready Mix Concrete (RMC) producing plants (Distance of plant from site to be approved by Engineer in Charge) to supply RMC for the work. The RMC plant proposed to be engaged by the contractor shall fulfill the following requirements.

a) It shall be fully computerised.

b) It should have supplied RMC for Govt. projects of similar magnitude.

c) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.

ii. The Ready Mix Concrete (RMC) producing plants of the main Cement producers shall be preferred.

iii. The contractor shall, within 10 days of award of the work submit list of at least three reputed RMC plant companies along with details of such plants Including details of transit mixer, pumps etc. to be deployed indicating name of company, its location, capacity, technical establishment, past experience for approval by Engineer-in-charge.

iv. The Engineer-in-Charge reserves the right to exercise check over the:-

a) Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials recordings of test results and declaring the material fit or unfit for use in production of mix.

b) Calibration check of the RMC.

c) Weight and quality check on the ingredient, water and admixture added for batch mixing.

d) Time of mixing of concrete.

e) Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.

For exercising such control, the Engineer shall periodically depute his authorized representative at the RMC plant. It shall be the responsibility of the contractor to ensure that the necessary equipment manpower & facilities are made available to Engineer and/or his authorized representative at RMC plant

v. Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the truck for transportation.

vi. All required relevant records of RMC shall be made available to the Engineer or his authorized representative. Engineer shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production and transportation of concrete mix which shall be binding on the contractor & the RMC plant.

vii. It shall be the responsibility of the Contractor to ensure that the RMC producer provides all necessary testing equipment and takes all necessary measures to ensure Quality control of ready -mixed concrete. In general the required measures shall be:-

a) CONTROL OF PURCHASED MATERIAL QUALITY

RMC producer shall ensure that the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the material Supplier and the requirement of the product mix design and quality control producer's. This shall be accomplished by visual checks, sampling and testing, certification from materials suppliers and

information /data from material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibration condition at the plant by the RMC producer.

b) CONTROL OF MATERIAL STORAGE

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed system, drainage of aggregates, prevention of freeing or excessive solar heating of Aggregate etc,

c) RECORD OF MIX DESIGN AND MIX DESIGN MODIFICATION

RMC producer shall ensure that record of mix design and mix design modification is available in his computer at RMC plant for inspection of Engineer or his representative at any time.

d) COMPUTER PRINT OUTS OF EACH TRUCK LOAD

Each truckload / transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be produced to Engineer or his representative at site before RMC issued in work.

e) TRANSFER AND WEIGHING EOUIPMENT RMC

Producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by the Engineer in writing to contractor. RMC producer shall also maintain a daily production record including details of mixes supplied. Record shall be maintained of what materials were used for that day's production including water and admixtures.

f) MAINTENANCE OF PLANT, TRUCK Mixers AND PUMPS

Plant, Truck Mixers and Pumps should be well maintained so that it does not hamper any operation of production, transportation and placement.

g) PRODUCTION OF CONCRETE

The following precautions shall be taken during the production of RMC at the plant

i) Weighing (correct reading of batch data and accurate weighing):- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to load the delivery tickets number for that load and the time of loading the concrete into the truck.

ii) Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete assessment of uniformity, cohesion, workability adjustment to water content. The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.

iii) Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregates or the workability of the concrete, cube tests etc. shall also be ensured.

iv) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.

v) Sampling of concrete, testing monitoring of results.

vi) Diagnosis and correction of faults identified from observations /complaints. The RMC plant produced concrete shall be accepted by Engineer at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

viii. The rate for the Item of design mix cement concrete shall be inclusive of all the ingredients including admixtures, if required, labour, machinery T&P etc. (except shuttering which will be measured & paid for separately) required for a design mix concrete of required strength and workability. The rate quoted by the agency shall be net & nothing extra shall be payable on account of change in quantities of concrete, ingredients like cement and aggregates and admixtures etc. as per the approved mix design.

ix. Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer.

x. Frequency of sampling and standards of acceptance shall be as per CPWD specifications.

i) No addition of water or other ingredients shall be permitted in the RMC at site or during transit.

ii) The RMC shall be placed by pump of suitable capacity end the contractor shall arrange sufficient length of pipe at site to place the RMC in the minimum required time. The contractor shall co-ordinate with RMC supplier and pumps hirer to have effective concrete placement.

iii) Pre-paid delivery tickets shall be produced with each truck load of RMC.

iv) The representative of RMC supplier shall attend the site meeting as and when decided by the Engineer

xi. i) The contractor shall assess the quantity of RMC requirement at site well in advance and order accordingly to the RMC supplier. In case excess RMC is received at site, the department shall not be under any obligation to get extra quantities utilized and no payment for such RMC shall be made.

ii) The contractor shall have to employ labour in shifts to ensure continuous casting of raft and other RCC members. No extra payment on this account shall be made.

PILE FOUNDATION to be followed as per CPWD Specifications Vol.2 - 2019, in SUB HEAD : 20.0, PILE WORK

3. BRICK WORK/ BLOCK WORK (AAC)

A. BRICK WORK

a) Bricks used in the work shall be obtained from kilns to be got approved from the Engineer in charge and shall be best quality well burnt ground moulded bricks as available in the vicinity. They shall have a compressive strength of not less than 75 Kgs/sq.cm and an absorption percentage of not more than 15 (Fifteen) % of its dry weight when immersed in water for 24 hours. In all other respects they shall conform to the provision in Latest CPWD Specifications for works.

b) Both the face of wall of thickness more than 23cm shall be kept in the proper plane. Walls of half brick thickness or less shall be measured separately and paid in sqm.

c) Bricks wall beyond half brick thickness shall be measured in multiple of half brick (i.e. more than 115mm or equivalent) which shall be deemed to be inclusive of mortar joints. In all other respects they shall conform to the provision in relevant specifications of the work.

d) For mortar, use of PP Cement shall be preferred.

B. BLOCK WORK

i. Precast CC blocks shall be procured from approved manufactures or manufactured at site. Nothing extra shall be payable on account of adding any admixture for making pre- cast blocks or for steam curing.

ii. The CC blocks shall have nominal size of 400mm x 200mm x 100m and 400mm x 200mm x 200mm respectively for 100mm and 200mm thick masonry wall, and shall confirm to IS 2185.

iii. The samples of CC blocks (each sample consisting of 6 specimens) shall be chosen randomly from the lot and tested for various parameters specified below. One sample shall be tested for every 100 cum or part thereof.

iv. Following parameters shall be tested.

a) Compressive strength.

b) Water absorption

c)Density

d)Dimensional Tolerances

The material shall meet following parameters :

a) Compressive strength shall be no less than 5.0 N/sq. mm.

b) Water absorption shall not be more than 5% in 24 hours of immersed water.

c) Density shall be not less than 1500 kg/cum.v

d) Dimensional tolerance in the size shall be not more than + 5mm for length and + 3mm for height and width.

Top course of all plinth, parapets, steps and top of walls below floor and roofs shall be laid with solid blocks, properly radiated and keyed into position to form cut (meru) corner. Where blocks cannot be cut to meru corners, cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) equal to thickness of the coarse shall be provided in lieu of cut blocks. No additional payment shall be made on this account.

Nothing extra shall be payable on account of chasing the CC block masonry work for embedding pipes, electrical boards/ boxes etc. and also filling the chases with cement mortar 1:4 (1 Cement : 4 Coarse sand). The chasing shall however be carried out using machine cutters so as not to disturb the joints in the masonry and without any cracks being developed in the masonry.

All other specifications for 100 mm thick and 200 thick block work shall be as describes for full brick and half brick masonry work respectively.

For unsupported lengths of 100 mm thick walls exceeding 3.5 m, 100 x 200 mm wide R.C. mullions shall be provided at 3.5 m centre, tied to the lintels at door height. Similarly, continuous R.C. beam of size 100 x 150 mm shall be provided at door height for 100 mm thick wall. Such RC mullion/ bands shall be measured and paid separately.

4. CEMENT PLASTER: - The use of PP Cement shall be preferred.

5. WOOD WORK:

a. Timber required for shutters of doors, windows, ventilators, partitions etc shall be as per Bill of Quantities and CPWD Specification.

b. The moisture contents of the wood used in the work shall not be more than that stipulated in the relevant clause of Latest CPWD Specifications for works. The rate quoted for various items shall be inclusive of kiln seasoning and

preservative treatment of wood. In all other respects the wood used in the work shall conform to the provision in latest CPWD specification for works.

c. The sample of species to be used shall be deposited by the contractor with the Engineer-in – charge before commencement of the work. The contractor shall produce cash voucher and certificate from standard kiln seasoning plant operator about the timber section to be used on the work having been kiln seasoned by them failing which it would not be so accepted as kiln seasoned.

d. Glass :-

i. Transparent sheet glass (Float glass) conforming to IS 1761 – 1970 shall be used.

ii. Minimum thickness shall be governed as under, unless otherwise specified in the item.

AREA of Glazing	**Max. Unsupported length**	**Thickness**
For glazing area up to 0.5 sqm	120 cm	6.0 mm
For glazing area more than 0.5 Sqm	120 cm (200 cm)	6.0 mm / 8 mm

iii. Glazing for toilet and in fixed ventilators shall be of frosted type.

e. Shutters:-

i. Factory made shutters, as specified shall be obtained from factories to be approved by the Engineer – in - charge and shall conform to IS 2202 (Part –I) 1977. The contractor shall inform well in advance to the Engineer – in – charge the name address of the factory from where the contractor intends to get the shutters manufactured.

ii. The contractor will place order for manufacture of shutters only after written approval of Engineer – in – charge in this regard is obtained. The contractor is bound to abide by the decision of the Engineer – in-charge. In case the factory already proposed by the contractor is not found competent to manufacture quality shutters, the Engineer – in – charge will recommend the name of another factory from the approved list.

iii. The contractor will also arrange stage wise inspection of the shutters at factory with the Engineer in charge or his subordinate authorized representatives. Contractor will have no claim, if the shutters brought at site are rejected by the Engineer in charge in part or in full lot due to bad workmanship/ quality or damages caused during their shifting from factory to site. Such shutters will not be measured and paid and the contractor shall remove the same from the site of work within 7 days after the written instruction in this regards are issued by the Engineer in charge or his authorized representatives.

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6. STEEL GRILL WORK:

a. All steel grills shall be according to the detailed drawings and obtained from approved suppliers. These shall conform to Latest CPWD Specifications for works.

b. In case of grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer. Nothing extra shall be payable for providing shop coat primer, but the zinc chromate primer, if additionally required, will be paid for separately.

7. ALUMINIUM WORKS/ UPVC WORKS

a. The scope of the work is the fabrication, supply and erection at site of all types of Aluminium/ UPVC glazed doors, windows and ventilators in accordance with the drawings and specifications.

b. The supply and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, rails, plates glazing bars, glass, hinges, arrangement, spring catches, cord and pulley arrangements, spring catches, cord and pulley arrangements door closers floor springs etc., required for the whole work whether the parts/ items are individually and specifically referred to in the schedules/ specifications/drawings or not provided that the supply and installation of such parts can be inferred there from and are necessary to make the work complete, unless separate provision is made in the bills of quantities for supply to such parts/items.

c. The doors, windows, ventilators, will be fabricated to suit the finished clear openings in the building/structure which the tenderer will himself measure.

d. Materials:-

(a). The members will be made out of aluminum alloy corresponding to IS:733 and will consist of extruded sections and of other shapes, and to sized gauges as shown in the drawings/ described in accordance with the relevant IS codes. The members shall be chosen to provide strength/ stability and maximum resistance to wear and tear.
(b). UPVC members shall be made of PVC material conforming to IS: 10151.
(c). The Sections will be as per approved makes, extruded sections. As indicated in the drawings the tenderer should specifically mention which sections he is using.
(d). The weight of sections and the corresponding catalogue numbers are mentioned. The IS specifications are to be strictly adhered.
(e). The extruder using recycled materials may be preferred.
(f). The alloy of extruded aluminum should be BS or IS old HE9, Alcon 50 SWP. to this effect test certificate has to be provided for the extruder.

e. Finishing:

i. The extruded aluminum section has to be mechanically finished to remove all scratches; extrusion marks etc and subsequently thoroughly cleared in all alkali baths prior to anodizing.

ii. The polyester powder coating, as required, as per item of work, shall be of desired shade with minimum average thickness to 50 microns or other shades as required and to this effect the tenderer must have to produce test certificate from authorized institutions Bureau of Indian Standard.

iii. The polyester powder coated material should be properly wrapped in gummed tape before fabrication to avoid scratches during fabricated and erection shall be kept protected till handing over.

f. Fabrication:

i. Before commencing the fabrication the contractor shall submit to the Engineer – in - charge for their approval detailed shop drawings, based on the Architectural drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements . Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer – in - charge and in accordance with the approved drawings. Sections for fabrication of door/ window/ventilators etc shall be as per architectural drawings or as approved by the Engineer – in - charge.

ii. A sample of finished door / windows/ ventilator railing etc.shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication,

iii. The doors, window, ventilators and partitions shall be as per thickness given in the approved shop drawings, Polyester Powder coating shall be as specified in the item specifications.

iv. All materials shall conform to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the the Engineer – in - charge shall be final and binding on the contractor.

v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitered at the corners, true right angles, and joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

vi. All fabricated/finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to avoid distortion/damage.

vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.

viii. Wood work faces /parts coming in contact with masonry shall before shifting to the site be given a heavy coat of alkali resistance bitumen paint. Steel items coming in contact with other incompatible materials shall be given a thick coat of zinc chromate primer.

g. Glazing:

Glazing shall be done with flawless sheet glass of best approved quality without waviness, distortion, coloration / discoloration, of specified thickness in sizes as shown in the drawings, fixed as required with special glazing clips, putty, neoprene/PVC gaskets. All glass shall be cleaned thoroughly before they are fixed in position. Unless otherwise specified the minimum thickness shall be 5 mm thick.

8. FIRE CHECK DOORS:-

a. General:-

i. The door shall be procured from approved manufacturer of CPWD / CBRI. The fire and smoke / hot gases check door shall be conforming to IS-3614 (Part-II)). The manufacturer shall have a prototype door tested and certified by CBRI Roorkee, of 120 minutes fire rating confirming to BS : 476 part 22 & IS : 3614 Part II .

ii. The fire and smoke / hot gases check door shall not collapse during the rated period of the fire under the specified fire conditions.

iii. The fire and smoke / hot gases check door shall not allow the passage of hot gases or the flames through the rebate of the gap between the door frame and shutter or through the holes, developed in the shutter during fire.

iv. **Material: -**Door frames and shutter shall be made from materials specified in the bill of quantities.

v. **Shop drawing:-** The contractor shall submit including required designing shop drawing for doorframes, shutters complete with

a. Plan, elevation with relative position of adjacent works

b. Glazing details with type size and fixing

c. Fitting and fixtures with type size, brand and fixing details.

d. Finishing details.

vi. **Sample Approval:-** A sample of fire check door including fittings and fixtures, shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication

b. **Metal Fire Doors & Frames: -** These shall conform to the BOQ and CPWD specifications.

9. GLASS ENTRANCES AND GLAZING WITH PATCH FITTING

a. GENERAL

i. The contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work as per Architectural concept drawings and specifications details.

ii. The specialist agency engaged to carry out the external glazing installation and supply shall have at least 5 years of relevant experience and have completed external glazing systems of similar nature and equivalent scale of works as shown in the tender documents.

iii. The specialist contractor shall submit an outline of recent comparable works (illustrated by appropriate drawings, sketches, photographs, brochures) by the firm/ its technical partner to illustrate the competence, experience and suitability of the firm.

b. The scope of work shall include:

i. Design, preparation of shop drawings, calculations, engineering data and test reports.

ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.

iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.

iv. Exposed Architectural mullions and other support members.

v. Finishes, protection coatings and treatments.

vi. Sealing with approved sealants within and around the perimeter.

vii. All thermal insulation, firesafing etc. including supports and/or backing.

viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.

ix. Electrical bonding and ear thing of all metal cladding elements.

x. Provisions to receive electrical outlets and cutouts for conduits and other electrical work.

xi. Glass and glazing.

xii. Transportation, storage, handling, protection and cleaning.

c. SUBMITTALS

i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.

ii. Shop Drawings

d. Fabrication and installation details, including followings

i. Plans, elevations and sections.

ii. Details of fittings and glazing.

iii. Hardware quantities, locations and installation requirements.

iv. Sample for verification, for each type of exposed finish required for

1. Metal finish: 150mm long section of patch fittings, rails and other items.

2. Glass: 150mm square, showing exposed edge finish.

e. MATERIALS

i. Glass

1. Glass shall be as specified in drawing or BOQ or as per design requirement. It shall be Indian/ imported hard coated reflective bronze and heat strengthened glass. It shall be of approved make.

2. In toughening of Glass, rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

DGU (GRIHA)
Option 1 : Guardian Glass (Neutral 70)
U- Value = 1.87 W/Sqm. K

SHGC = 0.52
VLT = 69%
Option 2 : SKN 144 II (Envision)
U- Value = 1.6 W/Sqm. K
SHGC = 0.24
VLT = 40%

ii. Components

1. Patch fittings: Stainless steel

2. Floating Transom Bar: Steel cladded in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.

3. Rails: Stainless steel

4. Accessory Fittings : Matching with patch fittings and rails metal and finish for overhead door stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.

5. Anchors and fastenings: Concealed

6. Weather stripping: Sweep type

iii. Hardware

1. Hardware should be heavy duty in matching finish

2. Concealed Floor Closer and Top Pivots

a. Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.

b. Swing : Double acting; Positive dead stop, concealed with hold open angle
c. Delayed action closing

d. Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.

e. Push-pull set : Stainless steel finish

3. Lock set of approved make.

f. FABRICATION

1. Provide holes and cutouts in glass to receive hardware, fittings, rails and accessories before tampering glass. Fully temper glass using horizontal (roller-

hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.

2. Factory assembled components and factory installed hardware to greatest extent possible.

g. EXECUTION

1. Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.

2. Install all glass system and associated components according to manufacturer's written instructions.

3. Set units in level and plumb.

4. Maintain uniform clearances between adjacent components.

5. Lubricate hardware and other moving parts according to manufacturer's written instructions.

6. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.

h. CLEANING

1. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.

2. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by the Engineer – in - charge.

3. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.

4. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles.

5. Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.

6. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer– in - charge.

7. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.

8. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.

9. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.

10. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.

i. PERFORMANCE GUARANTEE: The contractor shall offer a minimum of 10 year

Performance Warranty for the entire installation carried out.

j. MEASUREMENTS: - Measurements shall be in Sq.m of actual area covered.

k. RATE: - Rate shall include all required labour, material, designing, drawing conveyance, testing at approved laboratory breakage, wastage, supervision, protection till handing over etc. complete.

10. FLOORING:

a. The flooring in the building shall be as per the approved floor finish drawings and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWD specifications or manufactures specifications.

b. Wherever Vitrified Tile flooring is done, it shall be with multy grade/range 1st Quality tiles.

c. Slope in floors shall be provided as per architectural drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variation in floor level more than 3 mm.

d. Rate for the items of flooring is inclusive of provision of sunken flooring and finishing edges of the same in bath kitchen, toilets, cutting holes for traps/ pipes etc., and nothing extra shall be paid on this account unless otherwise specified.

e. Protective layer to be provided of any type of flooring and nothing extra shall be paid on this account.

11. FALSE CEILING: -

a. False ceiling items in general are carried out as per the description of the item in the Bill of quantities and also as per the manufacturer's specifications / as directed by the Engineer – in – Charge.

b. Location of particular type of false ceiling shall be as per relevant drawing, in its absence written approval of the Engineer – in - charge shall be obtained.

c. The false ceiling tiles from manufacturers using recycled materials shall be preferred.

12. UNDER DECK INSULATION

a. **Material:-**The under deck insulation shall be in accordance with Bill of Quantities and CPWD Specification.

13. STAINLESS STEEL RAILINGS

a. The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.

b. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in-Charge.

c. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.

d. The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of Engineer-in-Charge/ Client. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge/ Client. The mock-up shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account.

e. The stainless steel shall be of grade 304 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

f. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.

g. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.

h. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

i. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

j. The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

k. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

14. GLASS:

a. All glass and glazing material shall be verified and coordinate with the applicable Performance requirement.

b. All glass shall be cut to require size and ready for glazing. All glass shall be accurate sizes with clear undamaged edges and surfaces which are not disfigured. Any panel which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor's expense.

c. Glass shall conform to the quality, thickness and dimensional requirement specified in Bill of Quantities/ CPWD Specification.

d. Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm with in 260mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripple shall be consistent and is acceptable to Engineer-in-charge. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional and surface compression shall be in the range of 320-450 Kg/cm². All glass shall be delivered to site with the manufacturer's label of identification attached.

e. The glass glazed panel/ structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirement of local building codes.

f. Glass shall be free from defect or impurities detrimental to its performance. Defects such as bubbles, waves, spots scratches, spalls, discoloration, visibly imperfect coating, chipping, and bubbles delaminating of opacifier film shall be limited in accordance with the Manufacturer's / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass should be consistent in colour.

g. Double glazed units shall be procured only from approved manufacturer. Quality control tests shall be performed for mixing, curing, adhesion and dew point. The unit shall be guaranteed against condensation and dirt between the panes, failure of seal and damage to internal coating.

h. All glass breakage caused by the Contractor or his sub-contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

15. WATER PROOFING TREATMENT:

All the items for water proofing treatment with cement based water proofing treatment for roof slab and sunken portion in schedule of quantities shall be guaranteed for TEN YEARS the case of cement based treatment by the contractor as per Performa prescribed. The water proofing treatment work should be got done through specialized agency approved by EIC.

16. WATER PROOFING TREATMENT FOR ROOF /SUNKEN FLOORS OF W.C`S ETC.

a. Water proofing treatment for roof/ sunken floor has to be carried out as per the respective Bill of Quantities/ CPWD Specification.

b. The finished surface after water proofing treatment shall have required slope.

c. While treatment of sunken floors is done it shall be ensured that the 'S' or 'P' traps as the case may be have been fixed / eased and rounded off properly the work shall be carried out as per relevant CPWD specifications.

d. GUARANTEE: The above waterproofing, treatment shall be guaranteed for TEN YEARS against any leakage etc. the contractor shall have to execute a bond, 10 % of cost of items executed for waterproofing shall be retained for 10 years as security (Refer GCC provisions for (BANK GUARANTEE TO A VALUE OF 5% OF WORK DONE FOR 10 YEARS)).

17. ANTIBACTERIAL PAINT

a. The Antibacterial Paint shall be able to provide anti-Microbial Protection:

b. scope of work includes providing & applying approved makes anti-Microbial Paint on wall surfaces as per manufacturer's specifications complete in all respects & as directed by Engineer-in-charge. Following are the desired characteristic of the paint:

i. Protection: The product hygiene coatings to start the biocidal action as soon as the microorganism land on the surface, and prevents the growth of mould, bacteria and yeasts for at least 5 years.

ii. Lily Cycle Savings: The unparalleled durability of hygiene coatings should help to extend the maintenance cycle and to minimize all related material, labour and shut down costs.

iii. Chemical Persistence: The hygiene coatings should be highly resistant to abrasives, detergents and weak acids and alkalis used in cleaning regimes. Furthermore, they can be regularly steam cleaned without any loss of performance or adhesion to the substrate.

iv Interior coating VOC Limit (g/L) <50, Exterior coating VOC Limit (g/L) <200, Anticorrosive - gloss / Semi gloss / flat VOC Limit (g/L) <250

18. EXPANSION JOINTS

a. The work shall be carried out as per CPWD specifications and directions of Engineer-in-charge.

b. The work shall be carried out as per site requirement. The contractor shall submit detailed drawing/shop drawing for each type of joint within three days from the date of award and shall be got approved from Engineer-in-charge before execution of the work.

c. The contractor shall make minor modification in the samples as per site requirement with the approval of Engineer-in-charge if required and nothing extra shall be paid for this modification.

d. The contractor shall submit the test reports of the product of the manufacturers.

e. Guarantee:- All the joints shall be guaranteed at least for the period of 5years when installed by the certified applicator in the prescribed proforma.

f. Installation:- Installation shall be in strict accordance with manufacture's technical specifications, details and installation instructions. The work shall be carried out through the specialised agencies as approved by the Engineer-in-charge.

g. Protection:- The system and its component should be protected during construction and after work is complete, the exposed surface and adjacent areas should be cleaned by suitable cleaner to the satisfaction of Engineer-in-charge.

h. Rates: - The rate shall include the cost of material inclusive all taxes except VAT, excise and custom duty, fright charges, landing charges, insurance, transportation up to site

and fixing of expansion joints including all screws, bolts, adhesive, scaffolding etc. as per requirements on all the floors.

i. Sample for joints:-The agency shall supply sample of minimum one meter length of all types of expansion joints and the same shall be fixed at site at appropriate location and the same shall be approved by the competent authority which shall be duly intimated by Engineer–in–Charge. The agency shall place the order for procurement of mechanical expansion joint from the parent company for supply only after obtaining approval from Engineer-in-Charge.

j. Materials:- Materials to be followed as per the Bill of quantities/ CPWD Specifications.

19. **SAMPLES OF MATERIALS**:

a. Sample of all materials/ fittings and fixture to be used in the work such as doors, windows, tiles, sanitary, water supply, drainage fittings and fixtures shall be submitted well in advance by the contractor for approval from the Engineer-in charge of work in writing before placing orders for the entire quantity required for completion of work. Samples approved by the EIC shall be kept in Sample Room under the charge of Engineer-in-Charge and shall retain till completion of work.

b. Finished items in respect of typical portion of works of repetitive nature such as typical room, toilet, railing, door, window or any other work desired by the engineer- in- charge shall be prepared by the contractor to the satisfaction of Engineer-in –charge and got approved from him in writing before the commencement of these items for the entire work.

c. The requirements for preparation of samples shall be observed and fulfilled by the contractor well in advance to avoid any detriment to the general progress of work. In other words, this will not be allowed to have any effects on the general progress of work or on any of the terms and conditions of the contract. No claims of any kind whatsoever including the claims of extension of time will be entertained due to the incorporation of this requirement.

20 GRIHA requirements:

Materials shall be procured by the contractor keeping in view the recycled content to **conform** the **GRIHA 4 Star requirements** as detailed in SCC and elsewhere or relevant standards prescribed by the Architect**.**

21. VARIATION IN CONSUMPTION OF MATERIALS:

The variation in consumption of material shall be governed as per CPWD specification and clauses of the contract to the extent applicable.

22. MISCELLANEOUS:

Materials manufacture by reputed firms and approved by Engineer – in charge shall only be used. Only articles classified as “First Quality” by the

manufactures shall be used unless otherwise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of sample brought by the contractor shall be judged by the standards laid down in the latest CPWD specifications. For items not covered by the latest CPWD specification, relevant ISI standards shall apply.

23. TESTS:

a. Materials brought at site of work shall not be used in the work before getting satisfactory test results for Mandatory tests as per relevant provisions in Latest CPWD Specifications for works. Normally, part rate payment shall be allowed in the running account bills only if the materials are tested and test results are found to be satisfactory to by the Engineer-in-charge. These tests shall be got done from laboratories approved by Engineer-in - charge or the laboratory set up by the contractor at site as per directions of Engineer-in - charge.

b. The Engineer-in - charge of work shall check the test results and satisfy himself before allowing any payment in the running/ final bill.

CHAPTER C - TECHNICAL SPECIFICATIONS OF PLUMBING & SANITARY WORKS

SECTION 1 GENERAL REQUIREMENT

1. Scope of work

The work shall in general conform to the Latest CPWD Specifications for works as mentioned in Schedule 'F' of the GCC. 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.

SECTION 2 PLUMBING FIXTURES

1. Scope of work

a. Work under this Part shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings and specified in the Bill of Quantities.

b. Without restricting to the generality of the foregoing the sanitary fixtures shall include the following:-

i. Sanitary fixtures

ii. Chromium plated fittings

iii. Porcelain or stainless steel sinks

iv. Accessories e.g. towel rods, toilet paper holders, soap dish, mirrors etc.

v. Whether specifically mentioned or not, the rates quoted for the installation of the fixtures, appliances and accessories shall be provided with all fixing devices, nuts, bolts, screws, hangers, fasteners as required.

vi. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2. General

a. All sanitary fixtures, CP Fittings and CP/SS accessories shall be supplied at site of work as per manufacturers' standard supply.

b. All fixtures and fittings shall be provided with all such accessories and fixing devices as are required to complete the item in working condition, even if the same is not specifically mentioned the Bill of Quantities, Specifications or shown on the drawings. The rate quoted will include all devices for proper fixing arrangement, nuts, bolts, screws and required connection pieces etc.

c. Fixing screws shall be half round head stainless steel wood screws or bolts with Stainless Steel washers. Iron screws rust and will not be permitted.

d. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

e. Contractor shall provide poly-sulphide sealant appropriate for its use for all fixtures fixed near wall, marble core seal and edges.

3. Water Closets

a. European W.C.

i. W.C. shall be any one of the following types:

a. Wall hung wash down or

b. single or double siphon type or

c. As per BOQ

ii. Each W.C. set shall be provided with an approved type of plastic/wooden seat of approved finish compatible and fitting appropriately with the WC set with rubber buffers and hinges. The WC seat shall be those approved and accepted for fixing on a particular type of WC.

iii. The seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

iv. The edge between the fixture and the wall shall be sealed with approved type of poly-sulphide sealant.

b. Health faucet/spray (Optional)

A chromium plated spray with integral hand control valve and connected to a flexible pipe and angle valve with wall flange and hook are fixed as shown on the drawings or directed by the Engineer-in-charge. The angle valve and flange shall be paid under relevant item with tabulation tap.

4. **Wash Basins**

a. Wash basins shall wall mounted type or for under over/counter installation as specified in the BOQ.

b. Each basin shall be supported on **MS galvanized** or painted brackets and the basin securely fixed to wall or under/ above counter installation. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.

c. Each basin shall be provided with 32 mm dia. C.P. waste with overflow/ pop-up or standard waste with rubber plug and chain, 32 mm dia. C.P. brass bottle trap with CP pipe to wall and flange as specified in the BOQ.

d. Each basin shall be provided with a single tap for cold water or two taps for hot & cold water as per requirements and as per the direction of the Engineer –in – charge, waste fittings, wall flange etc.

e. The edge between the fixture and the wall or the counter shall be sealed with approved type of poly-sulphide sealant

f. Washbasins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cm or as directed by Engineer-in-charge.

g. Each washbasin connection (separately for hot and cold) shall be provided with angle valves with CP wall flange and CP connecting pipe and of required length.

5. Sinks

a. Sinks used shall be of any of the following types:

b. For kitchens, pantries, and designated utility rooms the sinks shall be stainless steel sinks conforming to SS 304 with or without drain boards.

c. Each sink shall be supported by **MS galvanized** or painted brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.

d. Stainless steel sinks shall be provided with 40mm dia. C.P (as supplied by manufacturer), 40mm dia. C.P. brass “P” trap with CP pipe to wall and flange.

e. Each sink shall be provided with individual taps for hot & cold with approved type as directed by the Engineer-In-Charge.

6. Shower set

a. Shower set shall be C.P. shower arm with wall flange and shower head adjustable type.

7. Accessories

a. Accessories shall be of any of the following types:

i. Towel rails

ii. Towel rings

iii. Coat hooks

iv. Soap dishes

v. Paper holder

vi. Mirrors

b. Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good.

c. Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work. The flange of the recessed fixture shall cover the recess in the wall fully.

8. Measurement & Rates

a. Sanitary fixtures shall be measured by numbers or as specified in BOQ.

b. Rates for all items mentioned above shall be inclusive of cutting holes and chases and making good the same, stainless steel screws, nuts, bolts, fastener and any fixing arrangements required and recommended by manufacturers, testing and commissioning

SECTION 3 SOILS, WASTE, VENT & RAINWATER PIPES & FITTINGS

1. Scope of work

a. Work under this Part shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the Schedule of Quantities.

b. Without restricting to the generality of the foregoing, the system shall include the following:-

i. Vertical and horizontal soil, waste, vent and rain water pipes, and fittings, joints, clamps and connections to fixtures.

ii. PVC SWR. Pipes soil & uPVC rainwater pipes.

iii. Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.

iv. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads/Khurras.

v. Testing of all pipe lines.

2. General requirements

a. All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-charge.

b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

c. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

d. Pipes shall be securely fixed to walls and ceilings by suitable clamps intervals specified.

e. Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

3. Piping System

a. Soil, Waste & Vent Pipes

i. The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in BIS: having separate pipes for waste for kitchen sinks, showers, washbasins, AHU's condensate drains and floor drains and is approved by Engineer-in-charge.

ii. All waste water from AHU's plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.

iii. Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement ceiling or to an external manhole directly where feasible and shown on the drawings.

b. Rainwater Pipes

i. All terraces shall be drained by providing down-takes rainwater pipes.

ii. Rainwater pipes are separate and independent and connected to the storm water drainage system as shown on the drawings.

iii. Rainwater in enclosed courtyards shall be collected in catch-basi

ns and connected to storm water harvesting chambers as shown in drawings..

iv. Any dry weather flow from waste appliances, AHU's pump rooms, shall not be connected to the sewerage system.

v. Materials as specified in the BOQ.

c. Balcony/Planter drainage

All balconies, terraces, planters and other formal landscape areas will be drained by vertical down takes as per the landscape/architectural drawings and details.

d. uPVC pipes & fittings (For Rain Water Pipes etc.)

i. Where specified, Polythene pipes shall be uPVC pipes confirming to I.S: 4985-1988. The details of the nominal outer diameter, weight and working pressure shall be as per the standards, for the respective pressure rating as specified in the B.O.Q.

ii. Polythene pipes may be cold bending to a radius of not less than eight times of their external diameter. Pipes bent for a smaller radius may be made by hot bending.

iii. Fittings used for Polythene pipes shall be compression molded fittings matching to the above specifications.

e. Jointing

i. All Polythene pipes shall be Drip seal/Sealant and jointed as per manufacturer's specifications and relevant I.S codes.

ii. All pipes shall be tested after installation for a pressure equal to twice the maximum working pressure in the line as per manufacturer's specifications.

f. Fittings

1. Fittings shall conform to the same Indian Standard as for pipes. Pipes and fittings must be of matching IS Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

2. Fittings shall be of the required degree of curvature with or without access door.

3. Access door shall be made up with 3 mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal later. The fixing shall be air and water tight.

g. Fixing

1. All vertical pipes shall be fixed by structural support clamps truly vertical.

Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

2. Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

3. Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Engineer- In-Charge/

Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

4. Traps

a. Floor traps

Floor traps shall be siphon type full bore P or S type PVC having a minimum 50 mm deep seal. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement :2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centring for the blocks. Size of the block shall be 30x30 cm of the required depth.

b. Urinal traps

Urinal traps/horn shall be PVC P or S traps with or without vent and set in cement concrete block specified for floor traps.

c. Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from G.I. pipe without, with one, two or three inlet sockets welded on side to connect the waste pipe. Joint between waste and hopper inlet socket shall be Drip Seal. Inlet shall be connected to a PVC P or S trap. Floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified in para above without extra charge.

d. Gratings for traps

Floor and urinal traps shall be provided with 100-150mm square or round C.P./ Stainless steel grating/ PTMT, with rim of approved design and shape as per BOQ.

e. Jointing

Soil, waste, vent and anti-siphonage pipes shall be jointed with Lead joint/ Drip seal joint as mentioned in the BOQ. The following minimum procedures shall be complied with while making the pipe joints:-

i. Ensure that the pipes are clean internally and undamaged.

ii. The pipes shall be cut square with sharp tools.

iii. The cut ends of the pipes shall be filed/ reamed and finished smooth.

iv. Any deformed ends shall be re-rounded.

v. It shall be ensured that the pipe ends shall enter the fittings and sockets to full depth of the jointing area.

vi. The pipe work shall be assembled in a manner such that it does not entail making of joints in restricted locations.

vii. Each metal pipe spigot shall be centered with three lightly wedged pieces of hardwood or folded lead.

viii. The jointing surfaces shall be cleaned to remove any coatings or cutting oils, etc.

f. Floor Trap Inlet/ GI Inlet Fitting:

Traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type PVC or G.I. inlet hopper without or with one or two or three inlet sockets to receive the waste pipe. Joint between G.I. waste pipe and hopper inlet socket shall be Drip seal joint. Hopper shall be connected to a CI 'P' or 'S' trap with at least 50mm seal (hopper and traps shall be paid for separately). Floor trap inlet hoppers and the traps shall be set in cement concrete blocks/ and supports as required for Floor trap above shall be provided without any extra charge.

5. Cleanout Plugs

a. Cleanout Plug on soil pipes

Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass suitable for the Pipe dia. With screwed to a G.I. socket. The socket shall be Drip seal caulked to the drain pipes.

b. Cleanout Plug on Drainage Pipes

i. Cleanout plugs shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Engineer-in- charge. Cleanout plugs shall be of size matching the full bore of the pipe but not exceeding 150 mm dia. Cleanout Plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.

ii. Cleanout Plug at Ceiling Pipes: - Cleanouts provided at ceiling level pipe shall be fixed to a CI flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanised sheets and angles with hinged type doors with fly nuts, gasket etc., as per drawing.

6. Waste pipe from appliances

a. General

i. Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of heavy galvanized steel /CPVC as given in the Schedule of Quantities or shown on the drawings.

ii. All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per good engineering practice approved by the Engineer-In-Charge.

b. Galvanized pipes

Waste pipes from appliances shall be galvanized steel tubes conforming to I.S.1239 (Heavy class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes in chase shall be wrapped with bitumen tape and then painted with two coats of black bitumen paint. Exposed pipes with one coat of Zinc cromate with etch coating primer and two or more coats of synthetic enamel paint or as given in the Schedule of Quantities. Colour shall be as per the approved colour code.

7. **PVC/ SWR/ RCC pipes for drainage**

a. All drainage lines passing under building, in exposed position above ground e.g. basement ceiling etc. shall be PVC/ SWR/ RCC pipes. Position of such pipes shall generally be shown on the drawings.

