

HLL INFRA TECH SERVICES LIMITED
(Subsidiary of HLL Lifecare Ltd., A Government of India Enterprise)

TENDER
FOR
DEVELOPMENT OF DISTRICT HOSPITAL PALAKKAD

Volume- IV

TECHNICAL SPECIFICATION

Tender No. HITES/IDS/22/28
(e-tender ID: 2023_HITES_567158_1)



Golden Jubilee Block, HLL Bhavan,
Poojappura P.O
Thiruvananthapuram
Ph: 0471 -2775500

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CHAPTER A

A BRIEF OF REQUIREMENT OF THE WORK

General Scope of Work:

The scope of work includes Construction of Civil works, Plumbing works, Electrical works, ELV, HVAC, Fire fighting works, Lift, External Signages, Building Signages, Substation & DG Building, RWT, Sump & Pump room, Septic tank, Collection tank, Site development (Incl. Compound wall, Gate, Drain, Demolition of Existing Septic Tank, Cable trench, road works, paver block etc.), Landscaping, Medical Gas System etc.

Details of Proposed Building :

No: of blocks proposed : 4 (Main Building, Substation, Incinerator, Toilet)

No: of storeys of Building : Main Building - 7 floors
: Substation - 2 floors
: Incinerator - 1 floor
: Toilet Block - 1 floor

Total area of each block : Main Building : 19867.506 m²
: Substation : 414.170 m²
: Incinerator : 54.000 m²
: Toilet Block : 60.860 m²

Floor wise Height : Main Building:-
LGF -3.6m; UGF, FF, SF, TF-3.9m; FF-4.2m;
LTF-3.3m, UTF-3.0m
: Sub Station: -GF-5.85m; FF-4.8m
: Incinerator: -4.8m
: Toilet Block: - 4.0 m

Total Height :34.35 m

Details of Existing Building:

- i. Police Aid Post & Radiology Department
- ii. Electrical Transformer Room
- iii. Female Payward
- iv. Female Payward
- v. Emergency & Trauma Care
- vi. De-addiction centre
- vii. Inquest Room
- viii. Mortuary
- ix. DNB Academic Center

- x. KHRWS Payward
- xi. KHRWSPayward
- xii. District Drug House
- xiii. Electrical Room
- xiv. Limb Fitting centre
- xv. Doctor Room
- xvi. TB Centre
- xvii. Pharmacy Store
- xviii. Pharmacy Store

Details of buildings to be demolished under hospital authorities scope:

Before construction:

- i. Nehru Ward
- ii. Surgery, OP Rooms
- iii. RBSY Counter
- iv. Canteen
- v. Old Building
- vi. Dumping area
- vii. District Chain Cold Equipment Workshop
- viii. Static workshop
- ix. GentsPayward
- x. Power Laundry
- xi. Rest room
- xii. Comfort station

After construction:

- i. Medical Shop
- ii. Dedicare Clinic Laboratory
- iii. Female Payward
- iv. Medicare District Laboratory
- v. Self Guard
- vi. Comfort Station
- vii. Karunya Medical Store
- viii. A R Menon Block
- ix. Incinerator Room

Details of Statutory Clearances:

Building Permit	- Obtained from Local Body
Fire NOC	- Obtained from Fire Department
PCB	- Under process
ECBC	- Under process

Type of Building : RCC Framed Structure

Foundation for proposed Structure : Pile Foundation

<u>Services:</u>	
a. Electrical	2 Nos 1000kVA transformer, 2 Nos 750kVA DG set and connected electrics has been included in the electrical system.
b. HVAC	The VRV system has been proposed as HVAC system.
c. Fire	The fire fighting and detection system has been proposed.
d. ELV	The CCTV, public addressing system, Telephone, Data and TV networking has been included in the ELV system.
e. Plumbing.	The domestic and non-domestic water supply system has been included in the system.
f. Medical Gas system	The automatic manifold system and piping has been proposed as medical gas system.
Project Completion Period	24 months

Special Conditions to be incorporated in Tender Documents as per Griha norms:-

1. Necessary measures to be implemented to reduce air and water pollution during construction at site.

- Provision of 3-metre high barricading around construction area
- Wheel washing facility at the vehicular entrance of the site
- Covering of aggregate and excavated earth on site with plastic and geotextile sheets.

2. Preserve and Protect Landscape during construction:

- Ensure that no existing mature tree is cut on site or transplant mature trees within the site and ensure they survive.
- During excavation the top soil should be kept separate and used as topping material after land filling, dressing, grading or leveling work is complete. Top soil and loose soil (20cm top layer of soil) should be mulched and covered with temporary vegetation to ensure that the fertility

of the soil is maintained. Location to preserve soil on-site should be demarcated for compliance and further be used in landscape. Soil fertility test of site's top soil (before construction) from an ICAR (Indian Council of Agricultural research) accredited laboratory is needed.

3. Construction Management Practices:

The Contractor should practice staging during construction. Construction management plan has to be prepared to effectively manage the construction activities.

- a. Water sprinkling on dusty walkways to prevent dust on site.
- b. Ensure that the temporary mud roads and loose material be sprayed with water periodically to control soil erosion as well as air pollution.
- c. To reduce the movement of the soil throughout the site, adapt the soil erosion channels and sedimentation control strategies.
- d. Provision of wheel washing facility at the entrance and exits of construction site for controlling air pollution.
- e. Make sure that all the tires of vehicles going in and out of the site be washed.
- f. The dusty materials be covered with plastic sheets to prevent dust particles from blowing into the air and causing pollution.
- g. Ensure that any loose soil/material which is stacked and stored on site be covered to avoid dust particles causing pollution and problem to construction workers.
- h. Provision for exhaust from the DG sets gets discharged upside at height greater than 10 feet from ground which is higher than the human level.
- i. Site to be barricaded to prevent dust generated at site to affect the surrounding areas.

4. Strategies to be implemented to reduce potable water during construction

The project should reduce the potable water required construction activities by using the following ways:

- a. Gunny bags for curing and using ponding for curing
- b. Gunny bags for curing and using ponding for curing
- c. Monitoring (by installing water meters) to avoid leaks and water wastage
- d. Use of treated waste water/captured storm water

5. Strategies to be implemented for waste management during construction

All construction waste such as Empty cement bags, empty paint cans, steel scrap, and debris should be dumped in their respective dumping areas which will make the waste segregation much easier. The waste should be routinely collected by the recycler who will then reuse/recycle it in some way and avoid the waste being thrown in the landfills.

- a. Proper signs to be put up and the dumping yards to be demarcated properly for the better site management.
- b) The gunny bags to be reused for curing purposes
- c) Out of the total waste generated maximum should be reused at site while the rest to be sold to recycler.
- d) Hazardous waste to be segregated and stored separately on site for safe disposal. It should be sent to the designated recycling facility.
- e) All the construction materials to be segregated at site and stored in designated scrap yards.

6. Labour safety & sanitation:

Contractor should also maintain and update construction waste template on monthly basis for accounting the waste generated during project construction. Challans/Gate passes need to be collected for record purpose.

The contractor need to consider sufficient measures to provide safe & healthy working condition to the workforce in accordance with the guidelines of ‘The Building and other Construction Workers Act, 1996 & Rules, 1998’ and National Building code 2005.

Listed below are few of the facilities required for construction workforce–

- Clean and hygienic basic facilities like toilets, clean drinking water will be provided
- Safety equipment like helmets, belts, boots etc. will be provided on site for the construction workforce so that they can be secure and to avoid accidents
- Adequate illumination levels in construction work areas
- Site emergency alarm
- First-aid and emergency facilities.

NOTE: *If the construction workforce is residing outside the project site boundary, provision of basic facilities should be made for them, like, Clean and hygienic toilets, clean drinking water.*

7. INCREASE IN ENVIRONMENTAL AWARENESS:

- a) It is required to bring awareness about sustainability and environmental conservation amongst the occupants and the building visitors. It can imply the following measures:
- b) The entire site area can be provided with signage depicting the importance and need of the sustainability and environmental conservation.
- c) The project can conduct weekly seminars discussing the importance of the same and create awareness.

- d) Occupant guidelines pamphlets can be provided to each and every one explaining the intent and purpose of sustainability.
- e) Bulletin board in the cafeterias where sustainability info is rotated monthly.
- f) Providing sustainability tours that point out sustainable building features.
- g) Collaborate with building managers and the waste manager to run a recycling campaign to promote waste recycling.
- h) Preferred parking space for 3 or more employees coming together.

8. OPERATION & MAINTENANCE PROTOCOLS:

- a) The provision for a core facility/service group responsible for the O&M of the building's systems after installation.
- b) Inclusion of a specific clause in the contract document of the systems supplier for providing training to the core facility/ service group responsible for the O&M of the building systems after installation, on the operating instructions/dos and don'ts/ maintenance requirements for the specific system.
- c) Development of a fully documented O&M manual/ CD/ Multimedia /information brochure enlisting the best practices for O&M of the building's systems

Also, O&M protocol should be prepared for-

- HVAC plant- AHU, Cooling tower, Chillers and pumps , VRF
- Electrical- Transformer, DG, HT & LT panels
- Energy Systems: Solar PV, Lighting, Equipment, wind mill, bio gasifier etc.
- STP and/or WTP

9. Innovation:

Organic Fertilizers- use of organic fertilizers for landscaping purposes at the project site so as to improve the core structure of the soil and increase its ability to contain water and important nutrients for a longer period of time.

CHAPTER B

TECHNICAL SPECIFICATIONS - CIVIL WORKS

EARTH WORK:

- The Contractor shall, at his own expense and without extra charges, make provision for all shoring without any extra payment.
- 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.
- Clearing of site including removal of shrubs, road etc

PLAIN CEMENT CONCRETE AND REINFORCED CEMENT CONCRETE WORK:

STONE AGGREGATE:

- 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.

SAND/ M Sand

- Sand/ M Sand to be used for the work shall be of as specified in CPWD Specifications. 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.

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

FLYASH

- Flyash 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.

CENTERING SHUTTERING AND SCAFFOLDING:

- 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.
- 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.
- 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.

