



INDIAN BANK

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

e-TENDER

FOR

**PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING
(Stilt + 5 Floors) @ NO. 2, RAMACHANDRA ROAD,
LUZ AVENUE, MYLAPORE, CHENNAI – 600 004.**

VOLUME - IV

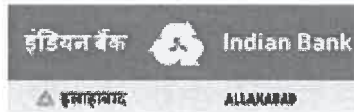
TECHNICAL SPECIFICATIONS

Tender ID: IB/MYL/CONTR/001/2023-24

ARCHITECT



CLIENT



PMC



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TECHNICAL SPECIFICATIONS

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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, Firefighting, 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/ Firefighting System/ 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. Comprehensive Fire Fighting/ Protection /Alarm System
- f. HT & LT Installation, DG Sets
- g. Elevator
- h. CCTV, EPABX/ Communication Systems
- i. 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. HT & 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.



CHAPTER B - CIVIL WORKS

1. EARTH WORK: As per relevant CPWD specifications.

- a. 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.
- b. 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.
- c. 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)

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 aluminum 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 die 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

- ii. 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.
- iii. 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.
- iv. 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.
- v. The batching and mixing plant shall be fully automatic.
- vi. 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.
- vii. 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.

- viii. 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.
- ix. However samples for testing etc. shall be taken as per the mandatory tests prescribed in latest CPWD specifications.
- x. All cubes shall be tested for 7 days and 28 days tests in conformity with the relevant CPWD specifications.
- xi. 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.
- xii. 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.
- xiii. 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.
- xiv. To receive anchor bolt / foundation for machines to be installed at later date, pocket of size minimum 110x100x300 mm shall be kept while concreting 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 computerized.
 - 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 EQUIPMENT 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 and 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**

Pile details to be followed as per CPWD Specifications Vol 2 - 2019, SUB HEAD :
20.0, PILE WORK

Boring, providing and installation bored cast-in-situ reinforced cement concrete piles of grade M-30 minimum cement content of 400 kg/ cum of specified diameter and length below the pile cap, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with

bentonite solution and temporary casing of appropriate length for setting out and removal of same and the length of the pile to be embedded in the pile cap etc. by percussion drilling using **Direct mud circulation (DMC)** or Bailer and chisel technique by tripod and mechanical Winch Machine all complete, including removal of excavated earth with all its lifts and leads (length of pile for payment shall be measured up to bottom of pile cap).

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 100mm 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.
- 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.

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:-**
 - i. 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.
 - ii. UPVC members shall be made of PVC material conforming to IS: 10151.
 - iii. 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.
 - iv. The weight of sections and the corresponding catalogue numbers are mentioned. The IS specifications are to be strictly adhered.
 - v. The extruder using recycled materials may be preferred.
 - vi. 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 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 earthing 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 clad 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 tempering 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, freight 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 - 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/Khurrras.
 - 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-basins 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 moulded 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 and 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.
- 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 main fire static tank and then overflow into the main 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 suti 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.

I. 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 $30 \pm 2 \text{ kg/cum}$.

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 /cm² 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. Static fire water storage tanks in compartments .Connections from the tube well water supply lines will be made into these tanks. Water will overflow into the raw water tanks

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 supplementary fire tanks located on the terrace of each 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 ($\frac{1}{4}$ th, $\frac{1}{2}$, $\frac{3}{4}$ 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/cm² (Test pressure 3.75 kg/cm²). 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/cm² 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/m² 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/m² air capacity at 0.5 kg/cm² 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 connections

- 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/cm² 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 than 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 - ELECTRICAL WORKS

SPECIAL CONDITIONS FOR ELECTRICAL SERVICES

1.0 GENERAL

Note:

01. Unloading, receiving at SITE, loading storing and leading shall be contractors account only.
02. Refer Schematic diagram and all panels should be as per the Schematic diagram only
03. Vendor should refer SLD for more details
04. Technical specification and make of materials should be get approved before the procurement of the materials
05. For Bus bars - 0.8A/Sqmm for AI & Earthing should be twin earthing
06. For all panels/Equipments, approval shall be taken for each panel in the form of GA Drawings before fabrication
07. Tesing & Liaisoning works with TNEB & other statutory approvals is inclusive scope of contractor only. Statutory fees will be reimbursed by CLIENT (IB) on receipt of the submission of original bills / receipt by the contractor.

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost of the purchaser. This shall also include spares for commissioning of the equipment.

2.0 The contractor shall obtain all sanctions (electrical loads, approval of drawing/ ESS/ D.G.'s estimator/ approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from TNEB & Director of Safety of the concerned state; a copy of the same shall be delivered to CLIENT. Contractor shall be responsible for handing over to TNEB and other authorities shall be responsibility of contractor till commissioning and getting electricity in the complex.

The CLIENT shall have full power regarding the materials or work got tested by independent agency at the electrical contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by CLIENT/ independent agency at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 2003, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, thereunder and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

3.0 DRAWINGS

i) The list of drawings along with these specifications is given in this tender. These drawings are meant to give general idea to bidder regarding the nature of work covered by these specifications.

ii) Any information/data shown/not shown in these drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications. Additional information required by the bidder/tenderer for successfully completing the work shall be obtained by him.

iii) Shop Drawings

The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, convenience outlets, D.G.'s, H.T., Transformer, M.V. Panel Boards/Relay Panel, PCC, DB's, Rising Mains, Cable Schedule with other relevant services and submit to the CLIENT for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components with wiring and cable details including system operating write up in the system i.e. 11 KV Panel Board, Control and Relay Panel Package Substation, D.G.'s, PCC's, MCC's, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution.

iv) Completion Drawings/As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the CLIENT 4 sets along with soft copy of 'As Built' drawings (in AutoCAD & PDF format) of the work along with 01 Nos. cloth tracing originals including write up (trouble shooting, installation, operation and maintenance manual with instructions) incorporating all such changes and modifications during engineering and execution along with warrantee & guarantee certificates from manufacturers.

These drawings must provide:

Run and size of conduit, inspection and pull boxes including routing and locations.

Number and size of conductor in each conduit.

Locations and rating of sockets and switches controlling the light and power outlet.

A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.

Location of outlets of various services, junction boxes, light fixtures.

Location of all earthing stations route and size of all earthing conductors.

Layout and particulars of all cables.

Location and details of PCC's, MCC's, Feeder Pillars, capacitor control panels, PLC D.G. set panel, UPS panel, and relay panels with description detailed control wiring diagram.

Location of transformer and its details and control wiring diagram.

Location of Hume pipe and manhole including HT/LT cable layout and scheduling.

Location of D.G.'s, exhaust and auxiliary equipment with schematic drawings.

Layout of cable trays with support and their fixing details.

Location of all earthing station, route and size of all earthing conductor.

Layout and particulars of rising mains with fixing details.

v) Position of HT/LT Switch Boards/Transformer & D.G.'S

The recommended position of the switch boards, transformer & D.G.'s as shown on the layout drawings will be adhered to as far as practicable.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the CLIENT. For all non-specified items, approval of the CLIENT shall be obtained prior to procurement of the same. CLIENT shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

4.0 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

5.0 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by CLIENT's Engineer-in-Charge, only the best quality materials and equipment shall be used.

The contractor shall fill in the data sheet for capital equipment as attached elsewhere in this document. The Material/Equipment shall be rejected due to not giving / filling in the details of the said equipment.

6.0 GENERAL DETAILS

6.01 Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

6.02 Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.03 Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

6.04 Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specification / BOQ whenever it is not mentioned it shall be as given below.

Installed out door: IP-55.

Installed indoor in air-conditioned area: IP-52.

Installed in covered area: IP-52.

Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.

For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

6.05 Rating Plates, Name Plates and Labels

Main PCC, PCC's, MDB and auxiliaries items installed in the building are to permanently attach to it in a conspicuous position. A rating plate of non-corrosive material with engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions of equipment in question has been designed to operate and such diagram plates as may be required by the purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates shall be trilingual including local language with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.06 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/soldering/brazing material for all copper/G.I. earthing and essential chemicals etc. which will be required to put the equipment/scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.



7.0 DESIGN IMPROVEMENTS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from CLIENT will be sought.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

8.0 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

His organization structure for the management and implementation of the proposed quality assurance programme.

Documentation control system.

Qualification data for bidder's key personnel.

The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.

Control of non-conforming items and system for corrective actions.

Inspection and test procedure both for manufacture and field activities.

Control of calibration and testing of measuring instruments and field activities.

System for indication and appraisal of inspection status.

System for quality audits.

System for authorizing release of manufactured product to the Purchaser.

System for maintenance of records.

System for handling storage and delivery.

A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his Vendor's quality management and control activities.

9.0 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

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

Welder and welding operator qualification certificates.

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

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

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

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

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

10.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE

The CLIENT or duly authorized representative shall have at all reasonable times free access to the Contractor/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval. The Contractor shall intimate the CLIENT the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test is pending payment would be made on successful completion of type/routine test(s) actually carried out as per CLIENT instructions.

The Contractor shall give the CLIENT thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The CLIENT, unless witnessing of the tests is virtually waived off, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in

the presence of CLIENT and he shall forthwith forward to the CLIENT duly certified copies of tests in triplicate.

The CLIENT shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.

When the factory tests have been completed at the Contractor's or Sub-contractor's works, the CLIENT shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the CLIENT, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the CLIENT. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the CLIENT to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the CLIENT.

The contractor shall arrange all necessary instruction and testing facilities free of cost for this purpose including air travel, lodging and boarding expenses.

For tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by CLIENT or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.

The inspection by CLIENT and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

The CLIENT will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.

The CLIENT reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

11.0 TESTS

11.01 Charging

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the CLIENT and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

11.02 Commissioning Tests



The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.

All instruments, tools and tackles required for the successful completion of the

Commissioning Tests shall be provided by the Contractor, free of cost.

Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.

The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment. However necessary fee shall be reimbursed by CLIENT on production of requisite documents.

12.0 PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. CLIENT takes no responsibility of the availability of any special packaging/transporting arrangement.

13.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

14.0 FINISHING OF METAL SURFACES

14.01 General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

14.02 Hot Dip Galvanizing



The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.

The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness,
- Uniformity of zinc,
- Adhesion test,
- Mass of zinc coating.

Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

14.03 Painting

All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be shovelled.

Powder coating/electrostatic painting of approved shade shall be applied.

The exterior color of the paint shall be as per shade no.697 of IS-5 or as approved by Engineer-in-charge and inside shall be white or as approved by Engineer-in-charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.

In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for CLIENT's review and approval.

15.0 HANDLING, STORING AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's Engineer(s) and shall extend full co-operation to them.

In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the CLIENT. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

The Contractor shall submit to the CLIENT every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

The Contractor shall be fully responsible for the equipment/material until the same is handed over to the CLIENT in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by CLIENT, as well as protection of the same against theft, element of nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.

The words 'erection' and 'installation' used in the specification are synonymous.

Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

16.0 PROTECTIVE GUARDS



Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

17.0 DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

18.0 DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the CLIENT/ CLIENT during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

19.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.



TECHNICAL SPECIFICATIONS FOR ELECTRICAL SERVICES- GENERAL REQUIREMENTS

1 GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (TNEB), D.G.s to the utilization equipment, all as shown in the drawings and described in these specifications. The quantities mentioned in BOQ are tentative. It will be the bidder's responsibility to work out the exact quantities from drawings or from work site, which trade provides said equipment, materials, tools and labour.

2 SCOPE

The bidder shall supply, install and commission along with requisite spare, maintenance tools and tackles the following equipment and system in the Project. The scope also covers the detailed engineering and calculations of the various equipment/system mentioned hereunder and the same shall be approved by the CLIENT/Engineer-in-charge prior to execution of the job.

11 KV Transformers

11 KV H.T. Switchboards.

Medium voltage switchgear.

Battery and battery charger.

Earthing.

Lightning protection system.

Capacitor with control panels.

Synchronization and AMF pane.

Laying and termination of H.T. cables.

Laying and termination of L.T. cables.

Conduiting for Fire Alarm and Public Address System

Busduct / Rising Main / Distribution Boards / Sub-Distribution Board.

Complete internal building wiring as per specification.

Safety to personnel and equipment during both operation and maintenance.

Reliability of Service.

Minimum fire risk.

Ease of maintenance and convenience of operation.

Automatic protection of all electrical equipment through selective relaying system.

Electrical supply to equipment and machinery within the design operating limits.

Adequate provision for future expansion and modification.

Maximum interchange ability of equipment.

Fail-safe feature.

Suitability for applicable environmental factors.

This specification defines the basic guidelines to develop a suitable electrical system as necessary for the Hospital. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned elsewhere.

Compliance with these specifications and/or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations.

All work to be performed and supplies shall be affected as a part of contract requires specific approval/ review of CLIENT or his authorised representative. Major activities requiring approval/ review shall include but not be limited to the following:

The engineering activities shall comprise the submission for approval of the following:

Basic engineering documents e.g. overall single line diagram, area classification drawing, overall cable layout, testing, type test report, guaranteed particulars of all equipment and maintenance manuals.

Quality assurance procedures.

Field testing and commissioning procedures.

Basic engineering calculations viz. load analysis; load flow, fault level calculations, and voltage drop calculations during motor start-up/re-acceleration etc.

Control and protection schemes.

Load sharing and annunciation scheme,

Sizing calculation for cable trays/cable trenches.

Area-wise illumination level calculation and preparation of power supply distribution drawing.

Calculation for earthing system and lightning protection.

The Contractor shall be responsible for:

Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, lighting layouts, cabling layouts, earthing and lightning protection layouts, including equipment installation and cable termination details etc. prior to start of work.

Preparation of bill of materials for cabling, lighting, earthing and miscellaneous items etc.

Cable schedule.

Lighting/power panel schedule.

Interconnection drawing.

Protection co-ordination drawings/tables for complete power system.

Shop inspection and testing procedures.

Field testing and commissioning procedures.

Preparation of as built drawings for all services.

Any other work/activity which is not listed above however is necessary for completeness of electrical system.

3 CODES & STANDARDS

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities' e.g. Electrical inspector, pollution control boards, TNEB as applicable before commissioning of electrical/DGs.

Indian Electricity Act.

Indian Electricity Rules.

Factory Act.

Pollution Control Act.

IS-732: Code of practice for electrical wiring installation system voltage not exceeding 650V.

IS-3043: Earthing.

IS-2309: Code of practice for the protection of buildings and allied structure against Lightning

IS-7689: Guide for control of undesirable static electricity. IS-3716: Insulation co-ordination application guide.

IS-8130: Conductors for insulated electrical cables and flexible cords. IS-5831: PVC insulation and sheath of electric cables.

IS-3975: Mild steel wire, strips & tapes for armouring cable. IS-3961: Current rating of cables

IS-694: PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100 volts.

IS-424- 1475 (F-3): Power cable flexibility test.

IEC-439/IS-7098: Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1 KV.

IS-1554: PVC insulated cables up to 1100 volts.

IS-10810: Test procedures for cables.

IS-6121: Cable glands.

IS-10418: Cable drums.

IEC-754(1): FRLS PVC insulated cable.

ASTM-D-2863: Standard method for measuring minimum oxygen concentration to support candle-like combustion of plastic (oxygen index).

ASTM-D-2843: Standard test method for measuring the density of smoke from burning or decomposition.

ASTM E-662/IEC 754(A) Standard test method for specific optical density of smoke generated by solid materials.

IEEE-383: Standard for type test class-IE, electric cables, field splicers and connections for power generation station.

IS 13947/IEC 947: Air circuit breaker/moulded case circuit breaker.

IS-8623: Specification for factory built assemblies of switch gear and control gear for voltage upto and including 1000vac/1200vdc

IS 1018: Switchgear and control gear selection/installation and maintenance

IS-1248: Direct acting indicating analogue electrical measuring instruments and testing accessories.

IS-13779: Digital measuring instruments and testing accessories. IS-3156: Voltage transformer

IS-2705: Current transformer for metering and protection with classification burden and insulation.

IS -2147: Degree of protection provided by enclosures for low voltage.

PART I, II, III Switchgear and control gear

IS-3427: Metal enclosed switchgear and control gear

BS-162: Safety clearance

IS-3202: Code of practice for climate proofing of electrical equipment.

IS-375: Marking and arrangement for switchgear, bus bars, main connections and auxiliary wiring.

IS-722: Ac electric meters

IS-3231/IEC-255: Electrical relays for power system protection.

IS-5082: Electrolytic copper/aluminium bus bars

IS-2834: Capacitors

IS-2713: Steel tubular pole

IS-335: Specification for insulating oil

IS-3837: Specifications for accessories for rigid steel conduit for electrical wiring.

IS-2026& 335: Distribution transformer

(PART I, II, III) GI/STEEL /PVC conduit pipe for electrical wiring.

IS-2274: Code of practice for electrical wiring installation system voltages exceeding 650 volts.

- IS-6665: Code of practice for industrial lighting
- IS-3646: Interior insulation part 1&2
- IS-1944: Code of practice for lighting of public through fares.
- IS-7752: Guide for improvement of power factor consumer's installation.
- IS-13346: General requirement for electrical for explosive gas atmosphere.
- IS-13408: Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
- IS-12360: Voltage and frequency for ac transmission & distribution system.
- IS-5572: Classification of hazardous area for electrical installations.
- IS-5571: Guide for selection of electrical equipment for hazardous area.
- IS-4201: Application guide for Current Transformer
- IS-4146: Application guide for Voltage Transformer
- IS-10028: Code of practice for installation and maintenance of transformer
- IS-8478: Application guide for on load tap changer
- IS-10561: Application guide for power transformer
- IS-1646: Code of practice for fire safety of buildings electrical installation
- IS-3034: Code of practice for fire safety of industrial building-electrical generating and distribution station
- IP-30: National electrical code (NEC) BIS publication.
- IS-4722: Rotating electrical machines.
- IS-4889: Method of determination of efficiency of rotating electrical machines.
- IS-325: Three phase induction motors.
- IS-4729: Measurement and evaluation of vibration of rotating electrical machines.
- IS-900: Installation and maintenance of induction motors.
- IS-4029: Air break switches.
- IS-2208-9224: HRC cartridge fuses.
- IS-2959: Contactors.
- IS-9537: Rigid steel conduit.
- IS-1030-1982: Specification for carbon steel castings for general engineering purpose.
- IS-1601/ BS-649: Performance & testing of Internal Combustion (IC) engines for general purpose.



AIEE-606(1959): Recommended specification for speed governing of I.C. engine generator units.

BS-5514/IS-3046 8528(Part-2): Reciprocating IC engine driven A.C. generators.

Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

In case of any deviation /conflict of this specification with the codes & standards, the following order of precedence shall govern.

- a) Specification, particular specification if any, and drawings. b) Indian regulations/codes and standards.

4 SITE CONDITIONS

i)	Design ambient	50 Deg.C. Maximum, 2 Deg. C.
ii)	Relative Humidity	85% maximum
iii)	Site environment	Normal

5 DESIGN CRITERIA

I	Electrical Details of Incoming Supply	
a	Supply Voltage	11 KV as per TNEB approved.
b	Fault level (sym.) at supply of point (designed)	350 MVA (to be confirmed from State Electricity Board by Tenderer).
c	Neutral Earthing	Solid Earthing
d	Voltage Regulation	10%
e	Frequency Regulations	3%
f	Combined	10%
II	L.T. Power Distribution Systems	
a	Voltage	415 V / 240 V
b	Frequency	50 Hz
c	Neutral Earthing	Grounded
d	Short Circuit Fault withstand Capacity	10 KA - 50 KA (1 Sec.) as per B.O.Q. and specification.
III	Emergency Lighting (Battery Operated With Self Charger)	
a	Voltage	12 V, DC
b	Source	Mains/D.G. Set

IV	Control Supply for Electrical System:-	
	The various supply voltage to be used in the control panels for main equipment are	
a	Spring Charge Motor	230 Volt A/C
b	Closing/Trip Coil	24 V DC / 230V AC
c	Alarm/ Indication/ Relay	24 V DC/ 230 V AC
d	Heaters	230 V AC
V	Power Supply Load Control / Distribution Panel	433 V TPN / 240 V 1 phase A.C. (other supply if required shall be derived by package vendor
VI	Painting of Panel	Powder coating of approved shade
VII	Painting of Cable Tray & Structure Steel	Powder coated of approved shade

6 CABLE DETAILS

i.	Internal Wiring	Copper conductor PVC insulated 1.1 KV grade as called for in BOQ
ii.	Power Cables (L.T.).	XLPE insulated Al. Armoured Cable as per BOQ.
iii.	11 KV.	Aluminium conductor XLPE insulated armoured cable.
iv.	Grounding Conductor.	Copper/G.I. strip as per BOQ.
v.	Lightning Conductor.	G.I. Strip.

7 ACCURACY CLASS OF METERS

a	Revenue Metres.	Class-0.5 or as per TNEB approved
b	Ammeter, Voltmeter, and Other Instruments.	Class – I Digital / Analogue as per BOQ



TECHNICAL SPECIFICATIONS - ELECTRIFICATION

SECTION –1: 11KV VCB SWITCHGEAR

1. SCOPE

All the necessary Approvals & Liasoning for Load enhancement from present approved load to the required load shall be in the scope of the contractor. Only fee paid to the authority shall be reimbursed against the submission of the receipt and nothing shall be paid extra.

Manufacturing and supplying of integrated cubicle type metal clad, form 3 a, floor mounted and draw out type free standing, front operated indoor type 11 KV switchgear as per specifications given below:

The switchgear enclosure shall conform to degree of protection IP 4 X. The switchgear shall be made from MS sheet steel 2 mm thick (CRGO) and shall be folded and braced as necessary to provide a rigid support for all components.

The switchgear assembly shall form a continuous dead front line up of free standing vertical cubicles. Each cubicle shall have a lockable front hinged door and a removable bolted back cover. All covers and doors shall be provided with neoprene gaskets. Suitable arrangement for lifting of each cubicle shall be provided. Design and construction of the switchgear shall be such as to permit extension at either end.

Vacuum Circuit breaker shall be provided with surge arresting device for protection against lightning and switching over voltage. Two separate and distinct connections to earth shall be provided for each surge arrestor.

2. STANDARDS AND CODES

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 2005, National Electric Code 2008, Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 - 1988 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

11000 volt Circuit Breaker: IS 13118; 1991

Metal Enclosed Switchgear and Control gear for voltages above 1000 volts: IS 3427: 1969

Electrical Relays for Power System Protection IS 3231: 1986

Voltage Transformers IS 3156: 1978

Current Transformers IS 2705: 1981

Rubber Mats for Electrical Works IS 5424: 1983

Danger Notice Plate IS 2551: 1982

AC isolators and earthing switches IEC 129

AC metal enclosed Switchgear IEC 298

HT AC contactors

3. BREAKER COMPARTMENT

Vacuum Circuit Breaker shall be mounted in draw out truck with front plate which covers the cubicle when the breaker is in service position. This front plate shall be provided with view glass to facilitate observation of mechanical ON/OFF indication of Circuit breaker, Spring charged / discharged indication and operation counter.

Necessary orifice shall be provided for manual charging of the springs. ON/OFF push button for opening and closing of the circuit breaker shall also be provided. The draw out truck shall have two positions for the circuit breaker VIZ isolated / Test & Service.

4. BUS BAR COMPARTMENT

Bus bars of rectangular cross section of copper conductor supported by cast epoxy insulator to withstand full short circuit currents up to 18.4 KA / as per BOQ specification for one second shall be provided at the rear. Bus bar chamber shall be provided with inter panel barriers with epoxy cast seal off bushings.

5. CT AND CABLE COMPARTMENTS

At the rear of the panel sufficient space shall be available to accommodate three numbers epoxy CT's of double core and two numbers three core cable termination. The cable entry shall be from the top / bottom.

6. SEPARATE COMPARTMENTS

Circuit breakers, instrument transformer, bus bars, cable etc shall be housed in a different compartments as required for form 3 a, compartmentalization. All relays, switches, lamps, etc. comprising the control, indication and protective devices shall be housed in a separate compartment on the front of the cubicle.

7. TECHNICAL PARTICULARS OF VCB CIRCUIT BREAKER Rated Current

630 A Rated Voltage	-	11 KV Rated Frequency
-		50 Hz
Rated Short Circuit breaking Current		18.4 KA for 1 Sec. Rated short circuit making current
-		50 KA
Insulation Level (KV rms/KVP)	-	28KV / 75 KV

8. EARTHING SWITCH

Cable earthing switch shall be provided in the cable chamber and shall be operated from the front of the panel. The ON/OFF position of switch shall be indicated by mechanical indicator. The Earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

Earthing switch shall also be provided on bus bar side. The ON/OFF Switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

9. ISOLATING CONTACTS

The breaker isolating contacts shall consist of two parallel flat silver plated copper bars with ball point contacts to give a vertical tolerance of ± 10 mm.

10. LOW VOLTAGE PLUG AND SOCKET CONNECTOR

A twenty pin plug and socket connection along with flexible leads shall be provided to connect control instrumentation and interlock circuits on the breaker truck and in the panel. The plug and socket assembly shall be suitably interlocked with the truck positions like service and test/isolated position

11. INTERLOCKS

The following interlocks shall be provided:

- The truck cannot be moved from either test to service position or vice versa, when the circuit breaker is 'ON'.
- The circuit breaker cannot be switched 'ON' when the truck is in any position between test and service position.
- Front part of the truck cannot be removed when the breaker in 'ON' position.
- The low voltage plug and socket cannot be disconnected in any position except test/isolated position.
- The truck cannot be moved inside the panel, when the LT plug and socket is disconnected.
- Earthing switch cannot be switched 'ON' when the truck is inside the panel.
- The truck cannot be inserted when the earthing switch is 'ON'.

12. SAFETY DEVICES

The following Safety devices shall be provided for the safety of the operating personnel:

- Individual explosion vents shall be provided for breaker/bus bar/cable chambers on the top of the panel to let out the gases under pressure generated in case of fault inside the panel.
- Cubicle with front plate to withstand the pressure for internal arc fault as per PEHLA recommendation.
- Circuit breaker and sheet metal enclosure shall be fully earthed.
- Self-locking shutters shall be provided which shall close automatically when the truck is withdrawn to 'Test position' and no separate padlocking of the shutter shall be required.

13. PROTECTIVE EARTHING

The earthing connection between the truck and the cubicle shall be by means of sliding contacts so that the truck is earthed in the isolated position when inserted and remains earthed when the truck is pushed further into the connected position or when the truck is being withdrawn until the truck has moved part the isolated position.

14. CURRENT TRANSFORMER

I. GENERAL REQUIREMENTS

Accommodation shall be provided in the circuit breaker panel, to mount one set of dual ratio CT. Access to the CTS for cleaning, testing or changing shall be from the front, back or top of the panel.

II. RATING



Dual ratio CTS of suitable burden (but each not less than 15 VA) shall be preferred with 5 amps secondary's.

Instrument Security Factor (ISF) of each CT shall not be more than 5.

The CT's shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. CT terminals shall be shorting type. Current & voltage circuits shall be laid in separate wire ways. Secondary terminals of CTS shall be brought out to a suitable terminal block which will be easily accessible for terminal connections. Test terminal block shall be provided in the front side of the panel for testing purpose.

CT'S shall have 2 Nos. of cores for following application:

Core -1 for metering

Core -2 for over current & earth fault protection. Class of accuracy of each winding Metering class 1 / as per BOQ specification

Protection class 5P10

15. POTENTIAL TRANSFORMERS

The potential transformers shall be confirming to IS 3156/ IEC 185. The primary windings of the potential transformers shall be insulated and shall be of the cast rest in type.

Potential transformer(PT'S) shall be mounted on a draw out trolley and housed in separate metal compartment and shall have control fuses on the H.V. side and a miniature circuit breaker on the L.V. side of the windings. HT HRC Control fuses shall be confirming to IS – 609385/ IEC – 282. Miniature Circuit breaker shall comply with IS –608828/ IEC – 898.

Padlocking facilities shall be provided for both service and isolated position. The potential transformer shall be as specified below:

Ratio	:	11000/ V3/ 110/ V3/ 110 V
V A Burden	:	100 V A for 100/V3 and 110 V winding
Class specification	:	CL –1 for both the windings / as per BOQ
Basic Insulation level	:	28/75 KV
Over voltage factor	:	1.2 Continuous

Single phase PT'S shall be used and shall be connected in Star/ Star.

16. PROTECTION AND TRIPPING ARRANGEMENT PROTECTION

The protection and tripping arrangement of circuit breaker shall be :

- Numeric Type Instantaneous short circuit protection Device No.50 Range 500 – 2000% shall be provided on all phases.
- Numeric Type Back up over current protection for Phase faults Device No.51 Range 50 – 200% shall be provided on all phases.
- Numeric Type Ground fault protection Device No.50G with stabilizing resistor.
- CT's. Range 20 – 80% shall be provided.
- Lockout and trip supervisory relays etc shall be provided with manual reset facility.
- Auxiliary relay for transformer fault.
- Surge Arrestor

17. CONTROL WIRING

The control wiring shall be carried out with minimum 1.5 / 2.5 sq. mm. PVC insulated copper conductor cables. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification PVC ferrules shall be fitted to all wire terminals to render easy identification and facilitate checking in accordance with IS 5578 and 11353.

18. METERING INSTRUMENT PANEL ACCESSORIES METERING

Digital type Trivector meter of approved make shall be provided on the incomer feeder. Specification of the meter shall be as follows:

Accuracy : Class 0.2, compliant to revenue class certification / as per

BOQ specification

ANS I – C 12.20 – 1998 on all measurements. : Real time measurement per phase & average

V, I, PF, KW, KVAR, KVA : Peak demand, sliding window. Protected.

: V & I unbalance, Phase reversal

: Time of Use (TOU) Power Quality Measurement : Total Harmonics
Logging & recordings for all measurement: Interval or event-based, 32 channel measurement & recording

: Event logging

: "Bust" data recording

: Min/ Max recording

Alarming : Over & under measurement detection by 24 set point functions.

Multiport Communication : One each of RS 485 and RS 232 ports.

II. INSTRUMENT PANELS



The instrument panel shall be part of the housing. Relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the vendors. They shall be of flush mounting type.

III. INSTRUMENTATIONS

Digital type Power factor meter of class of 1.0 accuracy conforming to IS : 1248 shall be provided at incomer panel.

Digital type Ammeter of specified range to class 1.0 accuracy and 96 x 96 sq mm in size as per IS - 1248 shall be provided at both incomer and outgoing panels along with necessary selector switches.

Digital type frequency meter class of 1.0 accuracy conforming to IS:1248 shall be provided at incomer panel.

IV. The following minimum indication lamps shall be provided in the front of cubicle.

Breaker open / closed / tripped, spring charged, trip circuit healthy and control supply healthy. Lamps shall be clustered LED type and trip circuit supervision scheme shall be of continuous supervision type.

V. After meeting all necessary control and indication requirements 2 nos. NO and 2 nos.. NC auxiliary of the breaker shall be made available for the CLIENT, wired up to terminal block (if required).