Fittings

Fittings used for S.W/ RCC drainage pipe shall conform to I.S. 1538 (Heavy class). Wherever possible, junction from branch pipes shall be made by a Y- tee.

Joints

i. Joints between pipes shall be made with pre-moulded rubber joints (Tyton Joints) supplied by the manufacturer to ensure compatibility and water tightness.

ii. Joints between pipes and fittings shall be made by caulked spun yarn dipped in tar and molten drip seal 45 mm deep by hammering with caulking tools.

8. Encasing pipe in Cement Concrete

Soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand :4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m. Rate for concrete round pipes shall be inclusive of pillars, supports, shuttering and centring.

9. Painting

a. All cast iron, soil, waste vent, anti-siphon age and rainwater pipes in exposed location in shafts and pipe spaces shall be painted with two or more coats of synthetic enamel paint to over a priming coat to give an even shade.

b. Paint shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe colour code.

c. G.I. waste pipes in chase shall be painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint over each priming coat.

d. Soil and waste pipes below ground and covered in cement concrete or lead pipes shall not be painted.

10. Cutting and making good

a. Pipes shall be fixed and tested as building proceeds.

b. Contractor shall provide all necessary holes cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or brick work in cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

11. Testing

a. Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid in basement ceiling.

b. Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing shall be certified for its calibration by an approved laboratory.

c. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site. All testing equipment must be calibrated and shall carry certificate from an approved laboratory.

d. Testing soil, waste and rainwater pipes

i. Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.

ii. After installation all connections from fixtures, vertical stacks and horizontal drains including pipes shall be tested to a hydraulic pressure not

exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.

iii. The entire installation shall be tested by smoke testing machine. The test can be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging all inlets by bellow plugs. Apply dense smoke keeping the top of stack open an observe for leakages. Rectify or replace defective sections.

iv. After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. Rectify and replace where required.

e. Contractor shall maintain a test register identifying date and time of each area.

All tests shall be conducted in presence of Engineer-in-charge and signed by both.

12. Measurements

a. General

i. Rates for all items quoted shall be inclusive of all work and items given in the specifications and Bill of Quantities.

ii. Rates are applicable for the work under floors, in shafts at ceiling level area for all heights and depths.

iii. Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.

iv. Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.

v. Pipes (Unit of measurement, linear meter to the nearest Centimetre) or as specified in CPWD specifications.

b. All SWR/ RCC Soil, waste, vent, anti-syphonage and rain water pipes shall be measured net when fixed correct to a centimetre including all fittings along its length. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above will apply to both case i.e. whether pipes are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level.

c. Pipes shall be measured per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal diameter of internal bore. The pipes shall be described as including all cutting and waste. In case of fittings of unequal bore, the largest bore shall be measured.

d. Cement concrete around pipes shall be measured along the centre of the pipe line measured per linear metre and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.

e. Slotted angles/channels shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

f. Fittings

Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

g. Painting

Painting of pipes shall be measured per running metre and shall be inclusive of all fittings and clamps. No deduction for fittings shall be made.

h. Excavation for soil pipes

No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs.

i. Engineer-in-charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION 4 - WATER SUPPLY SYSTEMS

1. Scope of work

a. Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

b. Without restricting to the generality of the foregoing, the water supply system shall include the following:-

i. Rising main from water supply pumps to all overhead tanks. And municipal water supply only for kitchen area distribution through HNS system.HNS placed in basement pump room.

ii. Distribution system from overhead tank to all fixtures and appliances for cold & hot water.

iii. Insulation to hot water pipes within toilets.

iv. Connections to all plumbing fixtures, and appliances.

2. General requirements

a. All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-charge.

b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

c. Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

d. As far as possible all bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 25 mm dia. Bends and elbows may be used for pipe dia. greater than 32 mm.

e. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

f. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals approved by the Engineer-In-Charge.

g. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. Water Supply System

a. Contractor should study the site plan and water supply system diagram for overviews of the system.

b. Source

i. Water supply will be acquired from Client's mains line (water report enclosed).

ii. The rising mains will be connected to the raw domestic water tank located in basement.

c. Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independent connected to a different pumping system.

4. G.I/ CPVC Pipes & Fittings

a. All pipe inside the building and where specified, outside the building shall be galvanized / CPVC steel tubes conforming to I.S. 1239 of class specified. When class is not specified they shall be heavy class.

b. Fittings shall be malleable iron galvanized /CPVC of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I./CPVC pipe shall include couplings, bends tees, reducers, nipples, union and bushes. Fittings shall conform to I.S. 1879-(Section I to X).

c. Pipe and fittings shall be joined with screwed joints, after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.

d. Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply.(Use of red and white lead sutli will not be permitted for screwed joints)

e. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I./CPVC pipes inside shall be fixed in wall chases well above the floor. No floor shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

f. Clamps

i. G.I/CPVC pipes in the shaft and other locations shall be supported by clamps of design approved by Engineer-In-Charge. Pipes in wall chases shall be anchored by hooks. Pipes at ceiling level shall be supported on structural clamps.

ii. Spacing of clamps, hooks etc. Shall be as per good engineering practice approved by the Engineer-in-charge

g. Unions

Contractor shall provide adequate number of unions on pipes 50mm and below to enable easy dismantling later when required Unions shall be provided near each

gunmetal valve, stop clock, or check valve and go on straight runs as necessary at appropriate locations as required and /or direct by Engineer-In- Charge.

h. Flanges

i. Flanged connections shall be provided on pipes 65 mm and above as required or where shown on the drawings generally as follows:

1. On straight runs not exceeding 30 m, near bends and at connections to main branch lines.

2. On all valves ends

3. On equipment /pump connections as necessary and required or as directed by Engineer – in - charge.

j. Flanged connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion neoprene gaskets Bolt hole dia. for flanges shall conform to match the specification for sluice valve and butterfly valve.

k. Trenches

i. All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

Dia. of pipe	**Width of trench**	**Depth of trench**
15 mm to 50 mm	30 cm	75 cm
65 mm to 100 mm	45 cm	100 cm

ii. Sand filling

Where specified in the Schedule of Quantities all G.I. pipes in trenches shall be protected with fine sand 15 cm all around before filling in the trenches.

l. Where shown on the drawings, main pipe lines may be run in masonry trenches from the pump house to the buildings in phase I & II , filled up with sand and buried in ground as per architectural /landscape details.

m. painting

All pipes above ground shall be painted with one coat Zinc with each coating and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by Engineer-in-charge.

n. Pipe protection

i. Where specified in the Schedule of Quantities all pipes in chase or below floor shall be protected against corrosion by the application of two coats of bitumen paint covered with bitumen tape and a final coat of bitumen paint before covering up the pipe.

ii. All G.I. / CPVC water supply pipes below ground shall be protected against corrosion by applying one layer of 4 mm thick multilayer anticorrosive polymeric mix tape applied over a coat of primer as per recommendations of the manufacturers. (Pypcoat)

o. Insulation

Hot water pipes within a toilet /kitchen from hot water header shall be insulated with fire resistance closed cell chemically cross linked polyethene is used in the forms of rolls, sheets and tubes. The thickness of insulation is 13mm on all sizes of pipes. Density of insulation is 30±2kg/cum.

5. Valves

a. Ball valves

i. Valves 50 mm dia. and below shall be screwed type ball valves with stainless steel balls spindle Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm^2 and accompanying couplings and steel handles to B.S. 5351.

b. Butterfly Valves

i. Valves 65 mm dia. and above shall be butterfly valve to be used for isolation and/or flow regulation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction. Valves shall be provided with matching flanges with neoprene insertion gasket 3 mm thick .P.N 1.6

ii. Butterfly valve shall be of best quality conforming to IS: 13095.

c. Non Return Valve

i. Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only, It shall be single door swing check type of best quality conforming to IS: 5312.P.N1.6

ii. Each butterfly and slim type swing check valves shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanized nuts, bolts and double washers of correct length.

iii. Sluice valve shall be of approved makes conforming to I.S.:780 of class as specified.

6. Storage Tanks

a. Overhead Tanks

Overhead water storage tanks for water supply shall be reinforced cement concrete.

b. Tank connection and accessories

i. Contractor shall provide the following to each tanks:

1. Inlet and outlet connections to pumps, equipment and main pipe lines.

2. Tank overflows with mosquito proof gratings

3. Scour drain and valve as per drawings

4. Water level gauge with approved type of brass gauges, plastic tube, a wooden board with level marking.

ii. Electronic level controllers, cabling, sequence controllers and all related equipment shall be provided by agency executing the pumping system work. Plumbing contractor shall provide necessary G.I. sleeves and co- operate with the contractor to ensure that the work is successfully executed.

7. Testing

a. All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg /cm^2 whichever is more. Pressure shall be maintained for a period of at least 12 hours without any drop & withstand for 8 hrs.

b. A test register shall be maintained and all entries shall be counter-signed by Contractor(s) in the presence of Engineer-in-charge.

c. In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

d. After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

8. Measurements

a. G.I./CPVC pipes

i. G.I./CPVC pipes above ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, and flanges. Deduction for valves shall be made. Rate quoted shall be inclusive of all

fittings, clamps, cutting holes chases and making good the same and all items mentioned in the specifications and Schedule of Quantities.

ii. G.I./CPVC pipes below ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of fittings, e.g. couplings, tees, bends, elbows, unions. Deduction for valves shall be made. Rates quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chases and making good and all other items mentioned in the specifications and Schedule of Quantities.

b. Gunmetal/ cast iron/ brass, butterfly and non-return valves puddle flanges, level indicators and meters shall be measured by numbers.

c. Brick masonry chamber for valves and meters shall be measured by number and include all items given in the Bill of quantities.

d. Painting/pipe protection

Painting/pipe protection for pipes shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made.

e. Engineer-In-Charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION – 5 WATER SUPPLY PUMPING SYSTEM & ALLIED SERVICES

1. Scope of work

a. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required for the satisfactory supply, installation, completion and commissioning of water supply pumping system and allied works as described hereinafter, as specified in the schedule of quantities and/or shown on the plumbing drawings and described in the scope of work .

2. The System

a. The system described below is for the contractors bidding for the works to understand the extent and scope of work and the intent in the manner in which the water supply system is planned and shall be executed. This does not form a part of the contractor's scope of work with respect to the various elements that are described in this paragraph.

b.Sources of supply

Local water supply for which a water main from the main road to the underground water tank will be laid by contractor.

c. Underground water tanks

i. Bore well/tankers are stored in a raw water tank. After the treatment , will be transferred to an overhead tank. Municipal water tank is stored separately for the kitchen.

ii. Raw Water Tank to hold the tube well as well as CWS Supply water will be made to:

1. A set of pumps will be connected to and water filter and chlorination system and the filtered water stored in the Treated Water Tanks (in three compartments. All piping and connections for this system are a part of this contract, if required.

2. Domestic Water Pumping Systems

iii. Water supply to the various buildings will be made from a set of pumping sets to the overhead water and on the terrace of building.

3. Rising Mains & level control system

a. Water from the pumps described above will fill each tank by a rising main to each tower.

b. To control the level in each tank and enable it to fill as the water demand so requires, each tank will be provided with a ball cock to shut off the water supply when the tank is full.

c. A set of electronic level sensing probes will be installed in each tank. The probes installed in each pumping system will be wired to a central electronic panel which will activate the pump when any one of the tank probe signals low water conditions and top up all tanks. No excess flow will occur due to the ball cock in the tank.

4. Level Controllers

a. Level controllers shall be electronic magnetic type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications:-

i. Provide a audible high water alarm when water level in the sump reaches a pre-determined high level in the sump location at MCC panel installed in wall near sump location

b. Overhead tank level controller cum indicators

i. Each OHT to be provided with required number of stainless steel electronically operated probes (housed in a stainless steel protective housing) and connected by a control cable to a central junction box connected to MCC panel located in the pump house at basement. A common multi-core cable from each group of buildings will be laid to the pump room in basement. The probes will function as follows:

ii. To cut off the water supply pumps when all the OHT is full and to start the pump if any OHT level reaches at pre-determined low level.

iii. Provision shall be made to enable the operation of the second duty pump in case the water level does not rise above a pre-determined level in the tank due to water demand which is higher than capacity of duty pump no.1 to meet.

iv. Indicate the water level in each OHT in the level indicating panel installed in the pump room

v. Each OHT are also provided with a float valve to stop the supply in individual OHT when level reaches a cut off high level.

c. Control & Indicating Panel (For overhead and underground water tanks)

i. A centralized indicating stand–alone wall mounted panel fabricated from 14 g. with seven tank process MS sheet and painted inside and outside with stove enamelled finish with clear vertical panels for each group of buildings & tanks shall indicate water level in each tank by means of digital display unit to indicate water level in each tank in four levels (¼th, ½, ¾ and full). The panel shall be installed on the control console panel located in the pump room or as directed by the Project Engineer. The panel shall have:

ii. Digital level indicator panel meter for each water tank.

iii. Etched plate identification plates.

iv. Control cabling from MCC to the panel installed in the control room as directed by the Engineer-In-Charge.

v. Cabling from PHT sensing probes to the panel

5. **Pressure filters for Water Supply System**, if required.

a. Specification shall apply for water filtration system

i. Pressure filters shall be manufactured with factory made bobbin wound polyester fibre glass multilayer filters fitted with internal GI distribution pipe with polypropylene diffusers on top, collector pipes and arms, inlet and outlet header vertical water pressure dished ends complete with initial charge of filter media, G.I. face piping, accessories testing and commissioning complete, Working Pressure 2.4 kg/cm^2 (Test pressure 3.75 kg/cm^2). Along with bfv & nrv & gauge, prv etc.

ii. Each vessel will be provided with suitable pressure tight manhole cover appropriately located for inspection and repairs.

iii. The diameter and height of each vessel shall be as per the design requirement and given in the BOQ and as per site conditions.

b. Multi-Port Valves

i. Each vessel will be provided with multi-port valves to operate and regulate the normal flow, backwash and rinsing, rapid washing, on the face piping.

ii. Provide suitable sampling cocks to draw water samples for raw water and treated water.

c. Face Piping

i. Each vessel shall be provided with non-corrosive face piping from the inlet to the outlet. Face piping shall be CPVC (IS 4985) 10 kg/cm^2 all CPVC fittings are heavy grade to pipe and solvent weld and flanged joints

ii. All valves shall be butterfly valves as specified in the piping section over 65 mm dia. and for pipe dia. below 50 mm dia. shall be provided with ball valves.

d.Water Filtration Plant (For Domestic Water)

i. Design parameters for the proposed filter shall be as follows:

1. Filter media: - Graded aggregate of required size selected coarse and fine silica sand as per latest water treatment practice. Aggregate and sand to be acid washed and having purity of 99.9%.

2. Depth of filter media:- Approx. 750-900 mm deep (as per manufacturer's design)

3. Back washing :- By air scouring through air blower (approx. 5.1 lpm/m^2 of filter surface area and water supply from raw water pumps by reverse flow

4. Output Water Quality for Domestic Filters: To conform to IS 10500 for the relevant design criteria

e. Chemical Dosing Pumps

i. Pump applications

1. Chlorination of raw water from tube wells,

ii. Dosing system comprising of an electronic metering pump with, 100 lit capacity uPVC/HDPE solution tank with level gauge and lid on top.

iii. Electronic driven metering pumps with mechanically actuated diaphragm with oil lubricated gear mechanism. The output of the pump should be adjustable for operation from 10-100%. Pump construction shall be corrosion resistant polypropylene or similar material. Pump electrical circuit shall be interlocked with the main raw water /pool recirculation pumps so that they operate only when the pumps are operating.

f. Air Blower for Back Washing

i. Low pressure air blower with TEFC electrical motor, belt driven or direct drive, all mounted on a common structural based plate with oil and water separator.

ii. Air blowers will be used for back washing operations. The air blower shall be designed for operation of one filter at a time. Blowers will be designed for air flow of

approx 5.1 lpm/m^2 air capacity at 0.5 kg/cm^2 pressure. (This may be modified to suit manufacturer's requirement for filters offered.)

iii. The electrical switchgear shall be included in the respective MCC panel of the system

SECTION 6 - PIPES & FITTINGS

1. **Headers, piping and connection**s

a. All pipes within the plant room building in exposed locations and shafts including connections buried under floor and for suction and delivery headers shall be G.I. / CPVC pipes (medium class) and thickness specified. Pipes up to 150 mm dia. shall conform to I.S. 1239.

b. Pipe 200 mm dia. and above shall be G.I. ERW tubes to IS 3589. If black pipes are available they shall be galvanized before use.

c. Fittings for G.I. pipes shall be approved type malleable iron or wrought iron screwed galvanized fittings for screwed joints. Fittings 200 mm dia. may be shop fabricated but shall be shop galvanized after fabrication.

d. All M.S. structural supports and clamps shall be galvanised. All the pipe work within plant room shall be adequately supported with G.I. structural supports from floor or ceiling as required and directed by Engineer-In-Charge.

2. Jointing
a. G.I. Pipes (Screwed joints)

Pipe shall be provided with metal to metal threaded joints. Teflon tape shall be used for lubrication and rust prevention. (USE OF LEAD /ZINC BASED JOINTING COMPOUND ARE NOT PERMITTED)

b. Flanged joints / Dead Joints

a. Flanges shall be provided on:

i. Straight runs not exceeding 12-15 m on pipe lines 80 mm dia and above.

ii. Both ends of any fabricated fittings e.g. bends, tees etc. of 50 mm dia or larger diameter. (When Permitted)

iii. Both end of all suction delivery and other headers.

iv. For jointing valves, appurtenances, pumps, connections with pipes, to water tanks and other places necessary and required as good for engineering practice.

v. Flanges shall be as per applicable I.S. with appropriate number of G.I. nuts and bolts, 3 mm insertion rubber gasket complete.

vi. The cost of flanges is included in the rates of pipes along with fittings.

c. Unions

Provide approved type of dismountable unions on pipes lines 50 mm and below near valves or inspector test/drain and assemblies and as required as per site conditions.

d. Vibration Eliminators

All suction and delivery lines and as shown on the drawings double flanged reinforced neoprene bellow type flexible pipe connectors shall be provided. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer's details.

3. Valves

a. Sluice valves

i. Full way Sluice Valves shall be used on the suction connection to pumps and headers.

ii. Sluice valves (80 mm dia. and above) shall be double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.

iii. Sluice valves shall be of approved makes conforming to I.S.780 PN1.6 class

b. Butterfly Valves (PN 1.6 rating)

i. Butterfly Valves shall be used in all other locations as required conforming to IS 13095.PN 1.6

ii. Disc shall be CI heavy duty electrolysis nickel plated abrasion resistant.

iii. The shaft to be EN-8 Carbon Steel with low friction nylon bearings.

iv. The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.

v. Built in flanged rubber seals.

vi. Actuator to level operated for valves above ground and T Key operated for valves below Ground.

vii. Built in flanges for screwed on flanged connections. Manufacturer's details on fixing and Installation will be followed.

c. Non Return Valves (NRV PN 1.6 rating))

i. Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.

ii. NRV shall be cast iron/ gunmetal/ brass slim type with cast iron gunmetal/ brass body and gunmetal internal parts and accompanying flanges. Valves shall conform relevant IS or match the butterfly valves.PN 1.6

iii. Built in flanges for screwed on flanged connections.

d. Ball Valves

Ball Valves up to 40 mm dia. shall be screwed type ball valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm^2 and accompanying coupling and steel handles (to B.S. 5351.

4. 'Y' Strainers (PN 1.6 rating)

Provide cast iron/ gunmetal/ brass 'Y' type strainers with gunmetal internal strainers, CI screwed plug to be provided on all water tank suction connections to pumps.

5. Measurements (Part 1, 2 & 3)

a. General

i. Unit rate for individual items, e.g., pressure tanks, MCC, level controller, water tank are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.

ii. All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

b. Drainage Pumps & Sewage Pumps

Drainage pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

c. Level controllers & Alarms

Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling up to surface box near the pump and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

d. Piping Work

i. Suction and delivery headers for each pumping system shall be measured per set with required length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.

ii. CPVC pipes between various filters and units shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or

hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts and testing.

iii. Vibration eliminators, “Y” strainers, butterfly valves, slim non return valves, ball valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications except from pump room.

a. The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-In-Charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

b. The warranty shall include replacement of any equipment found to have capacity lesser that the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-In-Charge.

c. The contractor shall separately submit with this offer his charges per month for operation of mechanical equipment(s) after commissioning and handing over.

CHAPTER D - TECHNICAL SPECIFICATIONS OF ACMV TECHNICAL SPECIFICATIONS

1.0 TECHNICAL SPECIFICATION FOR AIR CONDITION AND MECHANICAL WORKS

1.1.0 GENERAL REQUIREMENTS/SCOPE

The Special / Particular Instruction and Conditions of Contract as described in this document are intended to amplify the General conditions of Contract and shall be read in conjunction with specifications of work, drawings and all other documents forming part of this Contract wherever the context so requires. The following clauses shall be considered as an extension and not in limitation of obligation of the Contractor.
All expenses incurred by the contractor in connection with obtaining information for submittingthistenderincludinghisvisitstothesiteoreffortsincompilingthetendershall be borne by the contractor and no claims for reimbursement shall be entertained.
Not-withstanding the sub-division of the documents into separate sections and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the contract.
Wherever it is mentioned in the specification, that the contractor shall perform certain work or provide certain facilities, it is understood that the contractor shall do so at his own cost.
The obligation of Contractor in fulfillment of ACMV works are stated below:
1. Procurement, fabrication and supply.

2. Inspection and testing.

3. Expediting and co-ordinating with other agencies.

4. Scheduling and Monitoring.

5. Training the Client in the Operation & Maintenance of the Plant.

6. Erection, checking and testing.

7. Commissioning.

8. Carrying out performance tests to meet the specification requirement and to the full satisfaction of CLIENT.

9. Providing Guarantee, Maintenance during Guarantee/Defects Liability period & Final documentation.

1.5.0 VRF SYSTEM
1.5.1 GENERAL
This section specifies the requirements for the vendor submittal, manufacturing, supply, installation, testing &commissioning of VRV/VRF air conditioning indoor and outdoor units specified herein.

Units shall be air-cooled, multi split system consisting one or multiple outdoor units and combination of indoor units, each having capability to cool independently for the requirements of the rooms / required area.
Units shall be suitable to use R 410a or any zero ODP refrigerants, factory tested, evacuated, dehydrated and pressurized with refrigerant holding charge for field installation. The complete units shall be protected from damage, corrosion, weather etc., during transportation and storage until ready for installation. Fins, casing and all sections shall be protected from damage during installation. 7.1.7Highly energy efficient and latest space saving VRF indoor and outdoor unit model shall be provided.
The proposed VRF units for this project should have minimum Co-efficient of performance (C.O.P) of
3.90 at 100 % load and minimum C.O.P of 4.80 at 50 % load for the following indoor & outdoor conditions for single units and combined multiple outdoor units.
Outdoor conditions: 35°C (95°F) DBT / 24°C (75.2°F) WBT Indoor conditions: 27°C (80.6°F) DBT / 19°C (66.2°F) WBT. The OEM shall select the no. of outdoor units from the high efficiency models to meet the foresaid criteria.

Indoor Unit:
The indoor unit shall be of the high static ductable/ concealed, high wall-mounted units and four-way cassette type indoor units as per the requirements.
All indoors have electronic expansion valve that controls the flow of refrigerant in respond to the load variations of room according to set temperature, which can set by remote controllers. All Indoor units should have inbuilt drain pump with minimum 700mm vertical lift head except high wall-mounted units. External drain pump shall be provided for high wall- mounted units. Noise level of the VRF indoor unit in the room shall be limited to 50 dBA maximum. Electricity characteristics for Indoor unit shall be 240 Volts/ 1Phase / 50Hz.

High static ductable/ concealed unit:
Casing shall be made of Galvanized steel sheet (G.S.S) with minimum 0.8 mm thickness. Zinc coating thickness on G.S.S shall be of minimum 220 GSM. Inner and outer side of the casing shall have noise absorbing polyethylene insulation with adequate thickness. Unit shall be provided wired remote controller and it should facilitate on/ off function, change of temperature settings, fan speed setting, operation mode setting, clock function and error code display.

High wall mounted unit:
Casing shall be of ABS / Poly proplelyne with minimum 1.0 mm thickness and standard finish.

Unit shall be provided wired remote controller and it should facilitate on/ off function, change of temperature settings, fan speed setting, operation mode setting, swing setting, clock function and error code display.

Cassette type unit:
Casing shall be made of Galvanized steel sheet (G.S.S) with minimum 0.8 mm thickness. Zinc coating thickness on G.S.S shall be of minimum 220 GSM. All parts of housing, which are in direct contact with water, are made from moulded ABS / Polypropylene and lifetime against corrosion. Cassette panels shall be of ABS / ploy propylene with standard finish. Unit shall be provided wired remote controller and it should facilitate on/ off function, change of temperature settings, fan speed setting, operation mode setting, swing setting, clock function and error

code display. Independent vane control facility and angle swing flap shall be possible with remote controller.

Evaporator:
The evaporator shall be seamless deoxidized copper tube with mechanically expanded into aluminum fins. Coils shall be leak tested / pressure tested at 2,069 kPa. (300 psig.) Manufacturing of copper tubes shall comply with ASTM B280-16. Copper tubes shall have inner grooved type for better heat transfer. Air velocity on evaporator surface area shall be limited to 2.5 m/s maximum.

Fan and Motor:
Motor shall be of Brushless DC motor (BLDC). Motor shall comply with IEC standard and it shall be provided with minimum of IE3 efficiency and minimum rating of IP 54. The fan shall be statically and dynamically balanced to ensure low noise and vibration free operation. Bearing shall be of maintenance free and self-lubricated sealed type for lifetime. Bearings shall be designed to ensure an average operating life in excess of 1,00,000 hours.

Drain pan and Drain Pipe:
Drain pan shall be extended under complete coil section. For short coil section, drain pan shall be extended under complete fan and coil section. Drainpipe shall be of MS C" class heavy complying to IS 1239 standard pipe with minimum 25 mm diameter and shall be connected to nearest suitable condensate drainage system. In addition, PUF insulation with minimum 25 mm thickness along with 0.8 mm GSS cladding shall be provided to avoid condensation and mechanical protection respectively. Flexible connectors used for duct connections to indoor unit shall have same temperature and fire rating as that of the associated fan unit and ductwork System. It shall comply with the requirements specified in “Flexible duct connector “of the Technical Requirements.

Outdoor Unit:
The outdoor unit shall be a factory-assembled unit housed in a sturdy weather- proof casing constructed from rust proof panels with power-coated finish. In case of multiple compressors in an outdoor unit, in the event of one compressor failure, the other compressor should capable of operating as emergency operation until the failed compressor is replaced. The outdoor unit shall be provided with its own microprocessor control panel with provision for integration with local control system for air conditioning. Back-up function: In a multiple system, when the master unit failed, any single unit can be set as the master unit, and then remaining units can keep on working. The outdoor unit must have feature of record running parameters of last 3 minutes before failure, for fault analysis and easy, faster trouble shooting. In case of trouble occurs in one indoor unit, continuous operation of safe system and other indoor units should be possible.
The unit shall be designed in such a way the cleaning of drain pan, inspection and replacement of compressor should be easy. Drain pan shall be of SS 316 with 0.8 mm thickness and CPVC pipe shall be connected from the drain pan to nearest drain location. The noise / sound pressure level shall be limited to 60 to 65 dB(A) at normal operation measured horizontally 1 M away and 1.5 M above ground level for single and modular type of multiple outdoor units. The outdoor unit shall be modular in design and should be allowed for side-by- side installation. The outdoor units shall be capable of working at an ambient of 50 deg C and 0 to 100% RH. Electricity characteristics for outdoor unit shall be 415Volts / 3 Phase / 50Hz.

Casing cabinet:
Casing shall be made from Galvanized steel sheet (G.S.S) with minimum 1.0 mm thickness. Zinc coating on G.S.S shall be of minimum 120 GSM. Powder coating shall be applied on GSS with minimum of 80 -100 microns.

Compressor:
The outdoor unit shall be of fully D.C inverter technology with scroll compressor type.
The inverter compressor shall be capable of changing the speed to follow variations in cooling load requirement. Compressor shall be hermetically sealed which should be of high efficiency.
Thermal casing shall be provided for compressors to minimize the noise level. In addition to that, compressors shall be mounted on vibration isolators on the unit housing to minimize the noise level. Compressor shall be equipped with internal overload (overheated) protectors for safe operation. All parts of the compressor shall be sufficiently lubricated stock.

Condenser Unit:
Condenser coil shall be seamless deoxidized copper tubes with mechanically expanded into aluminum fins, leak tested / pressure tested at 3,448 kPa. (500 psig). Manufacturing of copper tubes shall comply with ASTM B280-03. OEM shall provide factory manufactured black fin epoxy coating on fins to provide strong protection from corrosion and the hydrophilic coating shall be applied to minimize the moisture buildup on fins. Manufacturer should have the UL certification of validation for the Aluminum fins employed on the outdoor unit of air conditioners under test method B of ISO 21207. The test method shall be simulating the corrosive load for 27 years of exposure in a more severe traffic environment with salt containment. The copper tubing shall be inner grooved type for better heat transfer. There shall be low and high sides access valves for pressure measuring. Terminal box for power input shall be water protected. Auto dust removal function shall be provided to remove dust on heat exchanger of outdoor unit by reverse rotation of fan with dipswitch setting.

Sub cooling feature:
The outdoor unit should have sub-cooling feature to further reduce the liquid refrigerant temperature from the condenser unit.

Fan and Motor:
Fan motor shall be of Brushless DC motor (BLDC) and shall be controlled by compressor discharge pressure. Motor shall comply with IEC standard and it shall be provided with minimum of IE3 efficiency and minimum rating of IP 54. Bearings shall be designed to ensure an average operating life in excess of 1,00,000 hours. Fans shall be of axial type, direct driven and protected by heavy gauge rust or corrosion resistance wire guard. Fan blade shall be of ABS / polypropylene. The fan shall be statically and dynamically balanced to ensure low noise and vibration free operation. Bearing shall be of maintenance free and self-lubricated sealed type for lifetime.

Refrigerant Circuit and safety devices:
The refrigerant circuit shall include an accumulator, liquid and gas shut off valves and a solenoid valves. The accessories for refrigerant circuit shall be provided and installed completely from factory i.e., electronic expansion valves, low pressure switch, high pressure sensor and switch, temperature sensors / thermistors, check valves, solenoid valves,

strainer etc. to complete the system requirements. All necessary safety devices shall be provided to ensure safe operation of the system.

Oil Recovery System:
Units shall be equipped with an oil recovery system to ensure stable operation. Precise oil control technology shall be ensured in every outdoor unit and compressor's oil always keep in the safe level in order to completely avoid the compressor oil lack problem. The system should not stop for oil recovery and it has to be a continuous process. The unit shall be charged with sufficient level of oil for safe operation.
Refrigerant:
The outdoor unit shall be filled with first charge of R410-A refrigerant as stated amount in the published
/ printed catalogue before delivering to site.

Electronic Expansion Valve (EEV) Kit:
OEM must supply EEV kit for Air Handling units. Capacity range of single EEV must be suitable AHUs.

Control/ Communication kit for Air handling units:
OEM must supply communication kit for the operation of EEV in case of Air Handling units. Communication kit hould have facility to vary AHU fan speed in 3
Different modes (High/Medium/Low). It should also have its own thermostat which should facilitate change of temperature set point, fan speed, operation mode and error code display.

Refrigerant piping system:
This section shall comply with the requirements specified in “Copper Refrigerant Pipes and Fittings” of the technical Requirements. Clause wise compliance matrix for the same shall be submitted for notice of no objection.

Insulation for copper refrigerant piping:
This section shall comply with the requirements specified in “Copper Refrigerant Pipes and Fittings” of the technical Requirements. Clause wise compliance matrix for the same shall be submitted for notice of no objection.

Signal/ communication Cables:
This section shall comply with the requirements specified in “Signal / communication Cables” of the technical requirements. Clause wise compliance matrix for the same shall be submitted for notice of no objection.

Power cables:
This section shall comply with the requirements specified in “Power Cables” of the technical requirements. Clause wise compliance matrix for the same shall be submitted for notice of no objection.

Central/ Master Controller:
The OEM of VRF units must supply central controller. It shall be provided for control and monitoring of VRV/VRF units. BMS / BMS compatible controller having

maximum capacity of accommodating 256 indoor units suitable for MODBUS / BACnetprotocol.
Individual and group control facility for all indoor units shall be possible. It shall have schedule functions. Interlocking functions shall be possible.External or inbuilt energy/ power monitoring device shall be provided by the OEM for the following: Accumulated / current power consumption of each indoor unit in KWH shall be possible.
Accumulated total power consumption of outdoor and indoor unit in KWH shall be possible.
The OEM should supply necessary Energy / KWH meters along with the signal / communication cables and power cables for all VRF units including AHUs.
Reporting E-mail facility feature shall be provided.
Central controller should facilitate emergency stop function in case of fire or emergency condition. Central control and monitoring of entire VRF system including AHUs should be provided and compatible with BMS / BMS operation through MODBUS / BACnet protocol.
The central controller shall memorize the latest malfunction code for easy maintenance.
The address of the indoor unit shall be set automatically in case of individual and group control.

1.3.0 COPPER REFRIGERANT PIPES & FITTINGS GENERAL

The section specifies the requirements for the vendor submittal, manufacturing, supply, installation and testing of the copper refrigerant piping and fittings. All pipes and fittings delivered to site shall be new and sealed with end capped. Copper pipe and fittings shall be protected from damage, corrosion, weather etc., during transportation and storage until ready for installation. Manufacturer's Eligibity criteria, Quality Assurance and performance Requirements.
Copper tubes shall be manufactured in a factory / facility registered to ISO 9001 (Quality management system) and ISO 14001 (Environmental management system). The manufacturer shall show at least five years of continuous and current experience in the manufacturing and supply of copper tubes of similar type proposed for the project as per specifications, standards and code shall refer to latest editions.

Technical Requirements:

Hard drawn copper tubes shall be used. Soft copper tubes shall be used up to 19.1 mm diameter with subject to notice of no objection from the Employer / ER. Please note that the copper tube fittings to be purchased from the same manufacturer of copper tubes. Copper tube fittings shall confirm to ASME B16.18 / B16.22 / B16.26 / B16.50. Copper tube fittings used for brazed connections in air conditioning and refrigeration systems shall comply with ASME Standard B16.22. OEM of VRF units must supply Y-Branch joints or header joints.

Installation / Testing Requirements:

Pipe installers for used installation and testing / commissioning shall have minimum of 10 years' experience in their trade. Authorization certification shall be issued from OEM for all personnel / contracting agency engaged for installation, testing, and commissioning.
Method statement of installation for copper pipes, fittings / Y-branch joins / header joints shall be submitted as recommended by the OEM of VRF units. Support details for copper refrigerant piping shall
be installed as per the typical installation drawings or method statement for installation by the manufacturer whichever is stringent.
Limitation of pipe length:

Actual and equivalent pipe length between outdoor units to the farthest indoor unit shall be permitted to maximum 175 M & 200 M respectively. Equivalent length from first branch joint to farthest indoor unit shall be permitted up to maximum of 90M. Level difference between outdoor unit and indoor unit shall be permitted to 100 M maximum when outdoor unit is located above the indoor units. Height difference between IDU to IDU shall be permitted to maximum of 40 M.
Total pipe length shall be permitted to 1000 M maximum.

The insulated pipes shall be laid on perforated cable tray and fully covered with top plain cover sheet. Perforated cable tray and top plain cover sheet shall be made of hot dip galvanised steel sheet with minimum of 0.8 mm thickness. Refrigerant piping shall be installed to ensure that the adequate circulation of refrigerant at all loads and ensure proper oil return to the compressor. Liquid lines shall be sized and installed to ensure that flashing of liquid refrigerant does not occur. Suction lines should be installed to ensure that oil shall be entered and carried back to the compressor by the suction gas under all load conditions encountered in normal operation. No pipe joints shall be permitted within the thickness of walls, floors or beam etc.,
Brazing
All personnel engaged on brazing operation must possess a certificate of competence issued by an approved authority. Brazing filler material shall be used in accordance with ANSI / AWS A5.8. Nitrogen gas must be filled for protecting copper pipe during brazing operation. After brazing, allow it for natural cooling. Brazing flux shall not be used in joints between copper tube and ASME B16.22 fittings. Brazing flux shall not be applied to the interior surface of the fitting.
Pipe cleaning / Pipe Flushing. Use nitrogen gas pressurize to 5 bar to 15 bar gradually through adjusting valve to flush pipeline to eliminate dust, oxide layer and moisture depending upon the length of copper pipes. Detailed method statement for pipe flushing shall be submitted as recommended by the OEM of VRF units prior to start the work for notice of no objection.
OEM of VRF units or authorized vendor of the OEM shall verify, validate and certify the installation and testing / commissioning of copper piping system.

E.CHILLED WATER CASSETTE UNIT

1. GENERAL

Chilled water Cassette air conditioners units shall be factory assembled and tested complete in all respect and confirming to Indian/ASHRAE standards.

2. CASSETTE UNIT (IN-DOOR UNIT)

These units shall be installed between the bottom of finished slab & top of false ceiling. The maximum allowable height for the cassette type units shall be 288 mm.
The unit must have in built drain pump, suitable for vertical lift of 750 mm. The unit casing shall be Galvanized Steel Plate.
Unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam.
The noise level of unit at the highest operating level shall not exceed 42 dB(A), at a vertical distance of 1.5 m from the grille of the unit.

Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (288 mm maximum).
The unit shall be supplied with suitable decorative panel.

Bidder Sign and Seal

The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy to remove, clean & re install.
The unit will be connected in series to a suitable Chilled water supply & it must be possible to operate the unit independently, through corded/ cordless remote specified in the “Bill of quantities”.
The unit shall be supplied with following from the factory Operation Manual
Installation Manual
Paper pattern for installation Drain hose/clamp metal/washer fixing plate/ceiling pads/clamp screws/washer for hanging bracket/Insulation for fittings.