REINFORCEMENT:

- TMT reinforcement steel shall be used as per design and conforming to IS: 1786 pertaining to Fe 500D grade of steel.
- TMT steel bars manufactured by main producers, as per list of makes, shall be allowed in the work. Contractor shall produce manufacturer Test Report for each dia and each lot Tests. Rate is inclusive of straightening, cutting, bending, placing in position, binding and rock anchoring.
- 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.
- 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.

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

CEMENT:

- The contractor shall procure 43/ 53 grade ordinary Portland cement [grade as per design/ drawings/ decision of Engineer-in-charge] conforming to IS 8112/Portland Pozzolana Cement conforming to IS:1489 (Part-I) 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. 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.
- 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 2000 bags of cement shall be constructed by the contractor at site of work for which no extra payment shall be made.

- 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.
- 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.
- 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.
- 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.
- 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.

CONCRETE MIX DESIGN

- The mix design shall be for MODERATE exposure and GOOD degree of quality control, unless otherwise specified.
- Concrete Batching Plant (Design Mix)

- 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.
- It shall be fully computerized.
- Facility to pump concrete upto the highest point of the building.
- It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
- It should have sufficient capacity to meet the requirement as per schedule.
- In case of failure of Batching Plant, RMC may be allowed with a written permission of the Engineer in Charge
- Approved admixtures conforming to IS.9103 shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of BS 5075. The total amount of chloride content in the admixture mixed Concrete shall satisfy the requirement of IS 456-2000.
- The concrete mix design with and without admixture will be carried out by the contractor through the Laboratories/ Test house as approved by Engineer-in- charge.
- The various ingredients for mix design/ laboratory tests shall be sent to the lab test house through the Engineer and the sample of such ingredients sent shall be preserved at site by the department till completion of work or change in Design Mix whichever is earlier. The sample shall be taken from the approved materials which are proposed to be used in the work.
- The batching and mixing plant shall be fully automatic.
- The contractor has to arrange to erect batching plant for the design mix concrete on his own.
- The concrete shall be transported to the site in specially made Transit Mixers & shall have suitable retarders so that it should not set before placing in position. It should have sufficient flow so that at height the concrete shall be placed by pumping only.
- Each Transit Mixer reaching site shall invariably have manufacturer's certificate containing details like truck number Grade of mix, time of

leaving the plant, time of reaching a site etc. A copy of the same shall be handed over to E- in – C or his authorized representative.

- However samples for testing etc. shall be taken as per the mandatory tests prescribed in latest CPWD specifications.
- All cubes shall be tested for 7 days and 28 days tests in conformity with the relevant CPWD specifications.
- In respect of projected balconies, projected slabs at roof level and projected verandah, the payment for the RCC work shall be made under the items of RCC slabs. Nothing extra shall be paid for the side shuttering at the edges of these projected balconies and projected verandah. All the exposed edge shall however be finished as per specifications and nothing extra shall be paid for this.
- In the items of RCC walls, railings and roofs etc. nothing extra shall be paid for making designs as per patterns given by Engineer-in-charges or for thickness of sections.
- The water will be tested with regard to its suitability for use in CC/RCC work and nothing extra will be paid for on this account.
- To receive anchor bolt / foundation for machines to be installed at later date, pocket of size minimum 110x100x300 mm shall be kept while 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.

READY MIX CONCRETE (RMC)

- 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.
- It shall be fully computerised.
- It should have supplied RMC for Govt. projects of similar magnitude.
- It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
- The Ready Mix Concrete (RMC) producing plants of the main Cement producers shall be preferred.
- 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.

- The Engineer-in-Charge reserves the right to exercise check over the:-
- 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.
- Calibration check of the RMC.
- Weight and quality check on the ingredient, water and admixture added for batch mixing.
- Time of mixing of concrete.
- 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
- 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.
- 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.
- 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:-

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.

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,

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.

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.

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.

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.

PRODUCTION OF CONCRETE

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

- 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.
- 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.
- 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.
- 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.
- Sampling of concrete, testing monitoring of results.
- 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.
- 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.
- 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.
- Frequency of sampling and standards of acceptance shall be as per CPWD specifications.

- No addition of water or other ingredients shall be permitted in the RMC at site or during transit.
- 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.
- Pre-paid delivery tickets shall be produced with each truck load of RMC.
- The representative of RMC supplier shall attend the site meeting as and when decided by the Engineer
- 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.

BRICK WORK

- 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.
- 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.
- 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.
- For mortar, use of PP Cement shall be preferred.

Solid/Hollow Block Work

- 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.
- The Solid CC blocks shall have nominal size of 400mm x 200mm x 200mm for 200mm thick masonry wall& Hollow blocks of nominal size 400mm x 200mm x 100mm for 100mm thick masonry walland shall confirm to IS 2185.
- 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 samples shall be tested for every 100 cum or part thereof.
- Following parameters shall be tested.
 - Compressive strength.
 - Water absorption
 - Density
 - Dimensional Tolerances
- The material shall meet following parameters :
 - Compressive strength shall be no less than 5.0 N/sq. mm.
 - Water absorption shall not be more than 5%.
 - Density shall be not less than 1500 kg/cum.
 - 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 200mm thick hollow/solid block work shall be as described 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.

AUTOCLAVED AERATED CONCRETE (AAC) BLOCK MASONRY:

- These Blocks are AAC (Autoclaved Aerated Concrete) blocks conforming to IS 2185 (part-III) Grade- I and as per relevant latest prevailing code with jointing Adhesive shall be used as approved makes and according to relevant CPWD standards. Crushing strength of aerated concrete block shall not be less than 40 Kg/Sqcm, minimum dry density of 550-650 Kg/cum, thermal conductivity in dry condition 0.24 w/mk. They are made with a mixture of cement, fly ash, lime, an aeration agent and water. Assisted by an aeration process, these involve very closely controlled processes that result in a unique, light-weight cellular structure and a dimensionally accurate block.

DIMENSIONS AND TOLERANCES:

Concrete masonry building units shall be made in sizes and shapes to fit different construction needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose, and partition block, and concrete floor units.

Concrete Block- Concrete block shall be referred to by its nominal dimensions. The term 'nominal' means that the dimension includes the thickness of the mortar joint. Actual dimensions shall be 10 mm short of the nominal dimensions (or 6 mm short in special cases where finer jointing*^k specified).

The nominal dimensions of the concrete block shall be as follows:

Length	400, 500 or 600mm
Height	200, 250 or 360 mm
Width	100, 150, 200 or 250 mm

In addition, block shall be manufactured in half lengths of 200,250 or 300 mm to correspond to the full lengths.

The nominal dimensions of the units are so designed that taking account of the thickness of mortar joints, they will produce wall lengths and heights which will conform to the principles of modular co-ordination.

Blocks of sizes other than those specified in the above table may also be used if so specified. In the case of special concrete masonry units such as jallie or screen wall block and ornamental block, the specified sizes may not necessarily apply.

The maximum variation in the length of the units shall not be more than ± 5 mm and the maximum variation in the height and width of unit, not more than ± 3 mm.

Subject to the tolerances specified in above and the provisions of Blocks with special faces, the faces of masonry units shall be flat and rectangular, opposite faces shall be parallel, and all arises shall be square. The bedding surfaces shall be at right angles to the faces of the blocks.

Blocks with Special Faces- Blocks with special faces shall be manufactured and supplied if so specified.

I. WETTING OF BLOCKS:

The blocks need not be wetted before or during laying in the walls. In case the climatic conditions so require, the top and the sides of the blocks may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of the required bond with the mortar.

First Course-The first course of concrete block masonry shall be laid with great care, making sure that it is properly aligned, leveled and plumbed, as this may assist the mason in laying succeeding courses to obtain a straight and truly vertical wall.

Before laying the first course, the alignment of the wall shall be marked on the damp-proof course. The blocks for this course shall first be laid dry that is without mortar along a string stretched between properly located corners of the wall in order to determine the correct position of the blocks including those of the cross walls jointing it and also adjust their spacing. When the blocks are set in proper position, the two corner blocks shall be removed, a mortar bed spread and these blocks laid back in place truly level and plumb. The string shall then be stretched tightly along the faces of the two corner blocks and the faces of the intermediate ones adjusted to coincide with the line. Thereafter, each block shall be removed and re-laid over a bed of mortar. After every three or four blocks have been laid, their correct alignment level and

verticality shall be carefully checked.

The construction of walls may be started either at the corners first or started from one end proceeding in the other direction. If the corners of the wall are built first, they shall be built four or five courses higher than the center of the wall. As each course is laid at the corner, it shall be checked for alignment and level and for being plumb. Each block shall be carefully checked with a level or straight edge to make certain that the faces of the block are all in the same plane, this precaution is necessary to ensure truly straight and vertical walls.

The use of a story-rod or course pole which is simply a board with markings 200 mm apart provides an accurate method of finding the top of the masonry for each course. Each course, in building the corners, shall be stepped back by a half-block and the horizontal spacing of the block shall be checked by placing a mason's level diagonally across the corners of the block.

When filling in the wall between the corners, a mason's line shall be stretched from corner to corner for each course and the top outside edge of each block shall be laid to this line. The manner of handling or gripping the block shall be such as to position the block properly with minimum adjustment.

To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as it will stiffen and lose its plasticity. As each block is laid, excess mortar extruding from the joints shall be cut off with the trowel and thrown back on the mortar board to be reworked into the fresh mortar. If the work is progressing rapidly, the extruded mortar cut from the joints may be applied to the vertical face shells of the blocks just laid. If there be any delay long enough for the mortar to stiffen on the block, the mortar shall be removed to the mortar board and reworked. Dead mortar that has been picked up from the scaffold or from the floor shall not be used.

II. DO'S & DON'T'S WITH AAC MASONRY:

S. NO.	DO'S	DON'T'S
1	Surface of AAC blocks to be joined with mortar is to be wetted with brush / cotton waste	Do not soak AAC blocks in water

	or with the help of a tray filled with 25 mm water	
2	Use only Adhesives (Jointing material)	Do not use mortars
3	AAC masonry should be as per IS code 6041 (1985) and IS code 1905 (1987)	The mortar should not be spread much ahead of the actual laying of blocks.
4	Chases for services in AAC masonry should be as per IS code 1905 (1987)	Do not deviate from the norms of chase cutting specified in the code IS 1905 (1987)
5	Use electro mechanical rotary tool for chase cutting	Do not use chisel and hammer for chase cutting
6	Chases should be filled along with plastering and a layer of chicken mesh is to be embedded in the plaster over the width of the chase with proper over lap	Do not fill the chase up to the top surface of the masonry to have a key while plastering.
7	While storing AAC blocks, care should be taken to avoid of excess moisture	Do not expose the AAC blocks during rains or snow fall

III. PHYSICAL REQUIREMENTS:

GENERAL:

All units shall be sound and free of cracks or other defects which interfere with the proper placing of unit or impair the strength or performance of the construction. Minor chipping resulting from the customary methods of handling during delivery, shall not be deemed grounds for rejection.