VI. Separate MCB's shall be provided for lamps, heaters and other instrumentation etc. on each panel.

VII Anti-condensation space heaters suitable for operation on 240 V single phase, 50

Hz A.C. for each cubicle and with thermostat control one incandescent lamp with switch and 3 pin 5 amps plug socket.

19. DRAWINGS/DOCUMENTS REQUIRED FOR REVIEW/APPROVAL

Following drawings documents shall be submitted by the manufacturer for approval.

- General arrangement (GA) of equipment layout.
- Equipment list.
- Relay and metering system schematics.
- Supply and erection schedule.
- Catalogue and specification sheets.

20. QUALITY ASSURANCE

Vendor shall submit in substantial detail a quality assurance plan indicating all activities step by step at various manufacturing/fabrication stages to meet the requirement of this specification and various standards/regulations/practices to enable comprehensive assessment of its merits and reliability.

21. TEST AT MANUFACTURERS WORKS



Copies of type tests and of routine tests carried out at manufacturer's works shall be furnished along with the delivery of the switchboards. Engineer-in-charges/CLIENTs reserves the right to get the switchboard inspected by their representative at manufacturer's works prior to dispatch to site to witness the routine tests, for which purpose the contractor shall provide the necessary facilities and also give due notice.

22. TESTS AT SITE

Pre-commissioning tests as per manufacturer's recommendations shall be carried out on the switchboard a site after installation including but not restricted to the following.

- Physical checking of the switchboard including checking for damage or cracks in components, bolt tightness, gasket ting etc.
- Checking of vacuum bottles to ensure leak tightness
- Insulation testing of Bus bar supports by 2.5 kV megger
- Insulation testing of Control wiring by 1.1 kV megger.
- Testing of relays and CTs with secondary injection kit.
- Checking of breaker operation.
- Checking of earth continuity.
- High potential test / Pressure testing



SECTION –2 : DISTRIBUTION TRANSFORMER

A. 11/0.433 KV OIL TYPE DISTRIBUTION TRANSFORMER WITH ON LOAD TAP CHANGER MECHANISM WITH AUTOMATIC VOLTAGE REGULATOR

1 GENERAL

The step down double wound core type transformers shall be suitable for Outdoor mounting with a voltage ratio of 11000/433 volts and of the naturally oil cooled with a Delta/Star configuration. The transformer shall comply with the regulations of IEC 76, B.S. 171 and I.S. 11171: 1985 as amended up to date.

2 TRANSFORMER DETAILED SPECIFICATIONS

Technical specifications and make of materials should be get approved before the procurement of the materials. All panels / equipments approval shall be taken in the form of GA Diagrams before fabrication.

2.1 TRANSFORMER OPERATION

The transformer shall be suitable for operation on 11 kV, 3 phase 50 cycle earthed system, connected Delta on H.V. side and star on the L.V. side with neutral brought out for independent Earthing (Vector Group DYN II). The transformer shall be suitable for continuous operation at the rated capacity under Site conditions.

2.2 TRANSFORMER MATERIAL

The material used in the manufacture of the transformer shall be of the best quality of their respective kind available as per standard specifications.

2.3 CORE

The core shall be built up with high grade non-aging, low loss and high permeability CRGO lamination special silicon steel suitable for transformers. After being sheared, the lamination shall be treated to remove all burs and shall be reannealed to remove all residual stresses. Each lamination shall be coated with a durable, insulating coating. Core assembly shall be provided with lugs suitable for lifting the complete core and coil assembly of the transformers. Core and coil shall be so fixed that there is permanent displacement of windings on other parts when the transformer is moved or during short circuit. Core frame parts shall be galvanized.

2.4 WINDINGS

The HV and LV windings shall be of copper conductors using highly densified glass fiber reinforcement. Temperature rise of winding shall not 50 deg C by resistance on continuous full load above ambient of 50°C and temperature rise of oil shall not exceed 45 deg C above ambient of 50 deg C. Flux density at any point in winding and core shall not exceed 1.7 T on normal rated voltage and frequency.



2.5 Off Load Tap Changer

The transformer shall be provided with an Off Load Tap Changer facility. The suitable for an incoming voltage variation from +5% to -10% in 6 steps on H.V side so as to give a near constant voltage of 433 volt on the L.V. side. The shall be provided with automatic voltage sensing relay and shall be fully automatic in operation.

The shall be supplied with the first filling of the oil, oil surge relay, shut off valve for the oil surge relay, trip contracts, access windows for connection etc. The shall be provided with motorized / manual operation along with handle for operating manually. Mechanical tap position indicator shall be provided.

2.6 INSULATION CLASS

The insulation material used shall be insulation class 'A'.

2.7 TRANSFORMER TAPPINGS

'OFF' load tap changing links on HV side. The tappings to be provided for variation on HV side from + 5% to – 10% in steps of 2.5%. each.

2.8 TRANSFORMER CHARACTERISTICS

The no load voltage ratio of the transformer shall be 11000/433 volts and the percentage impedance shall not exceed 5% or as per IS.

2.9 TRANSFORMER TERMINATIONS

The transformer shall have self-supporting cable boxes with suitable glands and cable sockets for receiving 11,000 volt grade XLPE cables on the H.V. side as required.

On the MV side the transformer shall have a suitable self supporting terminal arrangement with extended busbars to receive 1100 volt grade PVC insulated and sheathed aluminium conductor armoured cable as specified.

2.10 TEMPERATURE RISE PARAMETERS

Thermistor sensors shall be embedded in the low voltage winding for warning and tripping, for temperature control. The temperature detectors shall be suitable for 24 volts D.C. The temperature rise when continuously operated of windings by resistance method shall not exceed 20 deg C over 50 deg C ambient for warning and 45 deg C over

50 deg C ambient for tripping.

2.11 TRANSFORMER FITTINGS

The transformer alongwith shall be manufactured in accordance with the requirements as specified in the Standards stated above and shall be fitted with:

1. Diagram and Rating plate
2. Lifting Lugs.
3. Two earthing terminals on either side of the tank.
4. Four bidirectional rollers on the under carriage for movement.
5. Winding Temperature Indicator with alarm contacts for alarm and trip circuits.
6. Externally operated tapping switch with position indicator & locking arrangement.
7. Terminal marking plate.

8. Jacking Lugs.
9. H.V. cable box for 3 core XLPE cable as required.
10. L.V. cable box suitable for reception of PVCA armoured cables or chamber for receiving bus duct as required.
11. Oil conservator with drain plug.
12. Oil filling hole and cap.
13. Filter valve with plug.
14. Drain valve with plug or cover plate.
15. Oil level indicator with minimum marking.
16. Dehydrating breather (Silica gel breather)
17. Air release valve.
18. Explosion vent.
19. Thermometer pocket with plug.
20. 150 mm dial type contact thermometer with maximum temperature indicator and alarm and trip contacts for oil temperature.
21. Buchholz relay of double float type with alarm and trip contacts and M.S. box for terminating control cables of 4 x 2.5 sq. mm. size.
22. L. V. Neutral bushing
23. Shut-off valve between Buchholz relay and conservator.

The transformer shall be complete with the first filling of insulating oil as per IS 335 - 1983 including makeup fill at site.

2.12 TRANSFORMER GUARENTEED TECHNICAL PARTICULARS

The following guaranteed technical particulars of the transformer shall be furnished.

- a) Core loss
- b) Load loss
- c) Percentage Impedance

2.13 TRANSFORMER TESTING

Prior to acceptance and dispatch of the transformer, the CLIENT reserves the right to witness the routine tests at manufacturer's works. The transformer shall be subjected to the following routine tests as per relevant Standards at the manufacturers Works. The test certificates shall be submitted to the CLIENT/Engineer-in-charges for approval prior to dispatch. Except type test. The Performance load test should be done at factory in the presence of PMC / Bidder / Client. Incidental, to and fro charges and boarding and lodging expenses should be borne by the bidder..

- a) Measurement of Winding Resistance
- b) Ratio polarity and phase relationship
- c) No load and load losses
- d) Impedance voltage
- e) No load and load current
- f) Insulation resistance
- g) Induced over voltage withstand
- h) Separate source voltage withstand

In addition type test certificate for following parameters shall also be submitted to CLIENT/ Engineer-in-charges for record. Any type test if specifically asked for by CLIENT,

shall be carried out on the equipment covered by this contract shall be done at extra cost prior to dispatch.

- a) Temperature Rise
- b) Impulse voltage withstands.

2.14 INSTALLATION

The transformer shall be installed as per the manufacturers instruction manual and shall conform to the requirements of IS 10028: 1981.

Transformer and all other accessories shall be handled carefully in its upright position as indicated on the packing cases. Lifting lugs and jacking pads shall be use for lifting the transformer. Utmost care shall be taken in proper application of jacks. Where transformer is dragged or pulled on sleeper or rollers, the traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles.

Transformer shall be mounded on concrete plinth/foundation prepared for the purpose. Rollers shall be checked and locked to prevent movement of the transformer after being positioned after on the plinth.

The transformer cable end boxes shall be sealed to prevent entry of moisture.

The transformer neutral and body earthing shall be as per the requirements of IS 3043- 1966 and the Local Inspecting Authorities

2.15 COMMISSIONING TESTS

The following tests shall be carried out prior to commissioning at site by third party

- a) Insulation resistance of the winding between phases and phase and earth on the H.T. side.
- b) Winding resistance of all the windings on all tap positions.
- c) Voltage ratio test shall be carried out by applying low voltage on H.T. side and measuring the voltage between phases and phase and neutral on the L.T. side for every tap setting.
- d) On commissioning of the transformer the following readings shall be taken
 - MV side voltages at all tap settings
 - Temperature rise under no load conditions
- e) Transformer oil test
 - f) If necessary, the transformer shall be heated by applying low voltage on the HT side and shorting the LT side. This shall be done for a period of 48 hours or till all the moisture has been removed from the transformer.



SECTION 3 - TECHNICAL SPECIFICATIONS FOR D.G.SETS

General

All items of work under this Contract shall be executed strictly to fulfill the requirements laid down in the specifications. Type of equipment, material specification, methods of installation and testing and type of control shall be in accordance with the specifications, approved shop drawings and the relevant Indian Standards, however capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

The unit rate for all equipments or materials shall include cost in RUPEES for equipment and materials including all taxes and duties and also including forwarding, freight, insurance and transport into Contractor's store at site, storage, installation, testing, balancing, commissioning and other works required.

The rate for each item of work included in the Schedule of Quantities shall, unless expressly stated otherwise, include cost of :

a. All materials, fixing materials, accessories, appliances tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of work called for in the item and as per Specifications and Drawings.

b. Wastage on materials and labour.

c. Loading, transporting, unloading, handling/ double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and for the job in accordance with the contract documents, good practice and recognize principles.

d. Liabilities, obligations and risks arising out of Conditions of Contract.

e. All requirements of Specifications, whether such requirements are mentioned in the item or not. The Specifications and Drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.

f. In the event of conflict between Schedule of Quantities and other documents including the Specifications, the most stringent shall apply. The interpretation of the CLIENT/ Engineer-In-Charge shall be final and binding.

All equipments, quantities and technical data indicated in this Schedule are for the

Contractor's guidance only, these are based on the documents prepared by the CLIENT.

This schedule must be read in conjunction with other documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved Shop Drawings at the contract rates.

This Schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK including NIL items.

No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorised in writing by CLIENT. Any such alterations, notes or additions shall, unless authorized in writing, be disregarded when tender documents are considered.

In the event of an error occurring in the amount of the Schedule, as a result of wrong mention of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the amount shall be amended on the basis of rates.

Any error in totalling in the amount column and in carrying forward total shall be corrected. Any error, in description or in quantity, omission of items from this Schedule shall not vitiate this Contract but shall be corrected and deemed to be variation required by the Engineer –In-Charge / CLIENT.

Rates have been called for a number of items of works, as alternatives which, for the present do not form part of the total value of tender. However the rates for these items shall be quoted, with due care so that in the event of choice of an alternative item of work, said rate shall form part of the contract and shall not violate the contract any way.

The Contractor shall procure and bring Materials/ Equipment to the site only on the basis of drawings approved for construction and shop drawings and not on the basis of Schedule of Quantities which are provisional only. This also applies to the Contractor's requisition for CLIENT's supplied materials. Choice of make shall be as per approved makes

DRAWINGS

The drawings, specifications and bill of quantities shall be considered, as a part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice-versa, shall be executed as if specification called for in both. The contract drawings indicate the extent and general arrangement of various equipments and their wiring, etc. and are essentially diagrammatic. The drawings indicate the point of termination for conduit runs and broadly suggest the routes to be followed. The work shall be done as indicated on the drawings. However, any minor change if found essential to co-ordinate the installation of this work with other traders shall be made without any additional cost to the CLIENTs. The data given herein and on the drawings is as could be secured but its complete accuracy is not guaranteed. The drawings and specifications are for the assistance and guidance of the contractor. The exact location, distances and levels etc. will be governed by the space conditions. The contractor shall examine all Architectural, structural, Plumbing and Sanitary, Air-conditioning and electrical drawings before starting the work and report to the Engineer-in-charge any discrepancies, which in his opinion appear, on them, and get them clarified. He shall not be entitled to any extras, for omissions or defects in electrical drawings or when they conflict with other works.

SHOP DRAWINGS

The Contractor shall prepare and submit to the CLIENTs/Engineer-in-charge/ CLIENT for their approval detailed shop drawings within 30 days of signing of the contract or before 7 days of particular work or whichever is earlier. The shop drawings shall clearly indicate.

- The general arrangement and schematic diagram of main D.G Panel, PLC Panel, clearly stipulating the material, size of sheet steel, bus bar, inter connections detail, make and rating of switchgear and other equipment etc.
- Number, size and route of the Cable Tray, and fixing details.

c) Total number of cable runs, size make, material and type of cables with clear routing, trenches / trays detail, installation mode, starting and termination point of each and individual cable etc.

d) The shop drawings shall also show all setting out details and physical dimensions of all equipments components used in the system, location of manholes fixing, cutout details etc.

QUALITY

The CLIENT's decision with regard to the quality of the material and workmanship will be final and binding, any material rejected by the CLIENT shall be immediately removed by the Contractor from the site. The CLIENT or their representative shall at all reasonable times have free access to the works and / or to the workshops, factories or other places where materials are being prepared or constructed for the contract and also to any place where the material lying or from which they are being obtained, and the contractor shall give every facility necessary for inspection and examinations and test of the material and workmanship free of cost.

COST OF SAMPLES AND TESTS

The Contractor at his own cost shall supply all samples and the cost of making any test as per specifications shall be borne by the contractor. The Contractor shall submit four copies of all brochures, manufacturers' description data and similar literature. One copy will be returned to the Contractor after approval.

COMPLETION DRAWINGS

The Contractors shall submit to the CLIENT / CLIENT, layout drawings drawn at approved scale in six sets and a reproductive (original) copy clearly showing.

- a) Location of distribution and PLC Panel
- b) All types of cables (L.T. / Control etc.) layout.
- c) Layout of DG Room and switchgears and associated equipments. d) Layout of Diesel Generator Sets.
- e) Location of Fuel Tank, Cooling Towers, Pumps and fuel and water piping layout.
- f) As built drawing with equipments operation and maintenance literature. - After the completion of the work and before issuance of certificate of virtual completion.

FOREMAN / SUPERVISOR

The Contractor shall employ a competent, licensed qualified full time electrical engg./ foreman/ supervisors to direct the work of electrical installations in accordance with the drawings and specifications. The foreman / supervisor shall be available at all times on the site to receive instructions from the Engineer-in-charge / Engineer in the day to day activities throughout the duration of the Contract and as long as there after as the CLIENTs may consider necessary until the expiration of the "Defect Liability Period". The Foreman / Supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of the Local Government. The Contractor shall on the request of the CLIENTs

immediately dismiss from the works any person employed there on who may, in the opinion of the CLIENTs, be unsuitable or incompetent or who may misconduct himself and such person shall not be again employed or allowed on the work without the permission of CLIENTs/Employee.

INSPECTION AND TESTING

Contractor shall employ a full time qualified Engineer who shall be available at all working hours at site for taking instructions and to look after the quality of the work. Instructions given to the Engineer of the contractor shall be construed as issued to the contractor.

Contractor shall maintain at site the following tools and instruments, but not limited to the list below in working conditions.

- a) Clip-on Ammeter and voltmeter
- b) 1000 V Meggar and 5 KV Meggar
- c) Steel tapes of various lengths
- d) Sprit Level
- e) Hydraulic Crimping Tool
- f) Earth Testing Meggar
- g) Pipe bending Tool, thread-cutting die, bench vice etc.
- h) Cable jointing kit

The contractor shall provide at least four permanent benchmark at site, which shall be preserved till the completion of works. These are essential for laying of cables at correct levels.

CLEARANCE FROM LOCAL AUTHORITIES

The Contractor shall get the entire installation tested inspected and approved by Local Authorities like Electrical inspectorate pollution control explosive clearance and any other agency required to take permission for commissioning of the installation. He will also undertake the Liaison work with local Electricity Supply Company for obtaining the Electrical Service Connection.

SCOPE

In general, the contractor shall supply, store, erect test and commission all the equipment required for electrical installation. The contractor shall furnish all the materials, labour, tools and equipment for electrical work, as shown in the accompanying drawings and in the bill of quantities and specifications hereinafter described.

CONTRACTOR

The contractor shall be a licensed electrical contractor, possessing a valid electrical contractor's in the state, employing licensed supervisors and skilled workers having valid permits as per the regulation of Indian Electricity Rules and Local Electrical Inspector's requirements.



2.0 Preamble to BOQ for D.G. Set:

1. All items of work under this Contract shall be executed strictly to fulfil the requirements laid down under the specifications. Type of equipment, material specifications, methods of installation and testing, and type of controls shall be in accordance with the Specifications, approved shop Drawings and the relevant Indian Standards, however, capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

2. The rate for each item of work included in the Bill of Quantities shall, unless expressly stated otherwise, include cost of:

a. All materials, fixing materials, accessories, appliances, tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of the work called for in the item and as per Specifications and Drawings.

b. Wastage on materials and labour.

c. Loading, transporting, unloading, handling / double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and to fully complete the job in accordance with the contract documents, good practice and recognized principles.

d. Liabilities, obligations and risks arising out of Conditions of Contract.

e. All requirements of specifications, whether such requirements are mentioned in the item or not. The specifications and drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.

f. In the event of conflict between Bill of Quantities and other documents including the specifications, the most stringent shall apply and the interpretation of the CLIENT's shall be final and binding.

3. The unit rate for each equipment or materials shall include cost in Rupees for equipment and material including the excise duty, and also including forwarding, freight and insurance up to Contractor's store at site, storage, installation, testing balancing, commissioning and other works required.

The extension for (total) amounts against each item shall be based on the quantities indicated in this Schedule.

4. All equipment, quantities and technical data indicated in this Schedule are for the Contractors guidance only; these are based on the documents prepared by the CLIENTs. The contractor shall assess the required quantity of cables, cable trays, piping etc that are required for completion of the work. This schedule must be read in conjunction with these documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop drawings at the contract rates.

5. The quantities given in this schedule are provisional, the CLIENT reserves the right to increase or decrease the quantities of work or to totally omit any items of work and the

Contractor shall not be entitled to claim any extras or damages on these grounds. These variations shall be permitted until such time Contractors shop drawings are approved.

6. This schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK.

7. No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorized in writing by the CLIENT. Any such alterations, notes or additions shall unless authorized in writing be disregarded when tender documents are considered.

8. In the event of an error occurring in the amount column of the Schedule, as a result of wrong extension of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the extensions shall be amended on the basis of the rates.

9. Any errors in totalling in the amount column and in carrying forwarded totals shall be corrected. Any error, in description or in quantity or commission of items from this schedule shall not vitiate this contract but shall be corrected and deemed to be a variation required by the CLIENTs.

3.0 D.G. SET- 200 KVA / As specified in the BOQ

The D.G. set shall be provided with Diesel Engine of Model no. & no. of Cylinder as given below, vertical 4 stroke cycle, Air cooled radiator having turbo charged after cooled Engine at 1500 RPM under NTP conditions of BS: 5514. The D.G. set shall be provided with electrical starting arrangement and shall give the electrical output of as given below at 0.8 power factor, 415 Volts at the alternator terminal.

ELECTRICAL OUTPUT

No. of Cylinder

200 KVA / as specified in the BOQ 12 or as per approved manufacturer

Other accessories of the engine would be as under:

COOLING SYSTEM

- Thermostat
- Corrosion Inhibitor
- Self contained piping

FUEL SYSTEM

- PT fuel pump
- Injectors
- Fuel filters
- Self contained piping

LUBRICATING SYSTEM

- Oil pump
- Strainer
- Lube oil cooler



- Oil filter
- Bypass filter
- Self contained piping

AIR INTAKE SYSTEM

- Dry type filter
- Air intake manifold with necessary connections
- Turbo charged after Cooled

EXHAUST SYSTEM

- Exhaust manifold
- Flexible piping
- Silencer (Hospital) GOVERNING SYSTEM
- Electronic Governor

STARTING SYSTEM

- Starter, 24V, DC
- Battery charging Alternator
- With in-built Regulator

ENGINE CONTROL PANEL (ECP) (it will display)

- Lub oil pressure
- Jacket water temperature
- Engine RPM
- Battery voltage
- Engine Running Hours

SAFETY SYSTEM

- Low lub oil pressure
- High water temperature
- Over speed

OTHER SYSTEM

- Flywheel
- Flywheel housing

ALTERNATOR:

Output



i) 200 KVA / As specified in the BOQ Power factor : 0.8 Rated Generating Voltage Volts

Voltage regulation : +/- 1% all load between no load to full load & factor 0.8 to unity

Frequency : 50 Hz

Speed : 1500 RPM

Class of insulation : H

Winding connection : Star connection (all six leads will be brought out of stator frame)

Overload capacity : The Generator offered by the Tenderer should be tested for 24 hours at the factory at 100% load conditions and 110% load for one hour in every 12 hours of test run as per BS 5514 standard and CPWD Norms.

Bearings : Long life single bearing

Enclosures : Drip proof & screen protected IP-23

Parallel operations : All machines shall be suitable for operation in parallel. Damper winding shall be provided to facilitate parallel operation

Power Command Paralleling Genset Controls (PCC3.3 of Cummins or equivalent)

The features shall be given as below:-

- Digital governing
- Digital Voltage regulation
- AmpSentry Protection for true alternator O/C protection on PCC 3.3 for solo / paralleling applications.
- Analog/ Bargraph/ Digital AC output Metering
- Battery Monitoring System to sense and warn against a weak battery condition
- Digital Alarm and Status Message Display
- Genset Monitoring : Displays status of all critical engine and generator set functions
- Smart Starting Control System : Integrated fuel ramping to limit black smoke and frequency over shoot
- Advanced serviceability
- Synchronizers and load sharing controls
- KVAR and power factor controls
- Import / Export controls for paralleling with utility / main bus.



The alternator shall be of self-excited, self-regulated, self-ventilated in brush less design, provided with suitable automatic voltage regulator and shall conform to BS:2613 or BS : 5000 and shall give rated output at NTP conditions.

ESSENTIAL ACCESSORIES:

One set of essential accessories shall be supplied with each D.G. Set. This set of accessories shall comprise of the following:

BASE FRAME:

One no. MS Fabricated adequately machine Channel Common Base Frame with lifting facility, pre-drilled foundation holes suitable for permanent installation on concrete foundation for direct grouting or on anti-vibration mountings which will be suitable to receive the offered engine and alternator duly coupled through a flexible coupling. A suitable coupling guard shall also be provided.

FUEL TANK:

One no. Daily fuel tank of 990 LITRES capacity / or as per OEM Supplier Specification for each DG set made out of 3 mm thick MS sheet complete with inlet and outlet connections, drain plug, manhole, etc. & suitable for mounting on floor with mounting pedestals. Wire-braided hoses shall also be supplied with fuel tank.

BATTERIES:

For electrical control circuit of 24 volt DC, 2 Nos. batteries of 12 volts 180 AH for each set respectively (dry and uncharged) of approved make with battery leads for electrical starting of each DG Set.

4.0 DIESEL GENERATING SET DESIGN

1.1 The engine alternation set shall be capable of working at ambient temperature between 0°C to 50°C and relative humidity upto 95%.

The operating capacity of each set shall be arrived at after considering a load with power factor of 0.8 lagging, and after taking into consideration suitable de-rating on account of above parameters of the station.

Performance Load Test Procedure

1.2 The Generator offered by the Tenderer should be tested for 24 hours at the factory at 100% load conditions and 110% load for one hour in every 12 hours of test run (total 24 Hours) as per BS 5514 standard and CPWD Norms. The Performance load test should be done at factory in the presence of PMC / Bidder / Client. Incidental, to and fro charges and boarding and lodging expenses should be borne by the bidder.

1.3 Nominal output voltage of engine/alternator set shall be 415 volts 50 Hz AC Supply with manual adjustment at all conditions of load with coarse and fine controls with a range of $\pm 5\%$.

The frequency shall be maintained at 50 Hz $\pm 2\%$ for the set.

1.4 The output wave-form shall be sinusoidal at all load conditions.

1.5 The engine/alternator set shall be selected for a high degree of performance with over all low fuel consumption for the normal life of the alternator set.

1.6 The engine/alternator set shall meet the requirements of all linear & non-linear loads, but over-sizing of the alternator in order to meet the non-linear characteristics of loads in not envisaged.

1.7 The Engine shall be capable to minimum 60% bulk load of the rating during transfer of the load from NO Load position without tripping.

SYSTEM OPERATION

The set may be idle for a long time except for periodical test whenever there is a electrical supply failure, the set may required to run continuously for period even exceeding 24 hours.

SYSTEM FEATURE

The entire work shall confirm to Bureau of Indian Standards safety standards; British Standards, and C.P.W.D. specifications.

DETAILS OF ENGINE/ALTERNATOR

Scope

The scope of this section covers general requirement for reciprocating diesel engine and alternator complete with drive, safety controls, lubricating system, cooling system, instruments etc., including erection, testing and successful commissioning on load.

Diesel Engine

Diesel engine shall be multi-cylinder, 1500 RPM reciprocating, 4-stroke internal combustion conforming to BS 649 and shall be of welded construction or of fine grain cast iron. The crank case shall be of iron alloy, casting, crank shaft shall be of high tensile forging corresponding to medium carbon steel of 1045 (AISI) grade, Main B.E bearing shall be of high grade bearing material, connecting rod shall be of 1 beam high grade of drop forged steel corresponding to carbon steel of 1139 grade, cylinder liner shall be wet type cast alloy iron with specially machined groomed in the bores to serve as oil retaining surfaces, piston shall be of low expansion aluminium alloy with machined surfaces.

The engine shall be equipped with all required standard accessories:

- Fly wheel & housing
- Oil bath air cleaner
- Exhaust turbo charger & after coolers as called for.
- Flexible coupling and coupling guard
- Flexible connection between heat Exchanger and water pipe.
- Lubricating pump and fuel injection pump
- Nozzles

Electronic / hydraulic Governor as called for in BOQ.

- Oil pressure gauge and water temp gauge
- Fuel filter, fuel tank and fuel lines
- Turbo charged aspiration
- Water-cooled radiator/ Heat Exchanger as called for in BoQ.

12 cylinders or as required.

Other fittings as recommended by the manufacturer.

The lubricating system shall be positive pressure type for all moving parts. No moving parts shall require lubricating by hand, either prior to starting or while in operation.

The lubricating system shall consist of following major components.

- Oil pan
- Oil pump
- Oil filter
- Oil pipe/hose
- Oil cooler
- Piston cooling nozzle
- Oil temperature & gauge
- Oil pressure gauge
- By-pass filters.

Lubricating oil filter shall be provided for operation of 500 hour without any necessity of replacement or cleaning.

The engine shall be water cooled with Heat Exchanger. All standard accessories like inlet, outlet connection, fuel connection, drain plug etc. shall be provided.

Engines shall be suitable for running at 1500 RPM the speed of the engine shall be controlled by means of a governor which may sense the actual speed and make adjustment to the fuel system when required. The speed governing system shall be Class A hydraulic type as per BS 649. The maximum change in speed of engine shall be not more than 10% or 4% when the full load is either taken off or thrown ON temporary or permanently as the case may be. The engine/alternator set shall be able to attain the steady speed within a time period of 3 seconds from the time load change takes place.

Engine Starting

The engine shall be self starting type. The starter motor shall conform to BS-2613-1970. Time required for starting of engine from cold conditions shall be 10-20 secs maximum.

Fuel Tanks

Fuel tank(s) shall be fabricated from 3 mm thick MS sheet and of 990 litres capacity. Fuel lines shall be of MS "C" class welded pipe & standard hose pipes. The fuel tank shall have all standard fittings like outlet, fuel return, drain & vent connection. The fuel tank shall also level indicator so as to indicate the quantity of fuel present in litres with calibration chart.

It shall be provided with high & low level switches having potential free contacts for annunciation and also for auto control of fuel oil pump.

Exhaust System

Industrial type Air intake filter shall be provided in the turbo charger assembly of the engine unit. The exhaust system shall consist of turbo charger with clad pipe inter connecting it with the cylinder head inlet. The exhaust manifold shall be suitably lagged and covered as well. The exhaust pipe shall discharge the exhaustible smoke at the top of the building.

The exhaust system, which carries away the products of combustion from the engine to the atmosphere, shall be such as to restrict the backpressure within prescribed limit (below 75 mm of Hg) to ensure proper engine operation. The exhaust system shall consist exhaust pipe, flexible pipe of minimum 30 cm length, and exhaust noise suppressor silencer, and catalytic converter.

The silencer shall be of hospital type, which can provide suppression in noise as per specifications. A test certificate to this effect shall be furnished.

The exhaust piping system shall have a provision of condensate trap with drain plug valves. Exhaust piping shall be insulated with a layer of 75 mm dia glass wool with aluminium cladding rope to minimize the heat radiated to the room.

DETAILS OF D.G.SET

Engine Instrumentation on Engine

- Speedometer with time totalizer.
- Lub oil pressure gauge.
- Lub oil temperature gauge.
- Cooling water temperature gauge.
- Battery Charger (Separate).
- Starting switch with key.
- Over speed relays.
- Run/Idle toggle switch

Alarms/Trip (Audio and Visual)

- Over speed.
- High Cooling water temperature.
- Low lub oil pressure.

Alternator

Screen protected, drip proof, 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 p.f., 1500 RPM, self regulated, class H insulation, brushless alternator; continuous rating as per relevant Indian Standards, A removable gland plate shall be provided for the cables. Also an automatic voltage regulator at 415 Volts $\pm 2.5\%$ shall be provided. Enclosure shall be as per IP-23.

Rated voltage shall be 415 V suitable for 50° ambient temperature and overload capacity shall be 10% for one hour during 24 hours continuous running must have droop characteristics and others for synchronizing system and fine adjustment of voltages.

Exciter

Self excited, self regulated, providing alternator output regulation at plus or minus 2.5%, from no load to full load along P.F. between unity to 0.8 lagging, with 4% speed variable, of the engine. Solid state excitation system is preferred.