1.5.2 VENTILATION FANS

1.5.3 CABINET TYPE EXHAUST & FRESH AIR FANS

1.1 GENERAL
This specification covers the general design, materials and Full assembled construction features, manufacture, shop inspection and testing at manufacturer’s works, delivery at site, handling at site, erection testing, commissioning, performance testing and handing over of Centrifugal Fans of Ventilation and process plants.

1.2 CODES & STANDARDS
The design, materials, construction, manufacture, inspection, testing and performance of centrifugal fans shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipment is to be installed. The equipment shall also conform to the latest applicable Indian or equivalent standards. Other international standards are also acceptable, if these are established to be equal or superior to the listed standards. Nothing in this specification shall be construed to relieve the VENDOR / CONTRACTOR of this responsibility.

1.3 CONSTRUCTION FEATURES CASING
The casing shall be Single skin 18G thick as per specification

1.4 IMPELLER
The impeller shall have die formed blades welded to the rim and back plate. Rim shall be spun to have a smooth contour. Shaft sleeves shall be provided, if necessary. If required, intermediate stiffening rings shall be provided. The impeller shall be statically and dynamically balanced.

1.5 GENERAL
Belt driven fans shall be provided with V belts, V-belt pulleys and belt guards. Pulleys shall have minimum two (2) grooves to prevent start-up failure and premature belt failure. Pulleys shall be statically and dynamically balanced. Belts shall have a minimum service factor of 1.5.
Common base frame for belt driven fans shall be with adjustable rails for motors. Bolts, nuts and washers used shall be of non-corrosive material and of superior quality. Bearings shall have minimum life of 50,000 hours.

1.6 DRIVE MOTOR (HIGH EFFICIENCY IE3)

The motor shall be as per IS: 325 and with class "F" insulation, totally enclosed fan cooled, horizontal induction foot mounted type and rated not to draw starting current more than 6 times normal running current. Fan motors shall be suitable for 415 volts, 50 cycles, 3-phase, squirrel - cage, totally enclosed fan cooled with IP-55 protection. Motor shall be selected for quite operation and the speed of the motor shall not exceed 1400 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall of the oil-resistant type. Fan motor shall be suitable for variable speed by variable frequency drive application. . The motor shall be capable of handling the required starting torque of the pumps. Speed of motor shall be compatible with the speed of the pump. The cooling fans shall be directly driven from motor shaft. Motor situated outdoors or exposed to the weather shall be weather protected. Motors shall be enclosed type a and shall have dust tight construction with suitable means of breathing and of drainage to prevent accumulation of water from condensation. Drain holes shall exclude bodies greater than 6mm diameter.
All components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved. All motors shall be dynamically balanced. The enclosure shall be designed to provide an effective sealing between the primary and secondary air circuits. Motor winding shall be vacuum impregnated with heat and moisture resistant varnish glass fiber insulated. Two independent earthing points shall be provided in accordance with IS:3043 on opposite sides of the motor for bolted connection. The cable boxes and termination shall be designed to enable easy disconnection and replacement of cables.
(Motor should be part of scope with manufacturer & should not be supplied separately by ACMV Contractor)

1.7 FILTER SECTION
The Filter Section shall consist of Pre-filters,
Filter Section with Pre-filter of efficiency 90% down to 3 -10 Microns,

1.8 CABINET CENTRIFUGAL FAN
Fan contained within the cabinet shall be licensed to ear the AMCA Air and Sound Certified rating seal. Fan shall be DIDW backward curved with fan scroll, belt drive or direct drive assembled within a cabinet. Cabinet shall be constructed of Galvanized Steel material. Cabinet shall be “Panel Construction” assembled together by means of fasteners for ease of dismantling for service and maintenance. Welded cabinets are not acceptable. Cabinet shall be capable of taking on added acoustic
Insulation, if required to meet the acoustic noise levels specified. Thickness of the panel would be 25 mm and specs would be same as Air Handling unit.

1.9 KITCHEN EXHAUST FAN
Kitchen exhaust fan shall be SISW Centrifugal direct or belt driven type. DIDW Centrifugal fan where the belts or motors are in the air stream are not acceptable. The air flows specified are for NTP (normal temperature and pressure). While selecting the fan the temperature of the exhaust gas shall be considered.

1.10 NOISE & VIBRATION
Noise level produced by any rotating equipment individually or collectively shall not exceed 75 dB (A) measured at a distance of 1.5 meters from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1. Balance quality requirement shall be G 6.3 conforming to ISO 1940/1.

1.11 PERFORMANCE GUARANTEES

Performance parameters to be guarantee by the VENDOR / CONTRACTOR and tolerances permitted shall be as indicated in specifications. Bidder shall confirm acceptance of these by indicating values in data sheet attached along with the document. Fan or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters.
Bidder to note that all fan performance curves shall be AMCA certified. Contractor shall also submit corrected performance curves for the fan considering the as installed condition of the fan at site.

1.12 FACTORY TESTS

The Contractor / manufacturer shall describe the tests that will be conducted at their works. They shall furnish a test certificate / certificates to the effect that such tests have been duly performed on the Fans. However, Witness test for fan's units (One in each type of capacity) should be tested in presence of clients and clients representative. Contractor should consider 4 people to & fro charges and testing expenses in his Quote.

1.13 DATA TO BE FURNISHED BY THE VENDOR / CONTRACTOR AFTER THE ISSUE OF PURCHASE ORDER / AWARD OF CONTRACT

a) Schedule of drawings and documents to be submitted for review, approval and information with submission dates.

b) Quality Assurance Plan (QAP).

c) General arrangement and section drawing with all dimensions and complete part list with codes and materials of construction. This drawings shall include all data indicated in technical data sheets.

d) Foundation drawing with static and dynamic loads, unbalanced forces and moments, if any, pocket details. etc.,

e) Drawing showing fabrication and constructional details of the fan.

f) Fan rating chars or tables with selection marked.

g) Performance curves for fans with duty point marked (AMCA Certified, as well as installed Condition at site).

h) Torque-speed curve for fans.

i) Erection, operation and maintenance manual with lubrication schedule.

TECHNICAL REQUIREMENTS OF CABINET TYPE (OUT DOOR) FRESH AIR AND EXHAUST FANS

SI NO	DESCRIPTION	TECHNICAL DETAILS BY VENDOR
	CABINET TYPE (OUT DOOR) FANS	**LOCATION : FANS IN TERRACE**

Bidder Sign and Seal

	(Please furnish the following)	
	a) leaflet	
	b) details noted below for all Fans	
	c) Noise Spectrum from at various frequencies from 16 Hz to 8000 Hz	
A	**GENERAL**	
1	Manufacturers name	
2	Model & Size	
3	Overall dimensions - mm x mm x mm	
4	Overall weight (including cooling coil & fan	
5	Is fan Outdoor suitable Installation?	
B	**CASING**	
1	**PANELS**	
A	Material of Single skin	
B	Thickness of Single skin	
C	Finish of Single skin	
2	**FRAME**	
A	Description	
B	Material of frame	
C	Describe frame - panel joints	
3	Panel Insulation	
A	Material	
B	K value - W/m. °C	
C	Density - Kg/cum	

4	Access Doors	
A	List sections for which Access	
	doors are included	
B	Door material	
C	Construction details	
D	Type of hinges	
E	Type of handle	
5	**FAN AND FAN MOTOR**	
A	Type of fan	

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B	Number of fan drums	
C	Diameter of fan drum - mm	
D	Length of fan drum - mm	
E	Number of blades	
F	Type of blades	
G	Delivery – CFM	
H	Maximum static pressure capability – mm wg	
L	Speed – rpm	
M	Critical speed - rpm	
N	BKW	
O	Motor selected	
P	Type of motor	
Q	Motor speed - rpm	
R	Type of VFD	
s	Fan Noise Level? Please ensure that noise levels at various, frequencies are attached along with quote (starting from 16 Hz to 8 K Hz)	
t	Whether impellor and shaft dynamically, (and statically) balanced?	
u	Vibration level	
6	**FILTER SECTION**	
a	Overall dimensions - mm x mm x mm	
b	Number of filters - Nos.	
c	Nominal dimensions of each filter – mm	
d	Type of filter	
e	Media used	
f	Efficiency of filter (State the test method)	
g	Manufacturer's name	
h	Resistance of filter when clean- mm	

	Wg	
i	Maximum resistance of filter - mm Wg	
j	Is the media cleanable ?	
k	Is 2 sets of spare filters considered in the quote apart from one set in the fan	
l	Is one set of commissioning filters considered in the Quote?	
8	MIXING CHAMBER	
b	Is it with dampered outlets?	
c	Is material of construction in terms of thickness & material same as other panels?	
d	Is fan is of non Thermal Break Construction?	
9	SAFETY FEATURES	
a	Please specify safety features considered In fan?	

1.5.0 IN-LINE CENTRIFUGAL DUCT FAN

Fan shall be of SISW / DIDW, forward or backward curved centrifugal, Direct driven or Belt driven type.

Casing shall be of Galvanized steel. Impeller material shall be either Galvanized Steel or Glass Reinforced Polypropylene.

Motor shall be external power supply 220~240V/50Hz/Single Phase or 400~420V/50Hz/Three Phase. Fan should be of G.S.S. , the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m2) zinc coating & Zero Spangle, skinpassed, chromated and dry.

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SHEET METAL DUCTING, GRILLES, DIFFUSERS, LOW LEAKAGE VCDs &FDs GENERAL

The scope of this section comprises of the supply, erection, testing and commissioning of fabricated sheet metal ducting, grills, diffusers, thermal insulation and other connected works with the air distribution system, conforming of these specifications and in accordance with the requirements of the drawing and of the Schedule of Quantities.

1.0 SHEET METAL WORKS, GRILLES, DIFFUSER, ETC

.SHEET METAL WORKS

Ducts shall be made of aluminum sheets. The galvanized steel sheets shall conform to I.S.277 - 1965. Aluminium sheets shall be of grade S-IC or S-3 as specified in I.S.737 - 1965. Galvanizing shall be as per Clause VIII of ISI specification.

The thickness of sheets and type of bracings shall be as given below:

Longest side mm	Minimum Sheet Thickness (mm)		Type of Bracings
	for G.S.S.	for Aluminium	
Upto 600 601 to 750	0.63 0.63	0.80 0.80	Cross bracings 25 x 25 x 3 mm MS Angles bracing at 1200mm from joints.
751 to 1000	0.80	1.00	32 x 32 x 3 mm MS Angles bracing at 1200 mm from joints.
1001 to 1500	0.80	1.00	40 x 40 x 3 mm MS Angles bracing at 1200 mm from joints.
1501 to 2250	1.00	1.55	40 x 40 x 3 mm MS Angles bracing at 600 mm from joints or 40 x 40 x 3 mm MS Angles diagonal bracing.
2251 and above	1.25	2.00	50 x 50 x 6 mm MS Angles bracing at 600 mm from joints or 50 x 50 x 6 mm MS Angles diagonal bracing.

This specification covers the general design, materials, construction features, manufacture, testing, delivery, installation, testing, commissioning and carrying out performance test at site of Air Distribution System and its components.

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1.1 CODES & STANDARDS

The design, manufacture and performance of ducting, dampers & grilles shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the following latest Standards. Nothing in this specification shall be construed to relieve Vendor of his responsibility.

All sheet metal ducting work for various air systems shall be supplied, installed, completely connected, tested and adjusted. All main ducting shall be factory fabricated and only assembled at site. All ducting shall be provided with M.S duly painted angle frames only. The Contractor shall arrange at site all necessary equipments like lock forming machine, drilling machine, welding machines, etc for carrying out duct fabrication of site adjustment ducting, minor branching, collar connection pieces etc.,

The Contractor shall make working drawings of all duct work and the same shall include details of all fittings, dampers, elbows, grilles, return air risers, etc. required for the proper operation of the system.

All diffusers, duct lengths, grille necks / boxes must be kept duly covered during construction to keep out dust and rubbish.

All ducting flanges shall be out of M.S angles and duly nut bolted with gaskets. The nut bolting shall be within the maximum spacing of 150 mm. All duct angle flanges and duct supports shall be epoxy painted by VENDOR.

Ducts shall be adequately supported from ceiling trapeze hangers firmly fixed and generally suspended from the building structure with the help of welded joints / anchor fasteners / embedded plates. Ducts shall rest on supporting angle or channel and the angle or channel shall be supported by CS rods on both sides of ducts with weld or bolts. The hangers and supports shall not pierce the insulation. The hangers shall be spaced on average 2.4 m centres with a hanger no further than 0.6 m on each side of any change in direction. Ducts passing through any building expansion joints shall be supported on either side of the joint. All anchors, hanging rods and other metallic exposed parts must be galvanised or painted with a rust protecting paint.

For ducts having HEPA filters, food grade silicon sealant approved by

USFDA must be applied on all duct joints.

Transformations in main ducts and in branches must be tapered. The cross section of the duct must be gradually decreased at a rate of 1 mm / 5 mm of length.

Wire mesh of maximum opening of 10 mm shall be provided for all external opening to avoid entry of Birds.

In general the following points to be noted while fabricating/installing of ducts:

Duct sealant to be applied in all transverse joints. Exposed duct to be sealed on the inner surface only. Provide full radius tees and elbows for change in direction, except where square elbows are required due to space restrictions.

Provide balancing dampers, splitter dampers as per approved drawings Isolate equipment with connections.

Duct support shall be as per IS:655 standards / approved drawings / standard clean room practices. Irrespective of the standards, only angle flanges to be used for duct connection. Sheet flanges are not acceptable.

All the support angle and rods shall be painted with approved colour on one coat of red oxide.

1.2 MARKING OF THE DUCTS

The ducts and other equipment must be marked after insulation by arrows to indicate the direction of air flow and also the serial number of the system corresponding to the AHU distribution chart enclosed.

1.3 DAMPERS

Contractor shall supply and install all dampers where necessary for proper control of volume and balancing of air distribution system. These dampers shall be separate from any other dampers provided with supply and return air diffusers, registers and grilles.

A multi leaf opposed blade type damper shall be installed in each supply air duct / return air duct / fresh air entry near the air handling unit outlet to adjust the total supply air cfm.

Dampers shall be of rigid construction free of all rattling and vibrations

with edges crimped or creased for stiffness. It should be possible to adjust and lock the damper in any position. Fully open and fully closed position shall be clearly marked for ease in operation.

Dampers shall be provided with Teflon or brass bushings for blade shaft.

1.4 HANGER FOR DUCTS

Duct size (mm)	size of ms angle (MM x MM)	Size of rod dia (MM)
Upto 750	40 x 3	10
751 to 1500	40 x 3	12
1501 to 2250	50 x 3	15
2251 & above	50 x 3	15

NOTES: Where ducting is supported from ceiling/roof slab, Anchor grip bolts shall be used to fasten the suspension rods (for duct supports) to the ceiling/roof slab. All civil works involved including the drilling of holes for fixing the grip bolts and any chipping and finishing of the ceiling/roof slab shall be carried out by the successful contractor at no extra cost.

All joints shall be made tight and all interior surface shall be smooth. Bends shall be made with radius not less than one-half of the width of the duct or with scientifically designed interior curved vanes, as approved. The vanes shall be so spaced that the aspect ratio of each of the individual elbows formed by the vanes will be about five.

1.5 GRILLES & DIFFUSERS

All (supply) side air grilles shall be of approved make with single deflection vanes and approved dampers. Supply air grilles shall be provided with non-adjustable type horizontal bars and adjustable type volume control multi louver damper which shall be key operated from the front of the grilles.

All return air grilles shall be identical to supply air grilles except that they do not incorporate volume control dampers. All exhaust air grilles shall be of approved design with adjustable dampers. All ceiling outlets shall be of approved make. Ceiling outlets for supply air to be equipped with volume control dampers, fixed grid and blanking baffles, where desired.

All grilles and diffusers shall be complete with powder coated painting

(Color scheme will be provided by the Client.) All air diffusers and grilles shall be purchased only from Air master or from established sources with full application literature available and fixed with fasteners which are not visible from outside and dampers which are operated from the face.

All MS frames rectangular or circular for fixing thereon of supply and return air grilles and diffusers shall be supplied by the Air-conditioning contractors. All grilles/diffusers shall be fixed using brass screws only. All grilles/diffusers shall be selected in consultation with the Client/Architect. Different spaces shall require horizontal or vertical face bars and different width or margin frames.

1.6 LOW LEAKAGE DAMPERS

All volume control dampers except fresh air shall be of GI louvered type design of robust construction and tightly fitted. The fresh air dampers shall be provided with 74 deg. C fusible links as explained in 2.4. The design, method of handling and control, shall be suitable for the location and service required.

The casing and blades shall be of 16 G- GSS (1.55mm) stiffened suitably and strengthened by press bending.

Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation, control or setting in any desired position. Dampers and their operating devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all times.

Dampers shall be placed in ducts and at every branch supply or return air duct connection whether indicated or not indicated, on the drawings for the proper volume control balancing of the system.

1.7 FIRE DAMPER WITH ACTUATOR CUM SENSOR

The fire damper shall be constructed of 16 Gauge galvanized steel frame and 16 G GSS blades. Gravity is used to drop the blade stack on this type of damper. 74 Deg. C UL rated shall be employed. This damper shall be designed to fit completely in the inside of ducting with no transition required. Only heavy duty bronze bushes, GSS blade brackets with bronze fasteners shall be used. Metallic compression type seals at jambs shall be used for construction. Actuator shall be suitable for AC 230V, 50HZ operation, with fire sensors it shall be BMS

compatible.

1.8 FLEXIBLE DUCTING MATERIAL

The flexible ducts used to tap supply air shall be of high quality thermally insulated duct. The thickness of the insulation shall be 25 mm thick and the density shall be not less than of 16 kg / cum. The inner core of the flexible duct shall be of PVC / tough aluminum material bonded with stainless steel spirally reinforced wire. The outer jacket is made out of very tough spirally reinforced multiple layer aluminum laminated construction.

The flexible ducts proposed to install in the exhaust side shall be of same description as mentioned above but without insulation material having 2 layers of aluminized polyester construction, encapsulates a high tensile steel wire helix.

INSTALLATION PROCEDURE

Flexible ducts shall be cut to the required size to ensure a curved connection between the main duct and the air terminal plenum. The contractor shall not join any small flexible. pieces by any foreign materials before installation. The minimum length of the flexile duct shall not be less than 750 mm in length.

A groove of 2 mm shall be made on the round collars to ensure that the spiral wire inside the flexible duct shall be fitted ahead of the groove. Stainless steel metal clamps, which are made out of 8 -mm wide band with lifted edges, shall be used to tighten the connection of the flexible ducts on the round collars of the plenums. On the flexible ducts the clamp is fitted with a flip up and quick lock tightening head of ease of fixing. The contractor shall ensure that all the flexile ducts wherever installed shall follow the above procedure. The contractor has to obtain the approval from the consultant / project managers before starting the actual installation.

1. MATERIAL AND OTHER SPECIFICATION

The material and other specification for piping, valves and specialties shall be as per Data Sheet listed under the end of this section.
Colour code shall be used to identify pipe material. The CONTRACTOR shall be able to identify on request all random piping prior to any field fabrication.

The VENDOR shall furnish six (6) copies of certificates for piping for:-

2. HANGER AND SUPPORTS

All piping supports, guides, anchors, rod hangers, rollers, with incidental structural sub-framing shall be furnished and erected by the CONTRACTOR.

The fabrication of the hangers, anchors and materials shall conform to the requirements of MSS-SP-58

or PURCHASER"S specification unless otherwise noted. The provision of pipe support will include auxiliary steel or concrete pedestals wherever applicable. The CONTRACTOR shall be responsible for the design of hangers, supports etc., for the complete piping system. However, CONTRACTOR shall obtain ENGINEER"s / PURCHASER"s approval before fabrication and erection of these supports.

All piping shall be suspended, guided and anchored with due regard to general requirements and to avoid interference with other pipes, hangers, electrical conduits and their supports, ducts, and structural members. It is the responsibility of the piping CONTRACTOR to avoid all interference while locating hangers and supports.

Hanger's rods on all pipe lines shall not be less than 12 mm (3/8") to support pipes.

Parameter	**Valve**
Welding Process	Electric
Arc welding Type	Manual
Application	Chilled water piping
Groove Design Single	„V"
Size of Electrode Filler	11.5 mm to 4.0mm
Type of Electrode	J.B.
Advani Overcord „S" , Philips „2S" Size of Electrode filler	11.5 mm - 4.0mm Pre-heatNot required
Post weld heating	Not required
Welding technique	Root, filling and capping weaving
Welding progression	Vertical Upward.

Pipe installation shall be carried out in a workman like manner with approved drawings, which shows the locations of equipment, valves,

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drains and air-vents. Pipe hangers shall be spaced as follows:- (unless otherwise stated in the drawings)

Nominal pipe size mm - dia	Spacing (meters)	Hanger Rod size
12 & 15	1.25	9mm
20 & 25		9mm
32, 40, 50 & 65	2.00	12mm
80, 100 & 125	2.00	15mm
150 & above	2.50	20mm

1. SURFACE PREPARATION AND PAINTING

All pipelines and piping components shall be adequately protected against corrosion during manufacture, shipment and storage by appropriate protective paint. Use of grease or oil for this purpose is prohibited. After completion of cleaning and testing operations at site, completed pipe work, hanger and support components shall be give n a coat of primer as follows:

Before the applications of paint, the CONTRACTOR shall prepare all surfaces. The surfaces shall be cleaned of all mill scale, dirt, dust, soot, grease, rust etc., and of all substances which would damage the coating or impair its adhesion. Existing coating shall be removed thoroughly for satisfactory painting. Spools which are already corrosive shall be completely derusted and repaired as necessary before the application of paint.

Immediately after the surface cleaning, the CONTRACTOR shall give two coats of red oxide zinc chromate primer (confirming to IS 2074) with minimum Dry Film Thickness (DFT) of 25 microns per coat. The Contractor shall test the coating executed by him as regards to their satisfactory adhesion. Painting operations shall generally be in line with IS 1477 part II.

In addition to above all pipes other than galvanized or insulated pipes and pipe supports shall be given two coats of finish paints using enamel paint of approve make by brushing or spraying generally as per IS 1477 to give a minimum total DFT of 100

microns (after two coats of primer and two coats of finish paint). Shades shall be as per IS 5 or as indicated by PURCHASER. Paint manufacturer‟s instruction for primer or finish paint shall also be followed. Before selection of colour code, PURCHASER‟S /

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ENGINEER"s approval shall b obtained.

2. SURFACE PREPARATION

Pipe surfaces to be provided with underground protection shall be cleaned by shot or sand blasting. The cleaning shall e so carried out that the piping surface is free from mill scale, rust, oil, welding scale and other foreign materials. Primer shall be applied immediately after shot or sand blasting to prevent rust forming. Superficial rust formed shall be removed by wire brushing or by the use of emery paper. If the rust formation is heavy, reblasting may be necessary. Around field joints, the pipe surfaces may be cleaned by wire brushing prior to the application of anti-corrosive protection.

3. ACTUATOR SPECIFICATION FOR ALL VALVES

Supply voltage power Consumption	:	230V Frequency Control : 50HZ
Input Position Outp VDC, 4-20Ma, 3Point Floating, PWM.	:	2-10V DC, 0-10
Turn Time	:	2-10V DC 4-20mA
Direction of rotation fully open valve)	:	50Seconds (from closed to
Humidity Rating Bi- directional	:	15MM Grommet connection
Housing Material Board	:	Fully coated Electronic
Housing Insulation	:	A

luminum IP 5 Valve shall be electronic, dynamic, modulating, 2-way, control device.

Dynamic control valve shall accurately control flow, independent of system pressure fluctuation.

Maximum flow setting shall be adjustable to 51 different settings within the range of the valve size.

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4. VALVE ACTUATORS

Valve actuator housing shall be rated to IP 44.Actuator shall be driven by a 230 v, 4-20 mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals.
Actuator shall be capable of providing 4-20 mA or 2-10V DC feedback signal to the control system. External LED read-out of current valve position and maximum valve position setting shall be available. **VALVE HOUSING**
Housing for 15 – 40 mm size shall be constructed of forged ASTM (CuZn39Pb2) brass rated at no less than 2500 kPa static pressure and 120°C.
Housing for 50 – 150 mm shall be constructed of Ductile Iron ASTM A536-65T, Class 60-45-18 rated at no less than 4000 kPa static pressure and 120°C.
Valve housing for 15 – 40 mm shall be double union construction with a range of pipe connections available for the appropriate pipe size.
Identification tags shall be available for all valves.

5. FLOW REGULATION UNIT

Flow regulation unit shall consist of stainless steel and hydrogenated acrylonitrile butadiene rubber and shall be capable of controlling flow within +/- 3% of each rated flow. Flow regulation unit shall be accessible, for maintenance.
Optional dual pressure/temperature test plugs for verifying accuracy of flow performance shall be available for all valve sizes.

6. BALANCING VALVES

Balancing valves shall be supplied and installed as shown on the drawings to ensure proper balancing of water flows in the hydraulic heating and cooling system.

7. THERMAL INSULATION GENERAL

This section details the supply and application of thermal insulation to chilled water piping, condensate drain piping, thermal insulation for sheet metal ducting etc., for the temperature between ambient and(-

) 80 deg C and also for dual temperatures (both hot and cold) service with hot temperature above ambient and up to 230 deg C. Unless specified otherwise in section C and / or data sheet, the scope of supply of the contractor shall include, but not be limited to, the following items:

Insulation material of all types as specified and required.

Insulation adhesives, vapour barriers and finishing materials of all types asspecified and required. Auxiliary materials such as binding and lacing wires, wire netting, bands, screws, pop rivets etc., as specified and required. Angles, clamps, lugs etc., for supporting insulation.Weather hoods Any other material as may be required for making the insulation complete.

1.9 INSULATION MATERIALS

The insulation materials shall be on or more of the following types as specified in the technical specifications / data sheets,

NO	INSULATION MATERIAL	STANDARD	DENSITY Kg / Cum	TEMP RANGE DEG C	MATERIAL CODE
1.00	Fire-retardant quality expanded polystyrene	IS 4671		(-) 80 to 80	
2.00	Rigid polyurethane / Polyisocyanurate foarm	BS 5608		(-) 80 to 110	PUR / PIR
3.00	Phenolic foam	BS 3927		(-) 80 to 130	PF
4.00	Lightly resin-bonded glass wool mattresses	IS 8183		(-) 40 to 230	LRG
5.00	Resin-bonded glass wool pipe sections	IS 9842		(-) 40 to 230	PSG
6.00	Unbonded rock and slag wool	IS 3677		(-) 80 to 230	U 150

1.0 INSULATION ADHESIVES

The insulation adhesive shall be one or more of the following types as specified in the technical specification / data sheets:

SI NO	serial Description	MATERIAL CODE
1	Hot Bitumen of grade 85/25 or 85/40 conforming to IS 702 shall be uniformly applied at 1.5 Kg/sqm on the surface to be insulated. A similar layer shall also be applied on the inside surface of the insulation. This material shall not be used for stainless steel surfaces.	BIT

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	CPRX compound shall be uniformly applied at 1.5 Kg/Sqm on the surface to be insulated. A similar layer shall also be applied on the insde surface of the insulation. This material shall not be used for	CPRX
	MAS 83 with 0.5 mm wet film thickness shall be uniformly applied at 0.5 lit / Sqm by trowelling. MAS 83 shall not be used with polystyrene as insulation material. MAS 83 can be used only between (-) 46 and (+) 149 deg C	MAS 83

1. VAPOUR BARRIERS

The vapour barrier shall be one or more of the following types as specified in data sheets

SI NO	Material Description	MATERIAL CODE
1	**Hot bitumen of grade 85 /25 or 85 / 40 conforming to IS 702 shall be uniformly applied at 2.5 Kg/ sqm on the outer surface of insulation and allowed to dry. Reinforced** **Plastic (RP) tissue paper shall be applied on the dried bitumen. This material shall not be used for stainless steel surfaces** **0.1 mm thick factory-laminated aluminium foil with craft paper shall be provided. All joints shall be provided with 50 mm overlap and all joints shall be sealed with aluminium tape. For temperature between (-) 43 and (+) 149 deg C MAS 35 may also be used as sealant.** **MAS 130 with 1.02 mm wet film thickness primer coat at 1.0 lit / Sqm and 2.25 mm wet film thickness finish coat at 2.5 lit / sqm shall be uniformly applied over the insulation by spatula or trowelling. MAS 130 shall not be used with polystyrene as insulation material. MAS 130 can** **be used only between (-) 40 and (+) 60 deg C**	**1 ALF S 130**

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1.0 FINISHING MATERIALS

The finishing material shall be one or more of the following types as specified in data sheets.

SI NO	Material Description	MATERIAL CODE
1	Portland cement and inorganic fibre with water proofing compound at an application density of 1050 to 1100 kg / cum	
2	Aluminium sheet as per IS 737, designation 31000, condition H3	
a)	Insulation outside diameter above 450 mm - sheet thickness 18 SWG	
b)	Insulation outside diamter 150 to 450 mm - sheet thickness 20 SWG	
c)	Insulation outside diamter below 150 mm - sheet thickness 22 SWG	
d)	Air Conditioning ducts - sheet thickness 24 SWG	
e)	Equipment - sheet thickness 18 SWG	
3	Galvanised Steel (GS) sheets as per IS 277, designation GP	
a)	Insulation outside diamter above 450 mm - sheet thickness 20 SWG	
b)	Insulation outside diamter 150 to 450 mm - sheet thickness 22 SWG	
c)	Insulation outside diameter below 150 mm - sheet thickness 24 SWG	
d)	Air Conditioning ducts - sheet thickness 26 SWG	
e)	Equipment - sheet thickness 20 SWG	
4	MAS 134 with 1.0 mm wet film thickness at 1.0 lit / Sqm shall be uniformly applied when using over porous insulation materials. Wet film thickness shall be0.5 mm at o.5 lit / sqm for impevious insulation surfaces including polystyrene. MAS 134 can be used only between (-) 18 and (+) 82 deg C	

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1.0 AUXILLARY MATERIALS

Binding and Lacing Wires

Binding and lacing wire shall be annealed GS 24 SWG.

Wire Netting Wire netting shall be with GS 24 SWG wire and 20 mm hexagonal opening.

1.1 BANDS

For securing insulation material	24 SWG GS, 20 mm wide
For securing aluminium and GS Sheets anodized aluminum or SS 304, 20 mm wide	24 SWG

1.2 SCREWS

Screws shall be of self-tapping type and shall be of aluminum or stainless steel for aluminum sheets and GS for GS Sheets.

1.10 POP REVITS

Pop Rivets shall be of stainless steel

1.11 INSULATION OF PIPES, PIPE FITTINGS, VALVES AND OTHER SEPCIAL FITTINGS

All vertical pipes shall be provided with suitable insulation supports to prevent the insulation from collapsing due to its own weight. Any welding required, shall be carried out by the CONTRACTOR with the prior permission of the PURCHASER and only under his direct supervision. Where welding is not permitted, suitable clamped supports shall be used. The insulation shall be applied starting from bottom up. Mattress type insulation materials shall be clamped from top.

All pipe fittings, valves and special fittings shall be covered with the same type and thickness of insulation as specified for the adjoining pipe. On pipe fittings, insulation outside diameter shall be same as the outside diameter of adjacent pipe insulation. Unless specified otherwise in relevant section, valves and special fittings of sizes 100 mm NB and larger shall be provided with removable box type insulation. Box shall be fabricated from sheet material specified for adjoining pipes. Pipe insulation on adjoining flanges shall be stopped at one bolt length plus 25 mm before flange to permit removal of bolts and nuts. The insulation shall be applied after the finish has been

applied over insulation on the adjacent piping. Flanged joints shall also be insulated with removable type of boxes. Arrangement shall be similar to that for valves. The sheets shall be installed with the longitudinal lap joints at 45 deg below the horizontal for horizontal pipes and the joints sealed with bitumastic paint.

On vertical pipes the sheets shall be applied working from bottom up. Each section of sheet shall have a minimum overlap of 50 mm longitudinally and circumferentially. Each circumferential joint shall be made weather-proof by securing with a band of sheet material and sealing with bitumastic paint. Longitudinal lap joints shall be fixed with screws or pop rivets at approximately 150 mm centers.

Valves shall be insulated up to and including their bonnet flange

Weather hoods shall be provided for insulated piping passing through roof and external walls.

1.12 EQUIPMENT

Where the insulation material is in the mattress form, cleats in the form of wire nails or nuts or angles and flats for supporting the insulation material, shall be welded to the equipment by others. If wire nails are to be used as insulation cleats, these shall e bent and secured with the metal fabric of the mattress, after the insulation has been applied. Where insulation cleats are in the form of M6 and M10 nuts, the CONTRACTOR shall supply and install bolts of suitable length for fixing the insulation. The insulation applied to equipment shall be reinforced with wire netting. One course of wire netting shall be applied to the surface of the equipment and each layer of insulation shall be backed up with wire netting. All irregularities of the surface shall be filled and leveled over the with insulating cement. All mattress joints shall be butted tightly and mattresses shall be secured with 20 mm wide 24 SWG GS bands at 450 mm centers. After banding, all mattress edges shall be laced tightly.

All equipment, unless specified other wise, shall have a smooth aluminium or GS Sheet finish as specified in the technical data sheet, applied in a manner similar to that specified for piping. For fixing of aluminium or GS Sheets, wooden spacer rings at 1000 mm centers shall be fixed to the equipment by the CONTRACTOR. All vertical and horizontal sheets shall be overlapped a minimum of 75 mm. The lapped joints of adjoining sections of sheets shall be secured with screws or pop rivets. On all equipment above 2500 mm diameter and flat surfaces, the sheet shall be further secured by circumferential bands

at approximately 1000mm centers. Each sheet joints shall bitumastic paint. The roof sections shall overlap the side walls to prevent water seepage between insulation and the equipment wall. Side wall sheets be securely banded at intersections of the side wall and roof sections

All equipment manholes, hatches, bolted or screwed cover plates, flanged ends etc., shall have removable box type insulation, with same thickness of insulation as for adjacent surfaces. Insulation adjoining such
Equipment openings shall be tapered towards these openings to permit removal of bolts, screws, heads, covers or plates with no damage to adjacent surface insulation or cover.

Nozzles and other connections on tanks and other equipment shall be insulated in the same manner as the pipes.

Pump casing shall be completely insulated with removable type of boxes fabricated from the specified sheet material. Proper care shall be taken to maintain continuity of vapour barrier between static and removable portion of insulation.

Name plates on equipment shall not be insulated. Proper care shall be taken to eliminate seepage of moisture from such un-insulated portions into the insulating material.

1.13 INSULATION FOR SHEET METAL DUCTING

For Thermal Insulation for ducts, acoustic insulation (duct liner) & under slab insulation it is proposed to use Class “O” type Armaflex / Eurobatex (no alternative makes are acceptable) make closed cell elastomeric foam structure flexible thermal & acoustic insulation.

Insulation of specified thickness of above specified material manufactured as per ASTM E 84 test & which should also meet NFPA 90A supplementary materials for air distribution system which should not absorbs less 0.2% water by volume (ASTM c 209), should not support microbial growth (ASTM C1071, G21, G22) and should emit objectionable odors (ASTM C 665) and should have thermal conductivity of 0.27 (R - 2.78 in 3.4" thickness) and water vapor permeance of 0.10. All joints of the Insulation material should be further covered with 50 mm wide 3 mm thick self adhesive tape made of similar material & Black Cotton Tape shall not be used. The insulation executed on the ducts inside the AHU Room shall be further finished with fiber glass cloth for mechanical protection.

1.14 THICKNESS OF INSULATION

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Sheet Metal Ducting:-

SA & RA ducts passing through un-conditioned areas---------- 25mm

SA & RA ducts passing through conditioned areas---------- 19mm

Note: costing shall be included in insulation over that 24G aluminum cladding for protection, no such extra cost paid for cladding

1.15 ACOUSTIC LINING

Duct liner (Insulation) of specified thickness of above mentioned manufactures manufactured as per ASTM E 84 test & which should also meet NFPA 90A supplementary materials for air distribution system which should not absorbs less 0.2% water by volume (ASTM c 209), should not support microbial growth (ASTM C1071, G21, G22) and should emit objectionable odours (ASTM C 665) and should have thermal conductivity of 0.27 (R - 2.78 in 3.4" thickness) and water vapour permeance of 0.10.

1.16 PHYSICAL DATA / PROPERTIES OF MATERIAL SHOULD BE AS UNDER

Thermal Conductivity at 75 deg F mean Temperature

Thermal Conductivity at 90 deg F mean Microbial: Growth Temperature

Water permeability perm-inch (kg/(s m Pa): Corrosiveness

Flame & smoke rating through 1" 8: Should Not. As per ASTM G 21 (Fungal)

0.276 as per ASTM C 177 or C S18 ASTM G 22 (Bacterial

0.08 as per ASTM E 96 Procedure A Should not. As per ASTM C 665 25 / 50 as per ASTM E 84 CAN ULC S 102 Should Not. As per ASTM C 665

1.17 SOUND ABSORPTION COEFFICIENT AT VARIOUS FREQUENCIES

Thickness	Hz	Hz	Hz	0 Hz	0 Hz	0 Hz	C
5 & 10 mm	0.04	0.07	0.16	0.69	0.18	0.25	0.30
15 & 19 mm	0.00	0.08	0.32	0.55	0.23	0.21	0.30

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Should be as per ASTM C 423 with ASTM E 795 Type “A” Mounting insulation should be again Class “O”

1.18 UNDERDECK INSULATION

Roof Insulation of specified 20 mm thickness of same material as specified for thermal insulation & manufactured as per ASTM E 84 test & which should also meet NFPA 90A supplementary materials for air distribution system which should not absorbs less 0.2% water by volume (ASTM c 209), should not support microbial growth (ASTM C1071, G21, G22) and should emit objectionable odours (ASTM C 665) and should have thermal conductivity of 0.27 (R - 2.78 in 3.4" thickness) and water vapour permeance of

0.10. All joints of the Insulation material should be further covered with 50 mm wide 3 mm thick self adhesive tape made of similar material & Black Cotton Tape shall not be used.