Where units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks, or other imperfections, except that if not more than 5 percent of a consignment contains slight cracks or small chippings not larger than 25 mm, this shall not be deemed grounds for rejection.

DIMENSIONS: The overall dimensions of the units when measured as given in the Dimensions and Tolerances of IS: 2185 (Part-3)-1984 shall be in

accordance with nominal dimensions of concrete blocks as given in IS: 2185 (Part-3)-1984 subject to the tolerances mentioned in the Dimensions and Tolerances of IS: 2185 (Part-3)-1984.

BLOCK DENSITY: The block density shall conform to the requirements specified in Table 1 when tested in accordance with IS: 6441 (Part 1)-1972*.

COMPRESSIVE STRENGTH: The minimum compressive strength, being the average of twelve units, shall be as prescribed in Table 1 when tested in accordance with IS: 6441 (Part 5)-1972*. (To be specific 40 kg/sqcm).

THERMAL CONDUCTIVITY: The thermal conductivity shall not exceed the values specified in Table 1 when tested in accordance with IS: 3346-19801+.

DRYING SHRINKAGE: The drying shrinkage shall be not more than 0*05 percent for Grade 1 blocks and 0-10 percent for Grade 2 blocks when tested in accordance with IS : 6441 (Part 2)-1972++.

SAMPLING & TESTING: In any consignment, all the blocks of the same size and from the same batch of manufacture shall be grouped together into a minimum number of groups of 10 000 blocks or less. Each such group shall constitute a lot. From each lot a sample of 24 blocks shall be selected at random, In order to ensure randomness of selection, all the blocks in the lot may be arranged in serial order.

TESTING: All the 24 blocks shall be checked for dimensions and inspected for visual defects. Out of the 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3 blocks to the test density, 3 blocks to the test for thermal conductivity, and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if a need arises.

TESTS:

- **MODE DENSITY:** The block density shall be determined in the manner described in IS: 6441 (Part 1) -1972*.
- **COMPRESSIVE STRENGTH:** The compressive strength shall be determined in accordance with IS: 6441 (Part 5)-1972*.
- **THERMAL CONDUCTIVITY:** The thermal conductivity shall be determined in accordance with IS: 3346-19801+.
- **DRYING SHRINKAGE:** The drying shrinkage shall be determined in the manner described in IS: 6441 (Part 2)-1972.

WORKMANSHIP (JOINTING MORTAR IS TO BE USED IN PLACE OF CEMENT MORTAR):

Jointing Adhesive(Mortar) is a versatile thin jointing material for joining AAC blocks, fly ash bricks, concrete blocks etc. This mortar is specially designed to provide stronger, much more durable bonding between the blocks with superior adhesive strength. It replaces conventional cement and sand mix mortar.

- **APPLICATION:**

- **SURFACE PREPARATION:**

- (i) The surface of masonry units should be slightly wet prior to application of jointing mortar.
- (ii) The masonry units should be clean, with no loose particles or dust for better bonding.
- (iii) The surface must be structurally sound. Efflorescence & any other contaminant which could impair the natural bond should be removed.
- (iv) Surface defects such as cracks, holes or voids should be repaired prior to application.

- **MIXING:**

- (i) It is very important that jointing mortar is mixed with water thoroughly before use. It is advisable to use a mechanical stirrer for uniform mixing to save time, labour and for maximum workability effectiveness.
- (ii) Use a clean vessel/bucket which does not have any hole or cut and add some water in the empty vessel to ensure no powder gets stuck at the bottom of the vessel and put required quantity of Jointing mortar.
- (iii) Mixing Ratio - depending on the thickness of the product to be applied, add approximately 25-30% of the clean potable water. Water is added in stages to get a smooth, uniform, workable mix. Allow ample time for initial mixing.
- (iv) Ensure that no powder is left unmixed at the bottom of the vessel.
- (v) The jointing mortar is now ready for application.

- **METHOD OF APPLICATION:**

- (i) Layout the wall where jointing mortar is to be used and mark openings

like door, windows or any architectural appurtenances.

- (ii) Apply a thin uniform layer of jointing mortar, 3-4 mm thick, on the clean & leveled surface of masonry units using proper trowel.
- (iii) Place the next course of masonry units on the evenly laid jointing mortar bed in proper line & level. Each masonry unit should be properly bedded and set in position by gently pressing with the handle of a trowel.
- (iv) After placing the first unit, apply joint mortar of same thickness on both the sides of the unit, keeping continuous check for the line & level.
- (v) Inside face of the masonry unit should be buttered with mortar before the next unit is laid and pressed against it especially in case of bricks.
- (vi) Clean the excess material, if any immediately. Continue the procedure for the entire masonry work.

➤ **PRECAUTIONS DURING USAGE:**

- (i) Though jointing mortar contains no toxic material, still care should be taken to avoid dust inhalation while mixing and handling. In case of contact with eyes or face, wash with plenty of clean water.
- (ii) Keep it in a dry place and out of reach of children.
- (iii) Persons who are allergic to cement should take proper precautions before use.
- (iv) While curing the block masonry should be lightly sprinkled with water and not made excessively wet.
- (v) Expansion joints shall be provided in wall exceeding 30 m in length.
- (vi) Reinforcement of 8 m dia 3 Nos. 600 mm c/c both sides or weld mesh, should be provided in the bed joints in block work, one course above and one course below windows and above doors in order to distribute the shrinkage/temperature stress occurring at the corners of openings, more uniformly throughout the wall.
- (vii) In framed structures, erection of partition and panel walls should be delayed to take care of deformations due to structural loads.
- (viii) Partition wall should be suitably reinforced in lower courses to strengthen against excessive deflections of floor slabs and should be separated from the ceiling by a layer of resilient material. Joint shall be carried out in plaster or any other finish.

- (ix) The last layer of block masonry shall be laid by keeping groove of 15mm x 12 mm on the external side, which should be filled up with epoxy mortar and Metal.
- (x) Jointing Adhesive (mortar) shall be carried out with respect to relevant IS or Standards

CEMENT PLASTER: -

- The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item. The use of PP Cement shall be preferred.
- Finish: The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds. Precaution : Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge. (i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green. (ii) To prevent surface cracks appearing between junctions of RCC column/beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. The rate for plastering items shall be inclusive of this.

PAINT

- Low VOC paints shall be used for Exterior to comply GRIHA requirements. Interior painting shall be done as per BOQ and CPWD specifications.

WOOD WORK:

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

- 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.

Glass :-

- Transparent sheet glass (Float glass) conforming to IS 1761 – 1970 shall be used.
- 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	6.0 mm/ 8 mm

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

Shutters:-

- 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.
- 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.
- 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.

STEEL GRILL WORK:

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

ALUMINIUM WORKS/ UPVC WORKS

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

Materials:-

- The members will be made out of aluminium 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.
- UPVC members shall be made of PVC material conforming to IS: 10151.
- 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.

- The weight of sections and the corresponding catalogue numbers are mentioned. The IS specifications are to be strictly adhered.
- The extruder using recycled materials may be preferred.
- The alloy of extruded aluminium should be BS or IS old HE9, Alcon 50 SWP. to this effect test certificate has to be provided for the extruder.

Finishing:

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

Fabrication:

- 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 – incharge 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.
- 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,
- 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.
- All materials shall conform to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the the Engineer – in

- charge shall be final and binding on the contractor.
- 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.
- 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.
- 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.
- 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.
- **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.

FIRE DOORS:-

General:-

- 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, of 120 minutes fire rating confirming to BS : 476 part 22 & IS : 3614 Part II .
- The fire and smoke / hot gases check door shall not collapse during the rated period of the fire under the specified fire conditions.
- 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.

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

Shop drawing:- The contractor shall submit including required designing

shop drawing for doorframes, shutters complete with

- Plan, elevation with relative position of adjacent works
- Glazing details with type size and fixing
- Fitting and fixtures with type size, brand and fixing details.
- Finishing details.

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

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

GLASS ENTRANCES AND GLAZING WITH PATCH FITTING

GENERAL

- 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.
- The specialist agency engaged to carry out the external glazing installation and supply shall have relevant experience and the shop drawings submitted shall be got approved by EIC.

The scope of work shall include:

- Design, preparation of shop drawings, calculations, engineering data and test reports.
- Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.
- 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.
- Exposed Architectural mullions and other support members.
- Finishes, protection coatings and treatments.
- Sealing with approved sealants within and around the perimeter.
- All thermal insulation, firesafing etc. including supports and/or backing.
- All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and

building expansion joints between structures.

- Electrical bonding and earthing of all metal cladding elements.
- Provisions to receive electrical outlets and cutouts for conduits and other electrical work.
- Glass and glazing.
- Transportation, storage, handling, protection and cleaning.

SUBMITTALS

- Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.
- Shop Drawings
Fabrication and installation details, including followings
- Plans, elevations and sections.
- Details of fittings and glazing.
- Hardware quantities, locations and installation requirements.
- Sample for verification, for each type of exposed finish required for
- Metal finish: 150mm long section of patch fittings, rails and other items.
- Glass: 150mm square, showing exposed edge finish.

MATERIALS

Glass

- 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.
- 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.
- Components
- Patch fittings: Stainless steel
- 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.
- Rails: Stainless steel

- 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.
- Anchors and fastenings: Concealed
- Weather stripping: Sweep type
- Hardware
- Hardware should be heavy duty in matching finish
- Concealed Floor Closer and Top Pivots
- Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.
- Swing : Double acting; Positive dead stop, concealed with hold open angle
- Delayed action closing
- Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.
- Push-pull set : Stainless steel finish
- Lock set of approved make.