BATTERY CHARGING EQUIPMENT

Battery charging equipment should be incorporated in the generator control panel and shall comprise of:

- AC and DC "ON" and "OFF" switches with HRC fuses.
- Indicating lamps for indicating mains "ON" and battery charging.
- Ballast to give charging.
- Single phase double wound (copper conductor) impregnated natural air cooled mains transformer for rectifier stock.
- Rotary switch to give step control.
- Single phase full wave bridge connected silicon rectifier stack.
- Moving coil ammeter to indicate charging current.
- Moving coil Voltmeter with a selector switch to measure the battery/charger voltage.
- Silicon blocking diodes connected to a suitable tap to maintain continuity of DC supply. Trickle and boost arrangement must be there.
- AC and DC contactors of suitable rating as required

SPECIFICATION OF MATERIALS

Exhaust Silencer Piping

The exhaust silencer piping system shall be of heavy duty MS pipes confirming to Class C. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. MS screwed flanges and bends shall be used as per site requirements.

Exhaust pipe inside the building shall be lagged with 75 mm dia glass wool with aluminium cladding and suitably bonded with asbestos cloth.

Water Piping and Oil Piping

Water Piping shall be of C class MS pipe. Oil piping shall be of MS or braided flexible type only. Cooling water and oil piping shall be tested in accordance with ASA-B

31.1 pressure piping code. Wiring

All the wiring outside the panel shall be drawn to 16 gauge MS conduits.

The minimum size of wires outside the panel shall be 2.5 sq. mm stranded copper conductor.

The minimum size of control cables inside the panel shall be 1.5 sq. mm stranded copper conductor.

All the wires and cables suitable for 650/1100 Volts. As per IS-694-1990 latest amendment.

INSTALLATION OF GENERATING SET

The engine and alternator shall be mounted on specially designed common MS base plate and frame of extremely rigid welded construction, so as to provide no deflection.

The engine/alternator set shall be installed over the Dunlop-make, S-type anti-vibration cushy base in order to isolate the transmission of vibrations to the floor or building structures.

The exhaust system shall be designed and installed in such a manner that it avoids excessive stresses on the exhaust manifold of turbocharger, washing spray or any other source.

The exhaust pipe shall pass through an oversized collar, filled with glass wool when crossing floor/wall.

All exposed metal parts shall be suitably painted to prohibit corrosion under the climatic conditions at site.

The installation of fuel piping, power distribution and control panels shall be carried out in accordance with the specification of respective items.

PRELIMINARY TRIALS

After completion of erection of generating sets and before carrying out main trials, preliminary trials shall be conducted in the presence of the Engineer-In-Charge and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies

as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 15% shall be allowed on the fuel oil consumption to cover possible errors of measurement.

Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in BS: 639. Alternator insulation resistance and commutation check shall be as per BS 2613/BS 5000. Starting time of sets shall be tested at least five times the sufficient time integral to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment has to be checked. A further reasonable trial as suggested by the CLIENT shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to Engineer-In-Charge. The successful bidder has to submit a list of recommended spares to CLIENT for purchasing the same. A set of tools and tackles has to be supplied alongwith each set. List of recommended spares shall be indicated to CLIENT.

DAY SERVICE TANK

Day service tank shall be of 3mm thick MS sheet fuel oil storage tank of capacity 990 litres or OEM Vendor specification for each set with all accessories such as oil level indicator, inlet pipe connection. Outlet pipe connection, with gun metal valve through to collect split oil, air vent pipe, manhole with cover, low level and full level float valve arrangements and interconnections between tanks and painting. The tank shall be provided with Suitable calibration scale. The tank shall be fabricated from 3mm thick MS sheet.

FOUNDATION

Foundation shall be casted as per the recommendations of the manufacturer in consultation with the Supplier and as per the requirements of the site. The successful bidder shall submit detailed foundation drawings within 7 days of award of work.

PAINTING

The Contractor shall paint all exposed metal parts and equipment supplied by him. All sheet metal work shall undergo a process of phosphating, passivating and then sprayed with high corrosion treatment of two coats of synthetic enamel paint of approved colour. All piping shall be colour coded.

5.0 VOLTS DC BATTERIES & BATTERY CHARGER

Lead acid type batteries, 2 x 12V - 25 plates: 180AH as required conforming to IS shall be provided for each set for starting purposes as per requirements. These batteries shall be fitted with electrolyte (specific gravity 1.280) and initially charged, discharged and recharged and placed in suitable enclosure, in ready to use shape.

SHOCK TREATMENT CHART

Shock treatment chart explaining the method of shock treatment in English, Hindi and local language shall be provided dully framed in glass in the diesel generating station.

WIRING

Providing conduits and drawing wires for the following: -

- Control wiring between diesel generating set and the automatic mains failure panel.
- All wiring associated with the fuel oil transfer pump and including level controllers and circulating water pumps.
- All wiring associated with DC supply.
- All earthing conductors associated with this installation.
- All wiring and cables shall be PVC insulated stranded copper conductor wires and cables suitable for 660/1100 volts minimum size of wires for control wiring shall be

2.5 sq. mm and minimum size of wire for pumps shall be 4 sq.mm. The wires would be as per IS.

CABLES

MV cables shall be XLPE aluminium conductor armoured cables, laid in trenches between diesel generating set and DG panel. All power & control cables will be rated for

1.1 KV grade. Storing, laying, jointing procedures as same as that for the LT cables stated elsewhere.

TEST PERFORMANCE

Scope

This section lay down the procedure for conducting test on the installation. In general the procedure laid down here shall be followed. However, if manufacturer of the equipment has prescribed different procedure which is at variance, the same may be adopted. All required artificial load, testing equipment other required material required for testing purpose shall be supplied by agency.

Physical Test

- Particulars such as name plate details of all major component equipment shall be recorded and compared with what has been offered by the contractor as per agreement.
- Level of foundation.
- Firmness of mounting.
- Verticality of installed set.
- Tightness of nuts & bolts.
- Proper installation of exhaust pipe.
- Insulation of exhaust pipe with 75 mm dia glass wool with aluminium cladding.
- Provision of guard on engine/alternator set coupling joints.
- Termination of various cables.
- Rating of various fuses.
- Termination of earth leads on neutral & body.

Earth Resistance

The resistance shall be measured by isolating the connecting earth lead in respect of all earth stations.

Run Test

The engine shall be given a test run continuously for at least six hours with alternator supplying full rated load. During this run following observation shall be recorded.

1. Lubricating oil pressure
2. Exhaust gas colour
3. Speed engine
4. Output voltage
5. Load current
6. Load (KW)
7. Noise Level (DB)



Stator Temperature Rise Test

The alternator shall be loaded of full rated load and stator (alternator) body temperature be recorded as under at intervals of 30 minutes till such time that there consecutive readings are the same.

S.No.	TIME	AMBIENT TEMP	STATOR TEMP
(Hr)		(°C)	(°C)

a. The temperature rise shall be maintained within 60°C above the ambient. Fuel Consumption Test

Fuel consumption for half an hour shall be measured after the full load operation condition have stabilized.

During this measurement the load shall be maintained unchanged.

The fuel consumption shall be compared with values given in the technical particulars.

Over Load

Over load test to the extent of 10% over the rated load shall be conducted immediately after the full load run test.

The various parameters as in the case of run test shall regularly be monitored and recorded.

After the over load test, the load shall be normalized to rated value and all parameters recorded.

Insulation Test

Insulation test shall be conducted after testing the engine/alternator set at overload.

The insulation resistance between the starter coil and from shall be measure with 5000 volts meggar.

The insulation resistance of alternator winding shall be not below: Rated output voltage + 1 Mega Ohms

1000 + Rated output in KVA

Insulation resistance of control wiring with 500 volts meggar shall be measure, which shall not be less than one mega ohms.

Regulation Test

The voltage regulation from no load to full rated load at 0.8 p.f. and from no load to half the rated load at 0.8 p.f. shall be measured between phase & neutral under automatic and manual regulation mode, which shall not exceed 0.5% of the nominal rated output voltage.

In automatic regulation mode, the recovery line shall be noted which shall not exceed 3 seconds.



- The frequency of output supply of various load conditions shall be noted and recorded.
- The variation shall be compared with the accuracy standards specified.
- Change in speed of engine with change in load shall be observed and compared with standard reading for the speed governor.

Data Sheet:

Vendors shall fill in the performance data in the block columns of the attached Data sheets.

6.0 ACCOUSTIC ENCLOSURE

Construction Details

The Structure is fabricated using CRCA sheets of 14/16 SWG Thickness and steel members. The enclosure is fabricated on a MS Channel Frame work further strengthened by suitable cross members to make it robust and sturdy. Rock wool / Mineral wool of suitable thickness and density conforming to IS 8183 is used for acoustic insulation to reduce the sound level to 68 – 70 d b from the original sound level of 105 – 110 d b, when measured at 1mtr.distance from the D.G. Set. The acoustic enclosure consists of following:

a) Acoustic Insulation :

High density Fireproof Acoustic Enclosure Material i.e. resin bonded rock wool / fiber glass wool (75 – 100mm thick of 64Kg/m³ density) conforming to IS:8183 is provided on all doors and roof to absorb noise. The insulation material used is fire retardant. The insulation is covered with fiber glass cloth and is supported by perforated sheet. Sound attenuators / down stream silencers are provided at all openings for air inlet/outlet to facilitate free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions are provided inside the enclosure to attain further noise attenuation of the engine.

b) Noise Suppressor :

A suitably designed absorption type Hospital noise suppressor is provided which minimize the exhaust noise of the engine.

c) Exhaust System :

The exhaust gas is taken out through a specially designed flexible pipe, which prevents any back pressure on the engine.

d) Thermal Insulation :

The exhaust system and noise suppressor is provided thermal insulation by using glass wool & covering it with Aluminum sheet. This prevents it from radiating excess heat on the engine, makes it safe for the operator and enhances aesthetics.

e) Surface Treatment :

The enclosure is surface treated and painted with high quality polyurethane epoxy paint with prior zinc oxide primer base, which makes it weather proof and suitable for outdoor application. The paint is highly resistant to acids, alkaline, salt sprays, halogens, solvents,

lubricants etc and has very good dielectric properties and is resistant to abrasion and cracking.

f) Air Circulation & Ventilation System:

A suitable forced air circulation and ventilation system is designed to maintain safe operating temperatures inside the enclosure. Requisite air circulation for engine aspiration combustion and cooling is provided by means of Exhaust fans or tube axial fan driven by a 3 phase squirrel cage induction motor according to need of engine.

g) Vibration Isolation:

The engine and alternator is mounted on Anti-Vibration Mounting pads to eliminate engine vibration.

h) Hardware:

Inlet and Outlet for cable, draining of lube oil and diesel etc. are provided. The doors are gasketed with high quality EPDM gaskets to avoid leakage of sound. All doors are lockable.

i) Testing / R&D:

The Gen set shall be thoroughly tested on load before it is dispatched from factory.

Technical Data Sheet Diesel Generator (Alternator) 200 KVA (As per BOQ)		Name of the Project:	
		Date:	
S.No.	Item	Data	
1	Serial		
2	Type		
3	Make		
4	Voltage, Phase, Frequency	415V, 3PHASE, 50Hz	
5	Normal Continuous Rating	KVA as per BOQ	
6	Starting KVA	(PLEASE SPECIFY)	
7	Manufacturer		
8	MAXIMUM VALUE OF MOTORLOAD WHICH DOES NOT AFFECT STARTING	(PLEASE SPECIFY-minm. 60%)	
9	Power Factor	0.8	
10	Class of insulation	H	
11	Efficiency & losses at 0.8 p.f. and	AS REQUIRED / PER IS. Actual	
a)	1/4th Full load		
b)	1/2 th Full load		
c)	3/4 Full load		
d)	full load		
12	OVERLOAD CAPACITY	10%	
13	Build up time for voltage from no load to full load	20sec Maximum	
14	NO. of hours alternator can be run with no increase in temp under 10% over load	2 hrs Minimum	
Prepared by:		Name :	Date:

SECTION 4 : L.T. PANELS & SWITCHGEARS GENERAL

Technical specifications and make of materials should be get approved before the procurement of the materials. All panels / equipments approval shall be taken in the form of GA Diagrams before fabrication.

PERFORMANCE TEST

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.

The contractor shall consider the following details in their scope of works no additional cost shall be paid, wherever required:

- Supporting rigid steel framework.
- Cubicle type, 14 gauge CRCA sheet steel enclosed.
- Complete with interconnections and distribution bus bars.
- Proper bonding to earth.
- Painting/ lettering on Breakers and distribution boards, the location they serve, providing on each panel its circuit diagram.
- Providing cable clamps / supports within distribution boards cable alley.
- TPN ACB's / MCCB's shall mean 3 pole ACB's / MCCB's with adequate size of neutral link.
- All MCB's /MCCB shall be of minimum KA breaking capacity as per CPWD General Specification Part-IV Substation
- All motor feeders MCCBs shall be of motor duty.
- Distribution panels shall be Powder Coated with Siemens gray paint shade no. RAL-7032 of IS-5 or as per direction of EIC.
- Degree of protection for following type of distribution panel enclosure shall be as per IS: 13947-1993.
- All MCCB's shall be provided with operating mechanism for door interlock.
- Bus bars shall be of sufficient cross-section so that a current density of 130A/sq.cm (800A/sq.inch) is not exceeded at nominal current rating for aluminium bus bars, and 160A/sq.cm (1000A/sq.inch) for copper bus bars.
- Tinned copper earth bus shall be provided through out the length of each board.
- All measuring instruments (Meters) shall be of digital electronic with LED of approved make and compatible with BAS.
- All hinged door shall be earthed through 2.5 sq mm tinned braided copper wire.
- All panels shall have provision of the following:
 - Pad locking of Switch board doors.
 - Pad locking of MCCB's handles in "OFF" Position.
- Additional set of C.T.s, potential free contacts, connectors, contactors with wiring etc are to be provided for BAS including space required for various transducers in Main Switch Board sections. Only transducers shall be supplied by BAS contractor.
- All MCB's used for protection of resistive and lightly inductive load shall be type "B" characteristic and inductive (motor) load shall be of type "C" characteristic and discharge lamps and UPS etc. shall be of type D characteristic.
- All incoming and outgoing air circuit breakers shall be placed on middle portion of the vertical in single tier formation.
- All PTs / control transformer shall be provided with centre tap earth secondary.

- All DOL & Star-Delta Starters shall be provided with SPPR (single phase preventor relay) and 2 nos. of Aux. Contacts for Remote operation/monitor.
- The Panel fabricator shall provide Al./ Copper Bus-bars link from Breakers wherever more than two nos. of cables are terminated in the breakers.
- Readymade 16SWG Sheet steel Enclosure with cut out For MCBs
- The breaking capacity of MCCB's are mentioned panel wise. All MCCB's shall be with thermal magnetic releases upto 200 amps and micro processor based above 200 amps capacity, unless specified otherwise.

Medium voltage switch boards/distribution boards, the combination of both these and components shall conform to the equipments of the latest revision including amendments of the following codes and standards.

The drawings, specification and BOQ complement each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly of switch gear as shown on the drawing, specifications shall be construed as being required and no extra charges shall be payable on this account.

CODES & STANDARDS

The design, manufacture and performance of equipment shall comply with all the currently applicable statues, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Duto Technical Commission (IEC) Publication, NEMA, IDE & DEMA standard as amended upto date.

- IS: 13947- 1993/IEC 60947-1989: Air circuit breaker/moulded case circuit breaker.
- IS:3156 Voltage transformers.
- IS:2705 Current transformers for metering and protection with classification
- Part-I, II burden and insulation & III 1964
- IS:9224 Low voltage fuse and protection.
- IS:3231 Specification for electrical relays for power system protection.
- IS:8623 Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000-V AC/1200 V-DC.
- IS:4237 General requirements for switch gear and control gear for voltage not exceeding gear.
- IS:2147 Degree of protection provided by enclosures for low voltage switch gear and control gear.
- IS:1018 Switchgear and control gear selection/installation and maintenance.
- IS:1248 Direct acting electrical indicating instruments.
- IS:375 Arrangement for switchgear, bus bars, main connections, auxiliary wiring and marking.
- IS:2959 AC contactors for voltage not exceeding 1000V.
- IS:5578 Guide for marking of insulated conductors.
- IS:11050 Guide for forming system of marking and identification of conductors
- & apparatus terminal.
- IS:1248 Direct acting indicating analogue electrical measuring instruments and Testing accessories.
- IS:600 Code of practice for phosphating of iron & steel.

The board shall be metal enclosed single front, indoor, floor mounted, free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-55. However bus bar chamber shall have IP: 42 degree of protection

incase bus bar rating exceed 1600 Amps. Keeping in view the operating height of the top switch 1750mm from finish floor. 400mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 50mm height.

All cutouts and covers shall be provided with synthetic rubber gaskets (preferably neoprene).

The panel shall be divided into distinct vertical sections each comprising of:

- i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.
- ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.
- iii) Compartment for power and control cables of at least 300mm width covering entire height provided.
- iv) The panel shall have sufficient space at least 20% of outgoing feeders for future use. The front of each compartment shall be provided with hinged single leaf door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and MCCB/ACBs and accessories shall be of fixed/ draw out type as per BOQ.

Each feeder shall have compartmentalized or non-compartmentalized for MCB feeders only. Ri-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate with suitable numbers & sizes of knockout holes (as called for in schematic/ fabrication drawings) shall be provided.

The panel shall be provided with three phase buses & neutral bus bars of high conductivity electrolytic copper/Aluminium sections throughout the length of the panel & shall be adequately supported and braced to withstand the stressed due to the short circuit current of 35 KA rms. for 1 sec. as called for in BOQ/Data Sheet. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C. Bus bars shall be of sufficient cross-section so that a current density of 130A/sq.cm (800A/sq.inch) is not exceeded at nominal current rating for aluminium bus bars, and 160A/sq.cm (1000A/sq.inch) for copper bus bars.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 32mm minimum. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fiberglass moulded material.

All bus bars shall be colour coded as per IS: 375.

Copper /G.I./Aluminium earth bus of suitable size shall be provided at the bottom of the panel throughout the length. Similarly suitable size of strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel when MCCB is on position. Safety interlock with operating handle shall be provided.

Contactors shall be electromagnetic type with interrupted duty as per IS: 2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS: 6875 (Part-II).

General Note for ACBs/MCCBs/MCBs

Preferred Specification/Selection of Air Circuit Breaker and Moulded Case Circuit Breakers;

These should be confirmed entering into the agreements:-

- (I) MCCBs: MCCBs should preferably be used for loads below 800 Amperes.
- (1) Upto 160 A MCCBs shall be of $> 20 \text{ Ka}$ ($I_{cs}=I_{cu}$) at 433 V Short Ckt. Current rating and should be Thermal Magnetic.
- (2) From 200 A- 250 A MCCBs shall be of $> 35 \text{ Ka}$ ($I_{cs}= I_{cu}$) at 433 V Short Ckt. Current rating and should be Thermal Magnetic.

- (3) From 300A0 onwards MCCBs shall be of $> 50 \text{ Ka}$ ($I_{cs}=I_{cu}$) at 433 V Short Ckt.

Current rating and should be microprocessor based having over load and short circuit protection. If used as incomer should also have earth fault protection & time delay. Earth leakage modules are not acceptable.

- (II) ACBs: From 800 A onwards ACBs shall normally (MCCBs should be used judiciously for such loads) be used. These should have 50 Ka ($I_{cu}=I_{cs}$). Short Ckt. Current rating with microprocessor based overload, short circuit and earth fault protection at 415 volts, 50 Hz ACB (IEC 60947-2; IS 13947)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IEC with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value $I_{cs} = I_{cu}$). The breaker shall be provided with variable microprocessor based releases within built fault differentiation for integral over load, short circuit and earth fault & other protection as called for in BOQ, LED indication for type of fault, CT's for protection and measurement class as called for in BOQ, and LCD display of curves and parameters. Electrical endurance without maintenance shall be greater than 2000 cycles.

Mechanical & electrical anti pumping devices shall be provided in breaker, as required.

The breaker shall have memory for logging history for type of fault, load, time & date and the Vendor shall mention in the data sheet for no. of loggings available in the breaker memory.

The breaker shall consist of a horizontal draw out pattern triple/four pole, fully interlocked, independent manual/motorized spring operated mechanism. The mechanism should be such that the circuit breaker is at all times free to open immediately. The trip coil is energized. Current carrying parts should be silver plated and suitable arcing contacts shall be provided to protect the main contact arc-chutes for each pole shall be provided and shall be lifted out for the inspection of main and arching contact.



Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct positions - SERVICE/TEST/ISOLATED within the cubicle.

The ACB shall be with molded housing class II front fuse and shall be suitable for Isolation as per the annexure 7.1.2 in the standard.

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

- i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
- ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.
- iii) Interlock to prevent the breaker being closed unless it is fully raised.
- iv) Interlock to prevent the breaker from being made alive without its rack in position.

Protection Releases

Self-powered & true RMS sensing microprocessor based release with following features.

a) **Incomer ACB of Panels:**

Long time short circuit protection with time delay. Instantaneous and earth fault protection with LCD display to show RMS current in all three phases, neutral (for 4pole) simultaneously. The other features of the release to be as under.

- The release should display distinct fault indication for each type of tripping for faster fault diagnosis and reduce down time & should protect ACB from over temperature and Phase unbalance.
- Release should provide contact wear indication in display no. of operation seen by the breaker for case of maintenance.
- The release shall be self-diagnosis & should provide fault history including cause of fault as well as level of fault current. It should be possible to store minimum 20 last trip data with nonvolatile memory.
- The protection setting of release should be accessible to change locally.
- LCD display should be at least 4 line display and should be able to display current in all the 3 phases and neutral (4 pole) simultaneously.

b) **For Outgoing ACB feeder:**

Long time Short circuit protection with time delay (for discrimination), instantaneous. The other features of the release to be as under.



The release should have distinct fault indication for each type of tripping for faster fault diagnosis and reduced down time and shall protect ACB from over temperature and phase unbalance.

- Operation counter
- Alarm and warning indication

Type test certificate : The ACB's shall be type tested and certified for coupling is to IS 13947/equivalent / EC standard from Indian / International testing authority, supplier to submit certificate of the same.

MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall confirm to the latest IS13947-1993/IEC 60947. The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as specified.

MCCB shall be Current Limiting and comprise of Quick Make – Quick Break switching mechanism & Double Break Contact system. The arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating molded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload short circuit and earth fault adjustment with thermo- magnetic releases upto 250A and with electronic release above 250A onwards.

The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as called for in BOQ and is the required minimum value for that feeders/ panel, however if the rating of feeder mentioned is not available, the contractor shall used next higher rating without any extra charges. The service short circuit breaking capacity shall be equal to ultimate breaking capacity of MCCB, i.e. $I_{cs} = 100\% I_{cu}$

The trip command shall over ride all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination upto the full short circuit capacity of downstream MCCB. The

manufacturer shall provide both the discrimination tables and let thru' energy curves. The MCCB shall not be restricted to Line/Load connections.

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of

4 pole MCCB the neutral shall be defined and capable of offering protection upto full rating. The remote tripping coil should be of continuous duty. The general-purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

The switch shall be normally a fixed control box type heavy-duty unit.

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The color of the lamp cover shall be red for

'ON' and green for 'OFF' indicating lamps shall be provided with series resistor. MCCB

shall be provided with interlocking devise for interlocking the door of switchboard. Following shall be included if specified in the drawing or in the schedule of quantities:

- o Under voltage trip



- o Shunt trip
- o Alarm Switch
- o Auxiliary switch

CONTACTORS

The contactors should comply with the latest IEC947-4 and the corresponding IS13947-4 standards. They shall have UL and CSA approval. The contactors should be rated for AC3 duty at 415V and 50Hz. The contacts should be fast closing and fast opening type. The making and breaking capacity values of the contactors should be as follows (as per IEC947-4):

For AC3 Duty

- Making Capacity equal to or more than 10 le
- Breaking Capacity equal to or more than 8 le

For AC4 Duty

- Making Capacity equal to or more than 12 le
- Breaking Capacity equal to or more than 10 le

The contactors should be capable of frequent switching and should operate without derating at 600C for AC3 applications. They should be climate proof as standard. The coil of the contactor should have class H insulation to support frequent switching.

The rated voltage of the contactor shall be equal or superior at 690 V, and rated insulation voltage shall be 690 V. The rated impulse voltage of the contactor should be 8 KV.

The contactor should be modular in design with minimum inventory requirements and built in mechanically interlocked 1NO 1NC auxiliary contact up to 32A. They should be suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors. The contactors from

4 KW to 400 KW will be associated with the same auxiliary contact block range.

Wherever D.C control is required, the contactor should have wide range (0.7 to 1.25Uc) D.C coil with built in interference suppression as standard.

The control and power terminals should be at separate layers preferably with colour coding (black for power and white for control)

All contactors power connection will be finger safe (IP2X) as standard.

They should be capable of being integrated into automated system (PLCs etc.) without any interposing components in minimum operating conditions.

The thermal over load relay if used will be directly mounting under the contactor without any specific connections.

NAME PLATES & LABELS

- i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

ii) All nameplates shall be of non-rusting metal or 3-ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to CLIENT's approval.

iii) Suitable stencilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker labels. These labels shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

PAINTING

All steel work shall be pretreated in tanks and finally powder coated of approved shade.

WIRING

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 1.5 / 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.

Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or spliced between terminal points.

Terminal blocks shall preferably be grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

TESTING & INSPECTION

After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in presence of Purchaser's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

- i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.
- ii) Test for protective relay operation by primary or secondary injection method.
- iii) Operation of all meters.
- iv) Secondary wiring continuity test.
- v) Insulation test with 1000 Volts megger, before and after voltage test.
- vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)
- vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.
- viii) Measurement of power required for closing/trip coil of the breaker.
- ix) Pick up and drop out voltages for shunt trip and closing coils.
- x) CT Polarity test.



Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out alongwith copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switchboards.

DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

- i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.
- ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.
- iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.
- iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.
- v) Relay wiring diagrams.
- vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

- i) Technical literature giving complete information of the equipment.
- ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.
- iii) A comprehensive spare parts catalogue.

TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools with his quotation.

SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

QUALITY ASSURANCE



Quality Assurance shall follow the requirements of CLIENT as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

DEVIATIONS

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.



SECTION 5 : HT CABLES AND LT CABLES

H.T. CABLE (XLPE) (33 KV & 11 KV)

The cross-linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armored over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1977 and (Part-II) 1973. The screening shall be done on individual cover. The armoring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 33 KV (E) below the ground level in a trench 450mm wide.

Insulation tests shall be done before and after laying of cables.

After laying and jointing work is completed a high POT test shall be performed in presence of Engineer and test results submitted for approval in order to ensure that they have not been damaged during or after the laying operation. In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost.

L.T. CABLES & WIRE

a) Wires

The design manufacture, testing and supply of single core LEAD FREE FRLS PVC insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.

IS: 5831 PVC insulation and sheath of electric cables.

IS : 694 PVC insulated cables for working voltage upto and including 1100 volts.
IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth. Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

The material & insulation of wires shall be ROHS compliant (Reduction Of Hazardous Substance) and shall comply the following directives:

- EU Directive 2002/95/EC Issued Jan 2003
- EU Directive 94/62/EC and 2004/12/EC (amendment)
- EU Directive 91/338/EEC
- EU Directive 91/157/EEC & 98/101/EC (amendment)

Summary on related directives

Directive Ref.	Date	Objective	Remarks
2002/95/EC	27Jan03	Restriction of the use of certain hazardous	6 banned materials included Pb (Lead), Hg (mercury), Cr6+
		substances in electrical and electronic equipment (EEE) and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste EEE.	(Hexavalent Chromium), Cd (Cadmium) and Flame Retardants- Polybrominated Biphenyls – PBB 1000ppm & Polybrominated Diphenyls Esters- PBDE 1000ppm. • Max. conc. value - 0.1% by weight in homogeneous material for Pb, Hg, Cr6+, PBB/ PBDE • Max. conc. value - 0.01% weight in homogenous material for Cd.
94/62/EC 2004/12/EC (amendment)	20Dec94 2Nov04	Amending directive 94/62/EC, on Packaging and Packaging Waste is to prevent packaging waste by encouraging packaging re-use and recycling while at the same time avoid distortions in the internal market.	The targets defined are the following: • Recovery of minimum 60% by weight • of the packaging waste Recycling of at least 55% and a maximum 80% by weight of the totally of packaging materials, with a material-specific minimum recycling rate for plastic of 22.5%
91/338/EEC	18Jun91	Restriction on the use of Cadmium pigment (amending for the 10th time Directive 76/769/EEC)	The cadmium content (expressed as Cd metal) exceeds 0,01 % by mass is prohibited in the finished products or components of products manufactured from polymers or copolymers of vinyl chloride and stabilized by substances.



b) Cables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

IS: 8130 Conductors for insulated electric cables and flexible cords. IS: 7098 XLPE insulation and sheath of electric cables.

IS: 3975 Mild steel wires, strips and tapes for armoring cables. IS: 7098 Current rating of cables.

IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.

IS: 424-1475(F-3) Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.

IEEE : 383 Standard for type of test Class-IE, Electric cables, field splicers and connections for power generation station.

ASTME:662IEC:754(x) Standard test method for specific optical density of smoke generated by solid materials.

IS : 10418 Cable drums.

c) Technical Requirements:

i. The cables shall be suitable for laying in racks, ducts, trenches conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

ii. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.

iii. The aluminium/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformly good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.

iv. The cable should withstand 25 KA for 0.5 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration.

v. The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.

- vi. Progressive automatic in line indelible, legible and sequential marking of the length of the cable in metres at every one metres shall be provided on the outer sheath of all cables and at every 5 metre 'FRLS' marking in case of 'FRLS' cables.
 - vii. Strip/Wire armouring following method (b) mentioned in IS: 3975 shall only be acceptable. For single core cable aluminium wire armouring shall be used.
 - viii. Allowable tolerance on the overall diameter of the cables shall be + 2mm.
 - ix. The normal current rating of all XLPE insulated cables shall be as per IS: 7098.
 - x. A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and unarmoured cables as per IS: 5831.
 - xi. Outer sheath shall be provided by extrusion process as per IS: 5831
 - xii. The breaking load of armour joint shall not be less than 95% of that armour wire.
- Zinc rich paint shall be applied on armoured joint surface. xiii. In plant repairs to the cables shall not be accepted.
- xiv. All the cables shall be supplied in non-returnable drums as per IS: 10418.

d) In Case of FRLS Cables

- i) The outer sheath of cables shall have an oxygen index of not less than 29 as per ASIMD: 2863.
- ii) The maximum acid gas generation by weight as per IEC: 754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.
- iii) The cables outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ISTMD: 2843). In case the test for light transmission is conducted as per ASTM: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTM: 2843.
- iv) The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383.

e) Inspection:

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

f) Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, and the location of such joints shall be got approved from the CLIENT/CLIENT. The joints shall be done by qualified jointer strictly in accordance with manufacturer's instruction/drawings.

g) Joint Boxes for Cables



The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

h) Jointing of Cables

All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy-duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardware shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminium solderless crimping type conforming to IS: 8309 suitable for aluminium or copper conductor.