1. VOLUME CONTROL DAMPERS

Dampers shall be opposed blade type. Blades shall be made of double skin airfoil extruded aluminum sections with integral gasket and assembled within a rigid extruded aluminum alloy frame. All linkages and supporting spindles shall be made of aluminium or nylon, turning in Teflon bushes. In case of automatic dampers, sealed ball bearings shall be provided, in place of Teflon bushes. Manual dampers shall be provided with a Bakelite Knob for locking the damper blades I position. Linkages shall be extended for motorized operation if specified in technical requirement data sheets. Damper frames shall be sectionalized to minimize blade warping. Air leakage through dampers when in the closed position shall not exceed1.5% of the maximum design air volume flow rat at the maximum design air total pressure. Manual volume control dampers shall be provided at the discharge side of OA fan, and intake side of the EA fan.

Air Intake Section with Louvered Opening for drawing fresh air

Air intake section of 600 mm deep with louvered opening should be provided for drawing fresh air.

Exhaust air

sections (AC

return air exhaust)

Fan section

Specification

Motor and drive Specification

Volume Control

Dampers

Specification Back

Draft Damper

2. OZONE GENERATOR

Ozone Generator shall be supplied by the reputed manufacturer who exists in this field minimum 10 Years and installed in STP exhaust application.

There is a wide spectrum of possible inorganic and organic molecules, generated in the STP which can create unpleasant odors. Proposed Ozone generator should be a very strong oxidizer and reacts quickly with organic compounds, since there are majorly organic compounds releasing from the STP so ozone reacts with the organic compounds instantly and oxidizes them. Hydrogen sulphide and ammonia are two main parameters restricted by regulations. The concentration of H2S found in the exhaust air of Sewage Treatment Plant is in the range of 5 - 15 ppm. The emission level for ammonia is typical in the range of 50 to 150 ppm.Threshold limit of H2S = 0.002 - 0.15 ppm. Threshold Limit of NH3 = 5 ppm. Ozone generator system should be suitable for achieving reduction in volatile organic compounds, organic odors in indoor environment. Ozone Generator system should not produce any hazardous by- products, NOx (Oxides of Nitrogen) so it will not generate nitric acid, which can damage the Ducts. Feed gas to ozone generator should be industrial grade dry pure oxygen. Oxygen fed gas purity is 90-92%. MOC of Ozone Cell is Stainless/Aluminum with high dissipation design. Dielectric Tubes shall be fabricated of Quartz/ceramic to provide high efficiency dielectric. The Ozone Generator is suitable for operation Sailent Features: on 230V- 50Hz Single phase input power.

1.19 ELECTRICAL EQUIPMENT & INSTALLATION WORKS GENERAL

The scope of work covers execution and completion of the electrical installation work of the proposed project in accordance with drawings and specifications prepared by and under the direction and to the satisfaction of employer.

1.20 RULES & REGULATIONS

The installation shall generally be carried out in conformity with the requirement of Indian Electricity Act 1910 as amended up-to-date and the latest Indian Electricity Rules and supplementary regulations of the State Electricity departments and electricity undertakings. Where the installation is subject to inspection and approval of Fire Insurance and Explosive Authorities, such installation shall be planned and executed to conform their special rules.

1.21 MATERIALS

All materials, fittings and appliances used in the electrical installation shall be of the best quality obtainable and of approved manufacture and shall conform to the latest Indian Standard Specification wherever these exist.

1.22 WORKMANSHIP

Good workmanship and neat appearance are the pre-requisites for compliance with the various sections of these specifications. The work shall be carried out under direct supervision of a person holding

certificate of competency issued by the state government and in accordance with statutory rules and regulations in force. The relevant ISI code of practice shall be followed wherever applicable.

1.23 DRAWINGS

The tender drawings indicate only the general scheme of requirement. Exact position of all points, controls, switch boxes and inspection boxes, main and sub-distribution boards etc., shall be got approved by the Employer before the commencement of the work. Wherever required, detailed drawings shall be prepared and got approved.

The contractor shall provide detailed general arrangement drawing showing each compartments, modules, location of meters and relays etc. and wiring drawing with location of connectors, ferrule nos. Color code of wires etc., before starting of the manufacturing of panel.

The contractor is requested to obtain necessary approval from the Employer before start manufacturing the panel. Any modifications required as per the local authorities shall have to be carried out without any extra cost.

1.24 RATING AND STANDARDS OF MOTORS (HIGH EFFICIENCY ABOVE IE3)

Rating of the motors shall be as indicated under the equipment schedule. Where the equipment supplied needs a higher rated motor, the contractor shall point out the same clearly and make his offer for the higher motor required by his equipment. Ratings shall be on the basis of the specified ambient temperatures, and without exceeding the maximum temperatures specified in IS 325 - 1961 amended upto date.

Unless otherwise stated, Indian Standard Specifications shall apply.

1.25 INDUCTION MOTORS (HIGH EFFICIENCY ABOVE IE3)& STARTERS

All motors 11 kw and below shall be TEFC type with class 'B' insulation conforming to IS25, unless otherwise specified.

Bearings shall be combination of ball and roller bearings with limit lubricators.

Ventilation shall be by means of shaft mounted fans designed to give maximum ventilation with a minimum of noise.

Terminals shall be of ample size housed in a terminal box. Modified sheet metal terminal boxes shall be provided to suit for cable or conduit entry as required. Two earth terminals shall be provided for terminal boxes.

All motors used for open type compressors and for air cooled condensers, shall be provided with IP 55protection.

1.26 STARTER

Unless otherwise specified the following starting methods shall be adopted for the various motors.

Type of Motor	KW	Starting	Maximum Minimum
Squirrel Cage Induction	upto 9.0 to	D.O.L Star/delta	5.0 F.L. 2.0 F.L.0.4 F.L 1.2 F.L

Where the load torque calls for a higher starting torque, (essentially for compressor drive and centrifugal fan drive) the contractor may provide the appropriate type of motor required to meet the load torque.

i. Starters for Sq. cage induction motors shall conform to IS 1822 - 1961 and be the totally enclosed metal clad, dust proof, air enclosed type. The starter shall be suitable for the specified supply system and the ambient conditions.
ii. Semi hermatic compressors cooled by Refrigerant shall be started with part wind starter.
iii. Starters shall be complete with the following protection.
    1. Thermal overload on all the three phases with adjustable settings.
    2. Under voltage protection.
    3. L & T - ES - 100 / EE Single phase preventors. (These shall be provided separately in the panel as part of Electrical Work for all Starters of centralised AC system and only for compressors in Packaged Air conditioners.
    4. Sufficient extra contacts shall be provided for interlocks, indicating lamps etc. Starters for motors of 11.0 kw and above shall be provided with ammeters with CTs wherever required.

1.27 INSULATION FOR MOTORS

All motors shall be provided with two separate earth connections. Size of copper earth shall be equal to the size suitable for the supply conductor but not less than No. 8 copper.

Flexible connections shall be provided to all motor wherever the motor is mounted on slide rails and belt drive is adopted. Even in the case of direct drive the connections shall be flexible enough to prevent transmission of vibration. (Adequate slack to be provided).

1.28 TESTING OF MOTORS (HIGH EFFICIENCY ABOVE 95%)

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Motors shall be tested in accordance with the relevant Indian Standard Specifications and test certificates furnished for routine, type and high voltage tests.

Induction motor upto 37 KW shall be directly tested with 500 volts D.C meggar for one minute. If the insulation resistance is less than two meg ohms, the motor shall be dried out till a steady I.R. value of not less than two meg ohms is achieved.

1.29 ELECTRICAL WORKS

The equipment schedule calls for electrical work under the following heads.Motors and matching starters these shall be offered under the respective heads where called for. Switch boards for Air-conditioning/ventilation system. Electrical power wiring from switch board to individual motors and other equipment.

Control circuit wiring from switch board to individual motors and other equipment. Earthing stations and loop earthing of the equipment.

Note: Item (b) above is detailed with a starter. It is however clearly understood that this starter and ancillaries are the same as called for in (a) above and no duplicaiton of these items, is to be made. Item (c), (d) and (e) - the electrical scope of work shall include for wiring of all controls, interlocks, cabling, earthing etc. upto obtaining electrical inspectorate approval and all similar formalities.

1.30 GENERAL

1 Unless otherwise specified in the tender specification the entire equipment shall be suitable for operating on 400 Volts / 230 Volts, 50 Hz, earthed neutral, 3/1 phase AC system.

2 Electricity quality - motors and other electric equipments shall be operatable at following electricity quality without trouble

Voltage :400V, 3Ph, 230V, 1Ph +5%, -15% variation Cycle :

50 Hz +1%,-7% variation Voltage dip: 5Hz voltage dip shall

be allowed.

3 Control - if other voltage system for control system is required, necessary inbuilt

3.0 transformer shall be provided.

4 All components, accessories raw materials and finished parts used in the manufacture and assembly of switch boards, power and control circuit wiring and earthing system shall comply with the relevant Indian Standards amended upto date.

a) V.The entire work shall comply with I.E.Rules. Particular care shall be taken

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to ensure compliance with rules 41,45,51 and 61.

b) Site conditions

c) Ambient temperature 46 deg C average with 51 deg C peak Humidity 80% maximum Maximum temperature and humidity are likely to occur simultaneously

1.31 POWER WIRING

Three phase motors and other power circuits of the air-conditioning system shall be connected to the main switch board through 3, 3.5, 4 core PVC insulated sheathed cables conforming to IS 1334. The size selections of these cables shall be made taking into account of the maximum rated current of the equipment, ambient temperatures and the applicable de-rating factors.

All cables shall be of approved make only. They shall be of the **PVC Copper Armoured and installed in tight** fittings of treated brass glands and sockets. The cable sizing shall be done based on the manufacturer's data.

Each individual motor feeder shall have a continuous capacity of at least 125% of the motor full load current. The minimum capacity of a cable supplying a group of motors should be at least equal to the sum of the full load current ratings of all the motors plus 25% of the full load current rating of the largest motor in the group.

Cables shall be laid directly in ground or alternatively clamped in suitable metalic cable trays suspended from the ceiling or mounted on the walls. Wherever cables are laid underground, they shall be of the armoured type. The termination of cable sockets shall be of adequate dimensions. The cable conductors shall be crimped or soldered into these cable sockets. In the case of soldered joints, care should be taken to remove the oxide film through the use of appropriate type of flux .

Cables shall be laid generally in accordance with Indian Standard Codes of practice.

Cables shall be laid in trenches or buried or carried on walls as stated in the schedule, or approved by the EmployerWere more than one cable is running, proper spacing shall be provided to minimise the loss in the current carrying capacity.

The control cables shall be suitably supported with wooden cleats fixed on M.S. supports when run on walls or in a trench.

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The cables in trenches shall not be laid loose or haphazardly and shall be tied up so that cooling of cables can be effective.When burried they shall be covered with a layer of soft shifted earth and protected with cement concrete tiles.

Special care shall be taken to ensure that no undue stress is caused on the insulation. (to a radius of not less than 20 times the overall diameter).

When cables pass through pipes, wooden bushes shall be provided at the ends. When these pass through floors and walls the cable holes shall be sealed.

All cables shall have identification tags and shall be supported at close intervals to avoid strain on the glands.

For the cables to be directly buried in ground, the scope of Air-conditioning contractor shall include excavation of trenches, supply of sand, bricks, concrete troughs, cable markers and back filling of trenches with river sand.

1.32 ISOLATING SWITCHES

Isolating switches or lockable type on & off stations shall be provided for isolation of each motor in emergency in accordance with IS 900 - "Code of practice for installation and maintenance of induction motors".

All equipment's away from the main switchboard requiring isolators close to their location shall be fitted with such isolators. Isolators will be complete with sheet steel enclosures, mounted in an approved manner on free standing angle iron frames.

Double door constructions conforming to IP-55 grade of protection and epoxy coated isolators shall be mounted in an approved manner for the equipment's located in exposed atmosphere.

1.33 EARTHING

The Contractor shall provide earthing to ISI requirements. All the work shall be done to the satisfaction of the Electrical Inspectoriate / concerned authorities.

1.34 SIZE FOR EARTHING OF ALL EQUIPMENTS AND SWITCHBOARDS

The main panel shall be connected to the main earth bus by means of two numbers 50mm X 6mm GI strips. All switches, isolators db's and conduits shall be connected to the earth and the sizes of the earth conductors selected for various equipments shall be as follows:

1.

Cross sectional area of the size of earth conductor (Current carrying conductor Sqmm)

400V motor control centre 6mm - GI strip	50mmX
LT AC motor 150 to 200 kw 6mm - GI strip	50mmX
LT AC motor 110 to 132 kw 6mm - GI strip	40mmX
LT AC motor 55 to 90 kw 6mm - GI strip	25mmX
LT AC motor 15 to 45 kw 6mm - GI strip	25mmX
LT AC motor 3.75to 11 kw stranded GI wire	16sqmm
LT AC motor 0.75to 2.2 kw stranded GI wire	6sqmm
Control desk, control post stranded GI wire	50sqmm
Isolatorand socket outlet stranded GI wire Above 16A and upto and Including 100A	50sqm
Push button station, limit Switches, switch boxes stranded GI wire Isolators and socket outlets	6sqmm Upto 16A

The branch earth lines from the main panel to earth equipments shall be separated and should not criss- cross other lines. Earthing shall not be done by looping from one board. If screws slackens, all connection after that become ineffective. So it should be tied up or welded by running earth bus at convenient places and giving short and rigid lugs to the switches and glands.The earth resistance of the earth pit shall be measured and the Contractor shall submit a record of measurement so obtained.

1. MODE OF MEASUREMENTS

Representatives from the Contractor and Department shall conduct a joint inspection of the equipments. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report.

An approved metallic tape shall be used at site and utmost care shall be taken to see that the same is preserved in good conditions throughout the period of execution.

The entire refrigeration unit/Chillers with all accessories, starters, controls, control panels, control wiring, vibration mounts, local control stations, discharge side plenum for direct throw units, floor mounting MS angle iron base, wall mounting MS angle brackets, protection grill for condensing unit, suspension arrangement, refrigerant piping, refrigerant charge oil, erection, commissioning and testing shall be regarded as one unit for the purposes of measurement and payment. Refrigeration piping and its insulation will also form a part of refrigeration/chillers unit and hence no measurement will be carried out the same.

All sheet metal ducting complete with duct supports, hangers, vibration isolation pads, turning vanes, girth angles, flanges and gaskets, access panels, turning vanes, erected in position shall be measured externally and paid per unit area. All duct dampers shall be included in the duct area.

All manual control / splitter damper sections with operating linkages, locking, quadrant, sheet steel enclosure, frame, erection, supporting etc., shall be measured on the basis of damper cross sectional area and paid per unit area.

Intake louvers with bird screen, sheet steel louvers and control damper, frame, erection etc., shall be measured on the basis of cross sectional area and paid per unit area. Side wall grilles shall be measured on the basis of the core area excluding the margin flange and the unit rate shall include necessary frames. Ceiling diffusers also shall be measured on the basis of the core area excluding margin flanges and the unit rate shall include necessary frames and dampers. Area of duct insulation finished as per specification shall be calculated on the basis of finished duct area before insulation and paid at unit area. Air handling unit/Packaged unit insulation along with supply and return air plenum insulation shall form one unit.

Acoustic insulation shall be calculated on basis of external duct size and paid for per unit area. Room acoustic insulation shall be calculated on the basis of the finished area and paid for per unit area.

All painting shall form part of the cost of equipment, piping etc. No separate payment shall be admissible.

The unit rate for the cables includes the cost of cables and clamps, installation, commissioning and testing, cable marks or ceiling support.

The distribution board shall be considered as one unit and shall include:

Incoming and outgoing feeders Interconnections, controls and instrument wiring

Meters, relays, indicating lamps, CTS, control fuses etc. Supporting structure, sheet steel enclosure. Installation and testing.

All water pipes shall be measured net length as laid or fixed and measured linear over all fittings such as bends junction etc., and given in running meters. The length shall be taken along the centre-lines of the pipes and fittings. Length of other fittings (valves and strainers) which are paid under appropriate item shall not be re-measured under linear measurement, but they will be measured by number and paid separately.

1. TESTING

Routine and type test for various items of equipment shall be performed at the Contractor works and test certificates shall be furnished. If required by the Client, his authorized representative shall be permitted to be present during the tests.

After notification to the Client that the installation has been completed, the Contractor shall make under the direction of Client such tests and inspections as have been specified or as the Client shall consider necessary to determine whether or not the full intent of the specifications have been fulfilled and whether further tests shall be considered necessary. The Contractor shall bear all the expenses thereof.

The contractor shall operate, test and adjust all Air-conditioning, ventilation and exhaust system units, fan motors, all air handling appliances provided in connection with the installation and shall make all necessary adjustments and corrections thereof including the adjustments of all regulating dampers. A carefully detailed record of the results of these adjustments shall be furnished to and be subject to the approval of the Client.

2. 1.14.0 PERFORMANCE TEST

A performance test by keeping the plant running for a period of 72 hrs.shall be carried out in peak summer, peak monsoon and peak winter periods. During the tests reading shall be taken hourly. From the readings so taken, the Contractor shall also establish the plant capacity. The computed results shall tally with the specified capacities furnished with Tender.

All the test equipment, instruments, labor, operating personnel, oil and refrigerant required for these tests shall be furnished by the Contractor at his own cost.

If the tests do not show satisfactory result, the Contractor shall at hisown

cost, rectify/replace the defective installation or part thereof as directed by the Client within two months. The decision of the Client shall be final and binding in this respect. Only after all these tests are satisfactorily completed and the defects found during these are rectified, the plant will be finally accepted.

1.14.1 TEST READINGS

The following minimum test readings will be taken to assess the performance of the plant.

1. Compressor — Refrigerant gas, suction pressure(PSIG)

   Refrigerant gas, suction temperature (DegC)
   Refrigerant gas, discharge pressure (PSIG)

   75% load

   50% load

2. Condensers
   Refrigerant condensing pressure (PSIG) Refrigerant condensing temperature (DegC) Air flow rate - (lps)

   Air temperature - Leaving/Entering(DegC)

3. Air handling units Air quantity (CMH/Static Pressure)
   Coil entering condition (DB/WB) Coil leaving aircondition (DB/WB) Canvass temperature(DB/WB)

4. Motors
   Amperage Voltage Single phase trip time Power factor

3. TESTING GAURANTEE

All equipments and space conditions shall be tested after carrying out necessary adjustments and balancing to establish the equipment ratings and indoor space conditions. At least four sets of readings shall be taken daily for each item tested and submitted in the form shown separately.

Instruments required for testing shall be furnished by the Contractor All equipment shall be guaranteed for the specified ratings plus/minus 3% tolerance.

All equipments and the entire installation shall be guaranteed against defective materials and workmanship for a period of 24 (Twenty four) months from the date, the equipment and installation are handed over.

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CHAPTER E - TECHNICAL SPECIFICATIONS OF ELV (IBMS & BMS WORKS)

1.00 CCTV

1.0.1 5MP VF Dome Camera

The following are the technical parameters for the 5MP VF Dome Camera:		
S. No.	Features	Description
1.	Camera Type	Varifocal Dome Camera
2.	Edge Storage	MicroSD/microSDHC/microSDXCslot supporting memory card for min. 256 GB (Min. Class 6 or higher, Card to be included). In the event of failure of connectivity to the network storage the camera shall record video locally on the SD card automatically. After the connectivity is restored these recordings shall be automatically merged with the network storage recording such that no manual intervention is required to transfer the SD card based recordings to network storage.
3.	Image Sensor	1/2.8" CMOS or better
4.	Resolution	Min. 2592 × 1944 at 25 FPS or better
5.	Video Compression	H.264, H.265
6.	Audio Compression	G.711ulaw/G.711alaw/G.722.1/G.726/MP2L2/PCM/MP3/AAC, Should support Environment Noise Filtering
7.	Streaming	Min. three compressed stream (Individually Configurable)
8.	ID/Password	Multi-level user ID/Password
9.	Encryption	HTTP(SSL/TLS)/HTTPS
10.	Simultaneous Live View	Up to 6 channels
11.	Physical Layer	10/100 base Tx Ethernet
12.	Security	Password protection, complicated password, HTTPS encryption, IP address filter
13.	Protocol	TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, NTP, UPnP, SMTP, IGMP, 802.1X, QoS, IPv4, IPv6, UDP, Bonjour, SSL/TLS, PPPoE, ARP
14.	Lens Type	2.7 to 13.5 mm, Varifocal, with Auto-Iris
15.	Alarm	2 inputs, 2 outputs
16.	Audio	1 inputs, 1 output
17.	Image Enhancement	BLC, HLC, 3D DNR, AGC

18.	Image Parameters Switch	Yes
19.	Image Settings	Rotate mode, saturation, brightness, contrast, sharpness, gain, white balance adjustable by client software or web browser
20.	Target Cropping	Yes
21.	Illumination	Color: 0.002 Lux @ (F1.4, AGC ON), B/W: 0 Lux with IR
22.	IR Range	Upto 40 Mtr
23.	Signal Process	Digital Signal Process
24.	Privacy Mask	Yes
25.	Electronic Shutter	1/3 s to 1/100,000 s with slow shutter support
26.	Wide Dynamic Range	120dB
27.	Day and Night	Day, Night, Auto, Schedule
28.	Operating Temperature	-30 °C to +60 °C Humidity 95% or less (non-condensing)
29.	Internet protocol Support	IPv4 and IPv6
30.	Housing	IP67, IK 10
31.	Edge based video content Analytics	Line crossing detection, Intrusion detection, Motion Detection, Video tampering, Scene change detection, Audio exception detection, Face Capture, Unattended baggage detection, Object removal detection, Region entrance detection, Region exiting detection, The system focuses on human and vehicle targets, vastly improving alarm efficiency and effectiveness
32.	Power Source	12 VDC, PoE: 802.3af Class 3
33.	Certification	UL,CE,FCC,BIS

1.0.2 5MP VF Bullet Camera

The following are the technical parameters for the 5MP VF Bullet Camera:		
S. No.	Features	Description
1.	Camera Type	Varifocal Bullet Camera
2.	Edge Storage	MicroSD/microSDHC/microSDXCslot supporting memory card for min. 256 GB (Min. Class 6 or higher, Card to be included). In the event of failure of connectivity to the network storage the camera shall record video locally on the SD card automatically. After the connectivity is restored these recordings shall be automatically merged with the network storage recording such that

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		no manual intervention is required to transfer the SD card based recordings to network storage.
3.	Image Sensor	1/2.7" CMOS or better
4.	Resolution	Min. 2592 × 1944 at 25 FPS or better
5.	Video Compression	H.264, H.265
6.	Audio Compression	G.711ulaw/G.711alaw/G.722.1/G.726/MP2L2/PCM/MP3/AAC, Should support Environment Noise Filtering
7.	Streaming	Min. three compressed stream (Individually Configurable)
8.	ID/Password	Multi-level user ID/Password
9.	Encryption	HTTP(SSL/TLS)/HTTPS
10.	Simultaneous Live View	Up to 6 channels
11.	Physical Layer	10/100 base Tx Ethernet
12.	Security	Password protection, complicated password, HTTPS encryption, IP address filter
13.	Protocol	TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, NTP, UPnP, SMTP, IGMP, 802.1X, QoS, IPv4, IPv6, UDP, Bonjour, SSL/TLS, PPPoE, ARP
14.	Lens Type	2.7 to 13.5 mm, Varifocal, with Auto-Iris
15.	Alarm	2 inputs, 2 outputs
16.	Audio	1 inputs, 1 output
17.	Image Enhancement	BLC, HLC, 3D DNR, AGC
18.	Image Parameters Switch	Yes
19.	Image Settings	Rotate mode, saturation, brightness, contrast, sharpness, gain, white balance adjustable by client software or web browser
20.	Target Cropping	Yes
21.	Illumination	Color: 0.003 Lux or better at (F1.4, AGC ON), 0 Lux with IR
22.	IR Range	Upto 60 Mtr
23.	Signal Process	Digital Signal Process
24.	Privacy Mask	Yes
25.	Electronic Shutter	1/3 s to 1/100,000 s with slow shutter support
26.	Wide Dynamic Range	120dB
27.	Day and Night	Day, Night, Auto, Schedule

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28.	Operating Temperature	-30 °C to +60 °C Humidity 95% or less (non-condensing)
29.	Internet protocol Support	IPv4 and IPv6
30.	Housing	IP67, IK 10
31.	Edge based video content Analytics	Line crossing detection, Intrusion detection, Motion Detection, Video tampering, Scene change detection, Audio exception detection, Face Capture, Unattended baggage detection, Object removal detection, Region entrance detection, Region exiting detection, The system focuses on human and vehicle targets, vastly improving alarm efficiency and effectiveness
32.	Power Source	12 VDC, PoE: 802.3at/af
33.	Certification	UL,CE,FCC,BIS

1.0.3. 32CH Network Video Recorder

Video and Audio

IP Video Input 32-ch

Incoming Bandwidth 256 Mbps

Outgoing Bandwidth 160 Mbps

HDMI Output 1-ch, 4K (3840 × 2160)/30Hz, 2K (2560 × 1440)/60Hz, 1920 × 1080/60Hz,

1600 × 1200/60Hz, 1280 × 1024/60Hz, 1280 × 720/60Hz, 1024 × 768/60Hz

VGA Output 1-ch, 1920 × 1080/60Hz, 1280 × 1024/60Hz, 1280 × 720/60Hz

Video Output Mode HDMI/VGA independent output

CVBS Output N/A

Audio Output 1-ch, RCA (Linear, 1 KΩ)

Two-Way Audio 1-ch, RCA (2.0 Vp-p, 1 KΩ, using the audio input)

Decoding

Decoding Format H.265/H.265+/H.264+/H.264

Recording Resolution 12 MP/8 MP/6 MP/5 MP/4 MP/3 MP/1080p/UXGA/

720p/VGA/4CIF/DCIF/2CIF/CIF/QCIF

Synchronous playback 16-ch

Network

Remote Connection 128

API ONVIF (profile S/G); SDK; ISAPI

Compatible Browser IE11, Chrome V57, Firefox V52, Safari V12, Edge V89, or above version

Network Protocol TCP/IP, DHCP, IPv4, IPv6, DNS, DDNS, NTP, RTSP, SADP, SMTP, SNMP, NFS, iSCSI, ISUP, UPnP™, HTTP, HTTPS

Network Interface 2 RJ-45 10/100/1000 Mbps self-adaptive Ethernet interfaces

1.0.4 Auxiliary Interface

SATA 4 SATA interfaces

Capacity Up to 10 TB capacity for each HDD

Serial Interface 2 RS-485 (half-duplex), 1 RS-232

Alarm In/Out 16/4 (16/9 is optional)

USB Interface Front panel: 2 × USB 2.0; Rear panel: 1 × USB 3.0

General

Power Supply 100 to 240 VAC, 50 to 60Hz

Consumption ≤ 20 W (without HDD)

Working Temperature -10 °C to 55 °C (14 °F to 131 °F)

Working Humidity 10 to 90 %

2.0.0 VIDEO INTERCOM MASTER STATION

I. System parameters

Processor High-Performance Embedded SOC Processor

Operation system Embedded Linux Operation System

II. Video parameters

Camera CMOS 0.3 MP

Video compression standard H.264

Resolution 1280 x 720, 704 x 576

Video frame rate 25 fps, 12.5 fps

III. Display parameters

Display screen 7-Inch Colorful TFT LCD

Display resolution 1024 × 600

Operation method Capacitive Touch Screen, Touch Key, Physical Button

Operation interface Flattened UI Operation Interface

IV. Audio parameters

Audio input Built-in Omnidirectional Microphone + External Handset

Audio output Built-in Loudspeaker + External Handset

Audio compression standard G.711 U

Audio compression rate 64 Kbps

Audio quality Noise Suppression and Echo Cancellation

V. Network parameters

Ethernet 10/100/1000 Mbps Self-Adaptive Ethernet

Network protocol TCP/IP, RTSP Device interfaces

Network interface 1 RJ-45 10/100/1000 Mbps Self-Adaptive Ethernet Interface

RS-485 2 RS-485 Half-Duplex Port

USB 1 USB Interface for Inserting U-Disk

I/O input 4 On-Off Input

I/O output 2 On-Off Output, 2 Relay Output

VI. General parameters

Material Plastic

Power supply 12 VDC

Power consumption ≤10 W

Working temperature -10° C to + 55° C (14° F to 131° F)

Working humidity 10% to 90%

Certification FCC, IC, CE, C-TICK, ROHS, REACH, WEEE

2.0.1 VIDEO INTERCOM NETWORK INDOOR STATION

I. General

Power supply IEEE802.3af, standard PoE 12 VDC/1 A

Power consumption ≤ 6 W

Working temperature -10 °C to 55 °C (14 °F to 131 °F)

Working humidity 10% to 90%

II. System parameters

Memory 128 MB

Flash 32 MB

Operation system Embedded Linux operation system

III. Display parameters

Display screen 7-inch colorful TFT screen

Display resolution 1024 × 600

Operation method Capacitive touch screen

IV. Audio parameters

Audio input Built-in omnidirectional microphone

Audio output Built-in loudspeaker

Audio compression standard G.711 U

Audio compression rate 64 Kbps

Audio quality Noise suppression and echo cancellation

V. Network parameters

Wired network 10/100 Mbps self-adaptive

Alarm input 8-ch alarm inputs

Relay output 2

RS485 1

3.0.0 WIRELESS ACCESS POINT

A wireless access point (WAP) is a hardware device or configured node on a local area network (LAN) that allows wireless capable devices and wired networks to connect through a wireless standard, including Wi-Fi or Bluetooth. WAPs feature radio transmitters and antennae, which facilitate connectivity between devices and the Internet or a network.

3.1.1 KEY FEATURES

- 2.03 Gbps wireless throughput and 2 Gigabit wireline ports 5GHz 4×4:4 MU-MIMO
- Supports up to 200 concurrent Wi-Fi client devices
- Advanced QoS to ensure real-time performance of low-latency applications
- Anti-hacking secure boot and critical data/control lockdown via digital signatures, unique security certificate/random default password per device
- Self-power adaptation upon auto detection of PoE or PoE+
- Embedded controller can manage up to 30 local GWN series APs;
- GWN.Cloud offers unlimited AP management; GWN Manager offers premise based software controller

3.1.2 TECHNICAL SPECIFICATIONS

• Wi-Fi Standards IEEE	:	802.11 a/b/g/n/ac (Wave-2)
• Frequency Bands	:	2.4GHz Radio: 2412 - 2484 MHz 5GHz Radio: 5180 - 5825 MHz
• Network Protocols	:	IPv4, IPv6, 802.1Q, 802.1p, 802.1x, 802.11e/WMM
• Dimension	:	205.3mm(L)x205.3mm(W)x45.9mm(H)
• Weight	:	530g

4.0.0 Lighting Automation:

"Lighting automation" is a broad term, encompassing everything from a one-room scene-control system to a whole house system controlling interior lighting. It may be stand-alone, whole house, offer a room and/or house control, and be tied into the security system, or a complete home automation system.

4.1 Processor Unit

Modular Programming Architecture

Designed for enhanced scalability, the processor affords high-speed, real-time multi-tasking to seamlessly run multiple programs simultaneously. This exclusive modular programming architecture lets programmers independently develop and run device-specific programs for AV, lighting, shades, HVAC, security, etc., allowing for the optimization of each program, and allowing changes to be made to one program without affecting the whole. Even as your system grows, processing resources can easily be shifted from oneprocessor to another without rewriting any code. The end benefit is dramatically simplified upgradability with minimal downtime, whether implementing changes on-site or remotely via the network.

Ethernet & IP Control

IP technology is the heart of Processor, so it should be no surprise that its networking abilities are second to none. High-speed Ethernet connectivity enables integration with IP-controllable devices and allows the Processor to be part of a larger managed control network. Whether residing on a sensitive corporate LAN, a home network, or accessing the Internet through a cable modem, the Processor provides secure, reliable interconnectivity with IP-enabled touch screens, computers, mobile devices, video displays, media servers, security systems, lighting, HVAC, and other equipment — whether on-premises or across the globe.

Key Features

- Enterprise-class control system
- Substantially faster and more powerful control systems
- Exclusive modular programming architecture
- Onboard RAM (2 GB) & Flash memory (up to 8 GB)
- Expandable storage up to 3 TB
- memory card slot

- High-speed USB 2.0 host port and computer console port
- Industry-standard Ethernet and Proprietary wired communications
- Smart Graphics computer and web-based control
- iPhone, iPad, and Android control app support
- SNMP remote management support
- One RS-232/422/485 COM port with hardware and software handshaking
- RS-232 COM ports with software handshaking only
- IR/serial, relay, and Digital I/O ports
- Programmable event scheduling with astronomical time clock
- Installer setup via industrial grade software or web browser
- Increased network throughput and security
- Hardware level security using 802.1X authentication
- TLS, SSL, SSH, and SFTP network security protocols
- IPv6 ready
- 1-space rack-mountable

4.2 Power Supply Module

Power Supply module designed to snap onto a standard DIN rail for installation in a wall-mount enclosure. DIN rail mounting enables modular installation alongside DIN Rail lighting and automation control modules and other third-party DIN rail-mountable devices. All wiring connections are made using screw terminals positioned along the top and bottom of the unit, which is clearly accessible from the front for easy installation and servicing. Six NET power ports are provided.

Key Features

- 60 W power supply module
- Powers the Processor and other devices in the NET bus
- Includes six NET power ports
- 6M wide DIN rail mounting
- 100-277 Volt AC line powered

Technical specifications

- Line Power : 200 VA (2 A max) at 100-277 V AC, 50/60 Hz
- Input Current : 0.65 Amps at 230 Volts AC
- Power Consumption : 70 W @ full rated output
- Output rating : 60 W @ 24 V DC

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- Efficiency : 93 %
- NET Connection : 4-pin 3.5 mm detachable terminal blocks
- Temperature(Env) : 0° to 40° C
- Humidity (Env) : 10% to 90% RH
- Heat Dissipation : 26 BTU/hr
- Dimensions : 94 mm (H) x 108 mm (W) x 58 mm (D)

4.3 Distribution HUB

1. The HUB is a rail-mounted NET hub designed to facilitate the configuration of large NET networks. DIN rail mounting enables modular installation alongside DIN Rail lighting and automation control modules and other third-party DIN rail mountable devices.
2. NET is the communications backbone for lighting modules, wall box dimmers, shadecontrollers, thermostats, keypads, and many other devices. This flexible 4-wire bus normally supports approximately 32 devices without requiring a hub. The HUB features 3 isolated NET segments, each supporting an additional 24 devices, allowing for systems of approximately 80 devices total.

Key Features

- 3-segment NET hub
- For NET networks with more than 32 devices
- Configurable power distribution
- No programming required
- 6M wide DIN rail mounting

Technical specifications

- NET power Usage : 1 W
- Temperature (Env) : 0° to 40°C
- Humidity (Env) : 10% to 90% RH
- Heat Dissipation : 2 BTU/hr
- Dimensions : 94 mm (H) x 106 mm (W) x 58 mm (D)

4.4 Distribution Block

1. The Distribution Block is a rail-mounted NET distribution block designed to facilitate the termination of NET wiring at a head end or distribution point. DIN rail mounting enables modular installation alongside lighting and automation control modules and other third-party DIN rail mountable devices.

Key Features

- 14 port NET distribution block
- Detachable screw terminal blocks for easy termination and troubleshooting

- Split power bus for flexible 24V power distribution
- Diagnostic LEDs for network power and data
- Passive device — no programming required
- 6M wide DIN rail mounting

Technical specifications

- NET Power Usage - 1 W (0.01 A @ 24 V DC)
- Temperature (Env) - 0° to 40°C
- Humidity (Env) - 10% to 90% RH
- Heat Dissipation - 1 BTU/hr
- Dimensions - 96 mm (H) x 106 mm (W) x 60 mm (D)

4.5 On/Off Relay Module

The On/Off relay module is an 8-channel lighting control module designed to support non-dimmable lighting and fan switching. In addition, the Relay module features eight isolated digital inputs, allowing standard momentary switches to trigger events with or without a control system. Each channel handles incandescent loads up to 10 Amps, fluorescent loads up to 5 Amps, and 1/2 HP motor loads.

An override input is provided to allow an external contact closure to momentarily override the control system program and set each channel output to its override preset state. States can be set and saved locally from the front panel or remotely via software.

Key Features

- 8 channels of power switching
- 8 voltage-driven isolated digital inputs
- Support for 120 to 240 V lighting and motor loads
- Override input
- NET communications
- Setup via front panel or software
- Programmable functionality

Technical specifications

- Inputs : 8 pin detachable terminal blocks; Rated 12-24 V DC
- NET : 4-pin detachable terminal blocks, paralleled
- Override : 2-pin detachable terminal blocks, paralleled
- Power Usage : 6 Watts
- Temperature (Env) : 0° to 40° C
- Humidity (Env) : 10% to 90% RH
- Heat Dissipation : 18 BTU/hr
- Dimensions : 100 mm (H) x 170 mm (W) x 80 mm (D)

4.6 Dimmer Module

Standard Dimmer Modules provide cost-effective digital forward phase angle dimming for standard loads such as incandescent, low voltage, quartz, neon, cold-cathode and 2 and 4-wire fluorescent ballasts. The patented, high-density, dual modules feature modular installation and removal, fully magnetic circuit breakers and standard or enhanced risetime toroidal filters.

This Dimmer module is a DIN rail mounted lighting control module with four channels of dimming. A single model supports both 120 and 220-277 V electronic and magnetic low-voltage, incandescent, neon/cold cathode, 2-wire dimmable fluorescent, and non-dimmable lighting loads up to 5 Amps per channel, 10 Amps total.

Proprietary zero cross filter technology provides superior immunity to noise on the power line, reducing lamp flicker and compensating for fluctuations in line voltage and frequency.

An override input is provided to allow an external contact closure to momentarily override the control system program and set each channel output to its override preset level. Levels can be adjusted and saved locally from the front panel, or remotely via software.