FABRICATION

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

EXECUTION

- Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- Install all glass system and associated components according to manufacturer's written instructions.
- Set units in level and plumb.
- Maintain uniform clearances between adjacent components.
- Lubricate hardware and other moving parts according to manufacturer's written instructions.

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

CLEANING

- The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.
- 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.
- The internal surfaces of glass and aluminium frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.
- The Contractor shall provide written verification that cleaning agents are compatible with aluminium, 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.
- Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminium.
- 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.
- 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.
- 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.
- 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.
- 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.

PERFORMANCE GUARANTEE:

The contractor shall offer a minimum of 10 year Performance Warranty for the entire installation carried out.

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

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

FLOORING:

- 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.
- Wherever Vitrified Tile flooring is done, it shall be with multy grade/range 1st Quality tiles.
- 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.
- 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.
- The pointing work immediately above the dadoing works shall be done with proper slope.
- Protective layer to be provided of any type of flooring and nothing extra shall be paid on this account.
- The lowest base price for the ceramic tiles for wall cladding shall be Rs.550/Sqm. The thickness for the tile shall not be less than 5mm.
- The ceramic tile used for flooring shall be of Size 600x600mm. The lowest base price for the ceramic tiles for flooring shall be Rs.550/Sqm
- The vitrified tile used for wall cladding and flooring shall be of Size 600x600mm. The lowest base price for the vitrified tiles shall be Rs.600 /Sqm.
- The lowest base price for the granite used for flooring/staircase/counter slabs shall be Rs.2500/Sqm.
- The lowest base price for heavy duty vitrified tile of size 600 mm x 600mm shall be Rs1200/ sqm .

POLYCARBONATE SHEET ROOFING

- The polycarbonate sheet roofing shall be as per approved make of list and shall conform to manufacture's specifications. The contractor shall procure the sheets from the manufacturer as per the approved list. The material procured shall be free of any defects and damage to the edges, surface etc. The defective material shall be replaced by the contractor of his own cost. The contractor shall ensure that the material is procured and delivered at installation site without any damage.

Adequate care shall be taken for protection of the material before installation as well as afterwards till handing over the building for occupation. The contractor shall ensure careful handling and storage and prevent any rough handling, to prevent any edge or surface damage. Any panel with edge damaged or damage to the finish etc. shall not be allowed to be used in the work and shall be replaced by the contractor at his own cost. The contractor shall procure the material including providing for wastages, damages etc. in one lot so as not have any color and shade variation. Atleast one sample of the polycarbonate sheets brought by the contractor to the site of work shall be tested. The test shall be got done at reputed independent laboratory as approved by the Engineer- in-Charge. However, the contractor shall obtain and submit to the Department the manufacturer's certificate for compliance of the polycarbonate sheets as per the manufacturer's specifications and also copy of the manufacturer's test report for the record.

- The polycarbonate sheet shall be multi-wall (twin wall) section with thickness of the sheet not less than 8mm and the thickness of the walls on the two external faces not less than 0.5mm each. The sheet shall be extruded from polycarbonate material and shall have homogeneous composition of the material. The sheet shall have co-extruded UV protective layer. The sheet shall be fixed with the face treated for UV resistance, upward/exposed to sunlight. The weight of the sheets shall strictly followed as per the manufacturers specification. Light transmission shall be minimum 35 %. The sheets shall be obtained with closed edges. The sheet shall be bent (if required) to the require profile as per the architectural drawings but with radius not less than 175 times the thickness of the sheet. The sheet shall be fixed in a manner that the cells are parallel to the span of the shed.
- The polycarbonate sheets shall be of colour and shade as approved by the Engineer-in- Charge.
- The physical and the chemical characteristics of the polycarbonate sheets shall be as per the manufacturer's specifications and shall conform to the

ASTM standards. The sheets shall conform to BS 476 part 7 for the fire rating. The contractor shall submit written guarantee to the Engineer-in-Charge for the polycarbonate sheets procured and provided by him against any defects like peeling, breakage, fading of color/ discoloration, cracking, leakage through the roofing loss of strength etc. for a period of ten years after the date of completion of the work. The contractor shall obtain similar back-to-back guarantee from the manufacturer. The strength requirements are as specified below:

- Distribution load: 800 N per sq.m.
- The polycarbonate sheets shall be used in one piece along the span of the temporary sheds. The polycarbonate sheets shall be bent to required profile (linear or curvilinear) as per the architectural drawings and fixed in position, to the structural steel framework, using self-driving self-tapping screws with EPDM washers etc. The sheets shall be secured to the structural steel framework so as to withstand all the design dead, live, wind, other accidental loads etc. and shall be fixed in a workmanlike manner. It shall not have any sag. Therefore the fabrication work shall be got done through experienced & reputed fabricator, to be got approved from the Engineer-in-Charge. The contractor shall submit to the Engineer-in-Charge the shop drawings giving fixing details for the polycarbonate sheets in roofing and also quality assurance and methodology statement for the item. The polycarbonate sheets shall be jointed along the length of the shed using aluminium top & bottom pressure plates having required profiles for fixing the EPDM gaskets, screws, washers etc. The aluminium pressure plates shall be color anodized or powder coated to the require shade. The joints in the sheet shall be provided only on the RHS steel sections of the framework and shall not be permitted elsewhere. The joint width of about 3-4 mm may be provided between the sheets at the junction for thermal expansion. The EPDM gaskets of the required profiles shall than be fixed in the grooves in the aluminium pressure plates on either side of the joint in the polycarbonate sheet. The bottom aluminium plate shall be fixed to the structural steel framework using self-driving self-tapping screws; washers etc. (one screw fixed to each sheet) and the screws fixed @300 mm center to center along the span of the shed.
- The EPDM gaskets of the required profile shall be fixed in the grooves in the aluminium pressure plate on either side of the joint in the polycarbonate sheet. The top aluminium pressure plate shall than be fixed securely to the bottom aluminium plate using countersunk self-driving self-tapping screws, EPDM washers etc. All the screws shall be concealed using structural silicone sealant DC 995 of Dow Corning or equivalent approved brand. Also, wherever required (especially at the joint in the EPDM gasket etc.) the

junction of the polycarbonate sheet and the sides of the pressure plates on both sides shall be sealed using structural silicone sealant DC 995 of Dow Corning or equivalent brand as approved. The item includes cost of all the operations and all inputs of the material [including Polycarbonate sheet, EPDM gaskets, anodized aluminium capping, anodized aluminium edge capping to the sheet with U-shaped EPDM gasket, all structure silicone sealant, self-driving self-tapping screws with EPDM washers, nuts, bolts, washers etc. and the like, labor, T & P, all the incidental charges, wastages etc. involved in the work. However for the purpose of payment only the actual area of the polycarbonate sheet provided and fixed in position shall be paid for separately under relevant item. The contractor shall maintain the roofing scratch and damage free till the handing over the building for occupation, at his own cost.]

- Tolerance:-
 - Weight : 5%
 - Length : _-30 mm
 - Width : _ 0.5%
 - Thickness : _1mm
- The polycarbonate sheets shall be obtained with protective films on both sides. Care shall be taken while fixing to fix the sheets with UV protected side exposed to outside. The sheet shall be stored in a manner not to expose to direct sunlight. The sheet shall be cut to the required size or drilled using the toothed blade/machine. After fixing the protective film shall be removed and the sheets cleaned using non-alkaline based detergent and abrasive equipments or solvents be avoided. The silicones, gaskets, tapes etc. shall be compatible with the polycarbonate sheet.
- For joining the sheets, at least one complete channel width of each sheet shall be secured per sheet within the joining profile. Since thermal coefficient of expansion of the sheets is different from the RHS steel frames, suitable provision shall be made for accommodating differential expansions. Also any rigid jointing agent that may prevent thermal movements shall not be used. The required section aluminium profiles (upper central profile, lower central profile and top profile) for fixing the polycarbonate sheet to the structural framework as well as for joining the sheet shall be as per the manufacturer's specifications .The top capping profile shall be snap fit to the upper central profile, The EPDM gaskets and the screws shall be provided as per the manufacturer's specifications.
- The Gaskets shall be extruded micro wave/ steam cured EPDM/ silicone of approved quality compatible with substrates, finishes and other components

they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets, which are UV resistant. They shall not degenerate/discolor or/each on exposure to weather/ rain/pollutants etc.

FALSE CEILING: -

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

UNDER DECK INSULATION

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

STRUCTURAL GLAZING SYSTEM

SCOPE OF WORK

- The contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete structural glazing system to the proposed building, all in conformity with the Drawings as shown. Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the Drawings and/or without limiting the generalities of the foregoing, the structural glazing Systems shall include, without being limited to, the followings:
- Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings metal closure, windows etc.
- All anchors, attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
- All thermal insulation associated with the system. All fire protection associated with the system.
- All copings, end closure and metal cladding to complete the system.
- All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.

- Isolation of dissimilar metals and moving parts.
- Anticorrosive treatment on all metals used in the system. Polyester powder coating aluminium sections.
- The contractor shall also be responsible for providing the followings:
 - Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the structural glazing System.
- Scheduling and Monitoring of the Work.
- Mock-ups, samples and test units.
- Performance testing of the structural glazing framing and glazing assembly.
- Co-ordination with work of other trades.
- Protection.
- All final exterior and interior cleaning and finishing of the structural glazing System
- As-built record drawings and photographs.
- Guarantees and Warranties.
- All hoisting, staging and temporary services.
- Conceptualising and design of a suitable maintenance system for structural glazing.
- The water tightness and structural stability of the whole structural glazing System are the prime responsibility of the Contractor. Any defect or leakage found within the Guarantee Period shall be sealed and made good all at the expense of the Contractor.
- The structural glazing system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects. Specific details should be designed to accommodate thermal and building movements.
- The glazing specifications should be as per GRIHA requirements and as specified in BOQ.

BUILDING REGULATIONS

- Structural glazing shall comply with all Government Codes and Regulations including IS codes, if any.
- All structural glazing, individual aluminium and glass components and all completed work shall be designed and erected to comply with the following:
 - Design load and deflection.
- Structural glazing construction in its entirety shall be fabricated and erected to withstand without damage or permanent deformation inward (positive) and outwards (negative) pressure, all acting normal to the construction plane with a maximum deflection of not exceeding 1/175 of the clear span between structural support or 20mm maximum whichever is less.