Crimping of terminals shall be done by using Corrosion inhibitory compound, with crimping tool.

Fire resistant paint has to be applied 1 Metre on either side of cable joint.

The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the CLIENT.

i) Testing of Cables

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

i) Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of Engineer-in-charge/CLIENT/PMC.

ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

iii) Continuity resistance test.

iv) Sheathing continuity test.

v) Earth test.

j) Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes in directions in horizontal & vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.



The cable of 1.1KV grade shall be laid not less than 750mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable curvature shall be i.e. either 12 times the diameter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming

'Kinks'. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. All around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion are provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. Over the outer sides of the end cables.

Filling of trenches shall be done after the sand cushioning and laying of tiles or bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

GI / Hume pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters & with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) in side the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a

steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack

shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed & clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Engineer-in-charges/Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

k) Fire Seal System

i) All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.

ii) The fire proof sealing system shall fully comply with the requirements of relevant IS/BS: 476 Part-B. The fireproof seal system shall have minimum one hour fire resistance rating.

iii) The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry concrete members. The system shall be completely gas and smoke tight, antirodent and anti-termite.

iv) The material used in fireproof seal system shall be non-toxic and harmless to the working personnel.

v) Type of fireproof seal system shall be foaming type or flamemastic type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester In case the test results are unsatisfactory the cost of repairs and replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed. HV Cable (11 KV/ 33 KV) - HV Cable (11 KV/ 33 KV) 50 mm

ELV & LV 230 V/433 V - ELV & LV cable 230 V/433 V Equal to the diameter of the bigger cable.



HV cables (11 KV/33 KV) - ELV & LV cables 230 V/433 V 300 mm LV cables 433 V
- Telephone/Instrument cable 350 mm All cables - All hot pipe
work 200 mm

l) Quality Assurance

Quality Assurance shall follow the requirements of CLIENT/ CLIENT as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

m) Deviations

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

n) Spares for Commissioning Including Consumables

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools and consumables. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

CABLE TRAYS

a. Ladder type Cable tray – for Power Cables only

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and flats of required width as per design. Bends shall be prefabricated. The cable tray shall be hot dip galvanized or primed and painted with powder coating as asked for in BoQ or as approved by CLIENT/ CLIENT. The minimum weight of the zinc coating shall be 460 gm/sq.m and minimum thickness of coating shall not be less than 75 microns.

b. Perforated Cable tray – for Power Cables & Low current service both

The perforated cable trays are fabricated out of 1.6mm thick CRCA sheet steel having minimum 50mm depth or as called for in BOQ, hot dip galvanized or epoxy coated of approved shade. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/ aluminium clamps/M.S. clamps as per requirements.

Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending radius for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers spaced at a distance of not more than 125cms. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps or cable ties. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the CLIENT/Engineer-in-charge before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth continuity conductor. All nuts and bolts used shall be of galvanised steel.

Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.

Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).



SECTION 6 : DISTRIBUTION BOARDS & MCBs

General

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be constructed out of steel sheet all weld enclosure with double door IP42 protection and shall be powder coated. Ample clearance between the conductors of opposite pole, between conductors and sheet steel body shall be maintained in order to obviate any chance of short circuit. Removable conduits entry or knockouts plates shall be provided at top and bottom to facilitate drilling holes at site to suit individual requirements. Also on additional/separate adopter box of suitable length and size shall be provided to accommodate wires and cables. No. of conduits etc. and nothing shall be payable on this account. The MCBs shall be mounted on high-grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solderless cable sockets for crimping. Phase separation barriers made out of arc resistant materials shall be provided between the phases. Bus bars shall be colour coded for phase identification.

Distribution boards shall be recessed in wall nitch or if required mounted on the surface of the wall with necessary clamp bolts etc. The mounting height shall not exceed 1200mm from finished floor level. Distribution board shall be provided with proper circuit identification nameplate and danger sticker/plate as per requirements.

All the distribution boards shall be provided with engraved nameplates with 'lighting', 'power' or 'UPS' with DB Nos., as the case may be. Each DB shall be provided with a circuit list giving details of each circuit. All the outgoing circuit wiring shall be provided with identification ferrules giving the circuit number & phase.

Each distribution board shall have a separate neutral connection bar and a separate earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit & cable armouring shall be bonded together & connected to the distribution board earth bar.

Where oversized cables are specified due to voltage drop problems, it shall be contractors responsibility to ensure that satisfactory terminal arrangements are provided without an extra cost.

Earth Leakage Circuit Breaker

ELCB shall be 4 pole 415 volts 50Hz, 30-300mA sensitivity. These shall be of approved make. The rating of the ELCB shall be as specified in BOQ. These shall be suitable for manual closing and opening and automatic tripping under earth fault circuit of 30- 300mA as specified in item of work. The enclosure of the ELCB shall be moulded from high quality insulating material. The material shall be fire retardent, anti-tracking, non- hygroscopic, impact resistant and shall with stand high temperature. All parts of switching mechanism shall be non-greasing, self-lubricating material so as to provide consistent and trouble free operation. Operation of ELCB shall be independent of mounting position and shall be trip free type. The RCCB shall be protected against nuisance tripping by protective device.



Miniature Circuit Breaker

1. The MCB shall be current limiting type and suitable for manual closing and opening and automatic tripping under overcurrent and short circuit. The MCB shall also be trip free type.
2. Single pole/three pole versions shall be furnished as required.
3. The MCB shall be rated for 10 KA/15 KA fault level.
4. The MCB shall be suitable for its housing in the distribution boards and shall be suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.
5. The terminal of the MCBs and the open and close conditions shall be clearly and indelibly marked.
6. The MCB shall generally conform to IS: 8828. -1996
7. The MCB shall have 20,000 electrical operation upto 63A.
8. The MCB shall have minimum power loss (Watts) as per I.S./ IEC.



INTERNAL ELECTRICAL WORKS

A. Conducting (M.S Conduit)

All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

B. PVC Conduit

All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit 2mm thick as per IS- 9537/1983 (Part-III). All sections of conduit and relevant boxes shall be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be M.S. or otherwise mentioned. Conduit shall be terminated with adopter/PVC glands as required.

Accessories

Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run. Where it is necessary to segregate wiring metal filler shall be fixed with in the box.

Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. Nothing extra shall be paid to the contractor on this account. In case of exposed brick/ rubble masonry work special care shall be taken to fix the conduit and accessories in position along with the building work. Sufficient depth of the chases will be made to accommodate the required number of conduits. The chase will be filled with cement, coarse sand mortar (1:3) and properly cured by watering for one week.

If a chase is cut in an already finished surface the contractor shall fill the chase and finish it to match the existing finish. Contractor must not cut any iron bars to fix conduits. Conduits shall be kept at a minimum distance of 100mm from the pipes of other non- electrical services. Where the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting, conduits in chases shall be held by steel hooks of approved design at maximum of 100 cm centres. The embedding of conduits in walls shall be so arranged as to allow at least 12mm plaster cover the same. All threaded joints of conduit pipes shall be treated with some approved 'preservative compound' to secure protection against rust.

Suitable expansion joints fittings of approved make and design shall be provided at all the points where the conduit crosses the expansion joint in the building. (Preferably with Pilca metallic watertight conduits). Conduits shall cross at right angles of the joints only.

Separate conduit shall be used for:

- 1) Normal light, fan call bell
- 2) 16 A power outlets
- 3) Emergency Light Point
- 4) Fire alarm System
- 5) Computer Outlets
- 6) P.A System
- 7) Telephone system
- 8) TV Network
- 9) Or any other services not mentioned here.

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc. shall be installed in flexible conduits. Flexible conduits shall be formed from a continuous length of spirally wound interlocked wire steel with a fused zinc coating on both sides. The conduit shall be provided with approved type adaptor. A separate and accessible earth connection shall bond across the flexible conduit.

Conduit runs on surfaces shall be supported with metal 1.2 mm thick saddles, which in turn are properly secured on to GI spacer to the wall or ceiling. Fixing screws shall be with round or cheese head and of rust proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building and shall be painted in color matching the adjoining area. Unseemly conduit bends and offsets shall be avoided by using better appearance. Cross cover of conduits shall be minimum and entire conduit installation shall be clean and with good appearance. For surface work, the boxes shall be raised back pattern type, designed for use with distance saddles to give clearance of 6mm between the back of conduit and the fixing surface.

Where conduits are run on steel work, they will be fixed by means of purpose made GI Caddy clips in manner meeting with the approval of the Engineer prior to the installation being carried out. Other methods of fixing may be agreed in special circumstances, but approval must first be obtained from the site engineer.

The spacing of saddles shall be not more than 600mm centers for up to 32mm diameter conduits and at 750mm for conduit sizes of 40mm diameter and above in case of MS conduit and not more than 600 mm for PVC conduit. In addition, saddles shall be fixed at each side of any bend/Tee, or set at a distance of 200mm from the bend/Tee. The holes in the brickwork or concrete for fixing plugs shall be neatly drilled by means of a masonry drill of the appropriate size.

All the GI sheet steel /passivated boxes used for housing switches, plugs, fan regulator etc. shall be five sided conforming to IS: 5133 Part I-1969. Suitable size of boxes shall be provided a minimum of 2 adjustable fixing lugs on vertical sides. Suitable earth terminal inside each box shall be provided. All fixing lugs shall be threaded to receive standard

machined chromium plated brass screws. Sufficient number of knockouts shall be provided for conduit entry. Conduits carrying wires of different circuit can terminate in common J.B having metal compartments. Necessary GI pull wires shall be inserted into the conduit for drawings wires. In case conduit pipe is required to cross any RCC beam special adopter boxes shall be provided for crossing & nothing shall be paid extra.

Where conduits are used for non-air-conditioned space to air-conditioned space or into a fan chamber or duct, a junction box shall be installed to break the continuity of such conduit at the point of entry or just outside and conduit shall be sealed around the conductors.

Particular care shall be taken during the progress of the work to prevent the ingress of dirt and rubbish such as plaster droppings into erected conduits. Conduit which has become so clogged shall be entirely freed from these accumulations or will be replaced. Screwed plastic or metal caps or turned wooden plugs shall be employed to protect all open ends. Plugs of waste wood, paper, cotton or other fibrous matter shall not be used. All unused conduit entries shall be blanked off in an approved manner and where conduits terminate in adaptable boxes, all removable box covers shall be firmly secured to provide complete enclosure. If considered necessary by the Engineer-in-charge, the conduits shall be swabbed out by drawing swabs of rag through the conduit to remove moisture prior to any cables being drawn in.

All conduit installations must be completed and erected in their totality before they are wired and must be fully rewirable from outlets to distribution boards or trunking systems etc. to which they connect. No wiring of any part of the installation shall be commenced until instructions are received to do so by the Engineer-in-charge at such time as he is satisfied that the wiring will not be damaged due to building operations.

Conduits shall be installed so that they are self-draining in the event of ingress of moisture due to condensation or any other reason. A suitable drainage hole shall be drilled at the bottom of the lowest conduit box in every 9-meter of horizontal run.

PVC bush of good quality shall be used in each conduit termination in a switch box, draw box, lighting fixtures and circular junction boxes.

Exposed conduits running above false ceilings shall be suitably clamped independently along with the dropped ceiling. Perforated straphangers or twisted attachment shall not be acceptable. In no case shall raceways be supported or fastened to other pipe for repair and maintenance. They shall be arranged symmetrically and in the most compact design, in no way unduly criss-crossing each other. Proper spacing shall be maintained when two or more conduits run side by side. The layout of the pipes shall be co-ordinated with other services if any. The junction boxes and conduits used in hazardous areas shall be flameproof type with cast iron construction complete with threaded covers. The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements by means of special approved type of earthing clamp efficiently fastened to conduit pipe in a workman like manner for a perfect continuity between the earth and conduit.

The conduit system shall be so laid out that it will obviate the use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two-quarter bends from inlet to outlet. The conduit itself being given required smooth bend with radius of bends suiting to the site conditions but not less than 6 times overall diameter.

Outlet boxes shall be of heavy-duty sheet steel installed as to maintain continuity throughout. These shall be so protected at the time of laying that no mortar finds its way inside during concrete filling or plastering. For fluorescent fittings, the outlet boxes heavy duty shall be provided 300mm off centre for a 1200mm fitting and 150mm off centre for a 600mm fittings or as per B.O.Q.

Draw boxes of ample dimensions shall be provided at convenient points to facilitate pulling of long runs of cables. They shall be completely concealed with MS covers flush with plasterwork painted to match the wall. These boxes will be as few as possible and located where found suitable by the CLIENT.

Switch Boxes

The switch boxes shall be zinc passivated & shall not be less than 18 SWG thick or shall be as called for in BOQ. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw. Leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

Wiring

All the wiring installation shall be as per IS: 732 with latest amendment. PVC insulated copper conductor cables as specified in bills of quantity shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the CLIENT. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used and shall be as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each submain and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.

All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Industrial sockets shall be of moulded plastic BoQ and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS: 694-1990.

Wire size in	S	B	S	B	S	B	S	B	S	B	S	B

Notes:

- 1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
- 2) The columns heads 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
- 3) Conduit sizes are the nominal external diametres.



TELEPHONE , DATA, TV & CCTV SYSTEM

A TELEPHONE SYSTEM

1.0 Scope of work

Supply, installation, testing ,commissioning and handing over of telephone system including all materials and manpower as per the specifications , bill of quantities , drawings, layout and schematic diagram to the satisfaction of client, consultant.

The contractor shall carry out the entire work of the system which consists of following devices/items/works:

Telephone outlets

2 pair telephone cable Terminal blocks Junction box

Multi pair telephone cable Main distribution box Cable containment system

Contractor shall follow CPWD specifications for installation works for the system.

The list of approved manufacturers for the products covered in the system is attached separately.

The detailed bill of quantities, scope of work, technical specifications of products to be used, installation method, testing, commissioning and handing over procedures are attached to the tender documents.

Contractor shall avail product approval before procurement of the materials.

Shop drawings shall be submitted and get approved before commencing the installation works at site.

Contractor must go through the above mentioned documents before submitting the estimate for the system.

2.0. Standards and Codes

Following standards and codes are to be considered for the telephone system for the project.

CPWD standards for wiring installations

IEC 60364 -5 -523 conductors/cables	Installation method of electrical
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Sec 54, Electricity Act 2003 & R36	Wiring in high rise buildings
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IEC 732, IS 4648-1968(reaffirmed 1997)	Electrical wiring
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3.0 Manufacturing standards

Cables – 2 pair/multi pair

unarmoured & multi pair armoured	Code DOT GWIR06/02
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C-DOT/VDE: 0815, 0816/IEC189/IS5608

PVC conduits FRLS	BIS CODE: 4985 – 2000, IS 9537 part-3,
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Telephone sockets	BS 6305, 6312
Cable trays/trunking	IS 4759, 2629, 2633
PVC Ducts	ASTM D1785 & D2665

4.0. Technical specification

Telephone wires to be used must be one or more twisted pairs of copper wire as per UL - 444 & EIA/TIA 568 B for application up to 16MHz, with annealed bare high conductivity copper, PVC/PE/Cellular PE insulated overall sheathed cores, twisted to form a pair, individual or overall shielding using aluminium-mylar tape/copper tape. Armouring to be provided with an extruded inner PVC/PE sheath and overall sheath of PVC/PE flame retardant, wherever required.

2 pair, 0.5 mm dia cable must be used for wiring from each telephone outlets to the floor terminal box. 2 pair telephone cable must be drawn in PVC conduit embedded in concrete slab or installed on surface of wall.

The PVC conduit shall be medium gauge rigid type of minimum 25mm dia.

Contractor must use standard fittings like bend, couplers etc. from the same manufacturer to ensure good workmanship.

Cable tray to be used shall be perforated pre-painted GI cable trays with perforation not more than 17.5%, in convenient sections. Accessories like couplers, Tees, Bends, etc. must be from same manufacturer.

Telephone outlets shall be of modular type. Contractor must refer make list provided for wiring devices in electrical part of the specification for type and finish of the telephone socket.

5.0 Installation

For each floor, 2 pair wires from each telephone outlet must be taken to the terminal blocks fixed in lockable junction boxes. The junction boxes shall be suitably located in services room or in a convenient place located in each floor, preferably in the lobby at high level close to the false ceiling. 25 mm dia rigid medium gauge PVC conduit must be used to contain the 2 pair telephone cable. PVC conduit must be either embedded in concrete or installed below RCC slab on surface as per site condition. When conduits are to be taken open, it can be either installed on wall or beneath concrete slab by using GI saddle spaced at 60cm intervals.

When a bunch of PVC conduits are to be routed to the service room, cable containment system of appropriate size must be installed above false ceiling. GI back boxes of suitable size must be concealed in the block/RCC wall to accommodate telephone sockets. Type and finish of telephone sockets must match with other electrical wiring accessories of the project. Telephone socket and back box must be from same manufacturer. Telephone socket must be modular type matching with other electrical wiring devices. Cable tags must be provided at both ends to identify the cable.

Multi pair unarmoured telephone cable must be used for connecting floor terminal box to main distribution frame located in the main telephone room within the building. Multi pair cable must be laid in a suitable sized containment system (cable tray/cable trunking) which runs between floor distribution frame & MDF. Tray/Trunking shall be pre-painted GI

cable trays perforated type and installed on wall or hanged from RCC slab using proper support system/ anchor fasteners at regular intervals. Cable laid in the tray shall be neatly dressed using heavy gauge cable tie at regular intervals.

Multi pair armoured telephone cable must be used for interconnection of buildings if required. Heavy gauge PVC ducts of suitable size must be laid at specified depth in the excavated trench to contain externally laid telephone cables. Minimum size of PVC duct must be 100 mm. Inspection chambers at regular intervals must be provided in this route. Draw wires/Plastic rope must be provided to achieve hassle free cable pulling.

Floor distribution frame shall be located in the service room of each floor. It consists of multi pair terminal blocks located inside lockable type junction boxes. The work includes terminal blocks, cable manager, jumper wire etc.

Main distribution frame shall be consists of metal rack, terminal blocks, cable manager, jumper wires, power supply outlets etc.

6.0 Warranty

The contractor must submit written guarantee duly signed by the manufacturer and installer of the system for the period of 1 year from the date of substantial completion. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

7.0 Contractor's responsibility

Shop drawings

Upon award of the job, the contractor shall submit a set of shop drawings for the approval of the consultant. The drawing shall clearly indicate position of telephone sockets, routing of conduit, cable tray, floor junction boxes, main distribution frame etc. etc.

A schematic diagram must be submitted to have an overall view of the system. Standard symbols of devices and its mounting height must be clearly marked in the layouts.

The drawing must be submitted in hard copies of minimum A2 size.

Material Approval

The contractor shall submit technical data sheets of all components to be used for the system in the project for consultant's approval. The submittal shall include product's technical data sheets from the manufacturer, compliance statement, company profile, reference list etc.

All products to be proposed must be from a single manufacturer unless otherwise specified.

The material procurement may commence upon approval of material submittal and shop drawings.

8.0 As built drawings and Maintenance manuals

On successful completion of the work, contractor must submit three sets of hard copies and softcopy in DVD in AutoCAD format of latest version of as built drawings and operation & maintenance manual to the client. The document shall be submitted as directed by the consultant.



EPABX (quote to be taken for 100 lines for intercom facility only)(Flat to Security and House keeping)

(65 FLATS + 3 SECURITY + 2 HOUSE KEEPING)

The system shall be a fully digital switch based on PCM/TDM technique based on RISC/Pentium or any other powerful 32 bit microprocessor.

The system offered should be TEC approved .The TEC should be in the name of the Bidder. A copy of the valid TEC for the offered EPABX should be attached with the tender.

The bidder should be an ISO Certified company. The valid ISO certificate copy to be enclosed along with the offer.

The system should be of 100% non-blocking type and with universal port architecture. The system should be highly reliable and should ensure an uptime of 99.99%.

System should have hot standby duplication. The system should be equipped with hot standby PSU, CPU and all other control cards with duplicated Software.

The System should Operate with 230C AC/ 48V DC.

System should offer connectivity for the following

- Analog Trunk card with CLI facility
- Digital T1 trunk
- Digital E1 trunk
- ISDN PRI
- Analog Line (Extension) card with CLI facility
- Both Way Trunk
- Digital Line Card
- Operator Console – Digital/IP
- VOIP
- E&M – 2 / 4 wire with Type I to Type V Signaling
- The system should have IP networking facility.

Following features are required to be provided:

- Extension should be able to have flexible programmable 4 digit extension numbers.

- The offered system should provide 100% Power fail transfer for all C.O trunk lines to the pre-designated extension. The process should be automatic without any manual intervention.
- The offered system should provide least cost routing.
- The system should support both pulse and tone trunk lines.
- The EPABX should support PC based data logging.
- Call billing facility with software (without PC) for on line printing as well as printing through PC (with window based software).
- Programmable dynamic locking facility for local, Mobile, 95 & STD in each Extn.
- Programmable time based class of service for each Extn.
- Programmable facility for selectively assigning various trunk lines to various Extns.
- System should provide voice instructions for commonly used features. Example –voice instruction on how to set call back in case dialed extension is busy.
- In case trunk lines are busy, as in the case of call back facility, there should be provision to call back or alert the extension when the trunk line gets free.
- The system should have automatic online self-diagnostic and reporting system complete with visual/ audible indication facility, fault isolation and recovery features.
- System shall have in-built 8 port voice guided auto-attendant facility and shall be able to answer minimum eight calls simultaneously. The system should provide voice guidance with DID facility with welcome message and provision for directly connecting to the required Extension. If the Extension is not known or is busy, the caller should be able to connect to the operator.
- Storage of outgoing, incoming and internal call reports shall be generated on SMDR port of the system.
- Features given to an extension shall be accessed from any other extension by dialing the secret codes.
- System shall have call buffer storage (call details) for at least 1500.
- The EPABX should have minimum 3 nos. of RS232 for various CTI applications like, CRM integration, call billing data output, etc.

Voice assisted features to be provided for following:-

1. All CO lines (08) to be provided with voice guidance facility
2. The system should have voice guided feature assistance for system features

3. Voice assisted feature to be achieved without using any 3rd party hardware. All the related hardware/software should be from the same OEM for better integration.

The system shall have different dial tone for following :

- EPABX dial tone for directly dialing as intercom
- P&T dial tone.
- E1 Trunk dial tone
- Busy tone.

The Exchange should have following programmable features also for all Extensions:

- Call waiting service.
- Call transfer
- Ring back facility on engaged extensions and trunk lines
- Last number Redial facility.
- Call picking.
- Call forwarding (Internal & External)
- Follow me
- Call hunting.
- Incoming call beep alarm while conversation.
- Call appointment / reminder
- Party Conference
- Wake up call
- Automatic call back
- Priority.
- Mobi-call Facility (Forwarding of intercom extension to a pre-defined external/cell number).

Operator Console

The operator console should be a full-fledged operator console as well as a maintenance console. The Operator Console should have minimum features like recall, serial call, privilege extension/trunks, extension/trunk lines status enquiry, remote DOD control etc.

If the operator console is not a full-fledged maintenance console, then the vendor should supply a PC for system maintenance.

It should have minimum 2 line 16 character display.

Console should have 30 programmable key apart from the function keys.

Console should work on line voltage, it should not use any external power source for powering up the console

It should be possible to prioritize all the incoming calls by assigning separate key.

Operator console shall have provision for assisting extension, attendant call transfer, call intercept, indication of call waiting, night service control etc.

Main distribution board/frame with adequate protection for over voltage and over current for junction shall be in the supplier's scope.

The analog extensions should have a loop resistance of at least 1800 ohms.

The bidder should be an OEM or authorization from OEM for the bidder should be furnished for participating in this bid.

The bidder should provide service and spares support letter for 10(ten) years for the offered EPABX along with tender.

The EPABX should have a valid TEC certificate.



B. DATA SYSTEM

1.0 Scope of work

Supply, installation, testing, commissioning and handing over of data system including all materials and manpower as per the specifications, bill of quantities, drawings, layout and schematic diagram to the satisfaction of client, consultant.

The contractor shall carry out the entire work of the system which consists of following devices/items/works:

Data outlets

4 pair UTP Cat 6 data cable

Patch panels

Metal racks

Multi pair UTP Cat 6e cable

Main distribution box

Cable containment system

Contractor shall follow CPWD specifications for installation works for the system.

The list of approved manufacturers for the products covered in the system is attached separately.

The detailed bill of quantities, scope of work, technical specifications of products to be used, installation method, testing, commissioning and handing over procedures are attached to the tender documents.

Contractor shall avail product approval before procurement of the materials.

Shop drawings shall be submitted and get approved before commencing the installation works at site.

Contractor must go through the above mentioned documents before submitting the estimate for the system.

2.0 Standards and Codes

Following standards and codes are to be considered while designing the data system for the project.

CPWD standards for wiring installations

IEC 60364 -5 -523 : Installation method of electrical conductors/cables

Sec 54, Electricity Act 2003 & R36 : Wiring in high rise buildings

IEC 732, IS 4648-1968(reaffirmed 1997) : Electrical wiring

3.0 Manufacturing standards

Cables : Cat 6 UTP cable – ISO/IEC 11801

PVC conduits : BIS CODE 4985 – 2000, IS 9537 part-3, FRLS category

Data sockets : BS 6305, 6312
 Cable trays : IS 4759, 2629, 2633

4.0 Technical specification

4 pair unshielded twisted pair cable shall be used for data system wiring. Cat6 cable shall be Gig true 550Hz Solid Cable UTP of 23 AWG. The cat 6 cable must be drawn through 25 mm dia very heavy gauge PVC conduit from each data outlet to the nearest patch panel located in the service room of each floor.

The maximum length of the cat6 cable must be limited to 80 meters in the conduit. The cat6 cable must comply with following standards:

ANSI/TIA/EIA-568-C.2 –Category 6. UL® 444, Safety Vol.1, Sec 13. ISO/IEC 11801 Class E.

ETL Verified.

RoHS 2002/95/EC E196163-P

EN71-3, EPA 3050

PVC: CMR; CSA, CMG, FT4; Plenum: CMP, FT6

5.0 Installation

4 pair cat 6 cable must be used for wiring from each data outlet. For each floor, wires from each data socket shall be taken to the patch panel installed in a metal rack. Cable shall be provided with identification labels on both ends. Cable must be terminated in patch panel in a neat manner. Before termination, cable must be tested for its performance as per the standard specifications.

4 pair cat 6 cable must be drawn in PVC conduit embedded in concrete slab or installed on surface of wall. PVC conduit must be either embedded in concrete or installed below RCC slab on surface as per site condition. The PVC conduit shall be very heavy gauge rigid type of minimum 25mm dia. When conduits are to be taken open, it can be either installed on wall or beneath concrete slab by using GI saddle spaced at 60cm intervals. Contractor must use standard fittings like bend, couplers etc. from the same manufacturer to ensure good workmanship.

Cable tray to be used shall be perforated pre-painted GI cable trays with perforation not more than 17.5%, in convenient sections. Accessories like couplers, Tees, Bends, etc. must be from same manufacturer.

Data outlets shall be of modular type. Type and finish of data sockets must match with other electrical wiring accessories of the project. Data socket and back box must be from same manufacturer. Data socket must be modular type matching with other electrical wiring devices. Cable tags must be provided at both ends to identify the cable.

When a bunch of PVC conduits are to be routed to the service room, cable containment system of appropriate size must be installed above false ceiling. GI back boxes of suitable size must be concealed in the block/RCC wall to accommodate data sockets. Data sockets must be RJ45 type and back box must be from manufacturer of wiring accessories. Data socket must be modular type matching with other electrical wiring devices. Cable tags must be provided at both ends to identify the cable.

Cat 6 cable must be terminated at patch panels kept in metal racks of lockable type located in service room or in a convenient place located in lobbies at high level close to the false ceiling.

Provision must be done to contain the cables laid from each floor to the central control room for data system. This shall be achieved by using suitable sized containment system (cable tray/cable trunking) which runs between floors & main server room of the building. Tray/Trunking shall be hot dipped galvanized perforated type and installed on wall or hanged from RCC slab using proper support system/ anchor fasteners at regular intervals. Cable laid in the tray shall be neatly dressed using heavy gauge cable tie at regular intervals.

6.0 Warranty

The contractor must submit written guarantee duly signed by the manufacturer and installer of the system for the period of 1 year from the date of substantial completion. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

7.0 Contractor's responsibility

Shop drawings

Upon award of the job, the contractor shall submit a set of shop drawings for the approval of the consultant. The drawing shall clearly indicate position of data sockets, routing of conduit, cable tray, patch panels, racks etc.

A schematic diagram must be submitted to have an overall view of the system. Standard symbols of devices and its mounting height must be clearly marked in the layouts.

The drawing must be submitted in hard copies of minimum A2 size. Material Approval

The contractor shall submit technical data sheets of all components to be used for the system in the project for consultant's approval. The submittal shall include product's technical data sheets from the manufacturer, compliance statement, company profile, reference list etc.

All products to be proposed must be from a single manufacturer unless otherwise specified.

The material procurement may commence upon approval of material submittal and shop drawings.

8.0 As built drawings and Maintenance manuals

On successful completion of the work, contractor must submit three sets of hard copies and softcopy in DVD in AutoCAD format of latest version of as built drawings and operation & maintenance manual to the client. The document shall be submitted as directed by the consultant.



C. TV SYSTEM

1.0 Scope of work

Supply, installation, testing ,commissioning and handing over of data system including all materials and manpower as per the specifications , bill of quantities , drawings, layout and schematic diagram to the satisfaction of client, consultant.

The contractor shall carry out the entire work of the system which consists of following devices/items/works:

TV outlets

RG6 coaxial cable

Cable containment system

Contractor shall follow CPWD specifications for installation works for the system.

The list of approved manufacturers for the products covered in the system is attached separately.

The detailed bill of quantities, scope of work, technical specifications of products to be used, installation method, testing, commissioning and handing over procedures are attached to the tender documents.

Contractor shall avail product approval before procurement of the materials.

Shop drawings shall be submitted and get approved before commencing the installation works at site.

Contractor must go through the above mentioned documents before submitting the estimate for the system.

2.0 Standards and Codes

Following standards and codes are to be considered while designing the data system for the project.

CPWD standards for wiring installations

IEC 60364 -5 -523 : Installation method of electrical conductors/cables

Sec 54, Electricity Act 2003 & R36 : Wiring in high rise buildings

IEC 732, IS 4648-1968(reaffirmed 1997) : Electrical wiring

3.0 Installation

RG6 cable must be used for wiring from each TV outlet. Cable shall be provided with identification labels on both ends. Cable must be taken from each socket to the central control room with proper identification labels on both ends. RG 6 cable must be drawn in PVC conduit embedded in concrete slab or installed on surface of wall. PVC conduit must be either embedded in concrete or installed below RCC slab on surface as per site condition. The PVC conduit shall be very heavy gauge rigid type of minimum 25mm dia. When conduits are to be taken open, it can be either installed on wall or beneath concrete slab by using GI saddle spaced at 60cm intervals. Contractor must use standard

fittings like bend, couplers etc. from the same manufacturer to ensure good workmanship.