Key Features

- 4 channels of dimming
- 120 to 277 V 50/60 Hz operation
- Selectable non-dim mode
- Master air-gap relay
- Override input
- NET communications
- Setup via front panel or software
- Programmable functionality

Technical specifications

- Input Voltage : 120 to 277 V AC, 50/60 Hz
- NET Power Usage : 1 W
- Dimmer Channels : 4
- Max Per Channel : 5 A (1150 W @ 230 V AC)
- Module Total : 10 A(2300 W @ 230 V AC)

Key Features

This Keypad (Switches) offers an attractive, customizable wall mount keypad for use in controlling lighting, shades, AV, and other functions in any residential or commercial application. It installs in a single-gang European or UK electrical box and is available in different textured finishes.

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Customizable buttons – the keypad can be configured easily by the installer to provide the precise control functionality required by the end customer. Its two columns of buttons are each independently configurable using one of three furnished button strips as follows:
Set of two large buttons (or) set of three medium buttons (or) set of one medium and four small buttons.
Each button position is accompanied by a white LED indicator, which may be configured to confirm a button press, indicate the currently selected lighting scene, or display the active state of a controlled device.

Key Features

- Stylish and versatile wall mount keypad
- Single-gang UK/European electrical box installation
- Available in textured almond, black, or white
- Variable pushbutton combinations
- Programmable “button events” enable multiple functions per button
- White LED feedback indicators & Auto-brightness control for backlight and LED intensity
- 2 contact closure inputs
- Fully programmable

Technical specifications

- NET Power usage :0.6 W
- Connectors (NET) : 4 Captive screw terminals.
- Dimensions :87 mm (H) x 87 mm (W) x 38 mm (D)

4.7 Occupancy Sensor

An occupancy sensor is an indoor motion-detecting device used to detect the presence of a person to automatically control lights or systems. The sensors use microwaves to detect motions. While lights will be automatically turned ON when motion is detected and automatically turn OFF after some time when motion is no longer detected.

Key Features

- Microwave Base
- LUX, Time & Sensitivity adjustable
- Highly Sensitive

Technical specifications

- Detection Range : 360 degrees
- Power Source : 220-240V AC
- Power Frequency : 50 /60Hz
- Rated Load : Max 2000 W for Incandescent
  Max 1000W for Fluorescent.
- Detection Distance : 1-8m (radius)adjustable
- Time Delay : 10sec±3sec to Max. 12min±1min
- Ambient Light : <3-2000LUX(adjustable)
- Detection Motion Speed : 0.6-1.5m/s
- Installation Height : 2 – 6 meters

4.8 Motorized Curtain Controls

Your curtains will gently roll out on their own when it's time for you to wake up. Don't let the burglars know you're away from home. Make your curtains roll in and out at pre-set times throughout the day so strangers never know you're on a holiday! Insulate your glass windows from the cold in winter and keep your home cool in the Summer. Use KIOT Curtain Controller to maintain the optimum temperature in your home. Simply apply a temperature control routine on your curtains.

Key Features

- Noise Neutral Motor
- Compatible with automation platforms
- Intelligent Motor
- Manual Override in case of power failure
- Five Wired Motor

Technical specifications

- Rated Torque : 1.5 Nm
- Rated RPM : 100 rpm
- Rated Voltage : AC100-240V 50/60 Hz
- Rated Power : 65W
- IP Class : IP20

- Speed : 16 cm/s
- Motor Dimensions (in mm) : 316 x 68 x 53
- Noise : < 35 dB
- Max. Fabric Load Capacity : 50 kgs

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CHAPTER F - TECHNICAL SPECIFICATION FOR ELECTRICAL WORKS

PREAMBLE TO THE ELECTRICAL INSTALLATION FOR THE PROPOSED CONSTRUCTION OF EXECUTIVE QUARTERS (BASEMENT + SILT + 5 FLOORS) AFTER DEMOLITION OF OLD BUILDING AT NO. 75, MUSIRI SUBRAMANIAM SALAI (FORMERLY OLIVER ROAD), MYLAPORE, CHENNAI – 600 004.

- The Total expected is 275KW with an expected maximum demand of 137KW. The expected maximum demand is well within the limit of LT. (Refer Load List & SLD for details of loads)
- For lighting up the road, Street Lighting poles has been introduced to obtain required light level.
- LT Panel will have control devices to control input supply from Transformer & DG set.
- The LV Power control Centre will be equipped to feed the following major loads.
- Feeder for Auto-power factor control.
- Feeder for street light, Utility, Security
- Feeder for Fire Pump.
- Feeder for commercial building.

Towards charges for CEIG drawing approval, obtaining safety certificate, Demand Charges, Liasioning charges, including defects report rectifications, etc., to the total installation.

The total work to be completed to match with the completion time of other related works by the client. Hence the work must be done in nights or at late in the evening, etc. The rate quoted shall be for this kind of work.

The rates presently quoted can be applicable to other works or additional works apart from the bill of quantities included now. Hence the bidder should accept extension of this work to other areas with similar items of work at the same rates.

Approval from Electricity Board, MSES & CEIG, to be obtained for the works included in this tender. MSES comments during inspection to be rectified at free of cost including obtaining safety certificate etc.

The installation covered in this tender to be carried out as per relevant codes and practices. All materials used shall have prior approval from Client /Architect/Consultant before installation/procurement. No deviation in this regard will be entertained. Annexure to Preamble on the division of responsibilities & samples shall form part of the contract.

Charges quoted shall include preparation of as-built drawings, (duly coloured for various activities), in quadruplicate to the client, with additional copy to the Architect.

Provision of construction power and lighting shall form part of electrical contractor's scope.

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The temporary power supply shall be in the form of portable M.S self-supporting stand with adequate number of 6/16A & 20A power outlets duly wired in. It shall be separate for each floor. The temporary lighting including light fixture shall be included in this scope. The input & output wires/cables shall be FRLS PVC insulated PVC sheathed wires with **RESIDUAL CURRENT CIRCUIT BREAKER as PROTECTION.** This should be treated part of scope of work of Electrical contractor. The above arrangement is to achieve safety to human being.
No temporary or loose wires are permitted in the construction site.
The scope of work includes supply and installation of the following:

- Execution of the entire work with skilled work force, supervisor & Engineers acceptable to client / Architect.
- Day to day reporting system to deliver quality & quantity of work.
- Co-ordination with other agencies to obtain trouble free work front at site.
- All codes & practices, security system, entry & exit procedures, safety standards, etc. required by the client to be included in this scope of work.
- All incoming & outgoing cables connected from top of all switch boards & distribution boards shall be coated with FM approved “Fire retardant coating” up to minimum height of 1200mm.
- Wall opening and closing of opening for cable tray, bus duct, cable, conduit, etc. to be done as per Fire Regulations. The regulation for fire protection shall be as per fire regulation recommended by Fire Consultant. Refer detailed GA drawings of wall openings & floor openings, core cuts, pipe inserts for cable & earthing entry, etc. provided by Architects/Fire consultant. The fire consultant requirements to be followed for the entire installation.

- ***Drawing approval from CEIG/CEA, Inspection, rectification & report, completion certificates, obtain safety certificate & as fitted drawing, etc.***

All works, covered in the schedule of work shall be complete in all respect and any material required for total completion of each item shall be included in the rates, specifically mentioned or not in the schedule of work.

It is the responsibility of the contractor to carry out all connected civil works related with the installation. Only final touch up, wall finishing, etc., will be done by other agency.

Storing of materials, providing necessary security arrangement for your materials, etc., shall have to be taken care of by you. Since this being a time bound project utmost co-operation and liaison work to be given to the other agencies involved in the installation.

The work force like supervisors, senior electricians, wiremen, etc., should posse’s valid license issued by licensing authorities. They shall have adequate knowledge in carrying out such type of electrical installation connected with electrical work. If workmen found not efficient/knowledgeable, etc., they will be discontinued from the work spot at the direction of

the Architect/Consultant/Client. Neat workmanship is required for all the works involved in this project as per the special conditions, technical specification and drawings. Client norms are also applicable wherever required.

Important:

1. **The final As-built drawings to be submitted in triplicate with 2 sets of soft copy in Pen drive, as and when the works are completed. In addition to As-built drawing soft copy of the drawing to be submitted in Pen drive format.**

2. **Various Unit Rates have been established to carryout various works. These items can be used to an extend required for other areas. Hence rates quoted shall be applicable till completion of such works.**

3. **All tests described in the document shall be carried out in the field prior to commissioning the equipments to demonstrate that the equipments performance guarantees are met, equipments are properly installed, correctly adjusted & commissioning to be carried out & suitable for commercial operation. The sequence of testing & Method of statement, stages of testing & schedule for testing & commissioning is to be submitted by the successful bidder for Architects/Consultant approval.**

4. **All vendor & shop drawing to be submitted with Soft copy and in Pen drive for review/approval. Once the approval is confirmed in soft copy, 3 sets of hard copies shall be submitted for sign-off, parallelly the work can commence with soft approval. Work shall be executed with approved hard copy drawings.**

5. **The as fitted drawing, shop drawing of buildings, like lighting layout, power layout, single line diagram, earthing layout, cable tray layout, typical fixing arrangement of light fitting, DB fixing arrangement, copy of CEA or CEIG approved drawing (Xerox copy), safety certificate copy, CEA/CEIG drawing, scrutinizing letter copy, etc. to be submitted to Architects. (Hard copy & soft copy)**

6. **Soft copy, of all vendor As-built drawing be also submitted during the closing of works, through our site in charge. The as built shall also be approved by PM & Consultant before declaring as final as built**

* * * * * * *

SPECIAL CONDITIONS

The Contractor should possess a valid 'ESA' Class Contractor's License issued by the Electrical Licensing Board of the Respective State.

The work has to be carried out only by the licensed and skilled workmen under a supervision of a qualified & experienced supervisor. Client /Consultant shall terminate the workmen of the contractor if found not suitable for the job.

At any point of time one responsible person should be kept from the beginning to the end of the job on full time basis.

For work involving repetitive and large fabrication work, a sample approval is required from the Client/Consultant.

All meters like MFM, KWH meter, ammeter, voltmeter, etc. has to be calibrated in an approved testing laboratory before energization and test report should be furnished.

It is the contractors responsibility to co-ordinate with other agencies to avoid interference of work.

Contractor has to prepare 'as fitted' drawing of the complete work, in triplicate. It should be completed before the final invoice/payment.

All rates quoted shall be inclusive of all sundry materials like hardware, clamps, cleats, nuts and bolts, cement and sand, coke and salt, solders, fluxes including all consumables like electrodes, gases, etc.

The Contractor shall put up temporary structure to store his materials. Materials Supplied by the Client, if any, shall also be kept in the stores. Security of the materials, insurance, etc. for the materials stored shall be the Contractor's scope.

All works executed shall be of workmen like and substantial manner neat in appearance and arrangement. If found not acceptable to Client /Consultant, Contractor shall redo the job without any extra charges.

Contractor shall have adequate tools and tackles required for the job. If found insufficient, the same shall have to be brought by the Contractor.

Foundation pockets and cable opening wherever required, chase cutting in wall, plastering, curing, etc. shall be the Contractor's responsibility.

Final touch up of electrical equipment, shall be carried out by the Contractor.

On completion of job all wooden crates, small pieces of cable/wires, etc. shall be removed by the Contractor.

It is the responsibility of the Contractor the works in connection with CEIG & BESCOM/KEB Authorities.

The quantities covered in the schedule of work are tentative and may vary to suit site requirements.

Extra item of works not covered in the schedule of the work has to be carried out by the Contractor at mutually agreed rates.

The makes of material shall be as per the approved list. Any deviation in the makes of material due to non-availability, etc. shall have to be approved by the Client/Consultant.

All works carried out by the Contractor shall have to be guaranteed for twelve months from the date of completion including Testing & Commissioning.

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1. TECHNICAL SPECIFICATION FOR DISTRIBUTION TRANSFORMER - UPTO 11KV

1. SCOPE OF WORK

Design, manufacture, testing and supply of Distribution transformer with all fittings and accessories for which the details have been given in the tender/specific requirement. Items not specified or not but required for the successful completion of the work and commissioning of the equipment shall be included by the bidder.

2. STANDARD

The equipment covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with latest revision of relevant Indian Standards mentioned below and shall confirm to the Regulation of local statutory Authorities. Any miscellaneous equipment not stated here shall be deemed to be considered by the supplier.

BIS IS 1180-1:2014 Transformers	-Outdoor Type Oil Immersed Distribution
IS:10028-1985 (Part I) IS:10028-1981 (Part-II) IS:10028-1981 (Part III)	- Code of Practice for selection, installation and maintenance of Transformers.
IS:6600-1972	- Guide for loading power Transformers.
IS:3637-1966	- Gas operated relays
IS:335-1983	- New insulation oil.

3. DRAWINGS AND MANUALS

The following documents shall be submitted after award of contract.

(a) General arrangement of transformer showing all accessories.

(b) Schematic diagram for oil / winding temperature indicator, Buchholz relay etc.

(c) Installation, operation and maintenance manual.

(d) Factory test certificates.

(e) Guaranteed technical particulars.

4. SPECIFICATION

GENERAL & DESIGN CRITERIA TYPE

The power transformer shall be of core type, 2 winding, 3 phase, oil immersed, natural air cooled and shall be suitable for outdoor installation. The transformers shall be suitable for parallel operation.

i) VOLTAGE AND FREQUENCY VARIATION

Transformer shall be suitable for operation under the following conditions without abnormal heating provided increase in voltage is not accompanied by reduction in frequency.

(a) Within +/-10% of the rated voltage at rated KVA

(b) Within +/- 3% of 50 Hz.

The transformer shall be capable of delivering rated current at a voltage equal to 105% of the rated voltage

ii) RATED POWER AND TEMPERATURE RISE

The transformer shall be able to deliver its rated power when it is put in continuous operation without exceeding the limits of temperature rise as specified in IS:2026 (Part II).

iii) RATED VOLTAGE AND TAPPING

The principal tapping rated voltage shall be as specified in the technical date sheet. The tappings shall provide a variation in the transformation ratio without producing phase displacement. All tappings shall be of full power tappings.

iv) IMPEDANCE VOLTAGE

The impedance voltage at principal tapping shall be as specified in technical data sheet.

v) SHORT CIRCUIT WITHSTANDING CAPABILITY

The transformer shall be designed and manufactured to withstand the thermal and dynamic effects of external short circuit between phases or between phase and ground.

vi) INSULATION LEVEL

The insulation level shall be in accordance with IS:1180 to withstand the rated Lightning Impulse Voltage and Power Frequency Withstand Voltages.

vii) NEUTRAL EARTHING

The neutral connection of the LV winding shall be brought out separately and shall be suitable for solid earthing. The neutral terminal windings & links shall be designed for the highest over current that can flow through this winding.

viii) NOISE LEVEL AND VIBRATION

Necessary care shall be taken to minimize the level of noise and vibration in the design and manufacture of the transformer.

ix) HARDWARE

Nuts, bolts, washers, spring washers & Pins used for exposed areas to the atmosphere shall be either galvanized or zinc passivated.

CONSTRUCTION FEATURES

5) CORE

The core shall be built up, interleaved with high grade non-aging, low loss, high permeability, cold rolled, grain oriented silicon steel lamination properly treated for core material.

The final core assembly shall be rigidly clamped to ensure adequate mechanical strength and to prevent vibrations during operation.

The frame, clamps and core bolts shall be electrically insulated from the core. Such insulation shall be capable of withstanding maximum temperature existing in the core. For this purpose, class A or better insulation shall be used. Core clamps shall be electrically connected to the tank.

The Core and windings shall be suitably braced to prevent displacement or distortion during transportation or abnormal electrical conditions in service.

The core clamping frame shall have lifting facility for inspection purpose. The core shall have effective earthing with Transformer tank.

All metal parts of the transformer core assembly except, individual core laminations, core bolts and side clamping plates shall be earthed with the main tank. The magnetic circuit shall be earthed to the clamping structure through one removable core insulation test link only, placed in an accessible position beneath an inspection opening provided in the main tank cover.

6) WINDINGS

The coils shall be high conductivity electrolytic copper conductor properly insulated and stacked.

Coils assembly shall be suitably supported between adjacent sections by insulating spacers and barriers which shall be permanently secured in place and so arranged as to ensure a free circulation of the oil to reduce hot spot of the winding. To ensure permanent tightness of winding assembly, the insulation spacers shall be dried and compressed at high pressure before use.

All leads from the winding shall have rigid mechanical support to prevent damages against vibration & short circuit.

Windings shall not contain sharp bends which might damage the insulation or produce high dielectric stresses.

All the insulating material shall be insoluble, non-catalytic and chemically inert in the hot transformer oil and shall not be affected under the operating conditions. Moreover, this shall also be of proved design.

Coils shall be so insulated that the effect of impulse and power frequency voltage stresses are minimum.

The transformer winding shall be connected in vector group as specified. All terminal and typing markings shall be in accordance with IS:2026.

7) TANK

The tank shall be of all welded construction and fabricated from good commercial grade low carbon steel of adequate thickness. All seams shall be properly welded. Tanks shall be hydraulically tested to ensure against leak. The bottom of the tank shall have adequate space for sediment collection.

The tank wall shall be reinforced by stiffener of structural steel for general rigidity. The tanks shall have sufficient strength to withstand the following without any deformation.

i) The tank together with core and oil can be lifted and transported without damage or loss of oil.
ii) Mechanical shock during transportation.

The tank cover shall be bolted on to the tank with weather proof hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic straps shall be provided to prevent over compression. Bushings, turrets, cover, access holes and other devices, shall be designed to prevent any leakage of water into the tank or oil from the tank.

Tank cover shall not distort when lifted. Each tank shall be fitted with inspection covers of ample size to give easy access to internal connections of the bushings, winding connections and earth link for testing.

The tank cover shall be fitted with the pockets for oil temperature indications which shall be located in the position of maximum oil temperature at maximum continuous rating.

The under-carriage of the transformer shall be provided with four cast iron rollers. The wheels shall be mounted on plain axle. Rollers shall be bi-directional.

Each tank shall be provided with following handling facilities capable of lifting and/or moving the transformer complete and filled with oil.

Transformer top cover shall be slopped to avoid water stagnation (since it meant for outdoor duty).

iii) Lifting lugs of adequate capacity shall be provided on the tank to lift completely the assembled transformer filled with oil.

i) Jacking pads in accessible position shall be provided to enable the transformer to be raised or lowered.
ii) Suitable haulage holes shall be provided in the under-base to tow the complete transformer. Lifting handle shall be provided on the tank inspection covers.

Two numbers earthing terminals with lugs capable of carrying maximum system earth fault current for a duration of outlast equal to the period for which the main windings are designed shall be provided close to the base of the tank at diagonally opposite positions. Tank, tank cover and other associated components on the transformers shall have electrical continuity for earthing. Exterior of the transformer should be painted with standard colour over one coat of red-oxide primer.

8) COOLING UNITS / RADIATORS

a) The cooling unit shall consist of detachable type of radiators made of pressed sheet steel of thickness not less than 1.0 mm. or as specified in Specific Requirement.
b) Radiators shall be designed so that all painted surfaces can be thoroughly cleaned by hand and subsequently painted inside by suitable brushes. They shall be also so designed to avoid pockets in which moisture, dust or sand may collect.
c) Radiators shall withstand the pressure tests appropriate to the main tank. They shall be also capable of withstanding without damage the full vacuum associated with oil treatment.

a) The radiators shall be provided with the following accessories.
b) Bolted gasketed flanges connection at each point of connection to the main tank.
c) Air release plug on top.
d) Oil drain plug at bottom at convenient level.
e) Radiators shall be of detachable type.
f) Earthing stud to be provided inside the HT cable box for earthing the cable armour and shield.

9) CONSERVATOR TANK

A conservator tank shall be mounted on top above the highest point of the oil circulating system of the transformer. It shall be of ample capacity to accommodate the expansion and contraction of oil in the whole system over the extreme possible temperature range.

Conservator tank shall be connected to the main tank by the pipe through Buchholz relay with stop valves at both ends. The connection shall be such that air or gas is not entrapped.

The conservator oil outlet pipe shall be fixed above the base of the conservator to form a sump to trap condensation and sludge. One end of the conservator shall be fixed by bolts to enable the tank to be cleaned. Each conservator shall be fitted with.

i) Atleast one oil level indicator of direct reading prismatic glass type visible from ground level. The oil level indicator shall be marked to indicate the correct oil level. Low oil level alarm contact shall be built in.
x) Oil filling hole and cover.
xi) Weather proof dehydrating breather with activated silica gel as dehydrating for ventilation.

10) EXPLOSION VENT

The explosion vent shall be **of double diaphragm** type. An explosion vent of sufficient size shall be mounted on the tank to protect the tank from damage and to control the explosion of oil during an internal fault. The explosion vent shall be mounted such that pressure relief is not invalidated by the operation of valves and direct the oil downwards and away from tanks and bushings. It shall be capable of maintaining the oil tightness of the equipment under all conditions of normal service.

11) BREATHERS

a) Each conservator of the transformers shall be provided with a silicagel breather complete with oil seal and oil level indication window.
b) Visual indication of the extent to which the silicagel has absorbed moisture shall be provided. The unit must allow simple cleaning and replacement of the desiccant and sealing oil without the use of tools, by using wing nuts or similar forms of corrosion-resistant hand tightening devices.
c) The breather shall be mounted at approximately 1350 mm. from ground level and connecting pipe, to the main tank by means of brackets.

12) VALVES

Each transformer shall be fitted with the following valves:

i) One valve at the top and one valve at the bottom of the tank mounted diagonally opposite to each other for connection to oil circulating and filtering equipments. The

lower valve shall also function as drain valve. These valves shall be fitted with blank flanges.
ii) Oil sampling valves at top and bottom of the tank.
iii)1No. Air Release plug.

13. OFF LOAD TAP CHANGER (Refer BOQ for specific requirement)

a) The Off-load tap changing gear shall be provided on the H.V. windings for a variation of voltage as specified.
b) It shall be operated by changing gear with remote control cubicle. The on load tap changing gear will be controlled by an automatic voltage regulator for the voltage band as specified. The AVR shall have auto/manual selector switch.
c) A visual tap changing indicator for the tapping shall be provided and provision shall be made to padlock the handle in each tap position. The arrangement shall be such that the padlock cannot be inserted unless contacts are correctly engaged.

a) All contacts of the tapping shall be silver plated and held in position under strong contact pressure so as to avoid constant pitting of any type whats ever. The tapping switches shall be provided with mechanical and stops which prevent movement beyond an end position.

14. ON LOAD TAP CHANGER & REMOTE-CONTROL PANEL

a) The ON-load tap changing gear shall be provided on the H.V. windings for a variation of voltage as specified.
b) It shall be operated by a on load tap changing gear with remote control cubicle. The on load tap changing gear will be controlled by an automatic voltage regulator for the voltage band as specified. The AVR shall have auto/manual selector switch.

a) A visual tap changing indicator for the tapping shall be provided and provision shall be made to padlock the handle in each tap position. The arrangement shall be such that the padlock cannot be inserted unless contacts are correctly engaged.
b) All contacts of the tapping shall be silver plated and held in position under strong contact pressure so as to avoid constant pitting of any type whatever. The tapping switches shall be provided with mechanical and stops which prevent movement beyond an end position.
c) Technical parameters & General requirement shall match with the transformer requirement like OLTC driving mechanism, protections of all components, raise/ lower mechanism, local/remote operating devices, limit switches, built in manual operating device, operation counter, internal light fitting, pad locks, gland plate, control wiring, etc.
d) RTCC shall be of outdoor/indoor type with parameters & general requirement shall match with the transformer requirement like instruments, indicating lamps, switches, raise/lower control switches, tap position indicator, Auto/manual selector switch, AVR relay, tap position indicating lamps, audio/visual annunciator with accept & reset PB, voltmeter, alarms, illuminating lamps, master -follower selector switch,etc.

15. BUSHINGS

All bushings shall conform to the requirements of the latest revision of IS:2099 & IS 3347. The bushing ratings, impulse withstand levels and creepage distance shall be in accordance with the technical requirements attached.

All porcelain materials and bushing shall be sound, free from defects and thoroughly vitrified. The glaze shall not depend upon insulation, shall be smooth, hard, of a uniform shade of brown and shall cover completely all exposed parts of the insulator. Porcelain shall not engage directly with hard interposed between the porcelain and fittings. All porcelain clamping surfaces in contact with gaskets shall be accurately round and free from glaze. Stresses due to expansion & contraction in the building shall not lead to deterioration.

16. CABLE BOX

The cable box shall be of outdoor type, sheet steel construction, self supporting, with all standard facilities including the body earth terminals. The box shall be of an air insulated unit with phase barriers between phases. The cable box shall be suitable for termination of XLPE power cable on HV side and busduct on LV side. The neutral point of LV winding shall be separately brought out for connecting to earth pits. The box shall be provided with undrilled gland plates. Adequate space shall be provided within the box so that the conductor may be crimped with lugs without undue bending or stress on the lugs. Adequate electrical clearances shall be provided.

The LV terminal shall have air insulated disconnecting clamber suitable for termination as per specific requirement or as per BOQ.

17. MARSHALLING BOX

a) A marshalling box for indoor/outdoor use to transfer transformer control alarm and annunciation requirements to control panel shall be provided.
b) The box shall be mounted either on the transformer tank or on a separate mounting frame with brackets and shall conform to IP:55 degree of protection for the enclosure.
c) This box shall contain all auxiliary devices except those mounted on the transformer. The control terminals and connectors shall have suitable current carrying capacity. A removable bottom gland plate shall be furnished for cable entry. Cable glands and lugs shall also be provided to suit outdoor.

a) All wires / Cables from transformer & OLTC mechanism box to the Marshalling box to be properly supported and covered with metal helical spring positively

18. OIL TEMPERATURE INDICATOR CUM CONTROLLER

Thermometer pocket and sensing element with dial type thermometer of 6" dia with range 0-150 deg C, using mercury operated switches with a hand reset pointer to register the highest temperature attained, shall be provided for indicating transformer tank top oil temperature. The controller shall have 2N/O + 2N/C contacts for alarm and trip purpose.The cover shall be equipped with a viewing aperture of adequate size fitted with clear glass.

19. WINDING TEMPERATURE INDICATOR CUM CONTROLLER

One no. winding temperature indicator of dial type 6" dia with range 0-150 deg C, using mercury operated switches shall be provided in the marshalling box with a hand reset pointer to register the highest temperature attained. The controller shall have 2N/O + 2N/C contacts for alarm and trip purpose.

20. GAS AND OIL ACTUATED RELAYS (IF REQUIRED)

a) The Buchholz relay shall be as per the latest revision of IS:3637 - 1966. The relay shall be fitted in the expansion pipe connecting the transformer tank to the conservator. The pipe work shall be so arranged that all gas arising from the transformer shall pass into the relay. Sharp bends in the pipe work shall be avoided.
b) The design of the relay mounting arrangement and associated pipe work shall be such that the relay will not sustain damage during transport or service, or mal-function due to vibrations under service conditions.
c) The relay shall be provided with drain cock, airvent and facility for testing with air injection by hand pump. The device shall be provided with two independent floats double element mercury operated switches normally open type one for alarm on gas accumulation and the other for tripping on sudden rise of pressure due to abnormal conditions. The relay shall be provided with a window through which a scale indication can be seen in order that the quantity of gas collected within the relay housing can be determined.
d) The oil circuit through the relay shall not form a delivery path in parallel with any circulating oil pipe.

21. TRANSFORMER OIL

Insulating oil shall conform to IS:335 and shall be suitable in all respects for operating the transformer at the ratings and under conditions laid down in the specification. The transformer shall be supplied with oil for first filling.

An extra 10% of the total oil requirement shall be provided in non-returnable containers suitable for outdoor storage.

Oil soak pit to be considered for the transformer yard for a cumulative capacity of transformer oil amounting to more than 2000 liters. The size of the soak pit to be determined based on the total content of the oil with necessary allowance as recommended by local statutory authorities or as per general guide lines.

22. PAINTING

All accessories and transformer tank shall be sand blasted and finished with Epoxy based poly urethane to produce a smooth, clean surface, free from scale, grease and rust.

After cleaning, the surfaces shall be given a phosphate coating followed by a coat of high quality red oxide or yellow chromate primer.

The transformer, OLTC & Marshalling box shall be finished with two coats of synthetic enamel paint. The colour will be smoke grey of Shade 631of IS-5.

The RTCC panel finish of colour shall be Siemens Grey equivalent to RAL 7032 or as per client requirements to match with other panels in switchgear room.

23. GENERAL

a) Screw, studs, nuts and bolts shall be hot dip galvanized preferably GKW / TVS only. Exposed parts shall be designed such that accumulation of water at any point is avoided.
b) Materials in contact with oil shall be such as not to contribute to the formation of acid in oil.
c) All similar parts particularly the detachable ones shall be inter changeable.
d) All meters & relays etc. to be calibrated in an approved test laboratory before fitting.
e) Danger caution metal board to be fixed in OLTC & RTCC panel permanently
f) RTCC & OLTC shall be provided with laminated control scheme inside the door.

24. TESTS

The necessary tests shall be carried out at the manufacturer's works in accordance with IS: 2026 at free of cost and it will be witnessed by client.
The main tests are:
a) Resistance measurement of all windings at rated voltage connection on all taps.
b) Ratio tests on all taps.
c) Vector group test
d) Impedance & load loss at rated current.
e) No load loss
f) Power frequency withstand
g) Insulation resistance for windings, auxiliary devices, core 7 tank.
h) Magnetic balance test.

The above test shall form part of responsibility of executing contractor, whether specifically mentioned or not in the BOQ.

TYPE tests:
Typical type test certificate shall be furnished before dispatch.
Test certificate:
Three copies of test certificates including brought out items like valves, relays, temperature indicators, etc shall be furnished.

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SPECIFIC REQUIREMENT OF OIL TYPE DISTRIBUTION TRANSFORMER

(With ON Load Tap Changer)

Description	Unit	Our Specification
Rating	KVA	315
Service	-	Outdoor
Rated frequency	Hz	50
No. of phases/Wires	-	3Phase, 4Wire
Rated voltage- HV windings LV windings	 KV Volts	 11 (Highest system Voltage – 12KV) 433
Winding connections – HV winding LV winding (Neutral brought out separately for earthing withbrass tinned terminal pad to suit 1R 75X10mm copper including disconnect able link apart from earth pit link)	 - -	 DELTA STAR
Temperature rise in oil	C	40
Temperature rise in Winding	C	45
Designed Ambient temperature	C	50
Vector group	-	Dyn11
Impedance voltage	-	4.5% without negative tolerances & including IS tolerances of 10%
Type of cooling	-	ONAN
Tape changer		

Type	-	OLTC
Range	-	+10% to -10% 4.5%
Steps	-	-
Winding conductor material	-	Copper
Losses (Level 1 as per latest Amendment) Load loss at 50% (without positive Tolerance) Load loss at 100%(without positive Tolerance) No load losses	 KW KW KW	 As Per IS As Per IS **To be furnished by vendor**
Primary short circuit level	-	500 MVA
Reference standards	-	Latest Edition of IS:1180-2014
Bushing	-	HV – Epoxy LV – Epoxy
Insulation Level a.Impulse HV LV b.Power Frequency HV LV	 KV peak KV peak KVrms KVrms	 75 - 28 3
HV Cable box with disconnect able chamber		Required as per spec.
LV flange to suit cables / or as per BOQ.		Required as per spec

SPECIFIC REQUIREMENT OF OIL TYPE DISTRIBUTION TRANSFORMER FITTINGS & ACCESSORIES (IF APPLICABLE)

Standard Accessories (Considered)		**REMARKS**
Type Test Certificate (typical of same rating & same spec.)	To be furnished	
Tinned Multilayer Copper Earth clip for covers as per spec. & BOQ.	✓	
Name Rating & Diagram Plate.	✓	
Oil Conservator with sump & drain valve	✓	
Oil filling hole with flange and bolted cover	✓	
Prismatic Plain oil level gauge	✓	
Dehydrating silica gel breather with oil seal - 2 nos at 1350 mm from FGL	✓	
Thermometer Pocket	✓	
Air release plug	✓	
Inspection cover	✓	
Lifting lugs	✓	
Cover lifting lugs	✓	
Jacking Lugs	✓	
Top filter valve – 1 no.	✓	
Drain cum bottom filter valve – 1 no	✓	
Oil Sampling valve	✓	
Earthing Terminal – 2 nos	✓	
Storage & instruction plate	✓	
Skid type under base.	✓	
Bi-directional plain/flange rollers	✓	
Detachable type radiators with top and bottom shutoff valve.	✓	
Dial type OTI with alarm & trip contact -1 No	✓	
Dial type WTI with alarm & trip contact -1 No	✓	
Buchhalz Relay – double float type with shut off valve on both side.1 No with Alarm & Trip	✓	
Marshalling Box IP 55	✓	
Magnetic Oil Level Gauge- low oil level alarm contact.- 1 No	✓	
OLTC (Oil Type)	✓	
RTCC Panel free standing type without back cover and wall mounted not acceptable	✓	
AVR	✓	
Bottom channel Double	✓	
Explosion vent with double diaphram	✓	
Surge relay –double float type with shut off valve on both side.-1 No with Alarm contact	✓	
HV cable box with disconnecting chamber	✓	
List of makes of accessories	To be furnished	

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2. TECHNICAL SPEIFICATION FOR 11KV SWITCHBOARD

1. SCOPE OF WORK

Design, manufacture, installation, Testing & commissioning of 11KV switchboard. Reference to be made to the Tender document for Specific requirement of Indoor or Outdoor type of Breakers.

Items specified or not, but required for the successful completion of the work and commissioning of the equipment shall be the bidder's responsibility.

2. STANDARDS

The equipments covered in this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest revision of the following Indian Standard and shall conform to the regulations of Local Statutory Authorities.

IS-3427:1969 (1000 to 1100 V)	-	Metal enclosed switchgear and control gear
IS-11353:1985 and auxiliary wiring, IS-5578:1984 & IS-9920	-	Switchgear busbars, main connections marking and arrangements
IS-13118:1991 current circuit breaker.	-	Specification for High voltage alternating
IS-3427:1969	-	Metal enclosed switchgear & control gear for voltage above 1000V but not exceeding 11000V
IS-2705:1981	-	Current transformers (4 Parts)
IS-3156:1978	-	Voltage transformers (4 Parts)
IS-3231:1965	-	Electrical relays for power system protection
IS-1248:1983 measuring instruments and their accessories.	-	Direct acting indicating analogue electrical
IS-6875:1973	-	Control switches for voltages upto and including 1000V AC & 1200V DC.
IEC 62271	-	High voltage switchgear & control gear.

3. DRAWINGS AND MANUALS

The following documents shall be submitted after award of contract in 5 sets for approval.

- General arrangement drawings.
- Sectional details indicating interconnections of equipments, accessories with clearance.
- Single line diagram.
- Schematic diagrams for each feeder (Power Control & Protection).
- Technical leaflets for all components/equipments.
- Type test certificate & meters calibration certificates.
- Commissioning and maintenance instruction for the equipment.

4. CONSTRUCTION

The 11KV switchboard shall be of cubicle type, compartmentalized, single front, free standing, suitable for indoor installation. The switchboard shall be of dust and vermin proof and having uniform height. The switch board shall be type tested and suitable for 11000 V, 3 phase, 3W 50 Hz system. It shall of VCB as specified in the tender. Necessary surge protection devices to be included as part of control gear.

The switchboard shall be fabricated out of atleast 2 mm. thick CRCA sheet steel. The base frame shall be made of ISMC75 minimum.

The switchboard shall be extendible on either sides.

All openings, covers, doors, etc. shall be provided with neoprene rubber gaskets to ensure the switchboard as dust and vermin proof.

Suitable barrier shall be provided between live parts and auxiliary control circuits to permit the operation and maintenance personnel to work safely.

All hardware used shall be hot dip galvanised.

The switchboard shall be provided with lifting lugs for each shipping section.

All necessary hardware required for the installation of the switchboard like foundation bolts, lifting lugs, earthing truck, ramp for truck, etc., shall be supplied along with the switchboard.

5. BUSBARS AND INTERCONNECTIONS

The busbars shall be made of high conductivity, electrolytic copper and shall be housed in a separate compartment. The busbars shall have suitable and uniform cross sectional area throughout the length of the switchboard to carry the specified rated current and to withstand a fault level of 500 MVA for 1(one)second.

The insulators used to support the busbars shall be of moulded or resin bonded material having durable, non-hydroscopic surface finish and a high anti-tracking index.

The insulators shall be provided at appropriate intervals to withstand the electromagnetic stresses during the short circuit occurrence.

The minimum clearances between phases and ground shall be not be less than those specified for Class-A switchgear as per IS-3427:1969.

The busbars shall be covered with heat shrinkable type colour coded PVC sleeves with colours of red, yellow and blue. Busbar joints also shall be covered with sleeves.

Zinc passivated or cadmium coated high tensile strength MS bolts,nuts and washers shall be used for all busbar joints and supports. All joint surfaces between aluminium and copper shall be either silver/tin plated or bimetallic washers may be used.

The busbars compartment shall be suitably ventilated without compromising the degree of protection of enclosure. The maximum temperature rise shall not exceed 40 deg C over the ambient temperature under normal conditions.

The busbars shall be suitable for extension on both sides.

The interconnection between the busbars and the circuit breakers shall be made of vertical copper sleeved busbars of adequate rating.

6. CABLE CONNECTION

The switchboard shall have cable entry at the rear bottom side. Drilled gland plates of adequate size suitable for terminating XLPE cable of size specified shall be provided.

The incoming and outgoing connections shall be suitable for terminating multi runs of XLPE cables.

Barriers shall be provided in the cable compartment to avoid accidental contacts.

Suitable supporting arrangements shall be provided to clamp the cables.

7. CONTROL WIRING

The control wiring within the 11 KV switchboard shall be done using 1100V grade PVC insulated multistranded copper conductors. The size of the wires used shall be as follows:

(a) Signal wiring - 1.5 Sqmm.
(b) CT wiring - 2.5 Sqmm.

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(c) Control power supply & space heater wiring - 6.0 Sqmm.

All the control wires shall preferably be enclosed in plastic channels or bunched together.