- Structural performance of all parts of structural glazing system shall conform to relevant IS codes, wind load as per IS-875 and seismic loads as per IS-1893. Deflection shall cause no permanent set in excess of 1/1000 of span nor evidence of structure failure.
- Design Wind Loading
- 850 N/m² positive and negative to Podium.
- 1150 N/m² positive and negative to Tower.
- 1500 N/m² positive and negative to Crown to Tower.
- No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified.

MEASUREMENTS

Measurements of the structural glazing shall be in the metric system in sq.m correct to two places of decimal. The area considered for measurement shall be net area as fixed on the exterior face of the structural glazing including open able windows as part of structural glazing. The contractor shall be responsible for verifying all the dimensions and actual conditions on site.

RATE

The rates shall include the cost of all the operations described above including the cost of all materials, labour, design, fabrication, erection, finishing, scaffolding and testing of water tightness etc.

TENDER DRAWINGS AND SPECIFICATIONS

The tender drawings indicate profile and configuration required together with relationship to structural frame and interior building elements.

The Specification and tender drawings is of the performance type and includes only the minimum requirements of the/ structural glazing Wall System without limiting the Contractor to the method of achieving desired performance.

POST TENDER REQUIREMENTS

Design Proposals

The contractor shall propose the final design in such a way that all basic functional and architectural requirements are fulfilled and get the same approved by Deptt. However, basic design requirements as described in the specification and other Architectural requirements such as the size of window, net glass area, ventilator, configuration of windows and spandrels shall be retained.

The design proposals shall be in the form of drawings, drawn to full scale as far as practical and specification shown in or describing all items of work including:

Request details as indicated on the tender drawings.

Metal quality, finishes and thickness.

Glass quality, coating and thickness and proposed manufacturer's brand names.

Sections of the mullion and transom together with structural calculations.

Arrangement and jointing of components.

Field connections especially mullion to mullion and transom to mullion.

Fixing and anchorage system of typical wall unit together with structural calculations.

Drainage system and provision in respect of water leakage in the curtain wall/ structural glazing system.

Provisions for thermal movements.

Sealant and sealing method.

Glazing method.

Wind load and seismic load and any other specific load considered in the design.

Lightning protection link-up system of the curtain wall/ structural glazing for connection and incorporation into the lightning conductor system of the building. Design concept must be stated in the proposal.

The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case this tolerance exceed those specified in the Specification.

Any parts of the curtain wall/ structural glazing, when completed, shall be within the following tolerances:

Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m of length of any member, or 6mm in any total run in any line.

Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle, must not exceed 9mm total at any location.

Change in deviation must not exceed 3mm for any 3.5m run in any direction.

Samples

The contractor shall also submit samples of mullion and transom sections in lengths of 300mm with the same finish and workmanship along with the proposals and 300mmx300mm samples of glass (samples to include exposed screws and other exposed securing devices, if any).

Preliminary Programme

The tenderer shall also submit a preliminary programme of the contract works showing the various stages of design sampling, testing, fabrication, delivery and installation of the works.

Upon approval of the shop drawings, at least 4 copies shall be submitted by the Contractor.

The Contractor/Sub-contractor shall submit a maintenance manual for the curtain wall/structural glazing system inclusive of all metal parts, glass and finish etc.

During detailed design and execution any details may increase as per actual requirement at site, these variations shall be executed without any extra cost implications to the HITES.

PERFORMANCE GUARANTEE

The tenderer shall provide a performance guarantee of requisite value to be indicated in the General Conditions of Contract for a period of five years, to provide for expenses, to cover the risk and cost of rectification of defect, noticed during the five years guarantee period. Guarantee period to start from the date of completion of the project.

STAINLESS STEEL RAILINGS

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.

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.

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.

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/ HITES. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge/ HITES. 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.

The stainless steel shall be of grade 316 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

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.

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.

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.

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.

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.

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.

GLASS:

All glass and glazing material shall be verified and coordinate with the applicable Performance requirement. Wherever required ,the glass should meet the GRIHA requirements as mentioned in BOQ.

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.

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

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.

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.

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.

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.

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.

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.

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

- Water proofing treatment for roof/ sunken floor has to carried out as per the respective Bill of Quantities/ CPWD Specification.
- The finished surface after water proofing treatment shall have required slope.
- 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.
- **GUARANTEE:** The above water proofing, 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 water proofing shall be retained for 10 years as security (Refer GCC provisions).

ANTIBACTERIAL PAINT

- The Antibacterial Paint shall be able to provide anti-Microbial Protection:
- The scope of work includes providing & applying approved makes anti-Microbial Paint on wall surfaces as per manufacturer's specifications complete in all respect & as directed by Engineer-in-charge. Following are the desired characteristic of the paint:
- 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.
- 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.

- **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.

EXPANSION JOINTS

- The work shall be carried out as per CPWD specifications and directions of Engineer-in-charge.
- 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.
- 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.
- The contractor shall submit the test reports of the product of the manufacturers.
- **Guarantee:-** All the joints shall be guaranteed at least for the period of 5 years when installed by the certified applicator in the prescribed performance.
- **Installation:-** Installation shall be in strict accordance with manufacturer's technical specifications, details and installation instructions. The work shall be carried out through the specialised agencies as approved by the Engineer-in-charge.
- **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. **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.
- **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.

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

LEAD LINED DOOR

MATERIALS

- Acceptable Materials: - Wooden doors and frame product manufactured in accordance with CPWD Specification and as per direction of Engineer-In-Charge.
- Door Core Materials – Standard- Sheet leads are specified by weight per square meter (foot) and/or nominal thickness. Commercially available sheet lead of thickness 2mm, specified for radiation shielding, conforms to the standards.
- Lead: - Cast or rolled pure lead meeting Weights or thickness as specified to shield against radiation types and levels determined by the Engineer-in-charge of HITES.
- Composites: - Balance of core materials used in conjunction with lead shall be in accordance with manufacturer's proprietary design.
- Primers: - Rust inhibitive touch-up only.

SIGNAGE & ASSOCIATED WORKS

Signage (Internal& External)

- The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the Signage, till completion and handing over of the work.
- The item of work for the respective signage shall be conforming to BOQ. However the rate shall cover all operations, fabrications and their installations and materials required for finished product and nothing extra shall be payable on this account.
- The signage work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of such fabricator for the approval of the Engineer-in-Charge.
- The Contractor shall submit the Design, Size and installation

procedure along with samples to Engineer-in-Charge for approval. Approved samples will be kept at site till the whole work is completed. Engineer-in-Charge has right to modify the design of the approved samples also during the entire period of the contract without change in rates etc. and contractor is bound to follow these written instruction/ changes in design/ size etc. from Engineer-in-Charge.

- The typical patterns shown in the Bill of Quantities are only indicative. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating signage with detailing of frame work, if any, along with the fixing details. The details of the signage including location, etc. shall be shown in the shop drawings.
- The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the signage work, for approval. After approval of samples of materials, the Contractor shall prepare sample(s) for approval of Engineer-in- Charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge. 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.
- The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform 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.
- The item includes the cost of all inputs of labour, materials, T & P other incidental charges, wastages etc. The items also included providing and fixing with stainless steel anchor fasteners or other suitable arrangement for fixing the signage.
- 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.

External Signage

- The electrical power supply points, if required, for operation of the signage shall be provided by the Client.
- The contractor shall submit the design for the support structure, including foundations, if required, for the approval of the Engineer in

Charge and nothing extra shall be paid to the contractor in this account.

SAMPLES OF MATERIALS:

- 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.
- 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.
- 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.

GRIHA REQUIREMENTS:

- Materials shall be procured by the contractor keeping in view the recycled content to conform the GRIHA requirements as detailed in SCC and elsewhere. The material such as Paint, Glass ,adhesives etc shall comply GRIHA requirements.

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.

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.

TESTS:

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

ROAD WORKS

- General: Road works shall be in accordance with IRC/ MORTH/ CPWD specifications.

CHAPTER C

TECHNICAL SPECIFICATIONS 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 General conditions of contract. The Scope of Work under this contract shall in general, but not limited to, all plumbing works including supply of all materials, tools and tackles, labor etc. related to construction of the District hospital, Palakkad as per Schedule of Quantities and Specifications included in the Tender document and the direction of Engineer- in-charge, as per approved construction drawings available to the contractor.

The contractor shall plan, carry out, monitor and complete the works in every respect in accordance with the contract and in accordance with the directions and to the satisfaction of the owner and their authorized representatives in a proper workman like and most cost efficient manner, maintaining quality and safety performance. The contractor shall carry out their obligations under the contract with due care and diligence.

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. Porcelain or stainless steel sinks

- iii. Accessories e.g. towel rods, toilet paper holders, soap dish, mirrors etc.
- iv. 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.
- v. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2. Water Closets

a. European W.C.

Wash Down Type (European Type W.C.):

- i. Water closets shall be of white vitreous china conforming to IS 2556 (Part-1) and 2556 (Part-2), as specified and shall be of “Wash down type”.
- ii. The closets shall be either of the two patterns (Pattern I & Pattern II).
- iii. The closets shall be of two piece construction. Each water closet shall have not less than two holes having a minimum diameter of 6.5 mm for fixing to floor and shall have an integral flushing rim of suitable type.
- iv. It shall also have an inlet or supply horn for connecting the flushing pipe of dimensions, the flushing rim may be boxed or open type. In the case of box rims adequate number of holes, on each side together with a slot opposite the inlet shall be provided.
- v. The flushing rim and inlet shall be of the self-draining type. The water closet shall have a weep hole at the flushing inlet.
- vi. Each water closet shall have an integral trap with either ‘S’ or ‘P’ outlet with at least 50 mm water seal. For P trap, the slope of the outlet shall be 14 deg. below the horizontal. Where required the water closet shall have an antisiphonage 50 mm dia vent horn on the outlet side of the trap with dimension and on either right or left hand or centre as specified set at an angle of 45 deg. and invert of vent hole not below the central line of the outlet.
- vii. The inside surface of water closets and traps shall be uniform and smooth in order to enable an efficient flush. The serrated part of the outlet shall not be glazed externally.