Cable tray to be used shall be perforated pre-painted GI cable trays with perforation not more than 17.5%, in convenient sections. Accessories like couplers, Tees, Bends, etc. must be from same manufacturer.

TV outlets shall be of modular type. Contractor must refer make list provided for wiring devices in electrical part of the specification for type and finish of the TV socket.

When a bunch of PVC conduits are to be routed to the service room, cable containment system of appropriate size must be installed above false ceiling. GI back boxes of suitable size must be concealed in the block/RCC wall to accommodate telephone sockets.

Provision must be done to contain the cables laid from each floor to the central control room for TV system. This shall be achieved by using suitable sized containment system (cable tray/cable trunking) which runs between floors & main server room of the building. Tray/Trunking shall be hot dipped galvanized perforated type and installed on wall or hanged from RCC slab using proper support system/ anchor fasteners at regular intervals. Cable laid in the tray shall be neatly dressed using heavy gauge cable tie at regular intervals.



D IP BASED CCTV SURVEILLANCE SYSTEM (As per BOQ)

Scope of work

Supply, installation, testing, commissioning and handing over of IP based CCTV surveillance system in the premises of proposed residential building.

Detailed bill of quantities, technical specifications, make list and architectural layouts are attached to the tender documents.

Contractor shall carry out the entire work of the system which consists of following devices/items/works including all materials and manpower as per the specifications, bill of quantities, drawings and to the satisfaction of client and consultant

The major components of the system are given below:

- IP based IR PTZ camera, 1/3" CMOS, 2 Mega pixel for external areas like parking and internal roads.
- IP based IR dome Camera, 1/3" CMOS, 3 Mega pixel in all areas except JDC/DDC/ADC rooms, toilets, cold storage, storage, janitor & driver's rooms and child care room etc.
- 32 Channel network video recorders (NVRs) & hard disk of 8 TB with features like simultaneous Record/Playback/Live/Ethernet/Archive, integrated software for web based applications for remote viewing facility, MPEG 4 & H264 Video formats, coaxial/USB/RJ45 cable connectivity, to be located in server room of the building
- Ethernet switches to connect cameras and NVRs
- 32 inch full HD LED monitor, full HD to be located in security room
- Joy stick for PTZ control
- Patch panels and LIU
- Rack to accommodate NVR and hard disk to be located in server room of the building
- Optical fiber cable, OFC patch cords and its accessories
- Cat6 cable and patch cords, key stone modules
- Cable containment system such as PVC conduits

Standards and codes

UL 60950-1, emission EN55022 class B
FCC part15 class B

CE standards

ANSI C63.4: 2003



Class A Digital Devices UL 60065, 7th Edition. 2007-12-11 CAN/CSA-C22.2

UL60065-03, 1st Edition, 2006-04 + A1:2006

EN55022:2006, Class A

EN50130-4:1995+A1:1998+A2:2003 LVD 2006/95EC

EN60950-1:2006+A11:2009 IEC 60950-1:2005 (2nd Edition)

Technical specification

The system offered must be capable of simultaneous viewing, recording and playback facility. All components going to be used must be compatible for high definition & high resolution capability. The system shall be IP based and capable of viewing from multiple locations using appropriate web based applications apart from viewing in the monitor provided in the security room.

32 Channel Network Video Recorder

Professional and Reliable dual OS design to ensure high reliability of system running ANR technology to enhance the storage reliability when the network is disconnected HD input H.265/H.264+/H.264/MPEG4 video formats

Connectable to the third-party network cameras

Up to 32 IP cameras can be connected

Recording at up to 12 MP resolution

Supports live view, storage, and playback of the connected camera at up to 12 MP resolution

HD Output

HDMI and VGA outputs provided

HDMI Video output at up to 4K (3840 × 2160) resolution

HD Storage

Up to 4 SATA interfaces connectable for recording and backup

Storage space effectively saved by 50% to 70% with the use of H.264+decoding format

HD Transmission

1self-adaptive
10M/100M/1000M network
interface

8/16 independent PoE network interfaces are provided

Various Applications

Centralized management of IP cameras including configuration, information import/export, real-time information display, two-way audio, upgrade etc.

Connectable to smart IP cameras, recording, playback and backing up of VCA alarms can be realized

VCA detection alarm is supported

Instant playback for assigned channel during multi-channel display mode

Smart search for the selected area in the video and smart playback to improve the playback efficiency

Supports HDD quota and group modes; different capacity can be assigned to different channels

Video/Audio input	IP video input	32-ch
		Up to 12 MP resolution
	Two-way audio	1-ch, RCA (2.0 Vp-p, 1kΩ)
Network	Incoming bandwidth	256 Mbps
	Outgoing bandwidth	256 Mbps
	Remote connection	128
Video/Audio output	Recording resolution	12 MP/8 MP/6 MP/5 MP/4 MP/3
		MP/1080p/UXGA/720p/VGA/4CIF/DCIF/
		2CIF/CIF/QCIF
	HDMI output resolution	4K (3840 × 2160)/60Hz, 4K (3840 × 2160)/30Hz, 1920
		× 1080p/60Hz, 1600 × 1200/60Hz, 1280 ×
		1024/60Hz, 1280 × 720/60Hz, 1024 × 768/60Hz
	VGA output resolution	1920 × 1080p/60Hz, 1280 × 1024/60Hz, 1280 ×
		720/60Hz, 1024 × 768/60Hz
	Audio output	1-ch, RCA (Linear, 1 KΩ)
Decoding	Decoding format	H.265/H.264+/H.264/MPEG4
	Live view / Playback 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
	Capability	4-ch @ 4K, or 16-ch @ 1080p
	SATA	4 SATA interfaces for 4HDDs
Hard disk	Capacity	Up to 6TB capacity for each HDD
External interface	Network interface	1 RJ-45 10/100/1000 Mbps self-adaptive Ethernet interface
	Serial interface	1 RS-485 (half-duplex), 1 RS-232
	USB interface	Front panel: 2 × USB 2.0; Rear panel: 1 × USB 3.0
	Alarm in/out	16-Apr
POE Interface (for /P)	Interface	16 RJ-45 10/100 Mbps self-adaptive Ethernet interfaces

series	Power	≤200W
NVR only)	Supported standard	IEEE 802.3 af/at
General	Power supply	100 to 240 VAC
	Power	≤300 W
	Consumption	≤20 W (without enabling PoE)
	(without hard disk)	
	Working temperature	-10 to +55°C (14 to 131°F)
	Working humidity	10 to 90 %
	Chassis	19-inch rack-mounted 1.5U chassis
	Dimensions(W × D × H)	445 × 390 × 70 mm (17.5" × 15.3" × 2.8")
	Weight(without hard disk)	≤ 5 Kg (11 lb)

IP IR PTZ Camera

Image Sensor : 1/3" Progressive
 CMOS Optical Zoom : 18 or 20X
 Digital Zoom : OFF / ON (X2 ~ X8)
 Effective Pixels : 1920 (H) x
 1080 (V) S / N Ratio : >50dB
 Min. Illumination : IR LED ON - 0 Lux
 Color : 0.15 Lux, F1.35 (50 IRE AGC
 ON) B/W : 0.01 Lux, F1.35 (50 IRE
 AGC ON) Focus length : f=4.45 to 89mm (F1.6
 - F2.9)

Angle Field of view



Horizontal	:	Appr. 55.56° (Wide) to 3.10° (Tele)
Vertical	:	Appr. 43.32° (Wide) to 2.34° (Tele)
Focus Mode	:	Auto / Manual / One push
White Balance	:	ATW / AWC / INDOOR / OUTDOOR / Manual
Iris Control	:	Auto / Manual
Electronic Shutter	:	AUTO / MANUAL / A.FLK, X60 ~ 1/30,000
AGC Control	:	OFF, LOW, MIDDLE, High, MANUAL Selectable
Backlight Compensation		
OFF / BLC / HLC Selectable		
Digital Slow Shutter	:	Sens-up (X2 - 48)
Motion Detection	:	ON / OFF (programmable zones)
Wide Dynamic Range	:	ON / OFF
Day/Night	:	Auto, COLOR, B/W (ICR)
Image Inverse	:	Off / H-Rev / V-Rev / HV-Rev
Noise Reduction	:	Super 2+3D-NR, OFF, Low, Middle, High
Electronic Image Stabilizer	:	ON / OFF

Operation

Pan travel	:	
360°endless Tilt travel	:	
0 - 90° Manual Speed	:	
0.1°- 150°/s		

Presets	256
Preset Accuracy	0.1°
Preset Speed	180°/s
Swing	8
Cruise	8
Pattern	4
Privacy Mask	4
Proportional Pan & Tilt	Auto
Home Function	Preset / Swing / Cruise / Pattern

Auto Flip : Mechanical
 Resume after Power Loss Support
 IR Beam Distance : 100m
 IR Angle : Adjustable by zoom

IP Video

Main Stream Resolution : 1080P (1920 x 1080), 720P (1280 x 720), Q1080P (960 x 544)

Second Stream Resolution : 720P (1280 x 720), VGA (640 x 480), Q1080P (960 x 544) 240),

D1 (720 x 576), Q720P (640 x 360), QVGA (320 x

CIF (352 x 288), QCIF (176 x 144

Frame Rate : 1fps - 25/30fps

Bit Rate : 16 - 8000kbps

Video Compression : H.264 baseline, main, high profile / MJPEG dual stream

Encoding Control : CBR / VBR / GOP

Video Output : 1.0Vp-p complex video output, 75 Ohm

Network

Network Protocols : IPv4, TCP, UDP, HTTP, HTTPS, SMTP, FTP, NTP, DNS, DDNS, DHCP, ARP, UPnP, RTSP, RTP, RTCP, PPPoE,

ICMP, SNMP

System Integration

Supported Protocol : ONVIF Profile S

Alarm Input : 2 channels

Alarm Output : 1 channel, support alarm linkage

Alarm Linkage : SD card video recording / FTP Upload / Email / Snapshot / Preset / Alarm output / CMS

Audio : 1 channel input, 1 channel output, monitoring and talkback

Audio Compression : G.711ulaw / ADPCM

RS485 : Half-duplex, support Pelco P and Pelco
D General

Power Supply : DC12V5A $\pm$ 10%

Power consumption : 50W (IR LED and heater ON)

Edge Storage : Max 32G, support NFR

Operation Temperature : Outdoor -30°C

to 60°C Operation Humidity : 0 - 90%

RH (non-condensing)

Dimensions : 415 (H) x 243 (D) mm

Weight : 10kg

Protection : IP66, Vandal-proof IK10

Regulatory : CE, FCC, type-examination report

IR DOME CAMERA

Image Sensor	1/3" 3 Megapixel progressive scan CMOS
Effective Pixels	2304(H)'1296(V)
Scanning System	Progressive
Electronic Shutter Speed	Auto/Manual, 1/3s~1/30000s
Min. Illumination	0. 1Lux/F2.1(Color), 0Lux (IR on
S/N Ratio	More than 50dB
Camera features	
Max. IR LEDs Length	30m
Day/Night	Auto(ICR)/Color/B/W
White Balance	Auto/manual
Backlight Compensation	Auto/Manual
Noise Reduction	3D
Backlight compensation	Yes, zone optional
ROI	Support
Network Storage	NAS (Support NFS,SMB/CIFS)
Lens	
Focal Length	2.8mm
Angle of View	55 degree

Max Aperture	F 2.1
Protocols	TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv6, Bonjour
Standard	ONVIF, PSIA, CGI, ISAPI
Communication Interface	1 RJ45 10M/100M Ethernet interface
Operating Conditions	-30 °C – 60 °C (-22 °F – 140 °F) Humidity 95% or less (non-condensing)
Power Supply	12 V DC $\pm$ 10% PoE (802.3af)
Power Consumption	I3: Max. 5W I5: Max. 6.5W I8: Max. 10W
Ingress Protection level	IP66
IR Range	30 meters
Dimensions(mm)	194.04×93.85×89.52 mm
Weight	750g

Network switch

Network Ports : 8/24 auto speed-sensing 10/100 RJ-45 ports

Network Protocol and Standards

IEEE 802.3i 10BASE-T
 IEEE 802.3u 100BASE-TX
 IEEE 802.1p priority tags
 IEEE 802.3x Flow Control

IEEE 802.3af DTE Power via MDI

Performance Specifications

Forwarding modes: Store-and-forward
 Bandwidth: 1.6Gbps

Network latency: Less than 20 μ s
 for 64-byte frames in store-and-forward mode for 100Mbps to 100Mbps transmission

Buffer memory: 96KB embedded memory per unit

Address database size: 1000 media access control (MAC) addresses per system

Addressing: 48-bit MAC address

Mean time between failures (MTBF): 927,000 hours

Acoustic noise: 0dB (fanless)

Power Supply

Total power consumption: 56.1W maximum

802.3af power consumption: 53W maximum (Ports 1 – 4)

48V DC, 1.25A power output; plug is localized to country of sale

Physical Specifications

Dimensions: (W x D x H)

235 x 103 x 27mm (9.3 x 4.1 x 1.1in)

Environmental Specifications

Operating temperature: 32° to 104°F (0° to 40°C)

Storage temperature: -40° to 158°F (-40° to 70°C)

Operating humidity: 90% maximum relative humidity, non-condensing

Storage humidity: 95% maximum relative humidity, non-condensing

Operating altitude: 10,000ft (3,000m) maximum

Storage altitude: 10,000ft (3,000m) maximum

Electromagnetic Emissions

CE mark, commercial FCC Part 15 Class B VCCI Class B

EN 55022 (CISPR 22), Class B

C-Tick, Class B

LED monitor

Screen type	:	LED
Display size	:	32 inch
Panel	:	grade A
Screen resolution	:	1920X1080 pixel, full HD
Aspect ratio	:	16:10
Viewing angle	:	178/178 degrees
Contrast ratio	:	30000:1 dynamic
Colour system	:	PAL/NTSC/SECAM,

Interface : TV, VGA, AV, YPBPR, USB, HDMI & audio input, Audio output, wall mount or table mount kit

PAP facility : Variable

PIP facility : must be provided

Voltage range : 90 to 270 v ac Viewing matrix shall be 12 pictures in a single monitor

Hard disk

Cache (MB)	64
Rotational speed (RPM)	7200
Reliability/Data Integrity	
Load/unload cycles ⁴	300,000
Non-recoverable read errors per bits read	<1 in 10 ¹⁴
Limited warranty (years) ⁵	3
Power Management	
Average power requirements (W)	4.80
Read/Write	4.33
Idle	0.52
Standby and Sleep	
Environmental Specifications ⁶	
Temperature (°C, on the base casting) Operating	0 to 65
Non-operating	-40 to 70
Shock (Gs) Operating (2 ms, read/write) Operating (2 ms, read)	30 65
Non-operating (2 ms)	250
Acoustics (dBA) Idle	25
Seek (average)	26

Physical Dimensions	
Height (in./mm, max)	1.028/26.1
Length (in./mm, max)	5.787/147
Width (in./mm, $\pm .01$ in.)	4/101.6
Weight (lb./kg, $\pm 10\%$)	1.50/0.68

Optical fiber cable

Tensile rating	1000N
Maximum Crush resistance	3000N
Operating Temperature	-40 Degree C to +70 Degree C
Aarmor	Corrugated Steel tape Armor
Colour	Black
Outer jacket	High density polyethylene, anti - termite, anti - rodent suitable for direct burial application.
Secondary Buffer Material	Gel filled Loose Tube.
Min Bend	20 X Outer Diameter
Weight	90 Kg/Km (Approx)
Test (Must pass)	IEC794-1-E1 , IEC794-1-E2 , IEC794-1-E3 , IEC794-1-E4 , EIA-455-104 , IEC794-1-E7 , IEC794-1-E10 , IEC794-1-F1 , IEC794-1-F3 and IEC794-1-F5
Marking	Identification marking at regular intervals of 1 meter
Fiber Core	Raw fiber of corning. CORNING marking should be visible on the OFC
Approval	UL Listed
ISO certification	All quoted product and Brand should have ISO certification for manufacturing in India

Installation

The installation shall be carried out with quality workmanship as per the specifications, approved shop drawings and to the satisfaction of client and consultant.

Material Approval

Upon award of the job, the contractor shall submit technical data sheets of all components to be used for the system in the project for consultant's approval. The submittal shall include product's technical data sheets from the manufacturer, compliance statement, OEM's authorization letter, company profile, reference list etc.

The material procurement may commence only after getting approval of material submittal and shop drawings.

Shop drawings

Upon award of the job, the contractor shall submit a set of shop drawings for the approval of the consultant. Contractor must submit shop drawings clearly indicating location of cameras, network video recorders, LED monitor, racks, server PC, cable route, installation method of cameras etc. before commencement of work.

A schematic diagram must be submitted to have an overall view of the system. The symbols and mounting heights of all devices must be clearly marked in the layouts. The drawing must be submitted as hard copies of minimum A2 size.

Contractor must submit method statement and inspection report before commencing any installation.

Contractor may proceed with installation only after approval of shop drawings from the consultant.

Cat6 cable shall be drawn through PVC conduit from location of camera to the NVRs located in the server room of the building. PVC conduit to be used shall be of medium duty rigid type and contractor must use standard accessories of conduits like bends, couplers, junction boxes etc. from same manufacturer where ever required. The minimum size of PVC conduit shall be 25mm dia. PVC conduit shall be either concealed or surface type depending on the site requirement. If installed on surface, it shall be fixed on brick/concrete walls by means of GI saddles of proper size at regular intervals of 60cm. Contractor must coordinate with other services before finalizing the cable route and ensure that radio interference is avoided by keeping safe distance from other communication/electrical cables as mentioned in the specifications. PVC conduit may also be installed beneath the concrete slab of typical floors by the method mentioned earlier. When cable needs to be terminated in any device, suitably sized connectors must be used.

When conduit run along walls or concrete slabs the plumb and line must be maintained to ensure good workmanship. Conduit shall not run at angles other than 90 degree (vertical or horizontal) to the wall or slab.

Power supply to the CCTV equipments shall be taken from outlets fed from UPS.

NVRs with hard disks shall be placed in server room of the building. Metal racks of suitable size must be used to keep the NVR.

All cables from cameras shall be concealed in the wall and terminated in NVRs by appropriate method.

LED monitor shall be fixed on the wall in the security room by using wall mounting kits.

6Amp UPS power point shall be provided by the contractor to hook up the monitor. Necessary power points to feed NVRS must be provided by the contractor.

Testing

CCTV system shall be tested in accordance with the specifications, the testing instructions provided by the manufacturer and to the satisfaction of the consultant and client.

Testing must be done by the specialist contractor for the system to ensure that all equipments are performing to the requirements as mentioned in the specifications.

Testing may be conducted in the presence of representatives from consultant and client.

Performance of each device in the system may be verified against the values mentioned in the specification. Any suggestions from consultant may be incorporated by the contractor before handing over of the system.

Warranty

The contractor must submit written guarantee duly signed by the manufacturer and installer of CCTV system for the period of 1 year from the date of substantial completion. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

Other responsibilities

Training to the client

On successful completion of the work, contractor must conduct a training session to the client's representative in presence of the consultant. The session shall include familiarization of the system, operation, routine maintenance etc. Competent person from OEM must conduct the training session.

As built drawings and Maintenance manuals

On successful completion of the work, contractor must submit three sets of hard copies and softcopy in DVD in AutoCAD format of latest version of as built drawings and operation & maintenance manual to the client. The document shall be submitted as directed by the consultant.



BATTERY & BATTERY CHARGER

1. SCOPE

The specifications give details of the Battery Charger suitable for HT/ LT Panels. The batteries are housed in the Bottom Compartment of the Battery Charger. Sealed maintenance Free Batteries upto 24V – 200AH or Lead Acid Batteries upto 24V – 150AH can be housed in the Battery Compartment. The Battery Charger is a composite Battery Charger cum DC Distribution Board.

2. GENERAL

The Battery Charger shall be Float cum Boost type, Thyristor controlled. The Charger shall have selector switch for Auto Float – Boost/Manual Float/Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to Trickle charge.

Construction Feature

Float cum Boost Charger and DC Distribution Board shall be housed in Sheet Steel Cubicle with Panels of 1.6mm thickness, louvers for ventilation, gland plate will be provided for cable entry from bottom. The cubicle shall be painted in Siemens Grey Shade. The Battery Charger shall be divided into two Compartments. The Upper Compartment shall house the Battery Charger & DCDB with all the necessary controls. The Lower Compartment shall be suitable for housing the Batteries.

Performance

- a. The D.C. Output Voltage of Float/Boost Charger shall be stabilized to within $\pm 2\%$ for A.C. Input variation of $230V \pm 10\%$, frequency variation of $50 \text{ Hz} \pm 5\%$ and D.C. Load variation of $0 - 100\%$. The Voltage Regulation shall be achieved by a constant voltage regulator having fast response SCR controlled. The ripple content in output shall be within 3% of D.C. Output Nominal Voltage.
- b. There shall be provision to select Auto Float/Manual Float /Manual Boost Modes. During Auto Float Mode the Battery Charging shall automatically changeover from Boost Mode to Float Mode and vice – versa. During Manual Float/Boost Modes it shall be possible to set the output volts by separate potentiometers.
- c. The Battery Charger shall have automatic output Current Limiting feature.

Components

The Battery Charger shall essentially comprise of the following:

- a. 1 No. Double Pole ON/OFF MCB at A.C. Input.
- b. 1 No. Pilot Lamp to indicate Charger ON.
- c. 1 No. MAIN TRANSFORMER: Double Wound, naturally air – cooled, having Copper winding.
- d. 1 Set Single Phase full wave Bridge Rectifier consisting of 2 nos. Diodes and 2 nos. SCR's, liberally rated, mounted on Heat Sinks and complete with Resistor/Condenser network for surge suppression.

e. 1 No. Rotary Switch to select AUTO FLOAT/MANUAL FLOAT/MANUAL BOOST. During Auto Float Mode Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa.

f. 1 Set Solid state constant potential controller to stabilize the DC Output Voltage of the Float cum Boost Charger at $\pm 2\%$ of the set value for AC Input Voltage variation of 230V $\pm 10\%$, Frequency variation of $\pm 5\%$ from 50Hz and simultaneous Load Variation of 0 - 100% and also complete with Current Limiting Circuit to drop the Float Charger Output Voltage upon overloads to enable the Battery to take over.

g. 1 No. Electronic Controller to automatically changeover Battery Charging from Boost to Float and vice – versa.

h. 1 No. DC Ammeter and Toggle Switch to read Charger Output Current and Battery Charge / discharge current.

i. 1 No. Moving Coil DC Voltmeter to read the DC Output Voltage.

j. 2 Set Potentiometer to adjust the output Voltage during Manual / Auto Float and Boost Modes.

k. 1 No. Double Pole ON/OFF MCB at Charger Output. l. Dc Distribution Board :-

INCOMER : 1 No. 63A DP MCB, as called for in BOQ.

OUTGOING : Suitable No. 16A/20A DP MCB, as called for in BOQ.

Alarm Annunciation :

Visual and Audible Alarm with Manual Accept/Reset Facility shall be provided for the following:

- a) A.C. Mains Fail.
- b) Charger Fail.
- c) Load/Output overvolt.

RATING :

A C INPUT : 230V $\pm 10\%$ AC 50 Hz Single Phase

D C OUTPUT : To Float/Boost charge 24V / 100AH

Batteries and also supply a continuous load

CURRENT RATING : 15.0 Amps

FLOAT MODE : 27.0 V Nominal (Adj. between 24.0 – 28.0V)

BOOST MODE : 28.0 V Nominal (Adj. between 24.0 – 30.0 V)

Voltage Regulation : $\pm 2\%$ of the set value

RIPPLE : Less than 3%.

For 24V / 100 AH Batteries the Charger Rating is given in the Specification for

Batteries of other capacities refer to the Table as given below:

BATTERY CAPACITY

24V / 40AH

24V / 60AH

24V / 100AH

24V / 120AH

24V / 150AH

24V / 200AH

CHARGING RATING

10.0 Amp.

15.0 Amp.

15.0 Amp.

20.0 Amp.

25.0 Amp.

30.0 Amp.

Technical specifications and make of materials should be get approved before the procurement of the materials. All panels / equipments approval shall be taken in the form of GA Diagrams before fabrication.



EARTHING

All electrical equipment is to be earthed by connecting two earth tapes from the frame of the equipment to a main earth ring. The earthing ring will be connected via several earth electrodes. The cable armour will be earthed through cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity Rules 1956 and as per IS-3843-1966.

The following shall be earthed:

1. Transformer & D.G. Set neutrals.
2. Transformer Housing.
3. H.T. Panels.
4. Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, rising mains, panel boards, motor control centres, power panels, distribution boards, cable trays, metal conduits, welding sockets etc.
5. Generator & motor frames.
6. All fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with PVC insulated copper wire as specified in item of work. The earth wires ends shall be connected with solderless bottle type copper lugs.
7. The third pin of Outlets on UPS shall be provided with a separate PVC insulated Cu. Wire (green with yellow stripe) as Isolated ground earth wire apart from the earthing of box.

The earth connections shall be properly made. A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

The shop drawing for earthing system shall be prepared by the contractor and be got approved by CLIENT/Engineer-in-charge. The work shall be done in accordance with approved drawings.

All earth electrodes shall be given to a depth sufficient to reach permanently moist soil. Their location shall be marked and approval taken from Engineer-in-Charge before excavation for the same.

The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after a protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 1 ohm.

The earth loop resistance to any point in the electrical system shall not be in excess of 1 ohm in order to ensure satisfactory operation of protective devices.

The resistance to earth shall be measured at the following: -

- a) At each electrical system ground or system neutral ground.

b) At one point on each grounding system used to ground electrical equipment enclosures.

c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable sheaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. as per B.O.Q. and shall be protected against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor. However, the contractor shall use the sizes specified in the bill of quantities of the Tender.

Pipe Earth Electrode

G.I. pipe shall be of medium class and of the size and dia as specified in BOQ. G.I. Pipe electrode shall be cut tapered at bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20cm below ground level.

Plate Earth Electrode

The plate earth electrode shall consist of copper plate or G.I. plate as per item of work. The plate electrode shall be buried in ground with its faces vertical and top not less than 2.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it on all sides.

A watering pipe as specified in BOQ, of medium class G.I pipe shall be provided. The top of the pipe shall be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug shall be provided as per drawing. This will be housed in a masonry sump (with cement plastering) of not less than 40 cm square and 40 cm deep. A C.I. frame with hinged cover of 10mm thickness and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a suitable dia medium class PVC/ HDPE pipe. The overlapping in G.I. strips in joints shall be rivetted with rivets and welded in approved manner. The protection pipe within ground shall be buried at least 30 cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode, two nos. 50mm x 6mm GI/Cu. Strip the earthing lead shall be securely bolted to the plate with two zinc passivated bolts, nuts, checknuts and washers. In case of pipe electrode, it shall be connected by means of a through bolt, nuts and washers and cable socket. Main earthing conductor is taken from the earth electrode with which the connection is to be made.

No earth pit shall be fixed within 2.5M of a wall of foundation. The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. Effort shall be made to locate them in grass lawns or near flowerbeds or water taps. The distance between two earthing stations shall be at least 3.0 meters.



Testing and Commissioning

Testing and commissioning shall be done as per the programme/ instructions to be given by CLIENT's authorised representative. All testing equipments necessary to carry out the tests shall be arranged by the electrical Contractor.

Before the electrical system is made live, the electrical Contractor shall carry out suitable tests to the satisfaction of CLIENT that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

All tests shall be conducted in the presence of the CLIENT authorised representative by the electrical Contractor and shall be notified one week before tests are to take place.

All measurements shall conform to establish minimum acceptable test values. CLIENT's Engineer reserves the right to approve all test results before circuit or equipments are energised for the first time.



LIGHTNING PROTECTION SYSTEM

Protection of buildings against lightning shall generally be done in accordance with latest IS-Code. The installation shall be done as per routes and location of equipment indicated on the drawing and bill of quantities. The conductors and the earth electrode conductor shall be fixed so that they are free to expand and contract. Special care shall be taken in the fixing of support to allow free movement.

The materials of lightning conductors, down conductors, earth termination etc. shall be reliably resistant to corrosion or be adequately protected against corrosion. All air terminations shall be GI and the conductors shall be GI / as specified in the BOQ.

The entire lightning protection system should be mechanically strong to withstand the mechanical forces produced in case of a lightning strike. The system shall be installed such that it does not spoil the architectural or aesthetic beauty of the buildings but on other hand it should meet IS code/safety code.

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 metres away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is used. For a roof of larger area a network of parallel horizontal conductors shall be installed. Horizontal air terminations shall be laid along contours such as ridges, parapets and edges of flat roofs and where necessary area flat surfaces in such a way as to connect each air termination to the rest and shall, they form a closed network.

All metallic finials, chimneys, ducts, vent pipes, railings, gutters, metallic flag staff, on or above the main surface of the roof of the structure shall be bonded to and form part of the air termination network. All air terminations shall be effectively recessed against over turning either by attachment to the object to be protected or by means to substantial braces and fixing which shall be permanently and rigidly attached to the buildings.

Down conductors shall be distributed around the outside walls of the structure. They shall preferably be run along the corners and other projection, due considerations being given to the locations of air terminations and earth terminations. Lift shafts shall not be used for fixing down conductors. Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors but cannot replace them. Such conductors shall have disconnecting joints. All vertical conductors shall be plumbed before fixing. Insulation shall be provided between down conductors and wall.

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. The joint overlap shall not be less than the width of the tape. In the down conductor below ground level there shall be no joint. The joints may be clamped, screwed, bolted, revitted, sweated, braced or welded. The bonding of the external metal forming part of a structural or drain water pipe shall have a cross sectional area not less than that employed for the main conductors. Gas pipe, however, in no case shall be bonded to the earth termination system.

Conductors shall be securely attached to the building to be protected by fasteners, which shall be substantial in construction, not subject to breakage and shall be of steel. The conductors shall be secured at not more than 900mm apart for horizontal run and 750mm for vertical run.



Where tape are required to pass through roof asphaltting or other waterproofing membranes, a special seal shall be used comprising a 38mm diameter plastic, copper or aluminium tube with 100mm diameter flange 50mm from the top of the tube. The tube length shall suit the thickness of the roof through which the conductor passes, allowing for the tube to protrude 50mm above the membrane. The seal is to be asphalted in position and the conductor shall be sealed in the tube by a setting waterproof compartment.

Each down conductor shall have an independent earth termination. The interconnection of all the earth termination shall be preferable. It should be capable of isolation for testing purpose by "testing joints" at position approachable easily for the meggar testing. The whole of the system could have a combined resistance to earth not exceeding 2 ohm before any bonding has been affected to metal in or on structure or two surfaces below ground.