The following colour code shall be used for control wiring:

(a) Phase wiring	-	Red, Yellow, Blue
(b) Neutral	-	Black
(c) Earth	-	Green
(d) Control	-	Grey

All the wires shall be identified at both ends by PVC ferrules.

All spare contacts of aux. contactors, relays, timers, etc. to be wired upto terminal block.(Pl ref. preferred component list)

Wherever interpanel wiring required between panels of two different shipping section, they shall be terminated in terminal blocks of respective panels and suitable jumpers shall be used to connect them.

All wires shall be terminated using compression type lugs. Not more than two wires shall be connected to a single terminal (On both sides). For all CT, terminals shorting links shall be provided. 'Elmex' type (ref. preferred component list) terminals shall be provided with a minimum of 10% spare terminals for all control wiring.

8. EARTHING

All metallic parts of the switchboard other than current carrying parts shall be connected to the ***2 Runs of earth bus of size 50 x 6 copper*** or by means of suitable size of copper or Aluminum , PVC insulated bus bars.

All movable parts like instruments doors, gland plates, etc. shall be connected to the earth bus through flexible copper wires.

The circuit breaker trolley shall be connected to the earth bus through a plug & socket type arrangement. The plug contact shall be long enough to allow the safety shutters to close before disengaging from its socket when the circuit breaker trolley is being withdrawn. Suitable arrangements shall be made for earthing outgoing feeders to enable busbar maintenance. If necessary earthing trolley and ramp to be supplied along the panel.

9. PAINTING

All metal surfaces shall be thoroughly cleaned and degreased to remove scale, grease, rust and dirt and then phosphated prior to painting. Afterwards the surface shall be spray painted /powder coated with two coats of epoxy based final paint. The thickness of the coating shall be as per IS. The colour of the final shade shall be as specified in the technical data sheet/BOQ.

Unpainted metal parts shall be treated to prevent rust formation and shall be zinc passivated or cadmium coated.

10. CIRCUIT BREAKERS

The circuit breaker shall be of vacuum type suitable for operation at a system voltage of 11000V +- 10%, 50 Hz +- 3%, 3 Ph, 3W AC system. The rated current of the circuit breaker shall be as specified in the technical date sheet.

The breaker shall be of horizontal draw out or vertical draw out and trolley mounted type.

The breaker shall be spring assessed motor closing mechanism (EDO) with provision for manual closing facility in the event of failure of motor operation. The shunt trip coil shall be suitable for 30V DC.

The circuit breaker shall be capable of carrying the specified current continuously without exceeding the permissible temperature rise and shall be capable of withstanding the fault level of 600 MVA for 1 seconds.

The circuit breaker shall be complete with the following:

a) Mechanical indication for open, closed, service, test, isolated.
b) Control switch/push buttons
c) Indication lamps for off, ON, auto trip, trip healthy, etc
d) Operation counter.

Necessary safety interlocks shall be provided in the breaker compartment to prevent.

a) Withdrawal of breaker in 'closed' position or vice versa.
b) Closing of breaker when it is in the intermediate position.
c) Front door safety

The breaker compartment shall have a set of automatic metallic safety shutters which shall close automatically when the breaker is in isolated position. When the breaker is being inserted in its service position, the shutters shall automatically open to make the contacts engaged in their position.

11. CURRENT TRANSFORMERS

Current transformers shall be of cast resin insulated, having two cores each one for protection and metering. The current transformers shall conform to IS:2705.

The CT ratio and burden shall be as shown in the single line diagram.

The core for protection purpose shall have an accuracy class of 5P.

The core for metering purpose shall have an accuracy class of 1.0 or as specified in the schedule.

12. VOLTAGE TRANSFORMERS

The voltage transformers shall be of 3 phase, drawout type, cast resin insulated.

The ratio and burden of the VT shall be as shown in the single line diagram.

The VT secondary winding shall have an accuracy class of 1.0 or as specified in the schedule.

13. PROTECTIVE RELAYS

All the relays shall be of drawout type, suitable for flush mounting on the panel. Relays connected to CT circuit shall have provision for insertion of test plug, without disconnecting the permanent wiring.

All relays shall preferably be mounted on the front side of the switchboard.

All relays shall have built-in flags to indicate their operation. Provision shall be made to reset manually without opening the relay case. All the relays shall be of numerical type suitable for SCADA.

14. METERS

All meters shall be of square type of size 144 mm x 144mm, unless otherwise specified. It shall be suitable for flush mounting on the panel.

The meters shall be suitable for the rated secondary current/voltage of CT/VT respectively. The range shall be as shown in the single line diagram.

Ammeter & Voltmeters shall be of digital type and accuracy class suitable for SCADA shall be 1.0 as per IS-1248:1983.

15. CONTROL SWITCHES

All control switches shall be suitable for flush mounting on the panel, except space heater control switch which may be mounted inside the panel.

The switches shall be of rotary, back connected type, cam operated contact mechanism. The contacts shall be made of phosphor bronze. The contacts of all switches shall be shrouded to prevent increase of dust and accidental contact.

Ammeter selector switch contacts shall have ***'make'*** before ***'break'*** feature.

16. PUSH BUTTONS

Push buttons shall be of self resetting type having atleast 2 No + 2 NC contacts mounted inside an enclosure.

17. INDICATION LAMPS

Indication lamps shall be of low power consuming LED type supplied along with current limiting resistors.

18. CONTROL FUSE

All control fuses shall be of HRC link type mounted in front connected type bakelite fuse carriers.

19. AUXILIARY RELAYS & CONTACTS

Auxiliary relays and contactors shall be used for breaker/protective relays contacts multiplication purposes. They shall be rated for carrying the circuit current but not less than 5A at 250V AC.

Aux. relays/contactors may be mounted on the panel front side/inside the panel according to their nature.

20. SPACE HEATERS

Space heaters shall be used to prevent moisture condensation and to keep the cubicle temperature 10 deg C above design ambient temperature. They shall be controlled by a thermostat and a switch.

21. LABELS & NAME PLATES

The switchboard shall be provided with a name plate on top of the center panel at the front. Each panel shall have its feeder description name plates both at the front and rear sides.

The name plate shall be made of perspex sheet 3 mm thick with the white letters engraved on black background with reverse engraving.

All equipments like lamps, PB's, relays, contactors etc. mounted in the switchboard shall be provided with name plates made of anodised aluminium.

Warning/danger labels shall be provided on all doors and covers which give access to HV bus/cable connection while opening.

All name plates shall be fastened by counter sunk screws.

22. TESTS

The routine tests shall be carried out at manufacturers works in accordance with IS-3247 & IS-2516. The bidder shall furnish type test certificates for all tests specified in IS-2516 & IS-3427 at no extra cost.

1) Dielectric Test
2) Measurement of resistance of the circuits
3) Protection arrangements

4) Tightness tests
5) Auxiliary and control circuits
6) Short time withstand current and peak withstand current tests

The above test is only to highlight the important test to be carried out. However any test which is covered in the above IS & IEC to be carried out as part of responsibility.

Type test certificate (TYP) to be submitted along the Bid without fail.

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2. TECHNICAL SPCIFICATION FOR XLPE AND PVC CABLES

1. SCOPE

Design, manufacture, testing at works, inspection, supply, installation, testing & commissioning of Power cables and control and Lighting application. The cables to be properly packed for Transportation and delivery at site without damage..

2. STANDARDS

IS-694 PVC insulated for working voltages upto and including 1100V.

IS-1554 PVC insulated cables for working voltages upto and (Part-1) including 1100V.

IS-3961 Recommended current ratings for cables, PVC (Part-II) insulated and PVC sheathed heavy duty cables.

IS-3975 Mild steel wires, strips and tapes for armouring of cables.

IS-8130 Conductors for insulated electric cables and flexible cords.

IS-5819 Recommended short circuit ratings of high Voltage cables.

IS-5831 PVC insulation and sheath of electric cables.

IS-7098 Cross linked polyethylene insulated PVC sheathed cables for working voltage from 3.3 KV to 33 KV XLPE.

3. CONDUCTOR

The conductor shall be aluminium. It shall be smooth, uniform in quality, and free from scales and other defects. The conductor shall be either circular or sector shaped.

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4. CONDUCTOR SHIELD

Conductor shield shall be extruded in the same operation as the insulation. The semi-conductor polymer shall be cross linked.

5. INSULATION

The insulation shall be cross linked polyethylene and it shall preferable be gestured and also suitable for solidly earthed system. For PVC cables, the PVC compound used for insulation shall have reduced flame prorogation property.

6. INSULATOR SHIELD

This shall preferably be of the strippable, triple extruded thermoset type.

7. ARMOUR

The armour may be galvanized steel wires or galvanized steel strips for 3 Core & aluminium flat armour for Single Core cables of 11KV.

8. SERVING

The cable serving shall protect the cable sheath and armour from electrolysis caused by stray currents, and from galvanize action. It shall also protect the cable from mechanical damage and corrosion.

9. SHEATH

The outer sheathing shall be of PVC of black colour of adequate thickness as specified in the relevant IS.

10. TEMPERATURE RISE

The maximum conductor temperature shall not exceed 90º C. during continuous operation at full load current. The temperature after short circuit for 1 second shall not exceed 250º C. with initial conductor temperature of 90º C.

11. CABLE DRUM

Cable shall be supplied in drums of sturdy construction.

12. PHASE IDENTIFICATION

Phase identification shall be either marked continuously ONE, TWO, THREE at every one meter of each core (or) Red, Yellow and Blue.

13. PROCEDURE FOR TESTS

Necessary tests shall be in accordance with the provisions of relevant Indian Standard Specification and shall be carried out for each drum of cables.

14. PVC INSULATED CABLES CONDUCTOR

The conductor shall be aluminium or copper. It shall be smooth, uniform in quality and free from scale and other defects. The conductor shall be circular or sector shaped.

15. INSULATION

The cables shall be insulated for 1100V and suitable for 415V, solidly earthed system and PVC insulated so as to comply with the requirements of the relevant Indian Standards.

16. INNER SHEATH

For all cables having two or more cores, the individual cores shall be laid up and than be surrounded by common covering applied either by extrusion or wrapping or filling material

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containing a thermoplastic material. Adequate plastic tape may be applied over the common covering to be employed. It must be ensured that the circularity of the cable is maintained.

17. ARMOURING

Armouring shall be arranged over the inner sheath. The armour of cable shall be of galvanized steel wires or galvanized steel strips.

18. OUTER SHEATH

A tough outer sheathing of PVC insulated material in standard colours shall be provided over the armouring to offer a high degree of mechanical protection against abrasion.

19. IDENTIFICATION

Manufacturer's name, voltage grade of cable, year of manufacturing, nominal cross-sectional area of conductor shall be embossed on the outer sheath of the cables throughout the length at regular intervals. Phase identification shall be identified by coloured cores of PVC insulation (Red, Yellow, Blue & Black). The manufacturer shall be identified throughout the length of the cable by manufactures name or trade mark, voltage grade and year of manufactures of the cable intended or embossing shall be done in the outer sheath.

20. TESTS AT WORKS

Complete tests shall be at the manufacturer works to determine the performance and operating characteristics of the cables as per relevant Indian Specification.

5. TECHNICAL SPECIFICATION OF LIGHTING & WIRING INSTALLATION

1. SCOPE

This specification covers the wiring installation to light, fan, exhaust/wall fan, 6A plug points, etc. The wiring shall be complete in all respects and any item not included in this specification but essential for proper functioning shall be deemed to be within the scope of work whether it is specifically mentioned or not.

2. STANDARDS

The wiring shall be carried out as per IS-732. The M.S. conduit and accessories shall be with ISI mark confirming to IS-9537 Part II, IS-2607 & 3837. All wires proposed to be used shall of single core, stranded, PVC insulated 650/1100 volts grade bearing IS mark and shall be manufactured confirming to IS-694. All wires, conduit, accessories shall also confirm to fire insurance approval.

3. ERW OR PVC CONDUITING

All conduit pipes shall bear the name, trade mark of the manufacturer and size of conduit pipes on each length.
All conduits shall be concealed to ceiling, wall, column, etc. The thickness of conduit shall be as per the BOQ. Generally, M.S conduit pipes shall be 16gauge for 19, 25 & 32mm & 14 gauge for 38mm and above. The rigged PVC conduit pipes shall be FRLS of medium/heavy duty. It shall be 1.8mm or 2mm thick or as per BOQ. The necessary rough plaster for concealing the wall, column, etc. shall be the responsibility of the electrical contractor. The final plaster along with other areas shall be done by the civil contractor. For reasons and due to un-avoidable circumstances, the final plastering has been chased by the electrical contractor, the extra cost towards replaster has to be done by the electrical contractor.
Wherever M.S. conduits are exposed it shall be provided on a 25 x 6 mm. M.S. spacer clamp with provision for screwing the conduit with spacing between the spacer clamps not to exceed 600 mm.
Necessary pull boxes of adequate sizes shall be provided wherever required and it shall be part of Lighting installation.

The laying of conduit has to be preplanned and Co-ordinated with the civil contractor and progress chart. The threading to the conduit for joining shall not be less than 19 mm. After joining the conduit, the remaining portion has to be sealed and painted with enamel paint. The conduit shall be kept away from the ceiling/wall/column etc., so that after final concreting or plastering, there will be minimum 25mm. of concrete/plaster over the conduit pipe. The accessories like solid bends, couplers, junction boxes, etc., shall also bear IS marking and preferably from the same manufacturer of conduit pipe as far as possible. All conduit pipes and accessories shall be of IS regulation and shall be held properly in the ceiling/wall/column, etc., by 'u' clamp or wire as per IS Standards.

Elbows to be totally avoided in the conduit system. If becomes unavoidable only inspection type elbows can be used in case of surface conduit. After laying of conduit a 16 SWG GI draw wire to be pulled in the conduit for pulling of wires.
The conduits terminated in the switch boxes, distribution boards, etc., are to be filled properly to avoid sharp edges. It shall be fixed rigidly by heavy duty check nuts. Nipples shall not be used in such places. PVC or rubber bushes to be provided at the ends of conduits. The conduit ends in the switch boxes or distribution boards shall not be more than 10 to 12 mm. Unused conduit entries shall be blanked off is an approved method.

The conduit crossing over each other and crossing through columns shall be avoided as far as possible. If essentially required as per site conditions, such conduits shall be laid through PVC pipe inserts. The junction boxes kept for ceiling light point shall be kept at the bottom of the ceiling touching the shuttering to avoid junction boxes going deep into the concreting after removal of shuttering. Deep junction boxes shall be used wherever required to obtain the above. Bends in conduits pipe shall be carried out through bending

machine. If bends cannot be provided due to site problems, introduction of inspection boxes are necessary.

After laying of the conduit and before concreting, the contractor has to ensure to mark the exact routing of mains, primary and secondary conduit, the location of junction boxes, pull boxes, etc., on the drawing to enable him to prepare as built drawing.

The crossing of surface conduits to be avoided. If unavailable it shall have adopter boxes in such crossings.

The conduit shall be minimum 19 mm. dia as per IS complete with all accessories like bends, couplers, nipples, conduit junction boxes, M.S. junction boxes, pull boxes, concealed type fan hook, etc.,

All PVC conduiting shall be of minimum 20 mm. dia rigid pipes complete with all accessories like solid bends, junction boxes, etc.

4. WIRING

Point wiring shall include wiring from respective distribution boards, primary and secondary wiring upto the point. The wiring size for mains, primary & secondary points, etc., shall be as per the work schedule including provision of concealed type M.S. fan hook. M.S. boxes of size 75 x 75 x 75 mm. with 12 mm M.S. Rod 250 mm. long shall be used for hook and properly welded on both side of boxes for sturdiness.

Unless otherwise stated all wires shall be of 650/1100 volts grade, PVC insulated, single core, un-armoured, flexible, unsheathed, colour coded, stranded wires of copper conductor confirming to IS-694 and fire insurance approved. The colour codes shall be strictly followed as per the following:-

R Phase	-	Red colour
Y Phase	-	Yellow colour
B Phase	-	Blue colour
Neutral	-	Black
Earth	-	Green

For maximum number of wires that can be drawn in a conduit pipes of various sizes, reference can be made to be relevant IS.

Wires of different phases running in the same conduit shall not be permitted. Excess length of wires shall be provided in the switchboxes, junction boxes, distribution boards, etc., for proper routing and dressing of wires. The dressing of wires shall be carried out by PVC or rubber belts with spacing not to exceed 450 mm. and in ends. The wires shall not have any joints except for joints to loop the piece wires (control wires) for looping and looping out. The termination of wires in the switchboxes, distribution boards etc., shall be within the scope of wiring.

The earth wire of each circuit shall be separate. All switchboxes, junction boxes, pull boxes, etc. shall be earthed. All outlets like distribution board, junction boxes, pull boxes,

switchboxes etc., shall bear circuit number as per relevant IS. All the conduit ends shall also be earthed. The as-built drawing prepared by the electrical contractor shall include conduit route and circuit number. All switchboxes, 6A outlets shall have welded earth stud.

Cost of wiring shall include conduit pipes and its accessories, concealed type M.S. fan hook in concealed type M.S. Box, junction boxes, pull boxes, etc. covered with 3 mm thick perspex sheet, switches, sockets, wires, draw wires all consumables like insulation tape, screws, bolts and nuts, painting, clamping, all connected civil works, etc., including any item not mentioned but required for total completion of point wiring.

Controls to fan point shall be separate and control to light points shall as per layout. The termination for fan, light, etc., shall be through a 6 Amps connector.

The wiring for call push and call bell with looped mains from the primary point shall be treated as one point only. For ceiling tube light point 2 nos. of conduit boxes shall of provided.

Measurement of wiring shall be as per the quantity of points installed and all wastage of conduit pipe, wire bits, plastering spill over, wastage of paint, labour, etc., shall be deemed to be within the rate of point wiring cost and shall not be paid as extra work.

5. SWITCHES / SOCKETS & JUNCTION / SWITCHBOXES

All outlets, switches / sockets, switchboxes shall be as per BOQ. The switch boxes, cover plates shall be as per the relevant IS or as per the manufacturer based on the final selection of makes, etc.

Modular plate type switches shall be as per BOQ or as per GFC drawings issued to the contractor. Concealed switch boxes shall be protected against plater, curing, etc. Till the total completion of civil works.

6. TESTING & COMMISSIONING

After completion of all wiring and before energisation all wiring to be tested as per relevant IS. The insulation level of the combined wiring meggered thro' a 500 volts megger for 230 volts system shall not be less than 20 Meg ohms. The testing and commissioning of lighting wiring is within the scope and within the rate quoted.

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6. TECHNICAL SPECIFICATION OF DISTRIBUTION BOARDS

1. SCOPE

This specification covers the design, manufacture assembly, testing at works, supply, installation and commissioning of distribution boards at site.

The system and accessories shall be complete in all respects and any device not included specifically in this document, but essential for proper operation of the equipment and also to

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meet statutory requirements shall deemed to be within the scope of the specification whether it is mentioned in the Technical Specification or not.

If the vendor finds that it is required to undertake any work which is not sufficiently defined in this specification, or discovers that this specification conflicts with any other codes, standards and regulations which shall be required to comply, the same shall be clarified in writing from the Client/Consultant before undertaking work involved for avoiding the delay.

2. CONSTRUCTION

The distribution boards shall be fabricated out of 14/16 SWG sheet steel metal clad, totally enclosed dust damp and vermin proof, dead front, hinged door type of bolted/welded construction suitable for wall or floor mounting.

(1) BUSBARS

The busbar shall be air insulated and made up of high conductivity high strength Electrolytic copper busbars liberally sized with high safety factor for the required rating. The neutral busbars shall have adequate number of terminals for all number of outgoing single phase circuits and the holes shall be suitable for multistrand wires. In the same way suitable earth bus shall be provided inside each distribution board for earthing of the lighting/power circuits and also earthing of distribution boards. In case of 3 phase DB used for single phase outgoing, three independent neutral bars shall be provided.

(2) MINIATURE CIRCUIT BREAKERS, ELCB, RCBO & SURGE ARRESTORS.

Miniature circuit breakers (MCB) shall be of heat resistant, moulded type designed, manufactured and tested as per IS-8828.

The MCBs shall have inverse tripping characteristic against overloads and instantaneous trip against short circuits.

The MCB shall be of fault current limiting device also.

The MCB shall be slip on type to the DIN rail. The ON & OFF positions of the switch handle shall be clearly marked. The MCB shall be suitable for operating in an ambient temperature of 45 deg C. without derating. The MCB shall be suitable for 415V, 3 phase 4W 50 Hz system with a fault level of 9-10 KA (RMS) symmetrical. The terminals of MCBs shall be suitable for use with eye lugs. The 4 pole, 3 pole and 2 poles MCBs knobs shall be trunked with adequate strength tandum pin. The tripping curves shall be B,C,D for lighting, industrial loads and UPS loads respectively. The watt loss per pole shall not exceed 2W for 6A to 16A, 2.5W for 20A, 4W for 32A & 6W for 63A.

Each distribution board shall have individual hinged/bolted gasketed doors with suitable screws. Removable conduit entry plates shall be provided at top and bottom of the DB

to facilitate drilling the conduit holes at site to suit individual requirements or knock out shall be provided.

Protective insulated cover plate shall be provided inside the panel to shroud all the live parts. Only the operating handle of the switch and the operating knob of the miniature circuit breakers shall be projecting outside the cover plate in case of ordinary DB and shall be inside the front door in case of dust tight DB. The unused outgoing gap of DB shall be suitably blanked with PVC plates at no extra cost. The incoming switch terminal should be suitably shrouded to avoid accidental contact. Each outgoing in the MCB DB shall have shrouding between Phases. The distribution board shall be factory wired and assembled and local fabricated DB shall not be accepted.

If the Distribution Board shall be triple pole and neutral, four pole isolator shall be provided as incomer and for single phase and neutral Distribution Board, double pole isolator shall be provided.

Earth leakage circuit breaker (ELCB)to be provided wherever called for Suitable label shall be provided to mark the circuit number of outgoings circuits.

The sensitivity of ELCB or RCBO as per the schematic wiring diagram/BOQ. All ELCB & RCBO shall have built in with test push button to stimulate the fault to ascertain the healthiness of the breaker. The ELCB & RCBO shall have minimum fault level handling capacity up to 10KA and shall trip the circuit within 40 milliseconds during fault in the circuits. It shall have trip fuse mechanism.

Surge arrestors/voltage surge devices (VSD) shall be rated for 10KA and shall be DIN rail mounted. It shall be part of distribution board. The VSD shall suppress voltage spikes & surges that can occur between phases, phase to neutral, phase to earth & neutral to earth. It shall have capability of handling high surge currents.

3. EARTHING

The DBs shall be provided with two numbers brass earthing terminals with suitable nuts, washers, etc., for connecting to earth bus outside the DB. In case of flush mounting DB, these shall be provided inside the DB.

4. PAINTING

The DB sheet steel surface shall be chemically cleaned to remove scale etc., rinsed dried and shall be finished with two coat of powder coat paint over two coats of red oxide primer.

5. TESTS

All necessary factory routine tests shall be performed on the equipment before despatch. The test results shall be sent along with the supply of DB.

6. DRAWINGS & INSTRUCTION MANUALS

After award of order, the contractor shall submit the following documents for records.

- Complete technical particulars of DB, MCBs, isolators, ELCBs, SPDs, etc.,
- Tripping characteristic curves of MCBs.
- Type test reports as per IS 8828.

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7. TECHNICAL SPECIFIACTION OF CABLE MANAGEMENT SYSTEM

Slotted angle iron cable trays and perforated cable trays

TRAYS & RACEWAYS

General
The cable management system shall consist of well designed, field proven products based on popularly accepted international practices.

It shall be flexible, possible to use in various configurations. All Accessories required to use in such configuration must be available as standard.

Manufacture and finish shall be complete at the works. No welding should be expected to be done at site for installation. All accessories like bolts, nuts, washers, coupler plates, hangers, etc., shall form part of the system whether specifically called for not.

All products used outdoors shall be Hot Dip Galvanized as per the relevant IS Standards or powder coated as per Bill of Quantities or General description of work.

Those used indoors could be Powder Coated or of Pre-galvanized steel materials as detailed in BOQ.

The products vendor should be in a position to offer various products to match with the installation , like power, data & voice cabling, on floors, under floors and above floor locations. All the products used shall be originally manufactured and site fabrication shall not be allowed.

Ladder type cable trays

Trays shall be factory made and consist of a Bolted rung assembly of field proven design. It shall consist of side rails of 2.5 mtr standard lengths and slotted rung spaced 250mm center to center or as per BOQ.

The rungs shall be bolted to the side rails.

Coupler, Coupler fasteners, tray assembly fasteners should form the part of the equipment.

The Ladders should be sheet metal construction yet robust enough to carry a cable load of 50 Kg/m on a span of 1.25 mtrs. The runners shall be 100mm wide for 1250mm and 1000mm wide cable trays with rugs spacing intervals at every 450mm centre to centre with tray support at regular intervals of not more than 1.25mts. The runner shall be 70mm and 50mm in size for 750mm and 600/450 or 300mm wide cable trays respectively with tray support intervals at 1000mm and 750mm respectively. However the details of rugs, etc. remains same for all the trays.

Finish - Hot dip Galvanized as per IS 2629 to a Zinc coat of 460 gms/mtr.sq. (65 microns) for thickness above 2mm and 340 gms/mtr.sq (48 microns) for thickness below 2mm.

The design shall be flexible enough to accommodate change of widths at site.

Sections of 1.6/2/2.5mm shall be standard for different widths of trays as detailed in BOQ. Special cable trays with lesser thickness with proven mechanical strength with potential design can be accepted after submission sufficient document as proof.

However, where locations demand lighter sections shall be detailed in the BOQ.

Horizontal bends, Vertical internal/external, Tees, Crosses, etc., shall also be factory made as standard products and shall be free of sharp projections.

Hinged or flexible coupler assemblies for Vertical/Horizontal route changes shall be available as standard as also reducers (offset couplers).

Covers shall be of Pre-galvanized sheet 18 SWG (1.25 mm up to 300 mm wide) & 16 SWG (1.6mm on higher widths) construction of standard length of 1.25 mtrs possible for easy mounting and fixing on to trays.

Provision to add on earth flat holding clamps, trays fixing clamps should part of cable tray design.
Additional vertical hangers to be provided wherever required to avoid sag, bend, etc., to suit site conditions.

Perforated Type Cable Trays

Perforated cable trays of 1.6mm/2mm thickness and standard lengths 2.5 mtrs as detailed in BOQ shall be offered by bidder if required. Finish shall be as specified.

Support for Cable Trays

Shall be Flexible system consisting of Slotted Verticals usable in single fashions with racks on one side only or in suitable configurations with racks on two opposing sides.

The system should be fixable to walls, columns, ceilings & floors.

Wall clamps, foot plates, ceiling plates and telescopic coupler, etc., which are required for fixing as above should be available as standard equipment.

Racks with Tapered section lowest at free end should be engaged easily with Vertical stand sections.

Racks should have slots to fix cables/conduits or trays.

All sections like stand, racks, clamps shall be of minimum 2.5 mm thickness (12 SWG).

All products for the support system shall be Hot Dip Galvanized as per IS:2629 to achieve uniform zinc coating not less than 60 microns at any spot.

Trunking / Race ways / Wire ways

Wire ways of enclosed type with covers, cover screws, coupler, coupler screws or any other coupling method to ensure rigidity, and made of Pre-Galvanized sheet constructions or of powder coated finish with all accessories shall be offered by bidder as details in BOQ. Such Wire ways along with suitable junction boxes should be suitable for surface laying, on/under floors - viz below raised floor, under the floor or flush with floor.

Junction boxes should be able to accommodate raceways - either by insertion or butting.

Standard products for tapping (like knockouts) and end caps for blocking entry to be provided. Covers could be hinged, liftoff or fixed with screws type as detailed in the BOQ.

Samples

Quantities large in nature, as decided by Client / Consultant to be produced for approval before delivery.

Site measurement & co-ordination

The exact routing, fixing arrangement, etc. to be decided at site before manufacturing . Client / Consultant's approval to be obtained for final routing.

Special notes:

The description of each items called for in the tender shall be inclusive of all necessary accessories as standard fixtures like vertical / horizontal hangers, wall supports, cross supports, bolts & nuts, coupler plates, etc. whether specifically called for or not.

Specifications for cable tray supports

Cable trays are expected to be laid in trenches, on structures approaching or surrounding the buildings, on the walls of building, under the ceiling slabs , above false ceilings ,on the

concrete columns , on steel columns, below the truss structure, through the truss structure or suspended from purlins .

It can generally be presumed that welding to light sections of steel structure of the building may not be permitted .

Similarly drilling for expansion fasteners , may not be permitted on the concrete columns . The support system should be well designed ,robust, field proven – references of at least 3 locations in manner and quantities , similar to current requirement may be called for.

Supply in knocked down condition would be preferred with assembly scheme properly explained in catalogue or drawings .Items to be easily accounted for upon receipt and in stocking and issue.

Supports suitable for each width of tray and the type for each application should be contained in technical literature with the products .

All fasteners required to assemble the system and to fix the cable trays onto the prefabricated support have to be considered .

Load test data is to be provided ,for typical assemblies. The supplier is to be equipped with facilities for testing the assemblies in their premises.

Acceptance will be based on successful test carrying of 150% of the specified load without undue distortion or yield.

The support system should not distort during the process of cable pulling or laying .

The components of the support system could be :
a. rolled structural sections **with perforations, or**

b. formed sheet metal sections **with perforations , or**

c. weldments of rolled structurals and formed sheet assemblies **with perforations** .

Minimum thickness of mild steel sheet used in fabrication to be 2.5mm and
Rolled Structural section 5mm thick minimum.

All horizontal supports directly carrying trays shall be clubbed with the unit prices of Cable trays .Anchor plates and such accessories shall be related to the horizontal ,hence also in unit price of cable trays .

Horizontal distance between supports shall generally be at 1.5 mtr centre to centre ,but in no instance shall exceed the standard length of a single tray assembly .

Extra supports at all bends and changes in direction of route will be expected.

Verticals generally vary in different parts of the route , to be cut from long standard lengths .Shall be considered on running length basis .

The support system should be possible to configure easily ,for example to mount on Ceiling, wall or trench .

Configuring in multiple layers should be possible. Additional accessories or brackets to extend the system safely should be part of design .

Accessories that prevent sway or retain the system in plumb should be part of the system .

Soft pvc end caps in a bright color should be available to protect edges and prevent hurt.

Finish : Currently the finish required is hot dip galvanized , with an average coating of 65 micron zinc .The system should be suitable to be powder coated for sections of installation where necessary .All fasteners shall be zinc plated .

The supports, of any type, any sections suitable for wall/hanging from truss / ceiling / etc. will be measured on Kg. basis. The type of supports to suit to various locations / suitable for site conditions will be decided by consultant / client.

Inspection & Testing:
For large quantities, if the client / consultant prefers to inspect & test the cable trays at the manufacturer's premises, the same should be done. All relevant mechanical test, bending test, maximum withstand stress test, etc. to be carried out before dispatching.

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8. TECHNICAL SPECIFIACTION OF EARTHING

SCOPE

This specification to define the requirements for the supply, installation, testing and commissioning of the earthing system.

The earthing installation shall confirm to the following latest Standards/statutory provision.

1. Code of practice for earthing IS 3043-1987
2. Indian Electricity Rules 1956
3. Indian Electricity Act 1910
4. Local CEIG's Regulations

The main earth bus shall be copper or G.I. conductor or as specified in the tender. The earthing installation shall be done in accordance with the Indian Electricity (IE Rules) rules framed there under. The contractor shall carryout any changes desired by the Electrical Inspector or the Owner, in order to make installation confirm to Indian Electricity

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Rules at no extra cost. The exact location of conductors, earth electrodes and earthing points on the equipment shall be determined in consultation with Engineer or authorised person. Any changes of methods, routing, size of conductors, etc., shall be subject to approval of the Owner.

The excavation and refilling of earth, necessary for laying underground earth bus and earth pits shall be the responsibility of the contractor. Main earth bus for equipment earthing shall be laid in trenches, wall, ceiling and shall be firmly fastened to cleats (spacer clamps) made of minimum 25 x 3 mm. galvanised steel in the wall/trench/ceiling/rising main room. The earthing strips shall be protected against mechanical damage.

Joints and tappings in the main earth bus shall be properly riveted or braced in such a way that reliable and good electrical connections are permanently ensured. All joints tappings, ends, etc. are to be properly tinned. All connecting bolts and nuts shall be only cadmium plated with suitable size spring washers. Conduits in which cables have been installed, shall be effectively bonded and earthed. Cable armour shall also be earthed at both ends through glands.

Computer earthing bus shall run independently and in any case this should not be mixed with the equipment earth bus.

For equipment earthing 100mm. dia 13mm thick 2.5m long cast iron pipe earth electrodes shall be installed as shown in the drawing and also in accordance with IS-3043-1987. For neutral earthing 600 x 600 x 3.15mm copper plate with 50mm G.I. pipe for watering shall be installed as per drawing.

A number of electrodes shall be connected in parallel to reduce the earth resistance. The exact location and number of earth electrodes required shall be determined in consultation with Owner/Consultant.

Earth electrode shall be normally not to be located on the road, buildings, foundations, columns, etc. The minimum distance between the building and electrode shall be 3048 mm. All the earth electrodes shall be provided with disconnecting facility to check their individual earth resistance periodically. The main earth bus shall be connected to earth mass via several electrodes. All the electrical power consuming equipment shall be earthed by two separate and distinct earth connections from Main earth bus.

The following shall be positively earthed not limited to the following:

1. All power apparatus such as transformer, switchgear, motors, push button station, etc.

2. Cable gland and armour.

3. Motor control centers, power control centers, switch boards, etc.,

4. Distribution boards

5. Cable tray

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6. Frames of equipment supporting structure

All earth strips shall be jointed as follows:

1. Copper with 80mm fish plate and brazing. : Copper riveting

2. Galvanised Steel lap : Lap welding with 50mm minimum

All earthing connections for equipment shall be preferably from the main earth bus above ground only.

All earth stations shall have to be interconnected by the same size of main bus below ground level. All the main earth conductor above the ground level shall be painted with two coats of enamel paint. The following colour codes has to be followed:

(a) Main body earth bus - Green colour
(b) Main neutral earth bus - Black colour
(c) Lightning protection earth bus - Red colour or as preferred by Owner/Consultant.

Earthing system of equipment earthing, exclusive earthing, neutral earthing and lightning protection earthing should not be mixed together above the ground. These systems/connections shall be tested in accordance with IS 3043-1987. Earth resistance of the individual system shall be measured after connecting all the electrodes to the bus and the combined value shall be minimum of less than one ohm.

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9. TECHNICAL SPECIFIACTION OF TESTING AND COMMISSIONING

The scope of work for testing and commissioning of the total installation shall be for the capital equipments like transformers, switchgears, cables etc., and also for the associated equipments like relays CTs, PTs, etc.

The scope of work for testing and commissioning of electrical equipment for the above shall include but not be limited to the following:

a) Providing sufficient number of experienced Engineers, Supervisors, Electricians so that the installation can be commissioned in stipulated time.

b) All the instruments, tools and tackles required for carrying out the testing and commissioning shall be provided by the bidder.

c) The testing of electrical equipment shall be carried out as per the relevant Indian Standards/Code or Practices/Manufacturer's instructions.

d) Cleaning of electrical equipment, contacts cleaning and greasing etc. All the equipment and material required for above shall be supplied by the bidder.

e) Correcting the panel/equipment wiring for proper functioning of the schemes required/called for.

f) Installation and wiring of additional equipment on panels like auxiliary contactors, timers, etc. which may be additionally required for proper functioning of the schemes.

g) Checking of equipment earthing and system earthing as a whole.

h) Testing of all the cables.

i) Co-ordination with other contractors for testing and commissioning of interface cables.

j) Relay setting calculations & setting of relays to suit the upstream breaker setting & cts & meters calibration etc

k) The tests required as per CEA/CEIG for various parameters have to be carried out by an approved third party agency. Test result have to be formulated & submitted for records.

TESTS TO BE CONDUCTED:

a) All tests shall be performed in the presence of the bidder and customer/consultant. For all types of visual inspections, checkings, pre-commissioning, commissioning test and acceptance tests, IS Code to be followed for the tests given therein in addition to the instructions in this technical specification. The intention of giving the few test procedures, described below, is to provide a guideline for the bidder. However, bidder shall not restrict themselves in carrying out only the tests described in this document.

b) Bidder shall submit their proposed test procedures for approval and shall not commence testing such approval is given.

c) Bidder shall check and test all electrical equipment and systems installed and supplied them, including equipment supplied by the Owner.

d) Bidder shall supply all necessary test equipment and personnel both craft and supervisory to carryout the work without danger to personnel or damage to equipment.

e) Bidder shall ensure that no tests are applied which may stress equipment above the limits for field testing recommended by the manufacturer. Bidder shall be responsible for any damage to personnel or equipment resulting from improper test procedure.

f) All defective materials furnished by the bidder and defects due to poor workmanship revealed through field testing, shall be corrected at bidder expense without affecting the completion of the project.
g) Client/Consultant reserves the right to interpret and approve all test results prior to energisation of circuits or apparatus.

h) Bidder shall visually inspect all equipment for defects immediately upon arrival at site including those supplied by the Owner.

i) Relay coordination chart and final setting before/commissioning.

MECHANICAL CHECKOUT

After installation, but before any power supply is connected, the contractor shall make a complete mechanical check of all installed electrical equipment and systems. This shall include but not to be restricted to the following:

a) Check equipment numbers against drawings/documents.

b) Check name plates of transformers, switchgears, etc., for conformity with the data given in the drawings and specifications.

c) Check all equipment bus joints and connections for tightness.

d) Check all cable and wire connections for tightness.

e) Check phase sequence.

f) Check all bushings/insulators to ensure they are clean and unchipped. Inspect tank cooling tubes and radiators for leaks.

g) Check silicagel for dryness where breathers are supplied. If the colour of the silicagel is pink, remove from the breather and dry out following manufacturer's recommended procedure, until a light blue colour is restored and replace it.

h) Check valve in the connecting pipe between the conservator and transformer tank to ensure that valve is in 'open' position.

i) Check interlocking on access doors for mechanical and electrical safety. Check that key and electrical interlocking system functional and accomplish their purpose.

j) Check all plug in contacts for alignment and 'grip'.

k) Check all contactors for free manual operation.

l) Remove all locking devices installed for shipment.