- viii. The water closet, when sealed at the bottom of the trap in line with the back plate, shall be capable of holding not less than 10 litres of water between the normal water level and the highest possible water level of the water closet as installed.
- ix. European type W.C. with seat and lid shall be with 3/6 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (twin flush), with flow rate of 4.5 lpm (50 % below griha base rate).

3. Wash Basins

- i. Wash basins shall be of white vitreous china conforming to IS 2556 (Part-I) and IS 2556 (Part-4).
- ii. Wash basins either of flat back or angle back as specified shall be of one piece construction, including a combined overflow.
- iii. Wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require: White Vitreous China Flat back wash basin size 550x 400 mm with single 15mm C.P. brass pillar tap with regulator(5lpm flow rate)
- iv. All internal angles shall be designed so as to facilitate cleaning. Each basin shall have a rim on all sides, except sides in contact with the walls and shall have a skirting at the back.
- v. Basins shall be provided with single or double tap holes as specified. The tap holes shall be 28 mm square or 30 mm round or 25 mm round for pop up hole. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or beveled internally with dia meter of 65 mm at top.
- vi. Each basin shall be provided with a non-ferrous 32 mm waste fitting. Stud slots to receive the brackets on the underside of the wash basin shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud.

- vii. Every basin shall have an integral soap holder recess or recesses, which shall fully drain into the bowl. A slot type of overflow having an area of not less than 5 sq. cm, shall be provided and shall be so designed as to facilitate cleaning of the overflow.
- viii. Where oval shape or round shape wash basins are required to be fixed these shall be fixed preferably in RCC platform with local available stone topping either fully sunk in stone top or top flush with the stone topping as directed by Engineer-in-Charge.
- ix. White glazed pedestals for wash basins, where specified shall be provided. The quality of the glazing of the pedestal shall be exactly the same as that of the basin along with which it is to be installed. It shall be completely recessed at the back to accommodate supply and waste pipes and fittings.
- x. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor to top of the rim of basin 75 to 80 cm. All the waste fittings shall be brass chromium plated, or as specified.

4. Sink

- i. A shallow fixture, ordinarily with a flat bottom, that is usually used in kitchen or in connection with the preparation of food, laboratory purposes and for certain industrial processes.
- ii. Laboratory sinks and Kitchen sinks shall be of white glazed fire clays. The kitchen sink shall be of one piece construction with or without rim but without overflow. Stainless steel kitchen sink shall be of sizes as specified and shall be conforming to IS 13983.
- iii. Waste fittings for sinks shall be of nominal size 50 mm.
- iv. Kitchen sink as per IS 13983 with C.I. brackets and stainless steel plug 40 mm, including painting of fittings and brackets, cutting and making good the walls wherever required: Kitchen sink with drain board 510x1040 mm bowl depth 200 mm
- v. Hospital SS Bed Pan Sink SS 304/18 SWG SIZE 850 MM x 600 MM X 300 MM with 10 Liter CI High Level Flushing Cistern Flush Pipe.

- vi. Cleaner's sink with all accessories of 600x520 mm including two number bib tap Of 15mm nominal dia C.I. brackets, 32 mm.s
- vii. Wall mounted sink mixer with 170mm long swivel spout of 4lpm flow rate with flow regulators to attain green norms rating with 50 % reduction from griha base rate including all fittings and accessories.
- viii. Sink cock with 170mm long swivel spout of 4lpm flow with flow regulators (wall mounted) in position. confirming to green building norms through selection of low flow fix by 50% reduction below the griha base rate including all fittings and brackets of approved quality

5. Flat Back Lipped Front Urinal:

Urinal basins shall be of flat back type lipped in front. These shall be of white vitreous china conforming to IS 2556-(Part 6). The urinals shall of one piece construction. Each urinal shall be provided with not less than two fixing holes of minimum dia 6.5 mm on each side. Each urinal shall have an integral flushing rim of suitable type and inlet or supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self-draining type. It shall have a weep hole at the flushing inlet of the urinals.

At the bottom of the urinal an outlet horn for connecting to an outlet pipe shall be provided. The exterior of the outlet horn shall not be glazed and the surface shall be provided with grooves at right angles to the axis of the outlet to facilitate fixing to the outlet pipe. The inside surface of the urinal shall be uniform and smooth throughout to ensure efficient flushing. The bottom of pan shall have sufficient slope from the front towards the outlet such that there is efficient draining. Urinal shall be with battery based infrared sensor operated urinal having pre & post flushing with water (250 ml & 500 ml consumption) with flow rate of 2 lpm (50 % below griha base rate) including flow regulator.

6. Shower set

Shower set shall be C.P. shower arm with wall flange and shower head adjustable type. Shower rose with 15 or 20 mm inlet including shower arm with flow regulators having 6lpm flow rate confirming to green building norms through selection of low flow fixture

7. Brass bib cock and stop cock

- i. A Bib cock is a draw off tap of specified size and shall be screw down type with a horizontal inlet and free outlet and stop cock (stop tap shall be provided The closing device shall work by means of a disc carrying a renewable non-metallic washer, which shuts against water pressure on a seating at right angles to the axis of the threaded spindle, which operates if the handle shall be either crutch or butterfly type securely seated pattern. The cocks (taps) shall open in anticlockwise direction. C.P brass long nose bib cock with flow regulator of approved quality through selection of low flow fix with flow rate of 5lpm to IS standards and weighing not less than 810 gms. 15 mm nominal bore
- ii. The CP brass bib cock shall be conforming to IS: 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the bib cocks are normally fitted. The dimensions of body for Bib Cock shall be as per table given to IS: 8931. Each bib cock shall be legibly marked with the Manufacture's name and trade mark. brass bib cock of approved quality having 4lpm low flow fixture with flow regulator confirming to green building norms through selection of low flow fix by 50% below the griha base rates confirming to IS standards

8. 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. The mirror shall be of superior glass with edges rounded off or beveled, as specified. It shall be free from flaws, specks or bubbles. The size of the mirror shall be 60 x 45 cm unless specified otherwise and its thickness shall not be less than 5.5 mm. It shall be uniformly silver plated at the back and shall be free from silvering defects. Silvering shall have a protective uniform covering of red lead paint. Where beveled edge mirrors of 5.5 mm thickness are not available, fancy looking mirrors with PVC beading/border or aluminium beading or stainless steel beading/border based on manufacture's specifications be provided nothing extra shall be paid on this account. Backing of mirrors shall be provided with environmentally friendly material other than asbestos cement sheet.
- c. The towel rail shall be of PTMT as specified and as per direction of Engineer-in-charge.
- d. Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good.
- e. 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.
- f. PTMT towel ring trapezoidal shape 215 mm long, 200 mm wide with minimum distances of 37 mm from wall face with concealed fittings arrangement of approved quality and colour, weighing not less than 88 gms.

9. 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, and 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. SWR pipes for soil, waste, vent and rain water.
 - iii. Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.
 - iv. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads/ Khurras.
 - v. Testing of all pipe lines.

2. General requirements

- i. All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-charge.
- ii. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- iii. 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.
- iv. Pipes shall be securely fixed to walls and ceilings by suitable clamps intervals specified.
- v. 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, Rain & Vent Pipes

- i. The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in BIS: The system of plumbing in which soil and waste pipes are distinct and separate. The soil pipes being connected to drain direct and waste pipes through trapped gully. The AHU condensate drain, in central air conditioning, shall be led to underground recharge pits via dedicated gully trap. The waste water coming from urinal enter manhole via dedicated gully trap.
- ii. 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 descending inside the building shall connect to horizontal transition pipes leading to the exterior of the building before dropping to the yard.
- iv. Vent pipe: A pipe line installed to provide flow of air to or from a drainage system or to provide circulation of air within such system to protect trap seals from siphonage and back flow.
- v. Materials as specified in the BOQ.

b. Rainwater Pipes

- i. All terraces shall be drained by providing down-takes rainwater pipes.
- ii. Rainwater pipes are separate and independent and are connected to the storm water harvesting system or released as surface water runoff via rain water shoe. Down comer pipes connected to rain water harvesting system shall be fixed with inline filters including bypass line and valve. They shall be located at an operable location.
- iii. Rainwater in enclosed courtyards shall be led to the external yard via RCC pipes laid during construction. The FFL of enclosed court yards shall be suitably fixed to provide sufficient slope for the pipe.

- iv. The inlet mouth of rain water pipe cast iron grating 15 cm diameter and weighing not less than 440 grams.

c. Jointing

- i. Pipes shall be jointed using manufacturer approved solvent cement as per manufacturer specifications and relevant IS codes.
- ii. The interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of treated spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment.
- iii. Jointing of pipes& fittings, with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer-in-Charge. Concealed work, including cutting chases and making good the wall etc. 15 mm nominal outer dia pipes
- iv. Jointing of pipes with one step PVC solvent cement and testing of joints complete as per direction of Engineer-in-Charge 75 mm dia 6Kg/cm² - External work- Exposed on wall.
- v. Soil, Waste and Rain water pipes shall be jointed with utmost care. The plumber shall double check each joint before progressing to next. Pipe leak identified during testing shall be rectified.

d. Fittings

- i. 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.
- ii. Fittings shall be of the required degree of curvature with or without access door.
- iii. Access door shall be easily accessible. The threads of the door and pipe fitting shall be thoroughly cleaned and fastened well before testing.

- iv. un plasticized PVC pipefittings as per BS 4515 specifications.
 - v. Coupling, flange, branch, bend, tee, elbow, union, waste with plug, P or S trap with vent, ferrule, stop tap, bib tap, pillar tap, globe tap, ball valve, cistern, storage tank, baths, water closets, boiler geyser, pumping set with motor and accessories, meter, hydrant valve and any other article used in connection with water supply, drainage and sanitation.
 - vi. Anything fitted or fixed in connection with the supply, measurement, control, distribution, utilization or disposal of water.
- e. Fixing
- i. 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).
 - ii. 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.
 - iii. 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. Multi floor traps

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). Contractor shall provide all necessary shuttering and centring for the blocks. Width of the block shall be 30 cm with required depth. The above work refers to pipes in sunken slab only.

b. Gratings for traps

Multi floor trap 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.

c. Gully Trap (PVC) :

A trap water seal provided in a drainage system in a suitable position to collect waste water from the scullery, kitchen sink, wash basins, baths and rain water pipes.