CAPACITORS & CAPACITOR CONTROL PANEL

Power factor correction capacitors shall conform in all respects to IS 2834-1964. The capacitors shall be suitable for 3 phases 415V at 50Hz. frequency and shall be available in units as per B.O.Q. to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by means of high conductivity electrolytic copper busbars of adequate current carrying capacity having S.C rating of 25 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminium conductor armoured cables. Two separate earthing terminals shall be provided for each bank for earth connection. The capacitor bank shall be housed indoor.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use upto 45 Deg.C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

- Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.
- Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.
- Overload of 30% continuously and 45% for 6 hours in a 24 hours cycle.

The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing. The capacitor bank shall be provided with 7% Detuned reactor filter to compensate third harmonics from being generated.

Capacitors shall be of aluminium foil and craft paper. Hermetically sealed in sturdy corrosion-proof sheet steel 2mm thick containers and impregnated with non-inflammable synthetic liquid and of low power loss version. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitor shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 V or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnants. The capacitors shall withstand voltage of 2500V AC supply for 1 minute.

The insulation resistance between capacitor terminals and containers when test voltage of 500V A.C. is applied shall not be less than 50 megohms.

- Capacitor bank and switching equipments shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.
- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.
- Necessary discharge resistor shall be provided externally to reduce the terminal voltage to or less then 50V in 60 seconds of disconnection from supply.
- Testing shall be done as per applicable standards for shunt capacitors.

Capacitor Control Panel

The capacitor control panel shall general comprise of the following:

- Automatic power factor correction relay.
- Step controller with reversing motor.
- Time delay and no-volt relays.

- d) Protection MCCB / MCB.
- e) Contactor (AC-3 duty) for individual capacitors of suitable rating.
- f) Change over switch for either automatic operation or manual operation with push button control.
- g) C.T.s with ammeter and selector switch as asked for in BOQ.
- h) Voltmeter with selector switch.
- i) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, P.F. meter, Digital Microprocessor based P.F. correction relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, free standing front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed design completely dust tight and vermin proof. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

All sheet steel material used in the construction of capacitor control panel should have undergone a rigorous rust proofing process comprising Alkaline Degreasing, descaling in dilute sulphuric acid and recognised phosphating process. The steel work should then receive two coats of primer before applying final coat of epoxy paint of approved shade.

Quality Assurance

Quality Assurance shall follow the requirement of CLIENT. Q.A. documents as applicable. Q.A. involvement will commence at enquiry and follow through to composition and acceptable thus ensuring total conformity to purchaser's requirement.

Deviations

Deviations from the specification must be stated in writing at the quotation stage.

In the absence of such a statement it will be assumed that the requirements of the specifications are met without exception.

SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.



CHAPTER E -FIRE PROTECTION SYSTEM

1. SCOPE

The basic system requirement shall be as per National Building Code of India 2016 -Part 4

Type of Building Occupancy-**Group A : Residential (15m and above but not exceeding 35m)**. The Tenderer shall be responsible for preparing the drawings and prior to execution the tenderer should get it approved from the client engineer in charge.

2. CODES AND STANDARDS

NBC: National Building Code 2016, Part 4, Fire and Life Safety TAC: TAC Protection Manual / 1998 (Guidance only) & as per the direction given by the local fire force department

Engineering Practices

IS-1239 / IS-3589: Specifications for GI Pipes

IS-778/14846: Specifications for Gun Metal gate, globe, and check Values for water supply.

IS-814: Specifications for covered electrodes for metal arc welding of structural steel.

BS-5155: Specifications for C.I. butterfly valve.

IS-1641: Specifications for C.I. screwed fittings.

IS-903: Specifications for Branch pipes (long Pattern)

IS-3844: Code of practice for installation of internal Fire Hydrant in Multi storied building IS-
IS

5290: Specifications for hydrant landing values.

IS-903: Specifications for coupling double male double female instantaneous pattern for firefighting.

IS-1879: Malleable iron fittings (Parts I to X)

IS-4853: Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.

IS-636: Synthetic, jacketed hose pipes.

IS-1520: Electrically operated Centrifugal pump.

IS-5: Specification for painting

3. PUMPING SYSTEM

SI No	Pump Details
1	Booster pump 900 lpm @ 3.5 kg/sq.cm at terrace level, head 50 mtr

Positive suction arrangement is considered for firefighting pump sets.

4. DESIGN PARAMETERS

- The yard hydrants will be fixed on the stand post at 30 m intervals around the buildings.
- In each floor, in each riser, tapping will be taken for connecting a Single headed hydrant valve and a hose reel drum having 20mm dia rubber hose of 30m long with nozzle at one end.
- Each single headed hydrant valve will be provided with 2 Nos. of 15 m hose and 1No. of branch pipe.
- Pipes will be laid in ring form around the area protected. Isolating valves will be provided from maintenance point of view as will be provided from maintenance point of view as well as fire service requirements.
- The wet riser system piping will be as per relevant IS standards.
- The hydrant mains will be sized for the entire aggregate pumping capacity considering velocity of 5 m/s.
- Minimum pressure of 3.5 kg/cm² will be ensured at the remotest hydrant point.
- All the hydrants will be used oblique type with the outlet angle towards ground.
- All the outdoor hydrants will be provided with two (2) Nos. RRL hoses (63 mm size x15m long with couplings) and one (1) no. branch pipe with nozzle (20mm bore).
- At every internal hydrant location, one (1) no. of hose reel arrangement will be provided except for terrace level.
- In addition there shall be a set of fire department connections mounted on the external wall of the property near the main entrance. These shall comprise of 4 Nos. 63 mm dia male outlets capable of directly filling the complex's static fire storage tanks.
- The system will be automatic in operation.
- The power supply to MCC & control panel of the firewater pumps will be directly from the sub-station without any tapping.

Wrap coating to be done as per CPWD norms.

8. PIPE SUPPORT

All pipes will be adequately supported from ceiling or walls from existing inserts by structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats or by using anchor fasteners type as per site conditions. All clamps will be painted with one coat of red oxide and two coats of black enamel paint.

9. PORTABLE FIRST-AID FIRE EXTINGUISHERS

The portable first-aid fire extinguishers shall be provided for all the buildings as per requirements of NBC 2016.

SYSTEM DESCRIPTION

The extinguishers are used to put-off small fires. The extinguishers will be used in the incipient stage of fire. Fire extinguishers are easy to handle. This is useful to put off the fire in the initial stage itself and thus avoiding major losses.

10. SAFETY SIGNAGES

Safety signage shall be provided for exits & fire escape route.

11. STATUTORY AUTHORITIES' TESTS AND INSPECTIONS (Applicable if any)

The Tenderer shall be responsible for the submission of all necessary forms and drawings to the Statutory Authorities which shall conform to the latest architectural plans submitted to and kept by this Authorities. Tenderer shall be responsible for obtaining the initial and final NOC from Statutory Authorities. Statutory fees will be paid by the contractor as per the GO, which shall be reimbursed by Client on producing the original bill / receipt.

11. FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Tenderer shall carry out final inspection from fire and rescue department and obtaining the Final NOC.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Tenderer shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

12. REJECTION OF INSTALLATION

Any item of system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, and erection or on completion at site may be rejected by the in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect / Consultant/ Client/ Project Manager so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Tenderer at his own expense and to the satisfaction of the Authority/Architect/Consultant.

After works have been accepted, the Tenderer may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Client/ Consultant/ Project Manager.

13. WARRANTY AND HANDOVER

The Tenderer shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.



14. HANDING OVER OF DOCUMENTS All testing and commissioning shall be done by the Tenderer to the entire satisfaction of the Client. And all testing and commissioning documents shall be handed over to the Client

The Tenderer shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Client.



CHAPTER F -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 -40°C to +85°C. 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, I_m , V_m 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 25°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

- 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.
- 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

- Internal Faults:** In built protection for internal faults including excess temperature, communication failure, and overload and cooling fan failure (if fitted) is obligatory.
- 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.
- 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.

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.
- 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 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 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 conform 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

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.

10. FIRE EXTINGUISHERS:

The firefighting system for the proposed power plants for the fire protection shall be consisting of:

- CO2 type 4.5 kg fire extinguishers in the control room for fire caused by electrical short circuits.
- Sand buckets in the control room. The installation of fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing the batteries and PCUs.

11. LIGHTENING PROTECTION

There shall be required number of suitable lightening arrestors installed in the array field. Lightening protection shall be provided by the use of metal oxide arrestors and suitable earthing such that induced transients find an alternate route to earth. Protection shall meet the safety rules as per Indian Electricity Act.

12. EARTHING PROTECTION

Each array structure of the PV yard should be grounded properly. In addition the lightening arrester/masts should also be provided inside the array field. Provision should be kept for shorting and grounding of the PV array at the time of maintenance work. All metal casing/shielding of plant should be thoroughly grounded in accordance with Indian Electricity Act./IE Rules. Earth resistance should be tested in presence of the representative of CLIENT/CLIENT after earthing by calibrated earth tester. INVERTER ACDB and DCDB should also be earthed properly.

13. DANGER BOARDS

Danger board should be provided as and where necessary as per IE act/IE rules as amended up to date.

14. DRAWING & MANUALS

- 5 copies of Engineering, electrical drawings and installation and O&M manuals are to be supplied with each Plant.
- Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, along with protection equipment. Approved ISI and reputed makes for equipment to be used.
- For complete electro-mechanical works, bidders shall supply complete design details and drawings for approval before progressing with the installation work.

15. TOOLS & TACKLES AND SPARES:

After completion of installation & commissioning of the power plant, necessary tools & tackles and spares are to be provided free of cost by the contractor for maintenance purpose. A list of requisite spares in case of Inverter comprising of a set of logic cards, IGBT driver cards, Junction Boxes, Fuses, MCCBs etc. along with spare set of PV modules shall be supplied with the equipment. A minimum set of spares shall be maintained in the plant itself for the entire period of warranty and O & M which upon use shall be replenished.

16. QUALITY AND ADAPTABILITY OF THE EQUIPMENT:

Bidders must verify the grid behavior, solar insulation levels, and general site conditions on their own before bidding. The bidder shall accordingly ensure that the equipment and the design submitted shall be able to perform as per guaranteed performance levels in the available site conditions. The design of the plant and the equipment offered by the bidders shall be evaluated for its quality and adaptability to the site conditions based on the purchasers past experience, projects earlier executed by the bidders and from other sources. Bidders must submit detailed technical operational parameters and latest performance indicators.



CHAPTER G -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 $\pm$ 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 $\pm$ 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.
- (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	1.20 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
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 / 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.
		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/ cm². 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

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.



CHAPTER H - LANDSCAPE

(NATIONAL BUILDING CODE OF INDIA 2016 VOLUME 2)

PART 10 LANDSCAPE DEVELOPMENT, SIGNS AND OUTDOOR DISPLAY STRUCTURES

SECTION 1 : LANDSCAPE PLANNING, DESIGN AND DEVELOPMENT

1 SCOPE

This Code (Part 10/Section 1) covers requirements of landscape planning, design and development with the view to promoting quality of outdoor built and natural environments and the protection of land and its resources.

2 TERMINOLOGY

For the purpose of this Section, the following definitions shall apply.

2.1 Avenue — A wide road or pathway lined with trees on either side.

2.2 Buffer — The use of landscape elements to reduce or curtail view, sound or dust with plants or earth berms, wall etc.

2.3 Canopy/Tree canopy — The average horizontal spread of the tree, taken from dripline to dripline.

2.4 Climber — A woody or herbaceous plant which either clings to a wall, trellis or other structures or can be supported or trained as it grows.

NOTE — It is sometimes also called creeper or vine.

2.5 Columnar — A slender, upright plant form.

2.6 Contour — The form of the land, existing or proposed; a part of the topography, indicated by map lines at intervals, to understand the landform clearly. The contour line is imaginary and indicates continuous elevation above mean sea level or an assumed datum line.

2.7 Contour Interval — The difference in elevation or the vertical distance measured between consecutive contour lines.

2.8 Drainage — Drainage is the natural or artificial removal of surface and subsurface water from an area through use of vegetated/open channel, pipes, drain boards, chambers, etc.

2.9 Egress — A way out, or exit.

2.10 Elevation — A contour line or notation of relative altitude with respect to a benchmark, useful in plotting existing or proposed feature.



2.11 Erosion — Wearing away of soils, rocks, sediments, etc, by gradual action of natural processes (such as water, wind and glacier).

2.12 Exotic — A plant that is not native to the area in which it is planted.

2.13 Fence — A barrier of plant or construction material used to define the boundary of an area and to restrict visual and/or physical access.

2.14 Foliage — The collective leaves of a plant or plants.

2.15 Geogrid — A deformed or non-deformed netlike polymeric material used with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of the human made project structure or system.

2.16 Geo-Textile — Any permeable textile or fabric (natural or synthetic) used to retain or protect soil and filter and drain water as an integral part of project, structure or system such as terrace garden, etc.

2.17 Girth of Tree — Girth is a measurement of the circumference of the trunk of a tree, measured perpendicular to the axis of the trunk. It is measured at breast height (1.4 m above ground level).

2.18 Grade — The slope or lay of the land as indicated by a related series of elevations.

2.18.1 Natural Grade — Grade consisting of contours of unmodified natural landform.

2.18.2 Finished Grade — Grade accomplished after landscape features are installed and completed as shown on plan as proposed contours or spot levels.

2.19 Gradient — The degree of slope of a pipe invert or road or land surface. The gradient is a measure of the slope height as related to the length. The slope is expressed in terms of percentage or ratio.

2.20 Grading — The cutting and/or filling of earth to establish finished contours.

NOTE — Grading facilitates good drainage and shapes land to suit the intent.

2.21 Grasses — Plants that characteristically have joint

stems, sheaths and narrow blades (leaves). **2.22 Grass Paver** — Grass paver is a permeable

structural grid cellular system (concrete, HDPE or any other polymer) for containing and stabilizing gravel or turf.

2.23 Green Roof — A roof surface of a building that is partially or completely covered with a growing medium and vegetation. Green roofs can be deep (intensive) or shallow (extensive).

NOTE — Intensive green roofs are elevated greens which can sustain shrubs, trees, walkways and benches with their complex structural support, irrigation, drainage and root protection



layers. Extensive green roofs are shallow, relatively light and are solely used for their environmental benefits. They support native ground cover that requires little maintenance.

2.24 Green Walls — A supporting structure completely or partially covered with vegetation which is grown with soil or growing medium. It can be either free standing or part of a structure. They include climbing plants such as vines that grow directly on the wall, or walls that comprise of modular panels, containers and an integrated irrigation system.

2.25 Ground Cover — The planting material that forms a carpet of low height.

2.26 Hard Landscape — Civil work component of landscape development such as pavements, walkways, roads, retaining walls, sculptures, street amenities, fountains and other elements of the built environment.

2.27 Hardy Plant — Plants that can withstand harsh temperature variations, harsh wind, pollution, dust, extreme soil conditions, and can tolerate either drought or flooding.

2.28 Heat Island Effect — A phenomenon in which air and surface temperature of an area are higher than nearby areas due to the replacement of natural land cover with pavement, building, and other infrastructure.

2.29 Hedge — Shrubs or trees (usually of the same species) planted closely together in a linear configuration. A hedge may be pruned to shape or allowed to grow to assume its natural shape.

2.30 Herb — A plant with a non-woody or fleshy structure. Certain herbs are highly useful for cooking or of high medicinal value.

2.31 Ingress — A way in, or entrance.

2.32 Invert — The lowest inside point of a pipe, culvert, or channel.

2.33 Irrigation — The artificial application of water, to assist in growing and maintenance of plants.

2.34 Kerb — A concrete or stone or similar hard edging along a pathway, or along a road, often constructed with a channel to guide the flow of stormwater.

2.35 Microclimate — A local atmospheric zone where the climate (temperature, humidity, wind, etc) differs from the surrounding areas. The term may refer to areas as small as a few square metres or as large as many square kilometres.

2.36 Mound — A small hill or bank of earth, developed as a characteristic feature in landscape.

2.37 Mulching — A practice of using a protective covering, usually of organic matter such as leaves, straw, placed around plants to retain moisture, improve soil conditions and prevent the growth of weeds.

2.38 Permeable Paving — Paving surfaces that reduce runoff by allowing rainwater to soak through the surface into the underlying sub-base where the water is stored temporarily before allowing it to seep into the ground or flow to the drains.

2.39 Plants — The living beings consisting of trees, shrubs, herbs, grasses, ferns, mosses, etc, typically growing in a permanent site, absorbing water and inorganic substances through their roots, and synthesizing nutrients in their leaves through the process of photosynthesis.

2.39.1 Endemic Plant — The plant which is found only in one geographic location on earth.

2.39.2 Invasive Plant — The species of plant which is not native to a specific location (an introduced species) and has a tendency to spread to a degree believed to cause damage to the environment.

2.39.3 Native Plant — A plant indigenous to a particular locale.

2.39.4 Naturalised Plant — A plant that is established as a part of the flora of a locale other than its place of origin.

2.40 Screen — A vegetative or constructed hedge or fence used to block wind, undesirable views, noise, glare and the like, as part of in landscape design; also known as 'screen planting' and 'buffer plantation' (see also 2.2).

2.41 Sediment — The product of erosion processes; the solid material, both mineral and organic, that is in suspension, is being transported or has been moved from its site of origin by air, water, gravity or ice.

2.42 Shelterbelt — Shelterbelt is usually made up of one or more rows of trees or shrubs planted in such a manner so as to provide shelter from wind, and protect soil.

2.43 Shrub — A woody plant of low to medium height, deciduous or evergreen, generally having many stems.

2.44 Soft Landscape — The natural elements in landscape design, such as plant materials and the soil itself.

2.45 Spot Elevation — In surveying and contour layout, an existing or proposed elevation of a specific point noted as a dot on the plan.

2.46 Street/Outdoor Furniture — Items of furnishing in outdoor landscape such as benches, trash receptacle signage, play equipment.

2.47 Swale — A linear wide and shallow depression used to temporarily store, route or filter runoff. A swale may be grassed or lined.

2.48 Topsoil — The uppermost layer of the soil.

2.49 Transplanting — Technique of moving a plant from the place where it is growing and replanting at another location.

2.50 Tree — A woody plant, generally taller than 2.00 m, with a well-distinguished trunk or trunks below the leaf crown.

2.50.1 Deciduous Tree — Tree that sheds all its leaves during a part of the year.

2.50.2 Evergreen Tree — Tree that remains green for most part of the year and sheds leave slowly throughout the year.

2.51 Tree Drip Line — The branch spread of a tree defined by the outermost circumference of a tree canopy where water drips onto the ground.

2.52 Tree Grate — A grille, installed at the base of a tree otherwise surrounded by pavement that allows the free passage of air, water, and nutrients to the tree root, but does not interfere with the foot traffic.

2.53 Tree/Plant Guard — The protection around a tree or plant to help prevent damage.

2.54 Xeriscape — A landscape that requires little or no irrigation or other maintenance.

3 STATUTORY APPROVALS : NOT APPLICABLE

4 LANDSCAPE SITE PLANNING REQUIREMENTS

4.1 Framing the Landscape Programme or Brief Every site has a history of use and change. Prior to formulation of a landscape master plan and its detailed design, an assessment of the landscape requirements for the site shall be established.

4.1.1 Location

Landscape development brief shall include appropriate approaches for regional and bio-climatic variations.

4.1.2 Site

Specific site factors such as topography, site aspect, hydrology, soils, existing vegetation, visual value, drainage, utilities, subsurface conditions, vegetation, microclimate, existing site infrastructure, built mass, traffic and connectivity shall be considered while developing the brief for landscape development.

4.1.3 Brief

Landscape development brief shall be in consonance with the statutory/development requirements.

4.1.4 Users

Landscape development brief should be framed for specific uses or user groups including understanding of social, economic and safety related aspects.

4.1.5 Landscape Development for Special Conditions The landscape development brief shall recognize special conditions, such as reclamation and/or rehabilitation of land, mitigation of other special existing conditions and conservation of existing value, prior to formulating a landscape master plan.

5 GENERAL LANDSCAPE DEVELOPMENT GUIDELINES

5.1 General

5.1.1 The general landscape development guidelines should be applied at two levels:

a) Masterplan level . This consists of those projects where the level of intervention is

restricted to large scale landscape site planning; and

b) Detailed landscape design level. This consists of those projects where detailed landscape design is involved. Open spaces are often further defined based upon access and ownership as public, semi-public and private.

Planning and design of open spaces should consider the following aspects:

1) Sustainability . Environmental sustainability and green principles may be incorporated to ensure that landscape development does not hamper the existing ecology of the site and its surroundings (see also Part 11 .Approach to Sustainability. of the Code). Land, vegetation and water sensitive design options may be explored during the design stage by incorporating a clear grading, drainage and planting strategy while developing the landscape concept. Cut and fill of the land may be minimized while locating the built blocks and circulation spaces. Gentler slopes with adequate green cover aids in erosion control thereby retaining the humus rich top soil. Stormwater runoff within the site may be filtered and either stored or allowed to recharge the groundwater table depending on the site conditions. As far as possible, it is desirable to use native and naturalized non- invasive species.

2) Accessibility . The planning and design of open spaces may be accessible for a wide range of users, including pedestrians, cyclist, transit riders and those using private modes of transport (see also 13 of Part 3 .Development Control Rules and General Building Requirements. of the Code). An ideal public space may be well connected to a surrounding bus/metro/mass rapid transit system facility or a neighbourhood street or a regional route.

3) Resilience . Resilience is the ability of a landscape to adapt to change and regain its original state when subject to shock, such as flooding, drought and pest attack. Landscapes have an inherent ability to exhibit resilience, while human altered landscapes should be designed to incorporate resilience as a core principle of design.

4) Ease of maintenance . Ease of maintenance may be regarded as an important consideration in a well-designed landscape. This may also aid in ensuring savings in energy and resources.

5.1.2 The various guidelines for landscape spaces may be grouped as follows, which are given in 5.2 and 5.3, respectively:

a) Guidelines for general open spaces . These pertain to open spaces framed for specific uses and user groups, and include understanding of social, economic and safety related aspects.

b) Guidelines for special conditions . These pertain to open spaces which are either ecologically or culturally significant, and may require special considerations, such as reclamation, rehabilitation, restoration and/or redevelopment.

5.2 Design Guidelines for General Types of Landscape Open Spaces

5.2.1 The design for the general type of open spaces should consider the following parameters:

a) Hierarchy of open spaces . Open spaces may be studied with respect to its relative size to better understand the complexities of the issues related to them, with respect to functional, visual and ecological concerns.

b) Usage of open spaces . Design of open spaces should have a certain character based on its usage. It is desirable that the design of these open spaces take into consideration the existing and proposed use of the open space, as well as the specific needs of the users.

The design of these spaces may also be reviewed in terms of whether they are public, semi- public or exclusively private spaces. Open spaces may be planned for a variety of functional uses by different users or diverse user groups, so that they are able to provide for a variety of recreational opportunities and spatial experiences.

c) Location of spaces . The design guidelines may be interpreted so as to suit the biogeoclimatic setting of these landscapes. The approach to planning and design of these open spaces would vary greatly depending on the climatic conditions and layout of the site. The specificities of the requirements for landscape should be studied in detail before commencing the planning and design process.

The following types of generic open spaces may be identified:

- 1) Regional parks/city parks,
- 2) Roads,
- 3) Public plazas and urban squares,
- 4) Multipurpose open spaces/mela grounds,
- 5) Urban riverfronts and waterfronts,
- 6) District parks/neighbourhood parks,
- 7) Theme parks/waterparks,
- 8) Sports facilities/playgrounds/stadium complexes/sports centre,
- 9) Golf courses/equestrian grounds,
- 10) Plant nurseries,
- 11) Pocket parks, and
- 12) Open spaces associated with largescale developments.

5.2.2 Design to Take into Consideration the Site Context

a) The site and context study are important tools for assessing the suitability of land use and nature of design intervention. The design for any particular site may be developed as an outcome of the site analysis.

b) The design may be conceptualized so as to maximize the site potentials while the site constraints should also be taken into consideration.

5.2.3 Design for Maximising Usable Space

a) Landscape elements, such as outdoor furniture, lighting and other required facilities, may be placed sensitively along the proposed circulation path with consideration of usage patterns.



b) Adequate shading may be provided for areas where the community congregates in warmer climatic locations, while areas designed for public gathering in cold regions may be shielded from wind.

c) The extent of the paved areas may be restricted to a minimum, keeping in mind the pedestrian routes, density of usage, spaces for congregation, etc. Paved areas may be planned so that they do not restrict any natural surface flow of water and nor do they get waterlogged during the rainy months.

d) Landscape design may be used to improve the environmental quality of the open spaces. Sufficient landscape may be provided at both horizontal and vertical planes to reduce the ambient temperature and glare. This may be in the form of conventional planting or devices like vertical green walls, green roofs, etc. Large unshaded paved plazas may contribute to urban heat island effect. See 7.1.2.2 and 7.4.7 of Part 11 .Approach to Sustainability. of the Code.

5.2.4 Provision for Various User Activities Spanning Different Age Groups

a) A variety of recreational options for different ages and interests may be provided.

b) Different cultural recreation preferences may be considered while designing open spaces by using community feedback to determine their needs and requirements.

c) A variety of amenities that encourage extended use, such as water fountains, and picnic tables, may be provided.

d) Plants for hiding and materials for making shelters may be considered. Opportunities to create appreciation for nature and the pleasure of discovering scientific phenomenon may be provided.

e) Spaces should be designed for use by people of all abilities, including those using mobility aids (for example, wheelchairs). See 13 of Part 3 .Development Control Rules and General Building Requirements. of the Code.

5.2.5 Provision for Free and Imaginative Play Opportunities in Children Play Areas

a) Opportunities for children to explore imaginative play through interaction with natural elements of their environment may be provided.

b) Raised beds or planting areas, play shelters, niches, sand areas, etc, may be provided.

c) Ways of functioning of natural systems within the site may be explored. For example, hydrology and water flows that attract butterflies, birds, and frogs may be considered.

d) Science play opportunities that stimulate curiosity about science may be provided. Suggested elements may include centrifugal force, sound waves, sunlight refractors, weather stations and windmills.

e) Signage that gives cues to parents about things to show or teach their children, using equipment or other elements of the playground, may be provided.

f) All possible efforts should be made to extend opportunities to children of all abilities and age, by providing access to a variety of play features and using features that appeal to all of the senses. See 13 of Part 3 .Development Control Rules and General Building Requirements. of the Code.

5.2.6 Design for Safety and Security

a) Hard landscape materials and their details may be worked out so that sharp corners, injurious edges and easily breakable materials are avoided in the public landscape.

b) Plant materials may be selected taking into consideration the possible issues of allergic reactions or toxicity.

c) Level differences in the open spaces may be treated with adequate care so as to avoid potential fall/injury. Level differences of a single step may be avoided in landscaped areas since they may aggravate the chances of tripping and injury.

d) Durable, easy to repair equipment and safety surfacing may be considered for play areas. International Safety Standards, such as fall zones, safety surface, fall height, and entrapment concerns may be considered for play equipment and surfaces. The flooring material of these spaces may be impact absorbing and injury proof.

e) In areas for smaller children, the number of exits and their placement may be limited so that they are easily monitored by parents and guardians.

f) Creation of hidden areas in the landscape should be avoided. The density of vegetation and height of the understory planting may be decided so as to keep the view-lines clear.

g) Lighting may be done so as to ensure that all usable areas of the landscape are well lit and there are no dark spots in the landscape.

5.2.7 Review of Existing Master Plans, Regulations and Initiatives Existing master plans, regulations, byelaws, etc, that may have defined uses, connections, materials or conventions, shall be reviewed for ensuring compliance. Design of public open spaces may address the concerns of the neighbourhood and express the identities of the neighbourhoods they pass through.

5.2.8 Design for Continuity Between Multiple Public Open Spaces and Parks

a) Linear parks may be used to provide continuous paths for bicycles and pedestrians.

b) Greenway plans may be researched and opportunities to connect greenway paths be explored so as to establish connections between adjacent neighborhoods. Pedestrian movement corridors may be given precedence over vehicular corridors.

c) Commuting or high speed bike lanes may be separated from the pedestrian paths.

d) Signage style and vocabulary along multiple open spaces and parks to guide users may be kept consistent for ease of understanding. See Part 10 .Landscape Development, Signs

and Outdoor Display Structures, Section 2 Signs and Outdoors Display Structures. of the Code.

5.2.9 Pathways and Pedestrian Movement Corridors

a) Pedestrian circulation path consists of sidewalks, wheelchair ramp, and landings. Footpaths of minimum width 1.80 m may be provided along the length of road for any public or private building where pedestrian traffic is expected. See 4.3.2.1 of Part 3 Development Control Rules and General Building Requirements. of the Code for computation of capacity of footpaths with respect to their widths.

b) Natural materials such as stone, or manmade materials such as tiles or cast in-situ concrete, of appropriate thickness may be used as paving finish in external areas. Adequate slope and drainage facility may be considered for all external paved surface integrating it with the pavement design.

c) Surface treatment of the finishes may be such that it remains anti-skid throughout the seasons. Smooth finish is not recommended for external areas except to convey any design concept.

d) Change in levels and steps may be depicted in different texture or colour as a visual clue.

e) The cross slope of sidewalk may be designed so as not to exceed two percent (1 in 50). The longitudinal slope of path may not exceed 1 in 20, unless the longitudinal slope of the road exceeds this maximum, in which case the norms applicable to a ramp should be applied. Kerb ramps may be provided at pedestrian crossings. See also 13 of Part 3 Development Control Rules and General Building Requirements. of the Code.

f) All ramps should have minimum width of 1.20 m, excluding edge protection. The cross slope of ramp should not exceed 1 in 50 and the longitudinal slope of ramp may not exceed 1 in 12. All ramps may have an unobstructed level landing both at top and bottom of the ramp. The landing may have the minimum width as that of the ramp. The landing may be minimum 1.50 m in length. Any ramp beside the road may be located in such a way so that vehicles cannot park blocking the access. The ramps shall also comply with the requirements of 13 of Part 3 .Development Control Rules and General Building Requirements. of the Code.

g) Handrails may be provided for any ramp with a vertical height greater than 150 mm, to prevent pedestrians and wheelchair users slipping from the ramp. The height of the top handrail may be 900 mm from the top surface of the ramp. The ramp surface may be rough finished. All ramp and landing may be designed so that water does not collect on the surface of the ramp or landing.

h) Requirements of 7.4.3 of Part 11 .Approach to Sustainability. of the Code should also be taken in to consideration.

5.2.10 Provision for Adequate Parking Requirements

a) Parking spaces may be provided off-street or as dedicated parking pockets with ample turning radii for manoeuvrability of vehicles.

- b) The parking lots need to be shaded during the day while being well lit during the night and should be easily accessible.
- c) Pedestrian connections to and fro the parking lots may be denoted with easily recognizable signage elements.
- d) The parking spaces shall be provided in accordance with 10 of Part 3 .Development Control Rules and General Building Requirements. of the Code.
- e) Parking bays for persons with disabilities shall be provided as per 13 of Part 3 Development Control Rules and General Building Requirements. of the Code.