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m) Check all the coils for their continuity and proper voltages.

n) Check the arc chutes, arcing horns, main contacts of breakers are clean and undamaged. Check the carriages ride smoothly and reliably on their guide rails. Check for proper operation of circuit breaker operation mechanism, controls and adjustments.

o) Check the fuses are correctly rated and installed are clear, undamaged and fit for operation.

p) Check all relays and instruments are clean, correctly connected and undamaged. Check test plugs are installed in all protective relays. Check relays for free manual operation, if applicable.

q) Check instrument transformer ratings against drawings. Check for proper installation and connection.

r) Check interlock and auxiliary devices and the operation of the circuit breaker with the protection relay circuit.

s) Clean the equipment by vacuum cleaner before energising.

EARTHING:

a) Bidder shall test the buried earth grid and shall record the values.

b) Bidder shall inspect and test all earthing work carriedout by him, including all interconnections between ground loops, grounding of equipment and ensure all connections are permanent and that the earthing circuit is continuous.

c) Bidder shall megger and record earth resistance at various earth connection points.

TRANSFORMERS:

a) Windings and auxiliary wiring, rated 433 volts, or more, shall be tested with a 1000 volts megger. Readings shall not be less than 100 meg ohms between phases and earth.
b) Windings and auxiliary wiring, rated less than 433 volts shall be tested with a 500 volts megger. Readings shall not be less than100 meg ohms, between phases and between phases and earth.
c) Test the gas detector relay by simulating a fault condition using air pressure from a hand pump as per manufacturer's recommendation since excessive pressure may

damage the relay. Remove air from the relay by opening the bleed valve. Ensure that value leading to tank is left in the 'open' position.

d) Transformers shipped without transformer oil shall be tested by adopting standard cup-test. Test shall be conducted for all containers.
e) Samples of oil from each transformer shall be tested for di-electric strength after filling and before energising. Transformers with oil having a di-electric strength of less than 40 KV for one minute as standard cup-test shall not be energised. Such type of transformers shall have to undergo filtration of oil to obtain the above result.
f) Check for proper gasketing and correct installations of diaphram.
g) Check liquid level gauges temperature indicators and alarm circuits for proper operations.
h) Where transformers are shipped gas filled, check gas pressure prior to filling with oil.
i) Check all primary and secondary connections are property made, including taping and insulation.
j) Make continuity test.
k) Check tap changer switch for free operation.
l) Transformers which are kept idle for more than 6 months shall be dehydrated even if the results are satisfactory.
m) Check insulation resistance, test, voltage ratio test/ Turns ratio test, magnetising current test (at normal tap), short circuit test, magnetic balance test, winding resistance test, polarisation index test, calibration of oil temperature and winding temperature indicators, setting of alarm and trip contacts.

SWITCHGEAR:

a) Switchgears rated 433 volts or more shall be tested with a 1000 volts megger.
b) Auxiliary wiring rated less than 415 volts shall be tested with a 500 volts megger.
c) All protective relays shall be tested at sufficient points to establish their proper functioning in accordance with the manufacturer's specification and curves.
d) Operation checks and functional checks on all switchgear panels.
e) For current transformers insulation test, polarity test, ratio test, secondary injection test, operating current check, service setting in consultation with Client/Consultant.
f) For potential transformers, ratio test, insulation test, etc.
g) Contact resistance for breaker contacts between male and female.

WIRES AND CABLES:

a) Continuity testing of all cables.
b) Wires and cables rated 433 volts or more shall be tested with a 1000 volts megger. Cables rated less than 433 volts shall be tested with a 500 volts megger.
c) No wires or cable having resistance between conductors or between conductors and ground of less than 100 meg ohm shall be accepted.

FUNCTIONAL TESTING:

a) All circuit breakers, contactors, relays, remote devices, etc.,

PRECOMMISSIONING TESTS:

a) All pre-commissioning test stated as per IS for respective items.

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10. TECHNICAL SPECIFIACTION OF LIGHT FIXTURES & FANS

SCOPE

The scope of work shall cover the supply, installation and testing of fluorescent, incandescent light fixtures, LED fixtures and ceiling fans and handing over the same to the client.

Where fixtures are supplied by the client as free issue of material, scope shall cover installation only with all the accessories as specified in the schedule of work.

STANDARDS

The following standards and rules shall be applicable:

1. IS 3646 – 1968 Code of practice for interior illumination.
2. IS 1913 – 1969 General and Safety requirements for electric lighting fittings.
3. IS 8030 – 1976 Luminaries for Hospitals.
4. IS 374 – 1966 Electric ceiling type fan & regulators.
5. Indian Electricity Act and Rules issued there under.
6. IS 16101:2012 General lighting LEDs and LED module.
7. IS 16102 Self- Ballasted LED Lamps for General Lighting Services
8. IS 16103:2012 Led Modules for General Lighting (Part 1) Safety Requirements

All latest codes and standards to be followed wherever applicable local Electrical inspectorate codes and standards are to be followed wherever required specially to obtain safety of installation & safety to the operating personnel.

GENERAL REQUIREMENTS

All fixtures shall be complete with all accessories and miscellaneous materials like screws, bolts & nuts, washers, etc. necessary for installation whether specifically mentioned or not.

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Fixture housing, Frame or canopy shall provide a suitable cover for the fixture outlet box or fixture opening as described in the BOQ.

Fixtures shall be installed at mounting heights as detailed on the drawings or instructed at site by the Architects/Consultants and individually earthed with wires as mentioned in the BOQ.

The fixing arrangement or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture including vibration, etc. produced by the cranes, etc. Design of hangers and method of fastening shall be as per specification or recommended by the equipment manufacturers.

Pendant fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation as per Architect's/Consultant's instructions.

Flush mounted and recessed fixtures shall be installed so as to completely eliminate light leakage within the fixture and between the fixture and adjacent finished surface.

All light fixtures to be installed to plum line and horizontal & vertical facia to be adjusted to suit site conditions or as per the requirement of the consultant / client.

Fixture shall be completely pre wired and constructed to comply with the regulations and as per code of practice. Manufacturers name shall be marked in all fixtures complete with inspection label from the factory.

Wiring within the fixture and for connection to the branch circuit wiring shall be not less than 1.5 sqmm copper for 250-volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve.

Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with the specification or suit to the weight of the components, etc. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burrs and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

Ferrous metal shall be bonderized and given a corrosion resistant phosphate treatment or other approved rust removing prime coat to provide a rust-proof base before final finish. After final finish the metal surface shall be smooth & free from dents, etc.

Non-reflecting surfaces such as fixture frames and trim shall be finished in baked enamel paint or powder coating process.

Light reflecting surface shall be having a reflection factor of not less than 80%. All parts of reflector shall be completely covered by finish and free from irregularities. Finish shall be capable of withstanding 72 hours continuous exposure to an ultraviolet sun lamp placed 10 cm from the surface without discoloration, hardening or warping and retain the same reflection factor after exposure. Test results shall be furnished for each of fixtures.

Fixture with visible frames shall have concealed hinges and catches. Pendant fixtures and lamp holders shall be provided with ball type aligners or similar approved methods. Recessed fixtures shall be constructed so as to fit into an acoustic tile ceiling or plaster ceiling/plaster rings. Fixtures with hinged diffuser doors shall be provided with spring clips or other retaining device to prevent the diffuser from moving. Clean room fixtures shall adhere to international norms.

Sample fixtures to be submitted to the Architect/Consultants for approval before ordering. Shop drawings for non-standard fixture types shall be submitted for approval to the Architect/Consultant. Detailed catalogues showing the dimensional details, weight of the fixture, recommended fixing arrangement, etc. shall be submitted before ordering.

Recessed fixtures shall be constructed so that all components are replaceable without removing housing from the ceiling.

1. Lamp shall be supplied and installed in all lighting fixtures as per the contract. All lamps shall be rated for 250Volts.

2. Lamps used for temporary lighting service shall not be used in the final lamping of fixtures units.

3. Lamps shall be of wattage and type as shown on the drawings and BOQ. The details of the non-standard fixture & special application fixture to be discussed with Architect/consultant before procurement.

4. Fixing of lamps to the installation to be taken as last activity after final touch up of the ceiling.

5. Touch up work, point mark done by the general builder to be cleaned by the Electrical contractor before drying of the painting, plastering, etc.

FLUORESCENT FITTINGS

Only single and / or two lamp ballast shall be used in any one fixture. All ballasts shall be low loss electronic ballasts unless specified otherwise.

All fluorescent fixtures shall be provided with separate wiring channel with cover plate and an earth terminal. All screws shall be chromium brass screws. Lamp and starter holders shall be out of tough moulded plastic with spring loaded rotor type contactors and shall be shock and vibration proof. Condensers shall be low loss paper impregnated hermetically sealed complying with IS 1969. Internal wiring shall be neatly clipped and a suitable heat resistant barrier or sleeve shall be provided wherever wiring crosses heat producing elements like chokes, etc.

Surface mounted fixtures longer than 600mm shall have one additional point of support besides the outlet box fixture stud when installed individually. Pendant individually mounted fixtures 1200mm long and smaller shall be provided with twin stem/conduit hangers / furnished GI wire ropes / as per BOQ.

Lamps shall have bi-pin bases and a minimum approximate rated and guaranted life as specified in the catalogue. Colour spectrum of light shall be equivalent Osram / Philips & colour of the lamp shall be selected by Architect / consultant. Lamp starter, ballast and driver shall match the lamp.

The LED luminaire and device shall be already tested as per IESNA (The Illumination Engineering Society of North America)

INCANDESCENT FITTINGS

Incandescent fittings shall be of the type generally specified on the drawings. Contractor should have sample approved by Architects/Consultant before procurement.

Incandescent fixtures shall be equipped with porcelain, medium base, screw type sockets for lamps up to and including 200 watt and mogul screw type base for lamps 300 watt and over.

Relamping the fixture shall be possible without having to remove the fixture from its place.

Incandescent lamps shall be inside frosted or clear type as required by the Architect/Consultants.

CEILING FANS

Ceiling fans shall be complete with fan suspension stem canopies and regulators. 30 cm suspension stem shall be standard accessory and stems shall be heavy duty galvanized steel tubes to IS 1239-1958.

Fans shall be mounted on a pre-embedded hook with hard rubber isolator. Regulators shall be no-step type mounted in the switch box. The box in all such cases shall be large enough to accommodate the regulator and switches. One sample box with top cover shall be got approved before procurement.

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CHAPTER G :TECHNICAL SPECIFICATION SOLAR POWER

WORK DESCRIPTION-GENERAL

This section specifies the engineering, supply, delivery to site, installation, testing, commissioning and maintenance of solar power plant as described in the Content.

1. SOLAR PHOTOVOLTAIC MODULES:

The total Solar PV minimum array capacity should not be less than the KWp specified for each location as above and should comprise of poly crystalline modules of minimum 250 Wp and above wattage. Module capacity less than minimum 250 Wp should not be supplied. The Photovoltaic module must be tested and certified by an independent testing laboratory that is accredited in accordance with ISO Guide 25.

a. The PV modules should be of Indigenous make. The PV modules must conform to the latest edition of any of the following / equivalent BIS standards for PV module design qualification and type approval:

Crystalline Silicon Terrestrial PV Modules IEC 61215 / IS14286

Thin Film Terrestrial PV Modules IEC 61646 / Equivalent IS

In addition, the modules must conform to IEC 61730 Part 1(requirements for Construction) & Part 2 (requirements for testing, for safety qualification).

Further, the PV modules must also qualify the Salt Mist Corrosion Testing as per IEC61701 / IS 61701

b. SPV module Conversion efficiency should be equal to or greater than 14% at STC and AM 1.5 radiations.

c. The PV modules shall perform satisfactorily in humidity up to 100 % with temperature between -40ºC to +85ºC. Since the modules would be used in a high voltage circuit, the high voltage insulation test shall be carried out on each module and a test certificate to that effect be provided.

d. The prescribed electrical degradation shall not be less than 10 (ten) percent of the full rated original output at the end of the period of 12 years and not less than 20 (twenty) percent of the full rated original output at the end of 25 years.

e. Manufacturers/suppliers should confirm whether they are supplying PV modules using a RF identification tag (RFID), which must contain the following information. The RFID can be placed inside or outside the module laminate, but must be able to withstand harsh environmental conditions:-

i. Name & Serial No. of the Manufacturer of PV Module.
ii. Name & Serial No. of the Manufacturer of Solar Cells

iii. Month and year of the manufacture (separately for solar cells & module)

iv. Country of origin (separately for solar cells & module)
v. I – V curve for the module
vi. Peak Wattage, Im, Vm and FF for the module
vii. Unique Serial No. and Model No. of the module
viii. Date and year of obtaining IEC PV module qualification certificate
ix. Name of the test lab issuing IEC certificate
x. Other relevant information on traceability of solar cells and module as per ISO9000 series.

Until 31st March, the RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions. However from 1st April, 2015 onwards; RFID shall be mandatorily placed inside the module laminate.

f. Other general requirement for the PV modules and subsystems shall be the following:

i. Raw material (Solar cells) and technology employed in the module production shall have to be certified and a certificate giving details of major materials i.e. cells, Glass, back sheet, their makes and data sheets to be submitted for the modules being supplied by the bidder.

ii. The rated output power of any supplied module shall not have negative tolerance.

iii. The peak-power point voltage and the peak-power point current of any supplied module and/or any module string (series connected modules) shall not vary more than 3 (three) percent from the respective arithmetic means for all modules and/or for all module string, as the case may be

iv. Except where specified, the front module surface shall consist of impact resistant, low-iron and high-transmission toughened glass.

v. The module frame, if any, shall be made of aluminum or corrosion-resistant material which shall be electrolytically compatible with the structural material used for mounting the modules.

vi. The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and with arrangement for provision of by-pass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type IP65 rated.

vii. Necessary I-V curves at 250 C, 450,600 and at NOC are required to be furnished.

viii. Fill factor of module shall not be less than 0.70

2. ARRAY STRUCTURE:

a. The array structure shall be so designed that it will occupy minimum space without scarifying the output from SPV panels.

b. Wherever required, suitable number of PV panel structure shall be provided. Structures shall be of flat-plate design either or L sections.

c. Structural material shall be corrosion resistant and electrolytically compatible with the material used in the module frame, its fasteners, nuts and bolts. Galvanizing should meet ASTM A-123 hot dipped galvanizing or equivalent which provides at least spraying thickness of 70 micron on steel as per IS 5905, if steel frame is used. Aluminum frame structures with adequate strength and in accordance with relevant BIS/international standards can also be used.

d. Structures shall be supplied complete with all members to be compatible for allowing easy installation at the roof top site and the structure atop sloping roofs shall be done by the Bidder.

e. The structures shall be designed to allow easy replacement of any module & can be either designed to transfer point load on the roof top or UDL as per site conditions and design to be approved by CLIENT/CLIENT.

f. Each structure shall have a provision to adjust its angle of inclination to the horizontal as per the site conditions.

g. The array structure shall be grounded properly using maintenance free earthing kit.

h. Each panel frame structure should be so fabricated as to be fixed on the rooftop column/wall structures. The structure should be capable of withstanding a wind load of 200 km/hr. after grouting & installation. The front end of the solar array must be one meter above the rooftop. Grouting material for SPV structures shall be as per M15 (1:2:4) concrete specifications.

i. The structures shall be designed for simple mechanical and electrical installation. There shall be no requirement of welding or complex machinery at the installation site. If prior civil work or support platform is absolutely essential to install the structures, the supplier shall clearly and unambiguously communicate such requirements along with their specification in the bid. Detailed engineering drawings and instructions for such prior civil work shall be carried out prior to the supply of Goods.

j. The supplier shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings. Such details shall include, but not limited to, the following:

i. Determination of true south at the site;

ii. Array tilt angle to the horizontal, with permitted tolerance;

iii. Details with drawings for fixing the modules;

iv. Details with drawings of fixing the junction/terminal boxes; v. Interconnections details inside the junction/terminal boxes; vi. Structural installation details and drawings;
vii. Electrical grounding (earthing);

viii. Inter-panel/Inter-row distance with allowed tolerances; and ix. Safety precautions to be taken.
k. The array structure shall support SPV modules at a given orientation and absorb and transfer the mechanical loads to the rooftop columns properly. All nuts and bolts shall be of very good quality stainless steel. Detailed design and drawing shall have to be submitted for acceptance and approval before execution of work.

NOTE: The structural design of the complete system should be compatible with the structural strength and load bearing capacity of the roof. Design calculations and certificate to this effect shall be provided by a qualified chartered structural engineer.

3. POWER CONDITIONING UNIT (PCU)

The PCU required of appropriate capacities as follows, should convert DC power produced by SPV modules, in to AC power and adjust the voltage & frequency levels to suit the local grid conditions.

PCU should be appropriate capacity of proposed solar PV plants

3.1 POWER CONDITIONING UNIT (INVERTER PLUS MPPT CHARGE CONTROLLER)

Input Voltage:
• From PV Module: Minimum 08KWp, 120V nominal DC from Solar PV Array.

• From AC source: 410-415V (Phase to Phase) (+12%, - 20%), 3 ph, 50 Hz (+ .5 Hz)
Output Voltage:

Suitable for charging 120 V, 600AH tubular plate lead acid VRLA Gel type battery bank.

Protection:

• Short Circuit

• Deep discharge

• Over charging (Automatic trickle charge mode on full charge)

• Input surge voltage

• Over current (Load)

• Battery reverse polarity

• Solar Array reverse polarity

Indication (LED/LCD Indication):

• String on

• Mains on

• Input on

• Control on

• Charge on

	• Charger overload		
	• Battery on trickle		
	• Battery disconnected/fault battery reverse polarity		
	• Low solar power		
	• System fault		
	• Charger over temperature		
	• Input over/under voltage (for AC)		
	Operating Temp: 0-50 Deg C		
	Humidity: 0-95% non condensing		
	Enclosure IP 32		
	No Load Consumption: < 1%		
3.2	INVERTER:		
	Common Technical Specification:		
	Control Type: Voltage source, microprocessor regulation	assisted,	output

Output Voltage: 3 phase, 415 Vac (+12.5%, -20% Vac) Frequency: 50 Hz (+3 Hz, -3 Hz)
Continuous rating: As per Table Above

DC link voltage range: 0 to 800 V

Nominal Power: As per Table Above Total Harmonic Distortion: less than 3%
Maximum current ripple: 4% PP
Reactive Power: 0.95 inductive to 0.95 capacitive

Operating Temp. Range: 0 to 55 deg C

Housing Cabinet: INVERTER to be housed in suitable switch cabinet, Within IP 65 Degree of ingress protection for outdoor and IP 20 for Indoor.

Inverter efficiency: 95% and above at full load, Power Control: MPPT
Other important Features/Protections required in the INVERTER

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- Mains (Grid) over-under voltage and frequency protection
- Fool Proof protection against ISLANDING
- Designed to withstand starting in – rush current when pump is started and provide trip free operation.
- Included authentic tracking of the solar arrays maximum power operation voltage (MPPT)
- Array ground fault detection
- LCD and piezoelectric keypad operator interface Menu driven
- Automatic fault conditions reset for all parameter like voltage, frequency and/or black out.
- MOV type surge arrester on AC and DC terminals for over voltage protection from lightening-induced surges.
- INVERTER should be rated to operate at 0-55 deg. centigrade unless provision for air conditioning is included in INVERTER
- All parameters should be accessible through an industry standard communication link.
- Overload capacity (for 10 sec) should be 150% of continuous rating.
- The INVERTER shall be self-commuted and shall utilize a circuit topology and components suitable for meeting the specifications listed above at high conversion efficiency and with high reliability.
- The PCU shall give the preference to feed the loads from Solar Energy being produced and shall draw the additional power from mains to meet the load requirements in case the load is more than the solar energy being produced.
- PCU shall be capable to synchronize independently & automatically/to be phase locked with Power Supply Authority grid power line frequency to attain synchronization & export power generated by the solar panel to Power Supply Authority grid.
- Since the INVERTER is to be used in solar photovoltaic energy system, it should have high operational efficiency. The DC to AC conversion efficiency shall at least be 95percent at full load. The idling current at no load must not exceed 2 percent of the full load current.
- Transformer less inverters shall be preferred. Restriction of DC components on AC side shall be achieved.

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- The INVERTER output shall be 415 VAC, 50 Hz 3 phase.

- The INVERTER shall be capable of operating in parallel with the grid utility service and shall be capable of interrupting line-to-line fault currents and line-to-ground fault currents.

- The INVERTER shall be able to withstand an unbalance output load to the extent of 30%.

- The INVERTER shall include appropriate self-protective and self- diagnostic features to protect itself and the PV array damage in the event of INVERTER component failure or from parameters beyond the INVERTER's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the INVERTER front panel to cause the INVERTER to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the INVERTER, including commutation failure, shall be cleared by the inverter protective devices and not by the existing site utility grid service circuit breaker.

- The INVERTER shall go to shut down/standby mode, with its contacts open, under the following conditions before attempting an automatic restart after an appropriate time delay;

I. Insufficient Solar Power Input

When the solar available from the PV array is insufficient to supply the losses of the INVERTER, the INVERTER shall go to a standby/shutdown mode. The INVERTER control shall prevent excessive cycling during rightly shut down or extended periods of insufficient solar radiation.

II. Utility-Grid Over or Under Voltage

The INVERTER shall restart after an over or under voltage shutdown where the utility grid voltage has returned to within limits for a minimum of two minutes.

III. Utility-Grid Over or Under Frequency

The INVERTER shall restart after an over or under frequency shutdown when the utility grid voltage has returned to within limits for minimum of two minutes.

- The INVERTER generated harmonics measured at the point of connection to the utility services when operating at the rated power shall not exceed a total harmonics current distortion of 3 percent, a single frequency current distortion of 4 percent and single frequency voltage distortion of 1 percent, when the first through the fiftieth integer harmonics of 50 Hz are considered.

- The INVERTER power factor at the point of utility services connection shall be 0.95 lagging or leading when operating at above 25 percent of the rated output.

- The internal copper wiring of the INVERTER shall have flame resistant insulation. Use of PVC is not acceptable. All conductors shall be made of standard copper.

- The INVERTER shall withstand a high voltage test of 2000V rms, between either the input or the output terminals and cabinet (chassis).

- Full protection against accidental open circuit and reverse polarity at the input shall be provided.

- The INVERTER shall not produce Electromagnetic Interference (EMI) which may cause malfunctioning of electronic instruments including communication equipment, which are located within the facility in which the INVERTER is housed.

- The INVERTER shall have an appropriate display on the front panel to display the instantaneous AC power output and the DC voltage, current and power input. Each of these measurements\ displays shall have an accuracy of 1 Percent of full scale or better.

- The display shall be visible from outside the INVERTER enclosures. Operational status of the INVERTER, alarms, trouble indicators and A.C and the D.C disconnect switch positions shall also be communicated by appropriate messages or indicator lights on the front cover of the INVERTER enclosure.

- Communication Modbus protocol with LAN/WAN options along with remote access facility and SCADA package with latest monitoring systems including individual string monitoring with Web/IP data monitoring.

- The Inverter shall be with Bi-directional full sine wave charge controller 120 V DC output.

Electrical safety, Earthing and Protections

a. Internal Faults: In built protection for internal faults including excess temperature, communication failure, and overload and cooling fan failure (if fitted) is obligatory.

b. Galvanic Isolation: Galvanic Isolation is required to avoid any DC component being injected into the grid and the potential for AC components appearing at the array.

c. Over Voltage Protection: Over Voltage Protection against atmospheric lightening discharge to the PV array is required. Protection is to be provided against voltage fluctuations in the grid itself and internal faults in the power conditioner, operational errors and switching transients.

d. Earth fault supervision: An integrated earth fault device shall have to be provided to detect eventual earth fault on DC side and shall send message to the supervisory system.

e. Cabling practice: Cable connections must be made PVC Cu. cable, as per BIS standards.

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All cable connections must be made using suitable terminations for effective contact. The PVC Cu cables must be run in GL trays with covers for protection.

f. Fast acting semiconductor type current limiting fuses at the main bus-bar to protect from the grid short circuit contribution.

g. The INVERTER shall include an easy accessible emergency OFF button located at an appropriate position on the unit.

h. The INVERTER shall include ground lugs for equipment and PV array grounding. The DC circuit ground shall be a solid single point ground connection in accordance with WEC 69042.

i. All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed and painted or otherwise suitably protected to survive a nominal 30 years design life of the unit.

j. The INVERTER enclosure shall be weatherproof and capable of surviving climatic changes and should keep the INVERTER intact under all conditions in the room where it will be housed.The INVERTER shall be located indoor and should be wall/pad mounted, Moisture condensation and entry of rodents and insects shall be prevented in the INVERTER enclosure.

k. Components and circuit boards mounted inside the enclosures shall be clearly identified with appropriate permanent designations, which shall also serve to identify the items on the supplied drawings.

l. All doors, covers, panels and cable exists shall be gasketed or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks. All openings shall be provided with grills or screens with openings no larger than 0.95 cm. (about 3x8 inch).

m. In the design and fabrication of the INVERTER the site temperature (50 to 550 C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar considerations shall be given to the heat sinking and thermal for blocking diodes and similar components.

Factory testing

a. The INVERTER shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service, prior to its shipment.

b. Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.

c. Special attention shall be given to demonstrate utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.

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d. Operation of startup, disconnect and shutdown controls shall also be tested and demonstrated. Stable operation of the INVERTER and response to control signals shall also be tested and demonstrated.

e. Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonics content and power factor, but shall also include all other necessary tests/simulations required and requested by the Purchasers Engineers. Tests may be performed at 25, 50, 75 and 100 percent of the rated nominal power.

f. A factory Test Reports (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted.

g. Factory testing of the INVERTER should be carried out and witnessed by the Purchaser's Engineers at the manufacturers premises. Operating modes:
The following operating modes are to be made available:

a. Standby mode: Where the control system continuously monitors the output of the solar generator until pre-set value is exceeded (typically 10 watts)

b. Operational or MPP tracking mode: The control system continuously adjust the voltage of the generator to optimize the power available. The power conditioner must automatically re-enter stand-by mode when input power reduces below the standby mode threshold. Front Panel display should prove the status of the INVERTER, including AC Voltage, Current, Power output & DC Current, Voltage and Power input, pf and fault Indication (if any)

Codes and standards:-

The quality of equipment supplied shall be controlled to meet the guidelines for engineering design included in the standards and codes listed in relevant ISI and other standards, such as:

• IEEE 928 Recommended Criteria for Terrestrial PV Power systems.

• IEEE 929 Recommended Practices for Utility Interface of Residential and Intermediate PV Systems.

• IEEE 519 guide for Harmonic Control and Reactive Compensation of Static Power Controllers.

• National Electrical NEPA 70-(USA) or equivalent national standard.

• National Electrical safety Code ANSI C2-(USA) or equivalent national standard.

• JRC Specification 503 (Version 2.2 March 1991) or JPL Block V standard for PV modules.

• The inverter manufacturer should attach efficiency certificate from Independent Third party Testing laboratory i.e. IEC, TUV, SNL/ERTL or STQC. PCU should confirm to IEC

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61683 for efficiency measurements and IEC 600682 for environmental testing. MPPT unit should confirm to design qualification IEC 62093. Plant metering/data logging
a. PV array energy production: Digital Meters to log the actual value of AC/DC Voltage, Current & Energy generated by the PV systems shall have to be provided. 1 Nos. two way LT 415V energy meters (import – export) class 0.2S ABT compliant shall be incorporated in the system one for each Solar PV Plant.

b. Solar Irradiance: An integrating Pyranometer (Class-II or better) should be provided, with the sensor mounted in the plane of the array. Readout should be integrated with data logging system.

c. Wind Speed: An integrated wind speed measurement unit to be provided.

d. Temperature Sensor: Integrated temp. Sensor for measuring the module surface temp, inverter inside enclosure temp. and ambient temp to be provided complete with readout integrated with the following features:

e. Data logging systems(Hardware and software) one for each Solar PV Plant, for plant control and monitoring shall be provided with the following features suitable Computers: Desktop Computer 3 GHz Pentium i7 latest (3MB Cache) with 500 GB HDD, 4 GB RD RAM, 2 Parallel & 2 Serial Port, Wi-Fi Lan Card, DVD RW Drive, 20" LED Display, USB Scroll Mouse, along with All in one 1200 dpi/12 ppm Desktop LaserJet printers along with a 1 KVA on-line ups with 1 hour battery backup.

f. GSM Modem / Wi Fi modem in case GSM connectivity is used or Wireless Router +modem in case Ethernet connection is being used for remote access must be provided.

g. Remote Supervisory Control and data acquisition through SCADA software at the purchaser location through Handheld device /GSM cellular device with latest software/hardware configuration and service connectivity for online/real time data monitoring/control complete to be supplied and operation and maintenance /control to be ensured by the supplier.

h. All major parameters should be available on the digital bus and logging facility for energy auditing through the internal microprocessor and can be read on the digital LCD/LED front panel at any time the current values, previous values for up to a month and the average values. The following parameters should be accessible via the operating interface display:

o AC Voltage AC Output current
Output Power
o DC Input Voltage o DC Input Current o Time Active
o Time disabled o Time Idle
o Temperatures (C)

o Inverter Status

i. Protective function limits (viz-AC Over voltage (both input & output), AC Under voltage (both input & output), Over current (both input & output), Over frequency, Under frequency

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ground fault, PV starting voltage, PV stopping voltage, Over voltage delay, Under voltage delay over frequency, Ground fault delay, PV starting delay, PV stopping delay over temperature, short circuit).

Maximum Power Point Tracker (MPPT)

Maximum power point tracker shall be integrated in the Inverter to maximize energy drawn from the array. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism of MPPT shall be mentioned. The MPPT must have provision (manual setting) for constant voltage operation. MPPT unit should

confirm to IEC 62093 for design qualification and to IEC 600682 for environmental testing.

Disconnection and islanding

Disconnection of the PV generator in the event of loss of the main grid supply is to be achieved by in built protection within the power conditioner. This may be achieved through rate of change of current, phase angle, unbalanced voltage or reactive load variants. Operation outside the limits of power quality as described in the technical data sheet should cause the power conditioner to disconnect the grid. Additional parameters requiring automatic disconnection are:

- Neutral voltage displacement
- Over current
- Earth fault
- Reverse power

In case of the above, tripping time should be less than 0.5 seconds. Response time in case of grid failure due to switch off or failure based shut down should be well within 5 seconds.

Automatic reconnection after the grid failure is restored

INVERTER shall have facility to reconnect the inverter automatically to the grid following restoration of grid, subsequent to grid failure condition. The system should have integrated SCADA and software or plant control and remote communication with web monitoring to monitoring individual strings and complete power plant.

4. ARRAY JUNCTION BOX, MAIN JUNCTION BOXES WITH STRING MONITORING FEATURE TO THE INVERTER:

The junction boxes are to be provided in the PV yard for termination of connecting cables. The Junction Boxes shall be made of FRP/Powder Coated Aluminum with full dust, water & vermin proof arrangement. All wires/cables must be terminated through cable lugs. The J.Bs shall be such that input & output termination can be made through suitable cable glands.

• Made of FRP or cast aluminum

• Copper bus bars/terminal blocks housed in the junction box with suitable termination

• threads

• Conforming to IP65 (for outdoor)/ IP 21 (for indoor) standards and IEC 62208

• Hinged door with EPDM rubber gasket to prevent water entry.

• Single compression cable glands.

• Provision capacity MOVs provided within the box to protect against lightening.

5. PLANT CONTROL, DATA LOGGER & PLANT MONITORING UNIT

Basically, this unit should perform the following:

• Individual Array monitoring via string monitoring system.

• Measurement and/or recording of energy parameters.

• Simple data logger or energy meter to record the energy data on a predetermined interval basis.

• Measurement & continuous acquisition of ambient air temperature, wind speed, solar radiation, PV module temperature, individual string current, inverter output voltage and current, output frequency.

• Operating state monitoring and failure indication.

• Representation of monitoring data in graphics mode or in tabulation mode.

• Controlling & monitoring the entire power system through remote

• Necessary hardware & software shall have to be supplied by the contractor. Both the software and hardware required for interfacing the plant including CPUs, modems, Printers, UPS, cellular device are to be supplied and installed by the contractor.

• Remote control/instrumentation: The microprocessor control unit should have the provision for installation of Rs-232/485 communication link, should have remote control and monitoring capability (by personal computer). All parameters, status and indicators and targets accessible through the local operator interface may be accessed remotely through these ports. Optional analog outputs (0-5 DC) for AC powers, DC current, DC Voltage can be supplied to interface with external data acquisition systems. Optional contacts input from an external SCAD/RTU or other remote control device can be provided within the inverter enclosure for remotely disabling or resetting the unit.

ENERGY METER

A 3 Phase, 20-60 A Energy Meter shall be provided as approved by Engineer-in charge to measure the quantum of energy. Meter must be provided with the necessary data cables. Energy Meter should be 0.5 Class of accuracy.

6. DC DISTRIBUTION BOARD:

Each Solar PV Plant shall have its separate DC Distribution panel to receive the DC output from the array field with analog measurement meter for voltage, current and power from different MJBs so as to check any failure in the array field.

DCDBs shall be dust & vermin proof. The bus bars are to be made of copper of desired size. Suitable capacity MCBs/MCCBs to be provided for controlling the DC power output to the INVERTER along with necessary surge arrestors.

7. AC DISTRIBUTION PANEL BOARD

Each plant shall be supplied with its dedicated AC Distribution panel which shall be located at an appropriate location in the building itself. ACDBs are to be provided at the cable terminating points emanating from the inverters. The AC power from inverter of each individual Solar PV Plant shall be fed into its dedicated AC Distribution panel. Thereafter, the outputs shall be terminated into the main LT supply.

AC Distribution Panel Board (DPB) shall control the AC power from inverter and should have necessary surge arresters. Interconnection from ACDB to mains at LT bus bar is to be carried out and complete equipment along with metering to be installed in the ACDB. Requirement/specifications of DCDB and ACDB may be changed as per site conditions. All switches at the circuit breakers, connectors should confirm to IEC 60947, part I II & III DC/AC Distribution Board

DCDB: Circuit - I (from Array) 80 A DC Circuit Breaker: 2 Nos. (1 in use, 1 standby) ACDB: Incoming Circuit – I (from Inverter) 63 Amp, MCB: 2 No. (1 in use, 1 standby) Outgoing: 32 Amp SPN MCB 4nos. (3 in use, 1 standby)
Panel type: Wall mounting type & CRCA 2.5 mm thick with IP 32 protection Cable Gland suitable to Incoming & out going cable

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8. CABLES & WIRES

• Cabling in the yard and control room: Cabling in the yard shall be carried out as per IE rules. All other cabling above ground should be suitably mounted on cable trays with proper covers. Only LSZH XLPE cables must be used.

• The size of cable for connecting module to terminal box, terminal box to panel junction box, panel junction box to array junction box and array junction box to PCU to Battery Bank/ACDB shall be as per site requirement. The decision of Engineer-in-charge shall be final.

• Wires: Only FRLS copper wires of appropriate size and of reputed make shall have to be used.

• Cables ends: All connections are to be made through suitable cable/lug/terminals; crimped properly & with use of cable glands.

• Cable marking: All cable/wires are to be marked in proper manner by good quality ferule or by other means so that the cable can be easily identified. Any change in cabling schedule/sizes if desired by the bidder/supplier be got approved after citing appropriate reasons. All cable schedules/layout drawings have to be got approved from the purchaser prior to installation. All cable tests and measurement methods should confirm to IEC 60189.

• Multi Strand, Annealed high conductivity copper conductor

• PVC type 'A' pressure extruded insulation

• Overall PVC insulation for UV protection and confirm to IEC 69947.

• Armored cable for underground laying

• All cables shall confirm to BIS standards (IS 694)and (IS 1554)

• The size of each type of cable selected shall be based on minimum voltage drop, however the maximum drop shall be limited to 2 %

• Selected cable should carry a current density of minimum 1.2 Amp/Sq.mm

• All electrical/wires inside the building to be fixed in Rigid Steel Conduit for wiring inside the building.

• Proper/trenches as per site requirement.

• Voltage rating 660/1000V.

• Excellent resistance to heat, cold, water, oil, abrasion, UV radiation.

• For laying/termination of cables, latest BIS/IEC codes/ standards to be followed.

9. Civil Work

9.1 Concreting

• Concrete mix shall be of M-20/M-25 grade for pedestal and earth pit chambers.

• Pedestal base shall be provided with tapered gola using water proofing compound of IS-2649.

• Curing of all concrete work shall be carried out continuously for minimum of 7days.

9.2 Array layout:

Contractor shall design the array layout by incorporating following dimensions:

• Minimum 750mm space around the periphery wall of rooftop.

• Minimum 900mm space nears the rain water exhaust pipe, water tank and rooftop entrance.

9.3 Structural Design:

IS 800-2007 shall be followed for structural design. Contractor shall submit the DBR calculations along with the structural design.

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CHAPTER H - TECHNICAL SPECIFICATIONS FOR ELEVATORS

1.1 This section deals with technical requirement of Electric Traction Type & Passenger Elevator, its components, and safety devices. All features shall be of latest International standards such as EN81, European standards, American standards or IS 14665 (part -1 to 5) and amended up to date. The technical specifications given below are for general guidance only and standard specifications of manufactures are acceptable subject to the condition that these specifications meet the technical / functional requirement specified below.

The contractor shall be responsible to check and ensure dimensions of hoist way, before tendering those requirements of statutory laws and local codes of Electrical / elevator inspector are met with and the equipment offered are suitable for the space available and getting the approval from inspectorate. The scope of work also includes minor civil works and providing necessary channel supports etc for making lift shaft suitable for erection of Elevator.