PVC anti-shock gully traps allow fluids drainage from outdoor areas (streets, squares, terraces), but also from indoor environments such as garages, cellars, underground basements, sheds with an excellent breaking load. Items belonging to this range are manufactured in various sizes with non-slip surface; PVC anti-shock high capacity gully traps are also available in 110x110 mm size P type size which comply with UNI EN 1253-1: 2004. All PVC gully traps are made up of two elements: a body provided with a mouth for drain outlet and an extractable grid for rapid and effective inspection as per BOQ.

5. Jointing

Soil, waste, Rain pipes shall be drip free. 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. The jointing surfaces shall be cleaned to remove any coatings or cutting oils, etc.

6. Cleanout Plugs

Cleanout Plug on Drainage Pipes

- i. Cleanout Plug in Ground floor: - 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 100 mm dia. Cleanout Plugs on drains of greater diameters shall be 100 mm diameter fixed with a suitable reducing adapter. To access clean out plugs SS304 floor cover with screw over SS frame and rubber seal shall be provided.
- ii. Rodding eye at upper floors: - Rodding eye shall be provided at the start of the suspended drain pipe, A 45 degree bend is provided here with an end cap. The rodding eye shall be located considering sufficient vertical and horizontal clearance for rodding during maintenance.

7. Waste pipe from appliances

a. General

- i. Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of uPVC /SWR 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 (under specific requirement only)

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.

8. RCC pipes for drainage

- a. RCC pipes shall be provided in
 - i. As casing pipes for underground PVC pipes within building. For example the PVC drain pipe from enclosed court yard to the exterior yard.
 - ii. As casing pipes for pipe crossings in road where road formation work precedes drainage works.
 - iii. For underground rain water lines.

9. Painting

- a. Soil, waste vent, anti-siphon and rainwater pipes in exposed locations shall be painted with two or more coats of synthetic enamel paint 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.
- e. All sand cast iron/cast iron (Spun) pipes and fittings shall be painted with shade to match the colour of the background as directed by the Engineer-in-Charge.

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.
- c. Cores in slabs shall be packed as per standard procedure mentioned and shall not be paid separately.

11. Testing

- i. All water supply system shall be tested to Hydrostatic pressure test. Maximum operating pressure at varying degree of temperature
- ii. The pressure test is performed in 3 steps being preliminary test, main test and final test. For the preliminary test a pressure which is 1.5 times higher than the possible working pressure is applied and this is repeated two times in 30 minutes with intervals of 10 minutes. After a test period of 30 minutes, the test pressure must not be dropped more than 0.6 bar and no leak must occur. Main test follows the preliminary test. Test time is two hours, in doing so the test pressure taken from the preliminary test must not have fallen more than 0.2 bar. After completion of these tests, the final test comes which has to be done under a test pressure of 10 bars and 5 bar in the interval of 15 minutes. Between the respective test courses, pressure has to be removed.
- iii. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner. System may be tested in sections and such sections shall be entirely checked on completion of connection to the overhead tanks or pumping system or mains. In case of improper circulation, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and refinishing of floors and walls as required. 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 are not working efficiently shall be replaced by new ones.

- iv. All water supply systems shall be tested to hydrostatic pressure test. The pressure tests are similar to the test pressure used for other plastic/metal pipes. System may be tested in sections and such section shall be entirely checked on completion of connection to the overhead tank or pumping system or mains. For pressure testing the pipeline system, specially designed test plugs are to be used in female thread elbows instead of ordinary GI nipples with MS plugs before covering the pipes in chases.

12. Measurements

a. General

- i. Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule 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, and anti-syphonage and rain water pipes shall be measured net when fixed correct to a centimetre including all fittings along its length.
 - c. No allowance shall be made for the portions of the pipe lengths entering the sockets of the adjacent pipes or fittings. The above shall apply to both cases i.e. whether the pipes are fixed on wall face or embedded in masonry.
 - d. No deduction shall be made in the former case from the masonry measurement for the volume of concrete blocks embedded therein. Similarly no deduction shall be

made for the volume occupied by the pipes from the masonry when the former are embedded in the later.

- e. Pipes shall be measured per running metre correct to a centimetre 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 as specified in the schedule of quantities. The pipes shall be described as including all cutting and waste. In case of fittings of unequal bore, the largest bore shall be measured.
- f. Cement concrete pipes shall be measured along the centre of the pipe line measured per linear metre and include any masonry supports, shuttering and centring cutting complete as described in the relevant specifications.
- g. Slotted angles/channels shall include threaded rods, bolts, nuts and clamps embedded in masonry walls with cement concrete blocks or fixed to concrete slab are included in the rate of pipes and nothing will be paid extra for the same.
- h. Fittings- Nothing extra will be paid for fittings. Pipe fittings are included in the rate of pipes.
- i. 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.
- j. 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 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. (Applies to central hot water system only)
- 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.** 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.
- e.** Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals approved by the Engineer-In-Charge.
- f.** 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 overview of the system.
- b. Source
 - i. The source of water shall be checked at site. They shall be KWA water, Bore well, Open well, Rain water and STP treated water.
 - ii. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tank.
- c. Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independent connected to a different pumping system.

4. Solar water heating system

Solar water heating systems include storage tanks and solar collectors. There are two types of solar water heating systems active and passive. Solar water heaters require a well-insulated storage tank. Solar storage tanks have an additional outlet and inlet connected to and from the collector. In two-tank systems, the solar water heater preheats water before it enters the conventional water heater. In one-tank systems, the back-up heater is combined with the solar storage in one tank. Three types of solar collectors are used for residential applications. They are flat-plate collector, integral collector-storage systems, and evacuated-tube solar collector.

solar water heating system of capacity 10000L/day using flat plate collectors - 40 panels with forced circulation pump, 2 nos of insulated MS storage tank with FRP coating of 5000L capacity each and heat pumps 2 nos each of capacity 1000L/hr/36kw for back up and recirculation pump of 5m³/hr

a. Flat –plate collector

- i. Glazed flat-plate collectors are insulated, weatherproofed boxes that contain a dark absorber plate under one or more glass or plastic (polymer) covers. Unglazed flat-plate collectors typically used for solar pool heating have a dark absorber plate, made of metal or polymer, without a cover or enclosure.

b. Heat pumps

- i. Heat pump for hot water storage tank for 10000 LPD tank.
- ii. solar water heating system of capacity 10000L/day using flat plate collectors - 40 panels with forced circulation pump
- iii. Insulated MS storage tank with FRP coating of 5000L capacity each
- iv. Heat pumps 2 nos each of capacity 1000L/hr/36kw for back up and recirculation pump of 5m³/hr.
- v. The system shall be complete in all respects using necessary
- vi. CPVC pipes, brass isolation valves, temperature sensors, timer, non-return valves and other accessories complete.
- vii. An electric control panel shall be provided for automation of the entire system.

5. CPVC Pipes & Fittings

- a. Water supply pipes shall be CPVC. Pipes used for concealed work, exposed work or in trenches are designated by their nominal diameters. Pipes up to 50mm diameter shall be SDR 11. Pipes above 50mm shall be SCH 40.
- b. 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.
- c. Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply.(Use of red and white lead sutli will not be permitted for screwed joints)
- d. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. CPVC pipes inside shall be fixed in wall chases well above the floor. No pipes 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.
- e. All pipes and fittings shall have the approved manufacturer name and class embossed on them.

f. Clamps

- 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. 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 valve.

k. Trenches

- i. The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.
- ii. Cover shall be measured from top of pipe to the surface of the ground.

- iii. The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layers.
- iv. If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe. Where excavation requires blasting operation, it shall be ensured that no pipes have been stacked in the vicinity and completed pipe line in the vicinity has already been covered before starting of blasting operations; this is necessary to prevent damage to the exposed pipes in the vicinity by falling stones as a result of blasting.
- l. Where shown on the drawings, main pipe lines may be run in masonry trenches from the pump house to the buildings filled up with sand and buried in ground as per architectural /landscape details.

6. Valves

Gate valves shall be Gun metal with pressure rating of PN16. Non return valves shall be vertical or horizontal type Gun metal as per requirement. The pressure rating shall be PN 16.

i. **Ball Valve (Brass)**

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703 (Fig. 18.1). The ball valve shall be of following two classes:—

- a. **High Pressure:** High pressure float valves are indicated by the abbreviation ‘HP’ and are designed for use on mains having pressure of 0.175 MPa or above.
- b. **Low Pressure:** Low Pressure float valves are indicated by the abbreviation ‘LP’ and are designed for use on mains having a pressure up to. 0.175 MPa.

The ball valves shall be of following nominal sizes 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm. The nominal size shall correspond with the nominal bore of the inlet shanks. Polyethylene floats shall conform to IS 9762.

ii. **Bib Taps and Stop Valve**

Brass: A bib tap is a draw off tap with a horizontal inlet and free outlet and a stop valve is a valve with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clock wise direction. The flow through the bib tap shall be 5 lpm(50% below griha base rate).This shall be controlled with flow regulator installed in the bib tap.

iii. **Gate Valve - Gun Metal**

These shall be of the gun metal fitted with wheel and shall be of gate valve type opening full way and of the size as specified. These shall generally conform to IS 778.

iv. **Non-Return Valve (Gun Metal)**

A non-return valve permits water to flow in one direction only and is provided on the ascending part of the main to check return flow. The non-return valve shall be of Gun metal and shall be of horizontal or vertical flow type as specified.

The valve shall be of quality approved by the Engineer-in-Charge and shall generally conform to IS 778.

v. **Sluice Valves-Brass/Gun Metal** The sluice valves are used in a pipe line for controlling or stopping flow of water. These shall be of specified size and class and shall be of inside non-raising screw type up to 300 mm size and raising or non-raising screw type above 300 mm with either double flange or double socket

ends and cap or hand wheel. These shall in all respects comply with the Indian Standard Specification IS 14846. Class I sluice valves are used for maximum working pressure of 10 Kg/sq.cm (100 metre head) and class II sluice valve for 15 Kg/sq.cm (150 metre head). The body, domes covers, wedge gate and stuffing box shall be of good quality cast iron, the spindle of bronze, and the nut and valve seats of leaded tin bronze. The bodies, spindles and other parts shall be truly machined with surface smoothly finished. The area of the water way of the fittings shall be not less than the area equal to the nominal bore of the pipe. The valve shall be marked with an arrow to show the direction of turn for closing of the valve.

vi. **Pressure reducing valve**

Material of construction-forged brass as per IS 6912. Screwed Female Ends to IS 554 / BS 21 / ISO 7. It should be ideal for sensitive and a consistent fluid regulation. Provided with Premium Quality Nitrile Rubber 'O'Rings. As per IS5192-1. Demands low maintenance and virtually noiseless. Most of the critical working components shall have a distinct edge of being hot brass forged.