5.2.11 Adopting Rational Approach to Grading

- a) Grading may be used to minimize creation of steep slopes and retaining walls in the landscaped areas by assessing the existing contours and locating the functional landscape spaces, taking into consideration the existing layout of the land.
- b) Site grading may generally be limited to areas adjacent to the building, under access roads and driveways, or in areas where cut and fill are inevitable such as those sites which are prone to landslides.
- c) Buildings and roads may be planned so as to generally follow the existing contours. On sloping sites, buildings may have multiple levels to maximize the potential of contoured sites.
- d) Wherever possible, measures like naturally stabilizing slopes and bio-engineering measures may be explored in order to avoid construction of retaining walls.
- e) Where grading occurs, new slopes may be configured to retain the natural character of the site. New contour lines may be carved to mimic the natural contours.

5.2.12 Designing for Road Landscapes

- a) Kerbs may be provided on the edges of the driveways to adequately control drainage within the road, prevent moisture from entering the sub-grade, separate the road from the pedestrian area, and provide adequate lateral support for the pavement structure.
- b) The roads should provide clear access to fire fighting vehicles, ambulance, sanitation vehicles, etc, and also allow for safe movement for vehicles, pedestrians and wheelchair users. The road widths, alignments and service lanes, etc, may be such that they are adequate as per the relevant Indian Road Congress Standards.
- c) Lane markings, kerb edges, central median, etc, may be provided for smooth movement of the traffic and also to guide the vehicles to stay within the designated driveways.
- d) Driveways may preferably be shaded by trees. The choice and appropriateness of selection of plants along the road should be in accordance with 7.
- e) Pedestrian crossings (on grade/subways/foot overbridges) may be provided along the pedestrian sidewalks at vehicular intersections to allow for continuous uninterrupted pedestrian movement.

f) Pathways along vehicular roads may be physically separated by means of kerbs, graded separation, barrier, railing, or other means to prevent ingress of vehicles.

g) Roads may be designed with provision for appropriate street furniture (see 13 and other urban adjuncts for the convenience of the users). Benches, shelters, poles, signs, bus stops, etc, may be located on edge of the sidewalk with clear minimum width of 1.20 m to enable unhindered pedestrian circulation.

5.3 Open Spaces Design Guidelines for Ecologically Sensitive Zones and Historic Precincts

5.3.1 This category includes open spaces which may require interventions, such as reclamation, rehabilitation, restoration and/or redevelopment. These kinds of open spaces may be broadly classified into the following types:

a) Ecologically sensitive zones

- 1) National sanctuary/nature park/reserve
- 2) City forests
- 3) Hills/ridge/rocky patches
- 4) Open spaces governed by coastal regulation zone requirements including but not limited to beaches, estuaries, backwaters, lagoons, creeks, sandbars, saltpans, etc
- 5) Wetlands, islands, river floodplains
- 6) Urban landfill reclamations
- 7) Greenways/Nature corridors
- 8) Desert Edges and wastelands

b) Cultural and historic zones

- 1) Tea gardens, plantations and other special landscapes
- 2) Existing rural landscapes
- 3) Historic city centres and heritage structures
- 4) Religious and culturally significant landscapes
- 5) Sacred groves
- 6) Zones inhabited by tribal settlements/indigenous communities
- 7) Open spaces associated to historic precincts including but not limited to monuments, palace complexes, mausoleums, cemeteries, etc

5.3.2 Site Processes and Climatic Considerations

Whether designing to avoid impacts to a significant landscape area or to restore an ecological community, a detailed analysis may be conducted to understand the dominant site processes.

The following processes may be considered:

- a) Topography;
- b) Hydrology;
- c) Biotic aspects (plants and animals);
- d) Biogeochemical processes; and
- e) Climatic considerations.

Stormwater adjacent to restoration areas may be managed to prevent any additional stormwater runoff to these areas. For water conservation practices, see Part 11 .Approach to Sustainability. of the Code, in addition to the following:

- 1) Surface water runoff may be directed towards designed bio-retention systems (for example, swales, rain gardens, or vegetated filters).
- 2) Wherever possible, stormwater may be used as a resource and the offsite impervious area water runoff may be captured so that this stormwater can be used where it is needed. Watershed impacts in landscape patches may be taken into cognizance during the design stages. Areas where upstream development may cause increased runoff may be designed with higher peak flows.
- 3) Planting areas may be incorporated so that they may capture and help in filtration and percolation of stormwater for ground water recharge.

5.3.3 Design as a Response to the Existing Environment

- a) Preservation of existing elements of value, such as mature trees, rocky outcrops, etc, may be considered.
- b) The historic precedents in the vicinity may be taken into consideration. Opportunities for passive recreation as well as active recreation may be considered so that it minimizes the impact on the natural condition of the open spaces especially in regional parks and city level parks encompassing large areas.
- c) The processes of site inventory, and site assessment and analysis may be done to confirm the value of the site which needs to be retained or preserved.
- d) The proposed usage of the site may be verified against the historical, cultural and ecological values of the site to ascertain the validity of the proposal.

5.3.4 Designing and Locating Landscape Lighting



- a) Haphazard placement of landscape light fixtures shall be avoided. The landscape light fixtures may be chosen from a pre-determined palette or designed so as to enhance and complement the character of the site.
- b) Light fixtures and fittings may be located in a sensitive manner so as to minimize the glare as well as prevent night sky pollution. See 7.5 of Part 11 .Approach to Sustainability. of the Code.
- c) The height of light fixtures should be decided based on their spacing to prevent wastage of energy or creation of dark patches.
- d) Sturdy and durable light fixtures may be chosen to prevent vandalism.

5.3.5 Protection and Conservation of Significant Landscape Areas

- a) Barriers should be placed to prevent dumping and to restrict vehicle access, wherever necessary.
- b) Hard surfaces, including bike trails and boardwalks may be developed and strategically placed so as to avoid dissecting, diminishing, or disturbing preservation areas.
- c) Opportunities for ecological and conservation research may be identified.

5.3.6 Identification of Ecological Communities and their Connectivity

- a) The type of vegetation community present, whether forest, shrub land, meadow, stream, tidal marsh or wetland, can guide the design for adjacent sites and the design and construction practices required to protect the community. Designers may familiarize themselves with the extent and history of the site. Imported soils, the elimination of a surface water source, or nutrient inputs may drastically change the structure and function of the site flora or fauna, and these changes may or may not be reversible.
- b) Surrounding areas for vegetation/wildlife movement opportunities or concerns to be explored. Linked parks may provide connectivity for plant species to spread seed and for smaller animals and birds to move. However, this may be both problematic and beneficial, as both desirable and undesirable species may spread.
- c) Native species may be encouraged to migrate to new areas by mimicking the conditions of successfully established habitat nearby. Barriers for the spread of invasive species may be created. Site disturbance adjacent to areas which harbour endemic species, may be minimized.

5.3.7 Enhancement of Habitat Opportunities

- a) Habitat areas may be established in those areas where human usage is compatible or acceptably low.
- b) Contiguous and dedicated open spaces may be established. The adjacent patches of species. habitat may be connected whenever possible, prioritizing areas adjacent to existing habitat for expansion.



c) For river corridors, conditions that encourage fish migration may be enhanced. If there are upstream migration blockages, they may have to be removed.

d) Planting areas that can capture stormwater may be included in the landscape. Native vegetation that is consistent with the site that provides wildlife food may be planted. Vegetation along water edges for fish protection from predators may be provided.

5.3.8 Compliance with State Level, National Level and International River Revitalization Treaties, Coastal Management Program Policies, River Cleaning Missions, etc

a) Underutilized areas may be restored.

b) Water dependent and recreational uses may be minimized.

c) Damage from flooding and erosion may be minimized using non-structural technologies.

d) The consumption of natural resources may be minimized through efficient planning and design.

e) Water quality standards should be adhered to and discharge of hazardous substances into coastal waters avoided.

f) Compatible land uses with surrounding properties may be promoted.

g) Impacts to navigable waters may be avoided.

5.3.9 Preservation of the Character of Existing

Landscapes of Ecological and Culturally Significant Landscape Areas

a) The history of a site, including original designs, past reconstructions, master plans and other development plans are important and shall be referred to understand and preserve important cultural landscapes.

b) A cultural landscape report may be prepared if the landscape is historically important.

c) Archeological investigation may be conducted, if found necessary.

d) Sites with potential buried resources should be granted protection.

e) For cultural landscapes, existing viewsheds may be preserved and enhanced through tree preservation, removal and replanting.

5.3.10 Design for Resilience and Ease of Maintenance

a) Detailed as-built drawings that show locations of all hidden utilities of the external areas may be provided. The documents containing waterproofing and protection layer details should be provided to the maintenance team.

b) Hose tapping points no more than 20 m from all planting areas may be provided to minimize hose-runs.



- c) The amount of funds for maintenance and manpower requirement for the external development zone may be assessed before initiating the design, and the design should be commensurate with the maintenance budget.
- d) Manuals for equipment operation and maintenance, for tools, and for replacement parts may be provided, to be kept in a locked cabinet on site.
- e) Adequate training should be provided to all the operations personnel and gardeners.
- f) Preparation of a post-occupancy maintenance plan may be done in accordance with 7.1.2.3 of Part 11 .Approach to Sustainability. of the Code.

6 SIGNAGE

Signage shall be in accordance with Part 10 .Landscape Development, Signs and Outdoor Display Structures, Section 2 Signs and Outdoors Display Structures. Of the Code.

7 PLANTING DESIGN – NOT APPLICABLE

8 SPECIFICATIONS FOR PLANTING WORKS

The requirements relating to plant materials and other materials; execution of work of tree planting, shrub planting and grassing; maintenance; etc, shall be as given in 8.1 to 8.6. The contractor shall furnish all materials, labour and related items necessary to complete the work indicated on drawing and specified herein and shall carry out maintenance of the premises for 12 months after completion of the work or as specified by the landscape architect.

8.1 Materials

8.1.1 Plant Materials

Plant materials shall be well formed and shaped true to type, and free from disease, insects and defects such as knots, windburn, injuries, abrasion or disfigurement. All plant materials shall be healthy, sound, vigorous, free from disease, insect pests, or their eggs, and shall have healthy, well-developed root systems. All plants shall be hardy under climatic conditions similar to those in the locality of the project. Plants supplied shall conform to the names listed on both the plan and the plant list. No plant material shall be accepted if branches are damaged or broken. All material shall be protected from sun and adverse weather until planted. Nursery stock shall be inspected and approved by the landscape architect and the horticulturist/botanist shall do the botanical authenticity of the selected species. All plants shall conform to the requirements specified in the plant list, except those plants larger than specified may be used if approved, but use of such plants shall not increase the contract price. If the use of the larger plant is approved, the spread of roots or ball of earth shall be increased in proportion to the size of the plant. Plants shall be delivered with legible identification labels.

The minimum acceptable size of all trees after pruning, with branches in normal positions, shall conform to the measurement specified in the bill of quantities unless stated otherwise. Caliper measurement shall be taken at a point on the trunk 1.0 m above natural ground. All trees supplied shall have terminal shoots. All specimen trees shall have a minimum crown spread of not less than half the size of the overall height.

8.1.2 Topsoil (Good Earth) with pH Range between 6.5 and 7.5 Topsoil or good earth shall be a friable loam; typical of cultivated top soils of the locality contains at least 2 percent of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, earth clods, sticks, roots or other objectionable extraneous matter or debris. It shall contain no toxic material. No topsoil shall be delivered in a muddy condition. Top soil in the project area shall be stripped, stacked, stored and used for filling on completion of construction.

8.1.3 Fertilizer

Dry farm yard manure shall be used. It shall be free from extraneous matter, harmful bacteria, insects or chemicals.

8.1.4 Root System

The root system shall be conducive to successful transplantation. Where necessary, the root-ball shall be preserved by support with hessian or other suitable material. On soils where retention of a good ball is not possible, the roots should be suitably protected in some other way which should not cause any damage to roots.

8.1.5 Condition

Trees and shrubs shall be substantially free from pests and diseases, and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots shall be subjected to adverse conditions, such as prolonged exposure to drying winds or subjection to water logging, between lifting and delivery.

8.1.6 Marking

Each specimen of tree and shrub, or each bundle, shall be legibly labelled with the following:

- a) Its name;
- b) Name of the supplier, unless otherwise agreed; and
- c) Date of dispatch from the nursery.

8.2 Execution

8.2.1 Fine Grading

Grades should be smooth and even on a uniform plane without abrupt changes or pockets and slope away from the buildings. The nominated landscape contractor should verify the surface drainage of planting areas and notify the landscape architect of any discrepancies, obstructions or other conditions considered detrimental to proper execution of the work and plant growth.

8.2.2 Landscape work should be tied to the existing condition such as existing trees, landscape features, utility lines, pavement kerbs. Finished grade should bear proper relationship to such control. The nominated landscape contractor shall adjust all works as

necessary to meet the conditions and fulfil the intention of the drawings. After initial settlement the finish grade should be as follows:

- a) Turf : 20 mm lower than adjacent walks/kerbs.
- b) Shrubs and : 40 mm lower than adjacent ground covers walks/kerbs. Prior to planting operation, the contractor should ensure all planting areas free of weeds, debris, rocks over 25 mm in diameter and clumps of earth that do not break up.

8.3 Tree Planting

8.3.1 Trees should be supplied with adequate protection as approved. After delivery, if planting is not to be carried out immediately, balled plants should be placed cheek to cheek and the ball covered with sand to prevent drying out. Bare rooted plants can be heeled in by placing the roots in a prepared trench and covering them with earth which should be watered in to avoid air pockets round the roots.

8.3.2 Digging of Pits

Tree pits shall be dug a minimum of three weeks prior to backfilling. The pits shall be 1 200 mm in diameter and 1 200 mm deep. While digging the pits, the topsoil up to a depth of 300 mm may be kept aside, if found good (depending upon site conditions), and mixed with the rest of the soil. If the soil is bad below, it shall be replaced with the soil mixture as specified further herein. If the soil is normal it shall be mixed with manure; river sand shall be added to the soil if it is heavy.

8.3.3 Flooding of Pits to Reduce Air Pockets The soil backfilled, watered through and gently pressed down, a day previous to planting, to make sure that it may not further settle down after planting. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all round for watering.

8.3.4 Planting

No tree pits shall be dug until final tree positions have been pegged out for approval. Care shall be taken that the plant sapling when planted is not buried deeper than in the nursery, or in the pot. Planting should not be carried out in water logged soil. Trees should be planted up to the original soil depth; the soil marks on the stem is an indication of this and it should be maintained on the finished level, allowing for setting of the soil after planting. All plastic and other imperishable containers should be removed before planting. Any broken or damaged roots should be cut back to sound growth. The bottom of the planting pit should be covered with 50 mm to 75 mm of soil. Bare roots should be spread evenly in the planting pit; and small mound in the centre of the pits on which the roots are placed will aid an even spread. Soil should be placed around the roots, gently shaking the trees to allow soil particles to shift into the root system to ensure close contact with all roots and to prevent air pockets. Back fill soil should be firm as filling proceeds, layer by layer, care being taken to avoid damaging the roots.

8.3.5 Staking

Newly planted trees shall be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

The main methods of staking shall be:

- a) A single vertical stake, 900 mm longer than the clear stem of the tree, driven 600 mm to 900 mm into the soil.
- b) Two stakes as above driven firmly on either side of the tree with cross-bar to which the stem is attached (suitable for small bare-rooted or balled material).
- c) A single stake driven in at an angle 45° and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake (suitable for small bare-rooted or balled material).
- d) For plant material 3 m to 4.5 m high with a single stem, a three-wire adjustable guy system may be used in exposed situations. The end of stake should be pointed and the lower 1.0 m to 1.2 m should be coated with non-injurious wood preservative allowing at least 150 mm above ground level.

8.3.6 Tying

Each tree should be firmly secured to the stake so as to prevent excessive movement. Abrasion shall be avoided by using a buffer, rubber or hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and also just above ground level; normally two ties should be used for tree. These should be adjusted or replaced to allow for growth.

8.3.7 Watering

The contractor should allow for the adequate watering in all newly planted trees and shrubs immediately after planting and shall, during the following growing season, keep the plant material well-watered.

8.4 Shrub Planting in Planters and Beds All areas to be planted with shrubs shall be excavated, trenched to a depth of 750 mm, refilling the excavated earth after breaking clods and mixing with manure in the ratio 8 : 1 (8 parts of stacked volume of earth after reduction by 20 percent; 1 part of stacked volume of manure after reduction by 8 percent). Tall shrubs may need staking, which shall be provided if approved by the landscape architect depending upon the conditions of individual plant specimen. For planting shrubs and ground cover shrubs in planters, good earth shall be mixed with manure in proportion as above and filled in planters. Positions of shrubs to be planted should be marked out in accordance with the planting plan. When shrubs are set out, precautions should be taken to prevent root drying. Planting holes 400 mm in diameter and 400 mm deep should be excavated for longer shrubs. Polythene and other non-perishable containers should be removed and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level, after settlement, will be at the original soil mark on the stem of the shrub. The hole should be back-filled to half its depth and firmed by treading. The remainder of the soil may then be returned and again firmed by treading.

8.5 Grassing

8.5.1 Preparation



During the period prior to planting, the ground shall be maintained free from weeds. Grading and final levelling of the lawn shall be completed at least three weeks prior to the actual sowing. Regular watering shall be continued until sowing by dividing the lawn area into portions of approximately 5 m² by constructing small bunds to retain water. These bunds shall be levelled just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that the soil has completely settled.

8.5.2 Soil

The soil itself shall be ensured to the satisfaction of the landscape architect to be a good fibrous loam, rich in humus.

8.5.3 Sowing the Grass Roots

Grass roots shall be obtained from a grass patch, seen and approved beforehand. The grass roots stock received at site shall be manually cleared of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained. Small roots shall be dibbled about 75 mm apart into the prepared grounds. Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.

8.5.4 Maintenance of Grassing

As soon as the grass is approximately 30 mm high, it shall be rolled with a light wooden roller in fine, dry weather. When it has grown to 50 mm to 80 mm above ground, weeds shall be removed and regular cutting with a scythe and rolling shall be then begun. A top-dressing of farm yard manure, bone meal at the rate of 50 g/m² and NPK (Nitrogen, phosphorus and potassium fertilizer) at the rate of 10 g/m² shall be applied when the grass is sufficiently secure in the ground to bear the mowing machine, the blades shall be raised 25 mm above the normal level for the first two or three cuttings. That is to say, the grass should be cut so that it is from 40 mm to 50 mm in length, instead of the 30 mm necessary for mature grass. In the absence of rain, during monsoon, the lawn shall be watered with sprinklers, every three days, soaking the soil to a depth of at least 200 mm. Damage, failure or dying back of grass due to neglect of watering specially for seeding out of normal season shall be the responsibility of the contractor. Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the contractor's expense. The contractor shall exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

8.5.5 Rolling

Lawn mower with roller shall be used periodically, taking care that the lawn is not too wet and sodden.

8.5.6 Edgings

These shall be kept neat and shall be cut regularly with the edging shears.

8.5.7 Watering

Water shall be applied at least once in three days during dry weather. Whenever watering is done, it should be thorough and should wet the soil at least up to a depth of 200 mm.

8.5.8 Weeding

Prior to regular mowing, the contractor shall carefully remove rank and unsightly weeds.

8.6 Maintenance

8.6.1 The landscape contractor shall maintain all planted areas within the landscape contract boundaries for one year until the area is handed over in whole or in phases. Maintenance shall include replacement of dead plants, watering, weeding, cultivating, control of insects, fungus and other diseases by means of spraying with an approved insecticide or fungicide, pruning, and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape contract area neat in appearance.

8.6.2 Pruning and Repairs

Upon completion of planting work under the contract, all trees should be pruned and all injuries repaired, where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches, and to compensate for the loss of roots and result of transplanting operations.

Pruning and removal of any part of plant materials should be done with clean sharp tools. Tools used to carry out the pruning work shall be appropriate for the task. The surface of tools and equipment shall be sterilized after use on the plant materials that are suspected or known to be diseased. Cuts on plant materials shall be made into the living tissues to induce callousing. Cut surface shall be flat, sharp and without jagged or torn edges.

Pruning shall be done in such a manner as not to change the natural habitat or special shape of the trees. Pruning operation shall consider carefully the natural growth pattern of branches on the tree, palm or shrub. Tree branches shall be pruned back to the collar at the base of the branch.

8.6.3 Tree Guards

Where tree guards are necessary, care should be taken to ensure that they do not impede natural movement or restrict growth.

8.6.4 Nursery Stock

Planting should be carried out as soon as possible after reaching the site. Where planting needs to be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be heeled-in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting needs to be delayed for more than a week, packed plants should be unpacked, the bundles opened up and each group of plants heeled-in separately and clearly



labelled. If for any reason the surface of the roots becomes dry, the roots should be thoroughly soaked before planting.

8.6.5 Protective Fencing

According to local environment, shrubs shall be protected adequately from vandalism, until established.

8.6.6 Routine Maintenance Work Schedule

Sl No.

Operation Frequency

(1) (2) (3)

i) Watering Checking all planting areas and pits and water as often as necessary to ensure that planting material does not dry out

ii) Weeding Monthly

iii) Edging Monthly

iv) Fertilizing:

a) Trees/palms Once every three months

b) Shrubs/ground covers Monthly

c) Grass Once every three months

v) Loosening of soil Monthly

vi) Control of pest by applying appropriate insecticides Fortnightly

vii) Control of disease by applying appropriate fungicides Monthly, increasing the frequency to fortnightly during rainy season

viii) Grass cutting Fortnightly

ix) Pruning and shaping trees/ palms Once every six month for small and low sagging branches

x) Staking As and when required

xi) Trimming shrubs/ ground covers Monthly or as when required

8.6.7 Clean-Up Works

There shall be areas designated by landscape architect for the contractor to carry out clean-up works. These shall include the following:

- a) Removal of dead and/or overhanging branches of existing trees, palms, shrubs and ground covers.
- b) Removal of any garbage and unsightly foreign materials.
- c) Removal of dead vines and plant materials. The contractor shall prevent damages to the existing plant materials, identified to be conserved. The plant materials that are to be conserved if damaged beyond use during the clean-up operations, the contractor shall be liable to replace the plant materials at his expense.

8.6.8 Restoration

The contractor is responsible for the use of all materials, labour and equipment and any injury to the plant material, labour and equipment shall be repaired or the same replaced by the contractor at his own expense.

8.6.9 Completion

On completion, the ground shall be formed over and left tidy.

9 SERVICE/UTILITIES IN LANDSCAPE DEVELOPMENT

9.1 Designed integration of structures and elements related to external services (underground and over ground utilities) with landscape is most essential for any outdoor space. This may, therefore, be taken care of in conjunction with the provisions under Part 4 Fire and Life Safety, Part 8 Building Services, Part 9 Plumbing Services and Part 11, Approach to Sustainability, of the Code.

The following services, generally, are the subject of design coordination work for external areas:

a) Stormwater drainage

- 1) Stormwater network;
- 2) Open drain and swale;
- 3) Subsurface drainage system;
- 4) Catch basin and manholes;
- 5) Culvert and bridge;
- 6) Percolation pits;
- 7) Water harvesting units;
- 8) Retention walls and tanks;
- 9) Connection of all service lines up to out-fall; and
- 10) Other related structures.

b) Sewage disposal system

- 1) Sewerage network;
- 2) Manholes, inspection chambers and grease trap;
- 3) Septic tank, soak-pits, sewage treatment plant and root zone unit;
- 4) Solid waste management units;
- 5) Connection of all service lines up to out-fall; and
- 6) Other related structures.

c) Water supply (including irrigation)

- 1) Water supply network;
- 2) Inspection chamber and valve chamber;
- 3) Water tank and treatment plant;
- 4) Tube well, bore well and associated pump houses, etc;
- 5) Service lines, elements associated with water features and pools; and
- 6) Irrigation lines and allied requirements.

d) Fire lines

- 1) Yard hydrant lines;
- 2) Yard or fire hydrants and hose reel box;
- 3) Fire water tank and pumps; and
- 4) Inspection chamber and valve chamber.

e) Electrical works

- 1) Electrical network;
- 2) Light fixtures for road, pedestrian paths, special landscape features and building façade;
- 3) Inspection chambers, junction boxes and feeder pillars;
- 4) Electric poles, high voltage lines and towers;
- 5) Transformer, substation and distribution box; and
- 6) Other related structures.

f) Telephone and underground cable network

- 1) Telephone network;
- 2) Inspection chambers;
- 3) Telephone poles, transmission towers; and
- 4) Other related structures.

g) Fuel and gas line

- 1) Supply network;
- 2) Inspection chamber and valve chamber;
- 3) Fuel tank and gas tank; and
- 4) Other related structures.

h) HVAC

- 1) Ventilation shafts for basement ventilation; and
- 2) Chiller and cooling towers.

9.1.1 The following guidelines shall be applied for the designed integration of external services networks and elements in the landscape proposal:

a) Manholes and inspection chamber covers for all external services should be adequately designed for the imposed load (pedestrian or vehicular) and the top finish level has to be in alignment or flushed with the pavement or finished ground level. The alignment of these structures should be such that it is in geometric perpendicular or parallel with adjacent building or landscape lines. This would facilitate easy and unobstructed movement for pedestrians and increase the accessibility for wheelchair users in public place and also aid the landscape geometry to be maintained.

b) Fire hydrants should be prominently located and integrated with the landscape. Aesthetically designed fire hose cabinet with clear access as per statutory norms for fire safety, to be located in geometric relation with adjacent building or landscape lines. These structures should not be a hindrance to vehicular or pedestrian movement.

c) Irrigation hydrants should be unobtrusively located and generally at the edge of shrub planting and additionally in close proximity to a drainage chamber or catch basin to avoid waterlog. Hydrants should not be located inside the chamber to minimize waterlog from leaking pipes causing various health related hazards. Hydrants should be located 200 mm above the ground level.

d) Landscape lighting is a specialized activity and illumination consultant or designer should develop the landscape lighting plan taking into consideration energy saving measures, safety aspects, lighting pollution and illumination level. Light fixtures are an important part of street furniture and it is advisable to use pole mounted light fixtures for public landscape than bollards that are prone to vandalism and damage.

e) Water body and fountains in public spaces should have filtration facility to avoid health hazards related to stagnant water. The piping should be concealed and the pump room, balancing tank and all other service structures to be designed as an integral part of landscape.

f) Storage facilities for inflammable liquid fuel and gas should be designed as an integral part of the landscape and should be housed in designed enclosures taking into consideration all statutory norms these structures are subjected to.

g) All underground service lines have to be well coordinated and stacked appropriately in the design stage to avoid overlaps and marked with indicators above the ground for ease in maintenance and servicing. Underground service stacks should be generally aligned in soft areas with no tree plantation, this would facilitate easy maintenance without disrupting the hard surface.

h) Designed façade for service structures that are above the ground in external areas is advisable so as to assist in developing aesthetically pleasing exterior environment. Such structures should be designed in a modular way so that it would be part of the street furniture.

10 ROOF LANDSCAPE : NOT APPLICABLE

11 PROTECTION OF LANDSCAPE DURING CONSTRUCTION

Development projects involve disturbance to the existing soil conditions, removal of existing trees and overall change in the microclimate and drainage pattern. Measures to minimize hazardous effects should be put into effect as explained below.

11.1 Pre-Construction Measures

Measures for the prevention of soil erosion, sediment control and management of stormwater shall be implemented as given in 11.1.1 to 11.1.5.

11.1.1 Timing of Construction

Construction work and erosion control applications shall be scheduled and sequenced during dry weather periods when the potential for erosion is the lowest. Slope protection techniques to control erosion shall be used when construction during wet season is unavoidable. Sedimentation collection systems, drainage systems, and runoff diversion devices shall be installed before construction activity. The landscape architect/engineer-in-charge shall monitor the site conditions and progress of work and schedule appropriate timing and sequencing of construction.

11.1.2 Preservation of Existing Vegetation

11.1.2.1 Protection of existing vegetation (including trees, shrubs, grasses and other plants) where possible, by preventing disturbance or damage to specified areas during construction is recommended. This practice minimizes the amount of bare soil exposed to erosive forces. All existing vegetation shall be marked on a site survey plan. A tree survey in prescribed format shall be carried out as indicated in Table 3.



The landscape plan should indicate trees, which have been preserved, and also those, which had to be transplanted or removed clearly differentiating between these three categories.

11.1.2.2 Trees retained on the project site shall be protected during the construction period by following measures:

a) Damage to roots shall be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint, and other materials detrimental to plant health by restricting these activities to outside the area of the canopy of the tree.

b) Trees shall not be used for support; their trunks shall not be damaged by cutting and carving or by nailing posters, advertisements or other material.

c) Lighting of fires or carrying out heat or gas emitting construction activity within the ground, covered by canopy of the tree shall not be permitted.

d) Young trees or saplings identified for preservation (height less than 2.00 m, 0.10 m trunk girth at 1.00 m height from finish ground, 2.00 m crown diameter) within the construction site have to be protected using tree guards of approved specification.

e) Existing drainage patterns through or into any preservation area shall not be modified unless specifically directed by the landscape architect/engineer-in-charge.

f) Existing grades shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the landscape architect/engineer-in-charge.

g) Maintenance activities shall be performed as needed to ensure that the vegetation remains healthy.

h) The preserved vegetated area shall be inspected by the landscape architect/engineer-in-charge at regular intervals so that they remain undisturbed. The date of inspection, type of maintenance or restorative action followed shall be recorded in the logbook.

11.1.3 Staging Areas

Measures shall be followed for collecting runoff from construction areas and material storage sites; diverting water flow away from such polluted areas, so that pollutants do not mix with stormwater runoff from undisturbed areas.

Temporary drainage channels, perimeter dike/swale, etc, shall be constructed to carry the pollutant-laden water directly to treatment device or facility. The plan shall indicate how the above is accomplished on site, well in advance of the commencing of the construction activity.

11.1.4 Preservation of Topsoil

Topsoil removal and preservation shall be mandatory for development projects larger than 1.00 hectare. Topsoil shall be stripped to a depth of 200 mm from areas proposed to be occupied by buildings, roads, paved areas and external services. Topsoil is rich in organic

content and is essential to establish new vegetation. It shall be stockpiled to a height of 400 mm in designated areas and shall be reapplied to site during plantation of the proposed vegetation. Topsoil shall be separated from subsoil debris and stones larger than 50 mm diameter. The stored topsoil may be used as finished grade for planting areas.

11.1.5 Spill Prevention and Control

Spill prevention and control plans shall be made, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, petroleum products, fertilizers and solvents.

11.2 Measures During Construction

During construction soil becomes unconsolidated due to removal of stabilizing material such as vegetation and disturbance of stabilized existing grade resulting in loss of topsoil and also deposition in undesirable places. A soil erosion and sedimentation control plan to be prepared prior to construction. The soil erosion, sediment control and stormwater practices should be considered whilst construction is proceeding, in accordance with 11.2.1 to 11.2.4.