1.2 POWER SUPPLY

Client shall provide 415 V±10%, 3 phases, 50 Hz AC power supply for the elevator at suitable location in top landing. Elevator shall be suitable for operation on 415 V±10%, 3 phases, 50 Hz AC power supply. Wiring shaft lighting, earthing and required electrical panel with all switches and connections shall be carried out by the elevator contractor which shall be included in his quoted rates and nothing extra shall be paid on this account. All power required for erection, testing and handing over the elevator shall be in the scope of the contractor.

LIFT LICENSE :

CEIG / Lift Electrical Inspectorate license should be obtained by Bidder. Statutory fees will be paid by the contractor as per the GO, which shall be reimbursed by Client on producing the original bill / receipt.

The Performance test should be done at factory in the presence of PMC / Bidder / Client. Incidental, to and fro charges and boarding & lodging expenses should be borne by the bidder.

1.3 CODES & STANDARDS

1.3.1 Work carried out shall in general be in conformity with following:

(i) CPWD specification for electrical work.

(ii) IS 14665 (part -1 to 5) and amended up to date or international specifications which ever is superior shall be applicable and in accordance with regulations of local codes which govern the requirements of the elevator.

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(iii) In addition, Indian Electricity Rules 1956 and Indian Electricity Act 1910 and the rules issued there under with amendments issued from time to time shall also apply.

(iv) All the codes and standards mean the latest publication. Unless specified otherwise, the installation shall generally follow the Indian Standard code of practice/the relevant British Standard code of Practice.

1.3.2 All designs, materials, manufacturing techniques and workmanship shall be in accordance with accepted National or international standards/ practices for this type of equipment.

1.3.3 The tenderer shall also state, where applicable, the National or other International Standard (s) to which the whole or any specific part, of the equipment or system complies. In addition, any other information/ description, the tenderers may wish to provide, the features/ performance figures specified/indicated shall be with supporting documents/calculations.

1.4 TECHNICAL REQUIREMENT

Sl.No.	**Items**	**Technical requirement**
1	Type of Elevator	Passenger Lift
2	Capacity	**8 passengers (Minimum) capacity (minimum 544 Kgs)**
3	Speed	1.00 Mtr/sec
4	Serving Floors	Stilt floor to 5th floor
5	Travel in meters	Approx. 18.0 M
6	Stops & Opening	6 stops & 6 Openings.
7	Machine	Machine Room less Gearless traction machine with electro-magnetic brake placed in the hoist way on top.
8	Control system	Micro-processor based control with variable voltage variable frequency technology.
9	Operation	Simplex full collective.
10	Car Enclosure	Mat finish stainless steel panel on all the four sides & Ceiling.
11	Flooring	Granite flooring

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12	Number of Entrance	Entrance at front side on all the serving floors (All stops – Center opening). (Refer drawings attached to this document)
13	Car & Hoist way Entrance (landing) Doors.	Automatic center opening automatic mirror finish stainless steel door.
14	Safety Feature	(i) All safety feature required as per IS 14665 / EN 81-20/50 International Standards.
		(ii) Additional features.
		a) Reverse phase relay on controller.
		b) Single Phasing power supply protection.
		c) Overload warning indicator on car (visual and audio)
		d) Fireman's switch
		e) Battery operated alarm bell & emergency light with battery and charger.
		f) Infra red rays sensing device along the edge of the car door for full height.
15	Signals	a) LED Hall buttons/ landing call registered indicator at all landings.
		b) Digital car position indicator in car and at all landings.
		c) Up/ Down pre-announcing indicator at all landings
		d) Integral car operating panel with aesthetic luminous switches, emergency stop switch, key switch for auto/ attendant mode.
		e) Annunciator in car
16	Fixtures (In car)	a) Matt finish stainless steel fixtures four sides.
		b) Concealed decorative luminaries with LED lights complete with housing, reflector and accessories.

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		c) Axial pressure fan suitable design to suit the ceiling.
17	Inter com (In car)	Suitable to hook to EPABX system.
18	Automatic rescue device.	Solid state battery operated device to automatically rescue passengers trapped in the elevator car in between floors in the event of power failure.
19	Manual Rescue Device	Manual rescue device shall also be provided so as to bring the elevator car to the nearest floor in the event of failure of battery operated automatic rescue device.
20	Handrail	3 sides SS handrail to be provided
21	Shaft Lighting	LED Bulk head fittings and 6/16 AMPS modular power switched sockets for each floor

1.5 CONTROLLER

1.5.1 The control system shall be of microprocessor controller type, incorporating variable voltage variable frequency drive for elevators of 1.0 m/s speed. It shall be suitable for site programmability and shall have field test mechanism for quick fault diagnosis. The elevator motor shall be fed through this controller for smooth & silent operation of elevator.

1.6 ELEVATOR HOISTING MACHINE

1.6.1 Manufacturer's standard design/constructional features are acceptable. The elevator hoisting machine shall be compact, energy efficient and proven design. The hoisting machinery shall be gearless type with 3 Phase AC motor. The drive shall be of variable voltage variable frequency type.

1.7 MOTOR

1.7.1 The elevator hoisting motor shall be as per manufacturer's selection. Motor shall be dynamically balanced and shall have high starting torque and low starting current, suitable for elevator duty and equipped with required protection. Motor shall be part of drive unit.

1.8 INSTALLATION OF ELEVATOR HOISTING MACHINE

1.8.1 The required arrangement for installation of elevator hoisting machine shall be provided by the contractor. Necessary scaffolding, channels, load hooks, buffer spring, cutouts on slab and all related civil works shall be in the scope of the contractor.

1.9 GUIDE

1.9.1 Machined steel guides shall be provided for the car and counterweight. The guide rails shall have tongued and grooved joints, sliding clips shall be used for fastening the guides

to allow building settlement without distorting the guide. The flanges shall be mechanical for the fish plate mounting so that rail alignments at joints almost remain constant. To keep down the noises level and to reduce wear and tear of sections, only Nylon ribs shall be used in the guide shoes. However, initially cast iron ribs shall be provided for smoothening of guide rails which shall later be replaced free of cost by Nylon ribs.

1.10 DRIVING MACHINE BRAKE

1.10.1 Electric elevator machine shall be equipped with brakes which shall be applied automatically by means of springs in compression only or by gravity when the operating device is in the 'off' position or in the event of power failure. The brake shall be designed to have a capacity sufficient to hold the car at rest with 125% of its rated load.

1.11 ROPES / FLAT BELTS

1.11.1 The elevator shall be provided with round stranded steel wire ropes or flat belts having tensile strength not less than 12.5 tone/ cm^2. Lubricants between the strands shall be achieved by providing impregnated hemp core. The rope shall conform to IS – 2365 – 1963 amended up to date.

1.12 LEVELING

1.12.1 Leveling with floors should be exact virtually independent of passenger load. This is to be achieved by self adaptive load compensation.

1.13 SELECTOR

Selector shall be as per OEM, however selector shall be microprocessor based.

1.14 CAR DETAILS

1.14.1 CAR FRAME

The car frame shall be made of structural steel of rigid construction to withstand without permanent deformation the operation of safety gear. The car shall be so mounted on the frame that vibration and noise transmitted to the passengers inside is minimized.

1.15 CAR PLATFORM

1.15.1 The car platform shall be of framed construction and designed on the basis of rated load evenly distributed. The dimensions shall conform to IS – 3534 – 1968 amended up to date unless otherwise specified. The flooring shall be finished with antiskid wooden material (sample shall be got approved).

1.16 CAR BODY

1.16.1 The side walls of the car shall be as per BOQ.

1.17 CAR ROOF

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1.17.1 The roof of the car shall be solid type with extra supporting arrangement capable of taking load of maintenance team (at least 140 Kg weight) and also have a fan and light fittings.

1.18 CAR DOOR

1.18.1 The car entrance doors shall be as per BOQ. Doors shall be automatic side/centre opening horizontal sliding and power operated type.

1.19 HOIST WAY (LANDING) DOORS

1.19.1 Doors shall be as per BOQ. It shall be fitted with a locking device which shall comply with clause 21 of IS –3-4666-1980 amended up to date.

1.20 CAR DOOR & HOIST WAY DOOR OPERATORS

1.20.1 (i) Each hoist way door shall be provided with an interlock which shall prevent movement of the car away from the landing unless the door is in the closed position as defined in the IS codes.

(ii) Door system should have the following features:

(a) Reliable robust construction, linear drive door gear with electronically controlled closing and opening for trouble free operation under adverse duty conditions.

(b) Door system interface compatible with modern micro-contactor control system for optimum performance.

(c) Proven door safety devices for maximum safety of users.

1.21 SAFETY GEARS & GOVERNORS

(a) Elevator shall be provided with car safety devices attached to the elevator car-frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the elevator car with full rated load.

(b) The elevator shall be provided with over speed monitoring & tripping safety device and its operation shall be independent of power.

(c) The car safety is provided to stop the car whenever excessive descending speed is attained. The safety shall be operated by a centrifugal speed governor located at the top of hoist way and connected to the governor through a continuous steel rope. The governor shall be provided with ropes in proper tension. Even after ropes stretch, suitable means shall be applied to cut off power from motor and apply the brakes on applications of the safety.

(d) Temper proof infrared rays sensing device shall be provided through out the height of door or upto 1.8m above sill as per OEM to ensure the door reopens till the obstruction exits in case obstruction comes while the door is closing.

1.22 COUNTER BALANCE

1.22.1 A suitable guided structural steel frame with appropriate CI weights shall be furnished to promote smooth and economical operation.

1.23 TERMINAL SWITCHES

1.23.1 Elevator shall be provided with proximity switches arranged to stop the car automatically within the limits of top car clearance and bottom run by over travel from any speed attained in normal operation. Such switches shall Act independently of the operating device, the ultimate or final limit switches and the buffers.

Proximity switches may be fitted in the elevator car or in the elevator well or in the machine room and such switches shall be brought in to operation by the movement of elevator car.

An automatic safety switch shall be provided to stop the machine should the chain, rope or other similar device mechanically connecting the stopping device to the car, fail.

1.24 ULTIMATE OR FINAL SWITCHES

1.24.1 Elevator shall be provided with ultimate or final switches arranged to stop the car automatically within the top and bottom clearance independently of the normal operating device and the terminal switches.

Final switches shall act to prevent movement of the elevator car under power in both directions of travel and shall after operating remains open until the elevator car has been moved by a hand winding to a position within the limits of normal travel.

All ultimate or final switches shall be of enclosed type and shall be securely mounted. The contacts of all switches shall be opened positively and mechanically by the movement of elevator car.

1.25 TERMINAL BUFFERS

1.25.1 Heavy-duty spring Buffers/polyerethene rubber pads as per OEM to adhere the latest safety parameters shall be installed as a means of stopping the car and counter weight at the extreme limits of travel. Buffers in the pit shall be mounted on steel channels, which shall extend between both the car and counter weight guide rails. Oil buffer as per OEM standard is acceptable.

1.26 ELECTRICAL INSTALLATION REQUIREMENTS

1.26.1 IS: 4666 – 1980 amended up to date state the requirement for main switches and wiring with reference to relevant regulations and read in conjunction with clause-3.1 (i).

1.27 ELECTRICAL WIRING AND WIRING FOR SIGNALS

1.27.1 Complete electric wiring shall be done in copper cable/ wires by the elevator supplier as per clause 7.1.2 of IS: 1860-1980 amended up to date and read in conjunction with clause-3.1 (i).

The wiring for signals, landing call buttons & indicators shall use serial communication technique to reduce the number of wires and read in conjunction with clause-3.1 (i)

1.28 TRAVELLING CABLE

1.28.1 Flat traveling cable shall be 16/20 core to give better running performance.

1.29 OVER LOAD WARNING

1.29.1 Over load warning feature with audiovisual indication shall be provided (Visual indication shall show “Over Loaded” and a buzzer shall also operate). Car shall not move until the overload condition is removed.

1.29.2 A load plate giving the rated load and permissible maximum number of passengers should be fitted in each lift car in a conspicuous position.

1.30 INTERCOM SYSTEM

1.30.1 Intercom suitable to hook to EPABX shall be provided inside the car for making emergency calls.

1.31 EMERGENCY RESCUE DEVICE:

1.31.1 AUTOMATIC EMERGENCY RESCUE DEVICE:

Elevator system shall have automatic battery operated emergency rescue device to automatically rescue passengers trapped in the elevator car in between floors in the event of power failure having following features:

Automatic operation and immediate actions in the event of mains failure capable to move the elevator to the nearest landing, opens the doors automatically. Shall have sealed maintenance free battery back up of suitable size with automatic charging unit and auto change over unit on mains failure. Message indicator in the elevator car.

1.32 MANUAL EMERGENCY RESCUE DEVICE

1.32.1 Manual emergency rescue device shall be provided to rescue the passengers trapped in the elevator car in the event of failure of battery operated automatic emergency rescue device. The elevator car stopped in between floors due to power failure shall be brought to the nearest landing by releasing the break by means of pulling the mechanical lever provided in the last landing. The standard constructional feature of OEM for this manual emergency rescue device is acceptable.

1.33 OPERATION

1.33.1 The elevator shall be operated in simplex mode (with/ without attendant) and generally the elevator shall be in automatic mode. However a two position key- operated switch marked to indicate “ATT” (Attended Operation) and “AUTO” (Automatic Mode) shall be provided. When the switch is in the position of “ATT” mode, the elevator shall be in

attendant mode. It will connect the hall button pushes to the annunciate, provided in the car, to register the calls. In automatic mode, momentary pressure of the car button/ landing button will send/ bring the car to this landing and car will automatically stop.

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CHAPTER I - LIST OF APPROVED MAKES- CIVIL & PLUMBING SERVICES

S.No	Details of equipment/ material	Make/Manufacturer
1.	Adhesive for Ceramic tiles	Cico / Pidilite / BalEndura / Sikka/loft
2.	Adhesive for Wood Work	Fevicol/Vamicol/Dunlop
3.	Aluminium Cladding Sheets	Aludecor / Armstrong / Alucobond
4.	Aluminium Extrusion/ Sections	Hindalco / Jindal / Indal/ JSW
5.	Anchor Fastner	Hilti / Fischer /Bosch/ Canon
6.	Anti – Termite Treatment	It should be done by permanent members of IPCA
7.	Ball valves with floats	Zoloto / Leader / Sant / Jayco/ Lehry
8.	Batch Mix Concrete (BMC) / Ready Mix Concrete (RMC)	The contractor to install his own computerized batching plant of suitable capacity and arrange for Transit Mixers, pumps etc. as per approval of Engineer – In- Charge. Or The RMC shall be procured from the source as approved by Engineer – in Charge. RMC Producing plants of the main Cement
9.	Brass stop & Bib Cock	Jaquar / Toto / Kohler
10.	Butterfly valves	GM / RB / Leader / Lehry
L	C.I. Manhole Covers	Neco/R.I.F./B.C./Hepco/SKF/ HP/
12.	C.P. Fittings Mixer / Pillar taps/ C.P brass angle valve/ Valves Washers, C.P. brass accessories	Parko /Jaquar/ Toto/ Kohler
13.	Carpet Flooring & Skirting (Floatax)	Forbo/ Polyflor/ Tarket/Wellspun
14.	Cement	ACC / Ultra tech / Ramco/ Coromandel
15.	Cement: White	Birla White / JK
16.	Compressed Chequered tiles	Somany / Kajaria / Nitco /Orient /Johnson/Simpolo
17.	Concrete Additive	Sikka /CICO/ Pidilite / Fosroc / Fairmate / MC Bauchemie/ Saint gobain
18.	CPVC Pipes & Fittings	Supreme/ Astral/ ashirvad
19.	Door Locks	Godrej / Harrison / Link
20.	Glass : Float & Mirror	Saint Gobain/ Asahi India Safety
21.	Glass for Aluminum Doors/ Windows/ Structural Glazing	Modiguard / Saint Gobain / Asahi India Safety
22.	Paints - Cement Based	Snowcem Plus/, Asian / Dulux / Nippon/
23.	Paints - Other Paints / Primer	ICI Dulux/ Asian / Nerolac
24.	Paints - Plastic Emulsion Paint	ICI Dulux/ Asian / Nerolac
25.	Paints - Synthetic Enamel Paints	ICI Dulux (Gloss), Asian (Apcolite),
26.	Polycarbonate Sheets	Galina/ GE Plastic / / Skyarch/ Polytechno
27.	Polyethylene Storage Tank	Sintex / Polycon/ Fusion / Astral
28.	Pre-Laminated Particle Board	Novapan /Century /Green Ply/Sharonply/ Action tesa
29.	PVC Doors	Sintex/ Polyex/ Rajshri
30.	PVC flushing cistern	Commander / Parryware /

31.	PVC Pipes & fitting, Waste & Vent Pipes and fittings, Type B PVC Casing & Screen Pipes /CPVC pipes and Specials	Prince / Supreme / Finolex /Astrol
32.	PVC Water Stops	Prince /Supreme/ Astral/Ashirvad

PHE APPROVED MAKES

Sl.No	Items	Approved makes
1	Vitreous China Sanitaryware	Parryware,/Jaguar/toto/kohler
2	CP fittings & accessories	Parryware/Jaguar/Hindware/ toto/kohler
3	Extension nipple	Loki / viking
4	Kitchen sink	Nirali/ Carysil/Diamond
5	Level Controller & Indicator (Water	Auto Pump,Cirrus Engineering
6	Air Release Valve	Arco/ Itap /Marck/RB/Lehry
7	Centrifugal Pump	Grundfos/ Kirloskar / KSB
8	Submersible pump	Grundfos/ Kirloskar/ Mather&Platt/ KSB
9	Y Strainer	Emerald /Leader /Sant/ Zoloto / Lehry
10	Check Valve (non return valve)	Advance / Audco/ Leader/ Intervalve/ Zoloto / Lehry
11	Ball Valve	Zoloto/ Leader/Audco/ Lehry
12	Butterfly Valve	Advance / CRI / Lehry
13	Strainer	Zoloto/Leader/Emerald/Sant/ DS Engg./Trishul
14	Float Valve	Muesco/Singer/ OCV, Watts/Leader/Normex
15	Flexible Connection	Metaflex /Tozen / Mason / Kohler
16	Foot Valve	Leader, Socla, France., Val-Matic, Kits, Crane
17	Electromagnetic flow meter	Kent,Vsan and Local Manufacturer or approved equivalent
18	Floor drain, Roof drain, Floor Cleanout,	Chilly/ Local Manufacturer / Lipka
19	Pressure Gauge Set	Weiss/Trerice/Weksler/ Winter
20	Automatic Air Vent	Val-matic, Metaflex, APCO & RB/ Lehry
21	Water Hammer Arrestor	Hydra-Restor/ Zurn / PPP / Lehry
22	Flow Switch	Potter Electric / System Sensor / Viking
23	Vibration Isolator	Mason / Tozen / Resistroflex or approved equivalent
24	Starter	Square D / GE / Westinghouse / Siemens / KSB
25	Cable	Polycab / Havells/ Finolex
26	cPVC Pipes	Astral/Ashirvad/Prince
27	PVC/uPVC pipes	Prince/ Supreme/ Astral / Ashirvad
28	G.I. PIPES	TATA /JINDAL
29	G.I. FITTINGS	'R' BRAND
30	PIPE BRACKET AND SUPPORTS	HI – TECH OR M.S. FABRICATED AS PER DRAWINGS
31	Water treatment plant	Ion exchange or equal approved
32	Water Meter	Dasmesh /Sant,Rockwin /Aquamet /Capstan / Lehry

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33	Electronic Flow Meter	Electronet & Krohne (Forbes Marshall) / Lehry
34	Fire Sealant Material	3M / GE/ KBS / Hilti
35	Grey water treatment plant	ECO tech or equal approved
36	Grease trap	ACO, Kessel , Nugreen or equal approved

APPROVED MAKES-ACMV SYSTEMS

SL.NO.	NAME OF THE PRODUCTS	RECOMMENDED/APPROVED MAKES LIST
1	Air Cooled Chiller	Trane, York, Daikin,
2	Water Cooled Chiller	Trane, York, Daikin,
3	Pump Set	Grundfos, ITT-Xylem, Armstrong, KSB
4	Cooling Tower	Paharpur, Advance, Classik, Bell, Mihir
5	Air Handling Unit	VTS, Zeco, Citizen, Edgetech ,Luftek
6	Fan Coil Unit	Daikin, Caryaire, Edgetech, Luftek
7	Chilled Water Cassette Unit	Daikin, Caryaire, Edgetech
8	Chilled Water Hi Wall Unit	Daikin, Caryaire, Edgetech
9	Variable Refrigerant Volume/Flow Unit	Samsung, Daikin, Trane, Toshiba, Mitsubishi
10	DX Ductable & Package Unit	Samsung, Daikin, Hitachi,
11	DX Cassette Unit	Samsung, Daikin, Hitachi, Toshiba, Mitsubishi
12	DX Hi Wall Unit	Samsung, Daikin, Hitachi, Toshiba, Mitsubishi
13	Precision Unit	Emerson-Vertiv, Stulz, Climaveneta, Swegon BlueBox, Schneider-Uniflair, Flaktwood
14	Heat Recovery Wheel Unit	DRI, Ostberg, Flaktwood
15	Heat Recovery Pipe Unit	SPC(S & P Coil Products), HPT(Heat Pipe Technology)
16	Dehumidifier Unit	Bry Air, Munter, Appidi Technologies
17	Evaporative(IEC/IDEC/IEC+COIL/IDEC+COIL) Cooling Unit	HMX-ATE, DRI-Arctic
18	Air Washer/Wet Scrubber Unit	HMX-ATE, DRI-Arctic, Edgetech, Zeco, Luftek, Citizen
19	Plate Heat Exchanger	Sondex, Tranter, Alfa Laval
20	Cabinet Type Fan Unit	Kruger, Dynair, System Air, Flaktwood, Nicotra, Luftek
21	Axial Fan	Green Heck, Kruger, Dynair, System Air, Flaktwood, Nicotra

22	SISW Fan	Kruger, Dynair, System Air, Nicotra, Green Heck
23	Propeller Fan	Kruger, Dynair, System Air, Caryaire, Marathon
24	Inline Fan	Kruger, Dynair, System Air, Caryaire, Ostberg
25	Jet Fan	Green Heck, Kruger, Dynair, System Air,Flaktwood, Nicotra
26	DIDW Fan	Kruger, Nicotra, Dynair, Green Heck
27	Plug Fan	VTS, Kruger, Nicotra, Punker, Ziehl-Abegg, Green Heck
28	EC Fan	VTS, EBM-Papst, Ziehl-Abegg, Rosenberg
29	HVLS Fan	Green Heck, Kelley, Rite-Hite, Big Ass Fans
30	Motor	CG, Siemens, ABB, Havells
31	Air Filter	AAF, Mechmaark, Spectrum, Camfil,Freudenberg, Thermadyne
32	UVGI Light	Steril-Aire, Alfaa UV, Philips
33	Ionization Technology	Plasma Air, Atmos Air
34	Electrostatic Air Cleaner(Dry Scrubber) Unit	Rydair, Trion, Espair
35	Ecology Unit	System Air, AAF, Dynair
36	STP Exhaust Odor Control System	Chemtronics, ORAIPL, Ruks Engineering
37	Expansion Tank(Pressurised/Unpressurised) & Pressurization Unit	ITT-Xylem, Armstrong, Grundfos, Flamco, Reflex, Anergy
38	Vacuum Degasser	Spirotech, Flamco, Reflex, Anergy
39	Air Seperator/Microbubble Air & Dirt Seperator	ITT-Xylem, Armstrong, Spirotech, Flamco, Reflex, Anergy
40	Side Stream Filteration	LAKOS, JL Wingert, Flamco, Anergy
41	Electromagnetic Descaler	Eddy, CWT-Vulcan, Kashyap, Clearwater Enviro Technologies
42	Chemical Dosing System	Thermax, Ion Exchange
43	Variable Air Volume(VAV) Box	Honeywell, System Air, Cosmos, Dynacraft, Syncro, Ruskin Titus
44	Variable Air Volume(VAV) Controller	Honeywell, Belimo, Siemens, Distech, Delta, JCI
45	Constant Air Volume(CAV) Regulator	Trox, System Air, Ruskin Titus, Aldes
46	Mild Steel/ Galvanized Iron Pipe	Jindal, Tata, Sail
47	Copper Pipe	Rajco, Mandev, Mexflow, Uniflow, Totaline, Nippon

48	U-PVC/C-PVC Pipe	Supreme, Ashirvad, Prince, Astral
49	HDPE Pipe	RIL, Supreme, Ashirvad, Prince, Dutron
50	PPR-C Pipe	RIL, Supreme, Prince, KPT Piping System
51	Pre-Insulation for Pipe	Perma Pipe, Zeco, Seven Star
52	Butterfly Valve	Audco, Advance, Honeywell, Castle, Kirloskar
53	Pre-Insulated Butterfly Valve	Advance, Valtree, CR Valve
54	Two Way Valve(Modulating or On/Off Type)	Danfoss, Honeywell, Belimo, Siemens, JCI
55	Balancing Valve(Manual/Semi Automatic)	Danfoss, Advance, Honeywell, Oventrop, Castle
56	Pre-Insulated Balancing Valve (Manual/Semi Automatic)	Advance, Valtree
57	Pressure Independent Balancing Control Valve	Danfoss, Flowcon, Honeywell, Belimo, Siemens, JCI, Oventrop
58	Triple Duty Valve	ITT-Xylem, Armstrong, Grundfos, Kirloskar
59	Non Return Valve	Advance, Honeywell, Intervalve, Leader, Castle, Emerald
60	Pre-Insulated Non Return Valve	Advance, Valtree, CR Valve
61	Ball Valve	RB, Honeywell, Zoloto, Castle, Sant, Emerald
62	Pre-Insulated Ball Valve	Valtree, Equivalent
63	Ball Valve with Y Strainer	Zoloto, Castle, Sant, Emerald
64	Y Strainer	Honeywell, Emerald, Sant, Castle, Leader
65	Pre-Insulated Y Strainer	Valtree, CR Valve
66	Pot Strainer	Emerald, Sant, D.S. Engineering
67	Pre-Insulated Pot Strainer	Valtree, CR Valve
68	Suction Guide	ITT-Xylem, Armstrong, Kirloskar, Anergy, Emerald, Sant
69	Bellow or Expansion Joint(Metallic/Rubber)	Resistoflex, Easyflex, Cori
70	Pressure Gauge	Baumer, Precision Mass, H Guru, Pioneer, General Instruments, Wika
71	Temperature Gauge	Baumer, Precision Mass, H Guru, Pioneer, General Instruments, Wika
72	Thermowell	Baumer, Precision Mass, H Guru, Pioneer, General Instruments, Wika
73	Test Point	Anergy, Equivalent

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74	Automatic Air Vent	Honeywell, Anergy, Flamco, RB, Castle
75	Inertia Frame	Resistoflex, Easyflex, Equivalent
76	BTU Meter	Landis+Gyr, Siemens, Kamstrup, Belimo, Shenitech
77	Water Flow Switch	Honeywell, Anergy, Switzer, Equivalent
78	Drain Pump	Aspen, Microdam, Equivalent
79	Galvanized Steel Sheet	TATA, Jindal, SAIL
80	Factory Fabricated Galvanized Steel Duct (Rectangle/Spiral Round/Oval)	Rola Star, GP Spira, WAD, Seven Star, Cosmic, Radiant, Universal industries
81	Factory Fabricated Mild Steel Duct	WAD, Seven Star, Cosmic, Radiant,Universal industries
82	Pre-Insulated Duct(PIR/Phenolic)	Asawa, Zeco, PalDuct,Universal industries
83	Fabric Duct with related Air Terminals	Prihoda, Fabric Air, TurboaSOX
84	Flexible Duct(Insulated/Non Insulated/Semi Rigid)	Cosmic, Caryaire, Alpha Star, Up Twiga, Seven Star,Universal industries
85	Double Skin Plenum Box	Luftek, Zeco, Citizen, Edgetech, VTS, Cosmic
86	Cross Talk Silencer & Sound Attenuator	System Air, Air Master, Cosmic, Caryaire
87	Flexible Duct Connector	Resistoflex, Easyflex, Alpha Star, Equivalent
88	Volume Control Damper	System Air, Air Master, Cosmic, Caryaire
89	Round Volume Control/Butterfly Damper	System Air, Air Master, Cosmic, Caryaire
90	Non Return Damper	System Air, Air Master, Cosmic, Caryaire
91	Fire Damper(Fusible Link)	Green Heck, System Air, Air Master, Cosmic, Caryaire
92	Fire & Smoke Damper(Motorized)	Green Heck, System Air, Air Master, Cosmic, Caryaire
93	Actuator	Belimo, Honeywell, Siemens, JCI
94	Grille/Diffuser/Disc Valve/Other Air Terminals	System Air, Air Master, Cosmic, Caryaire
95	Louver	System Air, Air Master, Cosmic, Caryaire
96	Nitrile Rubber Insulation	Armacell, Aeroflex, K-Flex, Paramount
97	XLPE/Polyolefin Insulation	Thermobreak, Thermoshield, Aerofoam, Aerolam, Supreme
98	Glass Wool Insulation	Up Twiga, Owens corning, Equivalent
99	Expanded Polystyrene Insulation	Beardcell, River Insulation, Epack India

100	PUF/PIR Insulation	Beardcell, Lloyd, J.L.Engineering Services
101	Rock Wool Insulation	Rockwool, Lloyd, Equivalent
102	Variable Frequency Drive(VFD)	Danfoss, Schneider, Siemens, ABB, L&T
103	MCB, MCCB/Isolator	L&T, Schneider, Siemens, ABB
104	Electrical Panel	VKA Power Master, Dynamic Panels & Controls, Arostar
105	PLC Based Panel (Programmable Logic Controller Panel)	ABB, Siemens, Schneider, Allen-Bradley, Messung
106	Power/Control Cable	Polycab, Havells, KEI, Finolex, Lapp
107	Gland & Lugs	Dowell, Comet, SMI, Equivalent
108	MS Conduit	BEC, Gupta, AKG, Bharat, G.K. Steel
109	PVC Conduit	Polycab, Precision, Finolex, AKG
110	Cable Tray	Profab, Indiana, Pushpak, Niedax, Technofab
111	Sensor	Honeywell, Siemens, Belimo, Greystone, Dwyer, JCI
112	Sequence Timer Controller(For Split Units)	Countronics, Selec Controls, Dynamic Microtech, Softhard, VKA Powermaster, Equivalent
113	Anchor Fastener	Hilti, Hi-Tech, Fischer, Hira-Walraven
114	Vibration Isolator	Resistoflex, Easyflex, Cori, Equivalent
115	Wire Rope Support	Hilti, Gripple, GPL, Hira-Walraven, Fischer
116	Pipe Support	Hilti, Hi-Tech, Fischer, Hira-Walraven, Easyflex
117	Welding Electrode	ESAB, Advani, Sun Arc, Equivalent
118	Paint	Berger, Asian, Equivalent
119	Duct Sealent	Urja, Supex, Equivalent
120	Fire Stop Mortar & Fire Stop Sealant	Hilti, 3M, Promat, Fischer, Dow Corning

Note: Architect/clients reserves the right to choose any one of the make listed above. The rates quoted above shall be valid for any of the makes mentioned above.

LIST OF APPROVED ELV MAKES

ELV SYSTEM		
SR	**DESCRIPTION**	**PREFERRED MAKES**
A	**IP BASED CCTV SYSTEM**	
1	IP 5MP Dome Cameras (Varifocal)	HIKVISION/Honeywell/Norden
2	IP 5MP Bullet Cameras (Varifocal)	HIKVISION/Honeywell/Norden
3	Workstation	Dell / HP/ Lenovo
4	TV	Samsung/Sony/LG
5	HARD DISK	THOSHIBA/WD/SEAGATE
6	CAT 6 Cable	NORDEN / Legrand / Amp/D-Link
7	PVC FRLS Conduit	Precision/ Universal / BEC / Javeri
B	**WIFI SYSTEMS**	
1	WIFI access	D-Link / HIKVISION /Netgear
2	POE Switch	D-Link / HIKVISION /Netgear
C	**INTERCOM SYSTEM**	
1	MASTER CONTROL	HIKVISION/ I-SMART
2	VDP TOUCH SCREEN	HIKVISION/ I-SMART
D	**HOME AUTOMATION SYSTEM**	
1	LIGHTING AUTOMATION	ZENNIO/ CRESTRON
2	TV	Samsung/Sony/LG
3	CAT 6 Cable	NORDEN / Legrand / Amp/D-Link
4	PVC FRLS Conduit	Precision/ Universal / BEC / Javeri

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LIST OF APPROVED ELECTRICAL MAKES

ELECTRICAL WORKS		
S.No.	**ITEM**	**APPROVED MAKES**
1	HT PANEL (RMU)	SIEMENS / LUCY / ABB / SCHNEIDER
2	TRANSFORMER	ESENNAR / VOLTAMP / KIRLOSKAR / SUPREME
3	HT XLPE CABLES	POLYCAB / KEI / FINOLEX /UNIVERSAL / CCI
4	HT TERMINATIONS	RACHEM / 3M / MSEAL
5	CT & PT - 11KV	ABB /SEIMENS / AE / KAPPA /(AS PER OEM HT PANEL BOARD MANUFACTURER)
6	EARTHING	GEF TECHNILOGIES / CAPE ELECTRIC / OBO BETTERMAN
7	UPS	NUMERIC / ABB / APC / SOCOMEC / VETRIV
8	BATTERY	EXIDE/AMAR RAJA / ROCKET / HBL / PANASONIC/TATA GREEN
9	DG SET	
	ENGINE	CUMMINS /KIRLOSKAR /LEYLAND / PERKINS /GREAVES
	ALTERNATOR	STAMFORD / KIRLOSKAR GREEN / LEROY SOMER /MECALITE
10	BUS BAR TRUNKING/RISING MAIN	LEGRAND / SCHNEIDER /C & S / L & T
11	LT PANELS - TTA (Type tested Assembly panels only)	LEGRAND / SIEMENS /SCHNEIDER/ABB
12	MCCB	ABB - XT2 & XT4 SERIES / SCHNEIDER - NSX / SIEMENS - 3VA2 /LEGRAND - DPX3
13	AUTO TRANSFER SWITCH	HPL /ABB /SCHNEIDER
14	CONTACTORS	ABB / SCHNEIDER / SIEMENS / L&T

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15	DIGITAL METERS (MFM)	HPL / SCHNEIDER / RISHABH / L&T / TRINITY / ABB
16	SELECTOR SWITCH	SALZER/KAYCEE / L&T / RISHABH / SCHNEIDER
17	INDICATION LAMPS	VAISHNO/EMCO/ L&T / RISHABH / SCHNEIDER
18	CURRENT TRANSFORMER	AE / KAPPA / RISHABH/ INSTRANS
19	RELAY	BELUK / AREVA / L&T /SCHNEIDER / SIEMENS
20	AMF RELAY	GE / SCHNEIDER / ABB/WOODWARD
21	CAPACITOR	EPCOS / DUCATTI / L&T / SIEMENS / LEGRAND /ABB
22	SINGLE PHASE PREVENTER	L&T / AREVA / ABB / SIEMENS
23	APFCR RELAY	L & T / SIEMENS / ABB / DUCATI / GE / SCHNEIDER
24	LT CABLES	HAVELLS / POLYCAB / FINOLEX / GLOSTER
25	LT CABLE TERMINATIONS	JAINSONS/COMET/ OBO BETTERMAN / DOWELLS / HEX
26	CABLE TRAY	OBO BETTERMAN / PROFAB / NIEDAX / PUSHPAK /FERROGRATE

27	MCB DBs	PANASONIC/ ANCHOR / LEGRAND / SCHNEIDER/ ABB
28	MCB / RCCB	ANCHOR / PANASONIC / LEGRAND / SCHNEIDER / SIEMENS / ABB
29	LIGHT FIXTURE	PANASONIC /PHILIPS / WIPRO / HAVELLS / BAJAJ/ JAQUAR
30	SURGE PROTECTION DEVICE	OBO BETTERMAN / ABB / HAGER
31	PVC WIRES	ANCHOR /FINOLEX CABLES/ RR KABLES / HAVELLS / POLYCAB

32	INDUSTRIAL MULTI CORE FLEXIBLE CABLE	ANCHOR / RR KABLES / FINOLEX CABLES / HAVELLS / POLYCAB
33	MS CONDUIT	GUPTA / GB / BHARAT /SUPREME
34	PVC CONDUIT	ANCHOR /SUPREME /AVONPLAST / PRECISION / BAJAJ
35	CEILING FAN / WALL FAN	CROMPTON / ORIENT / USHA
36	EXHAUST FAN	ALMONARD / CROMPTON / ORIENT / USHA
37	SWITCHES AND SOCKETS	ANCHOR / PANASONIC /LEGRAND / CRABTREE / SCHNEIDER
38	METAL CLAD PLUG & SOCKET	ANCHOR / LEGRAND / HAVELLS / SCHNEIDER / ABB
39	ISOLATOR	ANCHOR / PANASONIC /LEGRAND / SIEMENS /SCHNEIDER/ABB
40	PRESENCE SENSOR	HAGER / LEGRAND / PHILIPS / WIPRO / PANASONIC
41	AVIATION LIGHT	BAJAJ / CROMPTON / PHILIPS
42	WATER PROOF BOXES	HENSEL / SCAME / CAPE ELECTRIC
43	SOLAR SYSTEM	TATA SOLAR / BOSCH / HAVELLS / V GUARD

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LIST OF APPROVED MAKES

	APPROVED MAKES - ELEVATOR
1	SCHINDLER/KONE / OTIS

Note:-

1. The contractor will use one of the approved makes as approved by the Client / Engineer - in-charge.
2. In case of different quality / pattern of same make, the pattern/ quality shall be approved by the Client / Engineer – in – charge.
3. All the items included in the list or otherwise to be used in the work should conform to CPWD and relevant BIS specifications / relevant codes, as applicable.
4. If any item is missing in the above list, its make will be decided by the Client / Engineer –in-charge.
5. If any major equipment is using a small component of make other than that given as a standard component with the equipment, the same shall be accepted.

END OF VOLUME - IV

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