11.2.1 Sedimentation Basin

A temporary dam or basin at the lowest point of the site has to be constructed for collecting, trapping and storing sediment produced by the construction activities, together with a flow detention facility for reducing peak runoff rates. This would allow most of the sediments to settle before the runoff is directed towards the outfall.

11.2.2 Contour Trenching

Contour trenching is an earth embankment or ridge-and-channel arrangement constructed parallel to the contours along the face of the slope at regular intervals on long and steep slopes (in sloping areas with slopes greater than 10 percent) (see Fig. 2). They are used for reducing runoff velocity, increasing the distance of overland runoff flow, and to hold moisture and minimize sediment loading of surface runoff. Vegetative cover of tree and native grasses in the channels may be planted to stabilize the slopes and reduce erosion.

11.2.3 Mulching

Mulching shall be used with seeding and planting in steep slope areas (slopes greater than 33 percent) that are prone to heavy erosion. Netting or anchoring shall be used to hold it in place. Other surface runoff control measures like contour terracing to break up concentrated flows shall be installed prior to seeding and mulching. Materials such as straw, grass, grass hay and compost shall be placed on or incorporated into the soil surface. In addition to stabilizing soils, mulching will reduce the stormwater runoff over an area. Together with seeding or planting, mulching aids plant growth by holding the seed, fertilizers and topsoil in place. It retains moisture and insulates the soil against extreme temperatures.

11.2.4 Geo-Grids



A deformed or non-deformed netlike polymeric material used with foundation, soil, rock, earth or any other geo-technical engineering-related material as an integral part of the human made project structure or system, called geo-grids may be used as control measure. On filling with lightly compacted soil or fine aggregate, a monolithic structure is created providing an effective means of confinement for unconsolidated materials within the cells and preventing their movement even on steep slopes. If required the area can then be seeded to maintain green environment. The junctions have a central opening through which water can permeate ensuring that organic material receives moisture for rapid growth.

12 SOIL AND WATER CONSERVATION

The soil conservation, sediment control and stormwater management practices as given under 12.1 to 12.3 shall be followed after construction is completed.

12.1 Vegetative Measures

The vegetative measures shall include the following.

12.1.1 Topsoil Laying

This includes the placement of topsoil or other suitable plant material over disturbed lands to provide suitable soil medium for vegetative growth. Topsoil laying shall involve replacing fertile topsoil that were stripped and stockpiled during earlier site development activities; the laid soil shall be stabilized before the next monsoon by planting grass, shrubs and trees.

The following guidelines shall apply to the placement of topsoil:

- a) Existing or established grade of subsoil should be maintained.
- b) A pH of 6.0 to 7.5 and organic content of not less than 1.5 percent by mass is recommended for topsoil. Where pH is less than 6.0, lime shall be applied to adjust pH to 6.5 or higher up to 7.5. Any soils having soluble salt content greater than 500 parts per million shall not be used.
- c) Prior to spreading the topsoil, the sub-grade shall be loosened to a depth of 50 mm to permit bonding. Topsoil shall be spread uniformly at a minimum compacted depth of on grade of 1:3 or steeper slopes; a minimum depth of 100 mm on shallower slopes is essential. A depth of 300 mm is preferred on relatively flatter land.

12.1.2 Planting/Vegetation Cover The most effective way to prevent soil erosion, sedimentation and to stabilize disturbed and undisturbed land is through the provision of vegetative cover by effective planting practices. The foliage and roots of plants provide dust control and a reduction in erosion potential by increasing the infiltration, trapping sediment, stabilizing soil, and dissipating the energy of hard rain. Temporary seeding shall be used in areas disturbed after rough grading to provide soil protection until final cover is established. Permanent seeding/planting is used in buffer areas, vegetated swales and steep slopes. The vegetative cover also increases the percolation of rainwater thereby increasing the ground water recharge.

12.2 Stormwater Management and Filtration Techniques The surface water flow is increased in urban areas due to predominance of hard surfaces. Stormwater

management techniques assure conservation of water thereby increasing the ground water recharge. Filters facilitate draining pollutants out from surface water runoff through straining before discharge into the drainage way. Rain water harvesting and sullage recycle systems need to be implemented on all new constructions over 1 000 m² in urban areas. See also Part 9 .Plumbing Services, Section 2 Drainage and Sanitation. and 7.2 of Part 11 .Approach to Sustainability. of the Code.

12.2.1 Rain Water Harvesting Structures in Urban Environment

12.2.1.1 Water harvesting refers to the collection and storage of rainwater and also harvesting surface and ground water, prevention of loss through evaporation and seepage, and other hydrological and engineering interventions aimed at conserving water.

12.2.1.2 The advantages of using rain water harvesting structures in urban areas are as follows:

- a) Water harvesting recharges ground water and is an ideal solution to water problems in areas with inadequate water resources.
- b) Increase in ground water aquifer level due to methods enhancing infiltration.
- c) Mitigation of the effect of drought.
- d) Reduction of stormwater runoff into the public drainage system.
- e) Reduction of flooding of the roads during monsoons.
- f) Removal of pollutants and soil from the stormwater runoff.
- g) Reduction of soil erosion.

12.2.1.3 Methods of ground water recharge may be as follows:

- a) Recharge pits.
- b) Recharge trenches.
- c) Reuse of abandoned dug wells.
- d) Reuse of abandoned hand pumps.
- e) Recharge shafts.
- f) Lateral shafts with bore wells.
- g) Spreading techniques like percolation ponds, check dams or gabion structures.

12.2.2 Structures for Rain Water Harvesting and Soil and Water Conservation

These may be as given in 12.2.2.1 and 12.2.2.2.

12.2.2.1 Infiltration techniques



- a) **Infiltration trenches** . An infiltration trench is a rock filled trench that receives stormwater runoff. Stormwater passes through a combination of pre-treatment measures, a grass swale and into the trench to be stored in void spaces and then infiltrates into the soil matrix.
- b) **Bio-filtration swale/grass swale** . Bio-filtration swales are vegetated channels with a slope similar to that of standard storm drain channels (less than 0.6 percent), but wider and shallower to maximize flow residence time and promote pollutant removal by filtration through the use of properly selected vegetation. It has to be designed to trap particulate pollutants (suspended solids and trace metals), promote infiltration and reduce the flow velocity of the stormwater runoff. It shall be integrated with stormwater system (see Fig. 3).
- c) **Sand filter** . Sand filters are devices that filter stormwater runoff through a sand layer into an underground drain system which conveys the water to a detention facility. They are effective in removing total suspended solids. The effectiveness of sand filtration is improved if it is preceded by a grass swale with infiltration trench.

12.2.2.2 Detention facilities

- a) **Wet ponds** . Wet ponds are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). Wet ponds retain the stormwater runoff in a permanent pool and facilitate pollution removal through settling and biological update.
- b) **Stormwater wet lands** . Stormwater wet lands are structures similar to wet ponds that incorporate wetland plants into the design. They have to be designed for treating stormwater runoff, and typically have less biodiversity than natural wetland systems. A distinction should be made between using a constructed wet land for stormwater management and diverting stormwater into natural wetland. The latter is not recommended because it would degrade the resource.
- c) **Wet vaults and storage tanks** . Wet vaults and tanks are underground facilities used for the storage of surface water, and typically constructed from reinforced cement concrete (vaults) or corrugated pipes (tanks). The water that is captured in these vaults and tanks may be used later for irrigation.

12.3 Conservation and Reuse of Water for Irrigation

The following measures shall be followed for design of irrigation systems for landscape works:

- a) Water conserving irrigation systems should differentiate between systems for different water use zones on the site. Supplementary irrigation sources should be used by means of appropriate water harvesting measures.
- b) The irrigation system should be designed considering the prevailing wind direction, slope and proposed grade, type of soil, soil percolation, and the type of vegetation to be watered.
- c) Spray irrigation to be designed to provide total head to head cover to avoid dry spots and spray on to paved areas and unplanted surfaces.
- d) Spray irrigation is to be avoided in areas of width less than 3.00 m.

e) Sullage recycle systems are ideal for large housing complexes and residential colonies. Sullage (or water from kitchens and bathrooms) is treated and recycled for gardening and toilet flushing reducing fresh water requirement by 60 percent. Irrigation system should be designed keeping sullage recycle in view.

f) For requirements regarding, the volume of water for different kinds of landscapes, Part 9 . Plumbing Services, Section 1 Water Supply. of the Code may be referred.

13 STREET FURNITURE

The design elements for outdoor spaces may be classified under the following categories:

a) Pavement and other pedestrian movement spaces, covering

- 1) Footpath with heavy pedestrian traffic,
- 2) Footpath with light pedestrian traffic,
- 3) Plaza and public assembly spaces,
- 4) Kerb to footpath, and
- 5) Steps and ramps.

b) Parking and vehicular movement corridor, covering

- 1) Parking unit,
- 2) Median and road divider,
- 3) Road marking, and
- 4) Speed breaker.

c) Traffic management units, covering

- 1) Bollards,
- 2) Barriers,
- 3) Crash guard,
- 4) Gate/Access control,
- 5) Vehicular height restrictors, and
- 6) Traffic separators.



d) Outdoor public conveniences, covering

- 1) Seating,
- 2) Drinking fountains, and
- 3) Toilet/Wash rooms.

e) Shelter and kiosks, covering

- 1) Bus shelters,
- 2) Police booth,
- 3) Telephone booth,
- 4) Milk booth/food stall,
- 5) Florist,
- 6) Information desk, and

7) Snack and coffee stall.

f) Outdoor illumination, covering

- 1) Street light,
- 2) Façade light, and
- 3) Ambient light.

g) Tree protection units, covering

- 1) Tree guard,
- 2) Tree grate, and
- 3) Planter.

h) Garbage collection units, covering

- 1) Litter bin, and



2) Spittoons.

j) Service utilities, relating to

1) Water supply network,

2) Stormwater network,

3) Sewerage network,

4) Electrical network,

5) Telephone lines,

6) Cable e-net,

7) Gas, and

8) Irrigation network.

k) Display and signage - Location of the street furniture shall be coordinated with the traffic flow pattern of vehicles and pedestrians and external services.



CHAPTER I - LIST OF APPROVED MAKES- CIVIL & PLUMBING SERVICES

S.No	Details of equipment/ material	Make/ Manufacturer
1.	Adhesive for Ceramic tiles	Cico / Pidilite / Ardex Endura / Sikka / Fosroc / BASF/Cera-Chem
2.	Adhesive for Wood Work	Fevicol/ Vamicol/ Dunlop
3.	Aluminium Composite Panels	Aludecor / Alucobond / Alstone/ Alstrong/ Eurobond
4.	Aluminium Extrusion/ Sections	Hindalco / Jindal / Indal
5.	Aluminium Fabricator	To be approved by the Engineer-in-Charge
6.	Anchor Fastner	Hilti/ Fischer/ Bosch
7.	Anti – Termite Treatment	It should be done by permanent members of IPCA as approved by Engineer-in-Charge.
8.	Automatic variable temperature control / fixed temperature control faucets	Jaquar/ Parry/ Angash
9.	Back up rod	Supreme Industry or equivalent
10.	Ball Cock	Sant/ L&T/ Audco/ Gpa
11.	Ball valves with floats	Zoloto/ Leader/ Sant/ Jayco/ Audco
12.	Batch Mix Concrete (BMC) / ReadyMix 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 producers shall be preferred.
13.	Brass stop & Bib Cock	Jaquar / Hindware / Crome /GROHE/ CERA
14.	Butterfly valves	GM / Uday / Parthiv / Zoloto/ Leader / Audco
15.	C.I. Manhole Covers	Neco/ R.I.F./ B.I.C./ Hepco/ SKF/ Kajeco
16.	C.P. Fittings Mixer / Pillar taps/ C.Pbrass angle valve/ Valves Washers, C.P. brass accessories	Jaquar/ Queo / Hindware / Kohler / /GROHE/ CERA
17.	C.P. Waste, Spreaders, Urinal	Jaquar/ Queo / Hindware / Kohler /GROHE/ CERA
18.	Cement	ACC, ULTRATECH, JP,AMBUJA/ INDIA CEMENTS
19.	Cement: White	Birla White/ JK / Ultratech Cement Ltd.
20.	Clear Glass / Clear Float Glass /Toughened Glass	Saint Gobain (SG)/ Asahi India Safety GlassLtd/ Modiguard

21.	Cockroach Trap	Chilly/ Player/ Camry/ Viking
22.	Compressed Chequered tiles	Somany/ Kajaria/ Nitco/ Orient/ Johnson
23.	Concrete Additive	Sikka/ Pidilite/ Fosroc/ MC Bauchemie / Fibrex / BASF/ Cera-Chem
24.	Copper Fittings (Capillary)	Yorkshire Imperial, U.K./ Rajco Metal Works Mumbai/ IBP Conex Ltd.
25.	CPVC Pipes & Fittings	Supreme/ Astral/ Finolex/ Prince
26.	Curtain Rod/Drapery Rod	Vista work/ Mac Décor
27.	Dash Fasteners	Hilti/ Fischer/ Bosch/ Canon
28.	Disc Filter	Azud/ Spain/ Amaid/ Arkal
29.	Door closer / Floor spring	Everite/ Hardwyn/ Doorma/ Godrej / HETTICH,
30.	Door Locks	Godrej/ Harrison/ Link
31.	Door Seal – Woolpile Weather Strip	Anand Reddiplex / Enviroseal
32.	Doors & Windows Fixtures / Fitting.	Everite / Classic/ Crown/ Earl Bihari / Ozone
33.	Drainage Pumps	Grundfos/ KSB/ Salmson/ Kirloskar/ DP Holland
34.	Ductile Iron Fittings (IS:9523)	Electrosteel/ Kesoram/ Tisco/ Jindal
35.	Ductile Iron Pipes (IS:8329)	Electrosteel/ Kesoram/ Tisco/ Jindal
36.	E.P.D.M Gaskets	Anand Reddiplex / Enviro Seals
37.	False Ceiling - Calcium Silicate Boards & Tiles	India Gypsum/ Aerolite/ RAMCO (Hilux)/ Saint Gobain (Gyproc)
38.	False Ceiling - Metal	Armstrong / Hunter-Douglas/ USG Knauf
39.	False Ceiling - Mineral fibre	Armstrong/ Decosonic / USG Knauf / Saint Gobain
40.	False Ceiling – Cement fibre	Everest / Gypro /Visaka /Saint Gobain .
41.	False Ceiling – Antibacterial / Microbiological Tile	Everest / ZICA /Saint Gobain .
42.	Fire rated Doors & Frames	Shakti-Hormann / Navair / Pacific
43.	Fire Rated Glass	Asahi India Safety Glass Ltd./ Modi/ Saint Gobin
44.	Fire Retardant Paint	Navier/ Nullifire/ Berger
45.	Fire Seal	Sealz/ Alstroflam/ Abacus



46.	Fire: Door Closures, Mortice Deadlocks	Becker Fire Solution/ Inersoll Rand LCN Series/ Dorma TH Series/ Godrej
47.	Fire: D-Type Pull Handles	Becker Fire Solution/ Dorma/ Hardwin/ Godrej
48.	Fire: Hinges	Becker Fire Solution/ Inersoll Rand/ Dorma
49.	Fire: Panic Exit Devices	Becker Fire Solution/ Inersoll Rand LCN Series/ Dorma PHA Series/ D-line
50.	Fire: Tower Bolts	Suzu/ Nulite/ Dorset/ Dorma
51.	Glass : Float & Mirror	Saint Gobain/ Asahi India Safety
52.	Glass for Aluminum Doors/ Windows/Structural Glazing	Modiguard/ Saint Gobain/ Asahi India Safety Glass Ltd.
53.	Glass Wool / Insulation Boards	Rockwool/ UP Twiga/ Lloyd Insulation
54.	Grab bars and Disabled Hardware	Dorma/ D-line/ Cera/ Jaguar/ Hindware / Ozone
55.	Gypsum Board / Gypsum False Ceiling/ Gypsum Partitions	USG Knauf / India Gypsum/ Saint Gobain (Gyproc)
56.	Hand Drier	Kopal/ Utech Systems/ Euronics Automat
57.	MS Saddle with G.I. Riser	Harvel/ Alprene/ Rain Bird, USA
58.	Night Latch	Godrej/ Harrison/ Link / Ozone
59.	OT: Conductive Flooring: ESD-Control Tile Flooring	Tarkett/ Gerflor/ Polyflor, / Armstrong
60.	P.T.M.T. Fitting	Cera/ Prayag/ Polytuf
61.	Paints - Cement Based	Snowcem Plus/ Asian/ Dulux/ Berger/ Nerolac/ Jotun
62.	Paints - Other Paints / Primer	ICI Dulux/ Asian / Nerolac/ Berger/ Nippon/ Jotun
63.	Paints - Plastic Emulsion Paint	ICI Dulux/ Asian / Nerolac/ Berger/ Nippon/ Jotun
64.	Paints - Synthetic Enamel Paints	ICI Dulux (Gloss)/ Asian (Apolite)/ Berger/ Nerolac/ Jotun
65.	Paints - Texture paint	Spectrum/ Unilite Heritage/ Asian/ Berger/ Jotun / Unistone
66.	Plywood/Block board/Ply board	Duro/ Greenply/ Century/ Kitply/ Archiply/ Merino
67.	Polycarbonate Sheets	Galina/ GE Plastic / Dan Pal / Tuflite
68.	Polyethylene Storage Tank	Sintex / Polycon/ Fusion
69.	Powder Coating Material pure Polyester	Jotun / Berger / Goodlass Nerolac



70.	Pre-coated Galvanised Steel Sheet	Tata BlueScope / Llyod Insulations India Ltd / Multicolor,
71.	Pre-Laminated Particle Board	Novapan /Century /Green Ply /AK Plywood/ Merino
72.	PVC Doors	Sintex/ Polyex/ Rajshri
73.	PVC Flooring	LG Floors / Gerflor/ Polyflor / Vibrant Floor / Armstrong / Takrket
74.	PVC Wall Cladding	LG Floors / Gerflor/ Polyflor / Vibrant Floor / Armstrong / Takrket
75.	PVC flushing cistern	Commander / Parryware / Hindware/ Jaquar
76.	PVC Pipes & fitting, Waste & VentPipes and fittings, Type B PVC Casing & Screen Pipes	Prince / Supreme / Finolex / Astral
77.	PVC Water Stops	Prince /Supreme/ Finolex /Astral
78.	R.C.C Pipes	Indian Hume Pipe/ Pragati Concrete Udyog/ ISI Marked Pipes/ Daya/ KK/ JSP
79.	R.O. Water Purifier Unit	Eureka Forbes/ Kent/ Zero B/ Dr. RO / Hindustan Lever
80.	Reinforcement Steel / Structural Steel	TATA, SAIL, RINL
81.	RQRC Hydrant	Harvel/ Alprene/ Rain Bird, USA
82.	RQRC Key	Harvel/ Aqua/ Drip & Drip
83.	Sensor Operated Auto FlushingSystem Urinals	Jaquar/ Hindware/ Kohler/ Parryware
84.	Silicon sealants /Weather Sealant /Structural Glazing Sealant	GE- Silicon/ Pidilite/ Forsoc/ CICO/ Sikka/Cera-Chem
85.	Sluice valve / NRV	Kirloskar/ IVC/ Kilburn/ Zoloto/ Castle/ Leader/ L&T/ Audco
86.	Stone ware pipes & Gully Traps	Perfect / SKF/ R.K/ Hind/ Anand/ Burn
87.	Submersible Drainage pump	Grundfos, CRI, Kirloskar, Mather&Platt, KSB
88.	Sunken Portion Treatment	Sika/ CICO/ BASF/ Dr. Fixit/ Fibrex / Pidilite, FOSROC,
89.	Super plasticizer	CICO/ Roffes Construction Chemicals/ Pidilite Industries/ Bostik
90.	Tiles: Ceramic tiles	Kajaria / Johnson/ RAK/ NITCO / Somany
91.	Tiles: Glazed (Ceramic) tiles	Kajaria / Johnson/ RAK/ Somany / NITCO
92.	Tiles: Heat Resistant Terrace Tiles	Thermatek or equivalent

93.	Tiles: Vitrified Tiles (Double / MultyCharged)/ Germ free	Kajaria/ Johnson/ RAK/ Somany
94.	ACID AND ALKALI RESISTENT TILES	KAJARIA, NITCO , SOMANY
95.	UPVC Pipes & fittings	Finolex/ Supreme/ Astral/ Prince/ AKG / Ashirwad
96.	Vacuum Dewatered Flooring	Tremix/ Sun Build/ Avcon technics
97.	Valve Box	Rain Bird/ Carson Brook/ Dura
98.	Veneered Particle Board	Greenply/ Century/ Novapan
99.	VFD Pump	Crompton/ Kirloskar/ Grundfos/ Wilo -Mather & Platt
100.	Vibration Eliminator Resisto-flex Pads& Connections	Mason/ Tozen/ Resistoflex/ Relay Corpn./ Kanwal
101.	Vitreous China/ Sanitary ware/ WCPan/ European WC/ Urinal/ Wash basin/ PVC Waste Pipe/ Waste coupling/ Towel Rail	Parryware, Jaguar & Hindware
102.	Water Cooler	Blue Star/ Voltas/ Usha/ Godrej
103.	Water Meter	Kant/ Vsan/ Kranti/ Anand/ Aristo/ Dasmesh/ Chambal
104.	Water Proofing treatment Agencies	To be approved by the Engineer-in-Charge
105.	Water Proofing Materials (Bitumenistic)	Cera-Chem / Fosroc / Sikka / Pidilite / Fibrex / / CICO / BASF/ Dr. Fixit
106.	Water supply pumps	Grunfos/ Kirloskar/ Crompton/ Wilo -Mather & Platt
107.	Gun Metal gate valve	Leader/ Krioloskar/ Sant/ Zoloto/ Jaquar
108.	Brass Ball Valve	Supreme/ Finolex/ Astral/ Kirloskar
109.	CP Brass Fittings	Parrryware / Hindware/ Jaquar/ Kohler / Cera
110.	SS Gratings/ Soap Dish/ Towel Railand other SS fitting	Camry / Gem/ Jaquar/ Grohe / Jayna/Chilly
111.	SW pipes & gully trap	Perfect/ S.K.F/ R.K/ Hind/ Anand
112.	RCC NP2 Pipes	Spun pipes/ Hume pipes/ MCP
113.	Safety foot Steps	MCP/ GP/ Surabh
114.	PVC Floor trap	Jay/ Saffron/ Platinum/ Khodiyar/ Supreme/ Finolex
115.	Centrifugal pump set	Grundfos, CRI, Kirloskar,/ Wilo -Mather & Platt
116.	Crash Guard/ Corner Guard	MDD/ TSI/ LSR/ Radius

117.	Door Shutter - Flush	Duro/ Greenply/ Archiply/ Century/ Merino
118.	Fire: Sealant	Birla/ 3M/ Hilti
119.	Paver blocks/ Tiles (All Types)	NITCO/ ULTRA/ DURACRETE
120.	Polyethylene Storage Tank	Hindware/ Neelkanth/ Nirali / Sintex
121.	Stainless Steel Sink	Fenesta/ CASSA/ Evolution/ Kommerling/ Neelkant / Kingston / Jayan
122.	UPVC Toilet Doors	FENESTA , NCL WINTech , VEKA
123.	Extension nipple	Loki / viking
124.	Level Controller & Indicator (Water	Auto Pump,Cirrus Engineering,
125.	Air Release Valve	Arco, Itap , Marck & RB
126.	Y Strainer	Emerald / Leader / Marck-Cair,Sant / Zoloto .
127.	Check Valve (non return valve)	Advance/ Audco/ Leader/ Intervall/ Zoloto .
128.	Strainer	Zoloto/ Leader/ Emerald/ Sant/ DS Engg./Trishul
129.	Float Valve	Muesco, Singer, OCV, Watts, Leader, GG
130.	Flexible Connection	Parryware/ Hindware / Jaguar / Metaflex/ Tozen/ Mason
131.	Foot Valve	Leader, Socla, France., Val-Matic, Kits, Crane
132.	Floor drain, Roof drain, Floor Cleanout,	Chilly, Local Manufacturer
133.	Pressure Gauge Set	Pressure Gauge Set
134.	Automatic Air Vent	Val-matic, Metaflex, APCO & RB
135.	Water Hammer Arrestor	Hydra-Restor, Zurn, PPP
136.	Flow Switch	Potter Electric/ System Sensor/ Viking
137.	Vibration Isolator	Mason/ Tozen/ Resistoflex
138.	Starter	Square D/ GE/ Westinghouse/ Siemens/ ABB



LIST OF APPROVED MAKES

APPROVED MAKES - ELECTRICAL WORKS		
S.No.	ITEM	APPROVED MAKES
1	HT PANEL (RMU)	SIEMENS / LUCY / ABB / SCHNEIDER /SYSTEM CONTROL
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 TECHNOLOGIES / CAPE ELECTRIC / OBO BETTERMAN
7	UPS	NUMERIC / ABB / APC / SOCOMEC / VETRIV
8	BATTERY	EXIDE/AMAR RAJA / HBL / TATA GREEN
9	DG SET	
	ENGINE	CUMMINS /KIRLOSKAR /LEYLAND / PERKINS /GREAVES/ BAUDIN
	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	LEGRAND - DPX3/ ABB - XT2 & XT4 SERIES / SCHNEIDER - NSX / SIEMENS - 3VA2
13	AUTO TRANSFER SWITCH	HPL /ABB /SCHNEIDER
14	CONTACTORS	ABB / SCHNEIDER / SIEMENS / L&T
15	DIGITAL METERS (MFM)	HPL / SCHNEIDER / RISHABH / L&T / TRINITY / ABB/ SECURE
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	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 / GE / SCHNEIDER

24	LT CABLES	POLYCAB / FINOLEX / KEI/ HAVELLS/ RR KABLES
25	LT CABLE TERMINATIONS	JAINSONS/ COMET/ OBO BETTERMAN / DOWELLS / HEX
26	CABLE TRAY	OBO BETTERMAN / PROFAB / NIEDAX / PUSHPAK / FERROGRATE
27	MCB DBs	LEGRAND / PANASONIC/ ANCHOR / SCHNEIDER/ ABB
28	MCB / RCCB	ANCHOR / PANASONIC / LEGRAND / SCHNEIDER / SIEMENS / ABB
29	LIGHT FIXTURE	PHILIPS / WIPRO / HAVELLS / BAJAJ
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	LEGRAND / ANCHOR / PANASONIC / CRABTREE / SCHNEIDER
38	METAL CLAD PLUG & SOCKET	LEGRAND / ANCHOR / HAVELLS / SCHNEIDER / ABB
39	ISOLATOR	LEGRAND / ANCHOR / PANASONIC / SIEMENS /SCHNEIDER/ABB
40	PRESENCE SENSOR	LEGRAND /HAGER / PHILIPS / WIPRO / PANASONIC
41	AVIATION LIGHT	BAJAJ / CROMPTON / PHILIPS
42	WATER PROOF BOXES	HENSEL / SCAME / CAPE ELECTRIC
43	SOLAR SYSTEM	HHV/ VIKRAM SOLAR / WARRE/ EMVEE/ TATA SOLAR



LIST OF APPROVED MAKES

ELV SYSTEM		
1	TELEPHONE WIRE	ANCHOR / RR KABLES / FINOLEX CABLES / HAVELLS / POLYCAB
2	TV SPLITTER BOX	SHYAM ANTENNA / CAT VISION / SWIFT
3	TELEPHONE / TV SOCKET	ANCHRO / PANASONIC /LEGRAND / CRABTREE / SCHNEIDER
4	TELEPHONE DISTRIBUTION FRAME	KRONE / CONNECTWELL / SCHNIDER
5	CAT6 CABLE	MOLEX / CLIPSAL / AMP / LEGRAND
6	EPABX	SYNTEL / MATRIX / ALCATEL / BPL
APPROVED MAKES - CCTV		
1	DOME AND BULLET CAMERAS	AXIS /HONEYWELL / GE / TYCO / HIKVISION / CP PLUS
2	IP CCTV SOFTWARE	
3	SERVER / PC /MONITOR	IBM / HP / DELL / COMPAQ / SAMSUNG
4	NETWORK VIDEO RECORDER	HONEYWELL / BOSCH / GE / TYCO / HIKVISION / PELCO / MATRIX / DAHUA
5	POE NETWORK SWITCHES	CISCO / 3COM / NORTEL/HP/ D-LINK
6	CAT6 TYPE PVC SHEATHED CABLE, WITH ALL FITTINGS & ACCESSORIES	MOLEX / CLIPSAL / AMP / LEGRAND
7	PVC CONDUITS AND FITTINGS	ANCHOR /SUPREME /AVONPLAST / PRECISION / BAJAJ
8	NETWORK RACK	NETRACK / VALRACK / RITTAL / D LINK



LIST OF APPROVED MAKES OF FIRE FIGHTING SYSTEM INSTALLATION

APPROVED MAKES - FIRE FIGHTING		
1	MS / GI PIPES	JINDAL(STAR) / TATA / SURYA ROSHINI
2	HYDRANT VALVE	NEWAGE / WINCO / SHAHBHOGILAL (AAG) /MINIMAX
3	HOSE REEL	NEWAGE / WINCO / SHAHBHOGILAL (AAG) /MINIMAX
4	BRANCH PIPE	NEWAGE / WINCO / SHAHBHOGILAL (AAG) /MINIMAX
5	FIREMANS AXE	NEWAGE / WINCO / SHAHBHOGILAL (AAG) /MINIMAX
6	AIR RELEASE VALVE & BALL VALVE	ZOLOTO / NEWAGE / LEHRY
7	FIRE BRIGADE INLET	NEWAGE / WINCO / SHAHBHOGILAL (AAG) /MINIMAX
8	HOSE BOX	NEWAGE / WINCO / SHAHBHOGILAL (AAG) /MINIMAX
9	FIRE EXTINGUISHERS	CEASEFIRE / SECUREZONE /MINIMAX / SAFEX
10	FIRE SIGNAGES	PROLITE / ASES / AUTOLITE
11	PRESSURE GAUGE	H GURU / WIKAI / BAUMER
12	PRESSURE SWITCH	INDFOS / SYSTEM SENSOR/ SWITZER /DANFOSS
13	PAINT (color coding as per IS)	ASIAN / BERGER / NEROLAC



14	WELDING ELECTRODES	ESAB / ADVANI / COSMOS /ADOR
15	MCC PANEL (COMPONENTS)	L&T / SCHNEIDER / ABB
16	FASTNERS	FISHER / HILTI / HIGHTECH / MUPRO
17	PIPE CLAMP AND SUPPORT	CHILLY / EUROCLAMP / MUPRO / HILTI
18	MECHANICAL SEAL	BURGMAAN /SEALOL /HILTI / BIRLA 3M / KBS
19	Y STRAINER	EMERALD /SANT / ZOLOTO
20	SLUICE VALVE	NORMEX / ADVANCE / INTERVALVE/AUDCO/ZOLOTO

APPROVED MAKES - ELEVATOR	
1	OTIS / SCHINDLER/ MITSUBISHI / KONE / JOHNSON

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