7. Relief vents

The air pressure relief vent, at least one-half the diameter of the building drain, shall be provided at the top of vertical offset so as to supply such additional air to the drain as may be required by the sudden increase in liquid velocity in the vertical offset. Where a building trap or other sharp change in flow direction shall be provided in the building drain downstream from the vertical offset, an air pressure relief vent should be provided at the base of, and within 3 ft (0.900m) of, the vertical offset. Lower relief vent should be branch –connected to the upper relief vent at a sufficient height. The recommended provision for soil and waste stacks more than ten stories in height is to provide a yoke relief vent at each tenth story of the drainage stack, counting downward from the top story. The lower end of the yoke relief vent should connect to the drainage stack by means of a Y located below the horizontal branch drain serving fixtures in that story, and the upper end should connect to the vent stack by means of a T or inverted Y located at least 3 ft (0.900m) above the floor level as shown in the drawing.

8. Storage Tanks

a. Overhead Tanks

Overhead water storage tanks for water supply shall be RCC tank.

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 overflow and vent 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. (As required)

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.

9. Testing

- a.** All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg /cm^2 whichever is more. Pressure shall be maintained for a period of at least 12 hours without any drop & withstand for 8 hrs.
- b.** A test register shall be maintained and all entries shall be counter-signed by Contractor(s) in the presence of Engineer-in-charge.
- c.** In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open

or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

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

10. Measurements

a. CPVC pipes

- 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. 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 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 Schedule of quantities.

- d. 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. Installation of pumps and laying of water main from other sources like bore well and open well is also in scope of the contractor.

c. Underground water tanks

- i. Underground water tanks include fire water, flushing water, domestic water, rain water and filter feed water.
- ii. Pumps – Pumps shall be centrifugal pumps or Open well submersible pumps as specified in the schedule of quantities.

3. Drainage system

- i. The function of a plumbing drainage system is to collect and transport wastewater from the fixtures to the building sewer.
- ii. In achieving this function in a safe and efficient manner, water-sealed traps are used to protect the interior of the building from hazardous or obnoxious gases that may be produced in the drainage system or sewer. Traps are

essentially water seals which permit the passage of water into the drainage system while blocking the flow of gas out of the system into the building. The normal depth of a trap seal is 50 mm (2 inches) for fixtures other than water closets, which generally have a seal depth ranging from 63 mm (2 1/2 inches) to 75 mm (3 inches).

- iii. SS centrifugal Waste water Transfer Pump(grinder pump), for pumping waste water/ Kitchen waste/ sewage waste from collection pit to Sewage treatment plant, with including control panel, solenoid valves, level switches, control wires etc. (1Working pump + standby) with suitable Capacity:150lpm@25mtr head

4. Rising Mains & level control system

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

5. Level Controllers

Automatic Three phase water level controllers with level sensors for submersible pump shall have the following features

- i. Switch off the motor when the water level in tank reaches a preset level below the over flow pipe.
- ii. Switch ON the motor if the water level in tank goes down below a preset value near.
- iii. Switch off the motor in the event of dry running

6. Smart water meter

- i. Water meters shall be selected according to flow to be measured and not necessarily to suit a certain size of main. Smart water meter are used to measure the volume of water used by buildings that is supplied with water by a public water supply system.
- ii. The smart water metre used complies with IS 4064 and is a multijet class B magnetic type 100mm battery-powered metre with the relevant fittings.
- iii. The water metre data concentrator panel/control module (IP65 protection, radio interface for reading data) must be portable in order to process data on a server. The price shall include software for server installation, integration with all installed water metres for data processing with user interfaces, and data storage

for gathering water consumption and metre information from each water metre installed for the project.

CHAPTER D

TECHNICAL SPECIFICATIONS FOR ELECTRICAL & ELV SYSTEM

1. Scope of Works:

- a. Electrical Installation (Internal & External)
- b. 11kV Substation & DG Set
- c. 11kV FP/DP structure
- d. 11kV metering panel
- e. 11kV cable
- f. 11kV Indoor HT panel including CT /PT unit
- g. In door Dry type transformers
- h. LT cum AMF panel, APFC panel & Other panel boards for power distribution
- i. LT cable & cable support system
- j. UPS
- k. Roof top on grid solar PV station
- l. IP based CCTV system
- m. Fire alarm system
- n. PA system
- o. Fire Fighters telephone system
- p. EPABX
- q. Telephone & Data Systems
- r. TV system (wiring only)
- s. Audio Video system

2. Standards and Codes applicable for the work

The work shall, in general, conform to the Latest CPWD Specifications for Electrical and all other works with up-to-date correction slips for all sub heads of work as applicable, and, Technical Specifications & BOQ 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 Schedule of Quantities, the Specifications and/ or the Drawings, the following order of preference shall be observed:

- a. Description of Schedule of Quantities
- b. Particular specification and Specific Condition, if any
- c. Drawings

- d. IS 732 & IEC 7th Edition – Wiring regulation
- e. NBC 2016 – Elect & ELV works
- f. CPWD works manual – Internal wiring 2013
- g. CPWD works manual – Substation Design
- h. Kerala state Inspectorate guidelines
- i. KSEB guidelines
- j. IS 3043 – 2018 Earthing design
- k. IEC 61439 -Type Tested Panel boards, if applicable
- l. CPRI & ERDA Guidelines - Electrical Panel Boards
- m. IS 1181 & BEE Guidelines – Transformer design
- n. CPCB Guidelines – DG sets
- o. FM & UL guidelines – FAS PAS manufacturing standards
- p. IS 2589/NBC 2016 – FAS PAS installation guidelines
- q. BEE guidelines –Light fixtures & ceiling fan selection
- r. 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.

3. General clauses

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.

The contractor shall obtain all sanctions & approvals of electrical loads, approval of schematic or single line diagram, general arrangement drawing of Electrical sub station / D.G.set / approval of meter room/ main schematic diagram 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 KSEB, Kerala State Pollution Control Board & Kerala State Electrical Inspectorate; a copy of the same shall be delivered to HITES.

The HITES 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 HITES/ 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, Works manual CPWD 2016, NBC 2016, Relevant IS codes, IEC codes etc.

The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/performance of the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

4. Drawings

The drawings are meant to give general idea to bidder regarding the nature of work covered by these specifications.

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.

a. Shop Drawings

The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, ceiling/exhaust/wall fans, position of switches, socket outlets, isolators for mechanical/biomedical equipments, distribution boards for various services, cables, cable trays/ladders, D.G set, H.T panel, FP/DP Structure, Transformer, M.V. Panel Boards/Relay Panel, PCC, DB's, Cable Schedule with other relevant services and submit to the HITES 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, mounting heights 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.

b. Coordination drawing

In case of locations where false ceiling is available, contractor shall prepare coordination drawings for below and above false ceiling services. Sectional details are to be prepared for locations in each floor where interference of many services are occurred.

The coordination drawing shall clearly mark with all services coming up in the floor with dimensions, clearances from wall/slab/other services. The possible false ceiling level shall be marked in the coordination layout.

While preparing coordination layout for below false ceiling services, contractor shall refer finalized and approved shop drawings of each services and aesthetical correction may be done with necessary changes.

When more services are to be laid externally, contractor shall prepare external coordination drawing.

Routing of all services, spacing between each service, depth and level of each service with respect to finished ground level etc. shall be clearly marked in the external coordination drawing.

Contractor shall commence the work only after getting approval of coordination drawing from engineer in charge.

c. Completion Drawings/As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the HITES 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.
- Location of UPS, battery bank and allied electrical panels, cabling etc.
- Layout of cable trays with support and their fixing details.
- Location of FP/DP structure, power intake arrangement(metering point) and HT cable route
- Location of all earthing station, route and size of all earthing conductor.
- Position of HT/LT Switch Boards/Transformer & D.G. sets

The recommended position of the switch boards, transformer & D.G. sets 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 HITES. For all non-specified items, approval of the HITES shall be obtained prior to procurement of the same. HITES shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

5. 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.

6. Materials and equipment

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by HITES'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.

6.01 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. LED 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 outdoor: 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 fuels, 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. 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 HITES 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. 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. 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. Inspection, testing and inspection certificate

- The HITES 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 HITES 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 HITES instructions.
- The Contractor shall give the HITES thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The HITES, 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 HITES and he shall forthwith forward to the HITES duly certified copies of tests in triplicate.
- The HITES 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.
- Contractor shall arrange factory acceptance test for DG set, Transformer, HT/LT panels, UPS, Busduct & any other specialized electrical equipment which is eventually required to complete the project. Contractor shall arrange the factory inspection at his cost. Inspection team shall include engineers from client, Contractor & HITES. All expenditure in connection with factory inspection such as flight/train/bus tickets, accommodation and other expenses involved in due course shall be borne by the contractor. When the factory tests have been completed at the Contractor's or Sub-contractor's works, the HITES shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the HITES, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the HITES. 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 HITES 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 HITES.

- The equipment shall not be dispatched to site unless the formalities of testing gets completed in accordance with the FAT procedure.
- 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 HITES or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.
- The inspection by HITES 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 HITES 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 HITES 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. Tests

11.1 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 HITES 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.

11.2 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, immeasurable 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 the client on production of requisite documents.

12. 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. HITES takes no responsibility of the availability of any special packaging/transporting arrangement.

13. 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 piping 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. Finishing of metal surfaces

14.1 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.

14.2 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 discoloured 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.

14.3 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 swaf 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, staving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be shoved.
- 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 HITES’s review and approval.

15. 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 HITES. 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 HITES 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 HITES 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 HITES, 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. 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. 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. Design coordination meeting

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the HITES 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. 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.

GENERAL REQUIREMENTS

1. GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (SEB), 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

ELECTRICAL SERVICES

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 HITES/Engineer-in-charge prior to execution of the job.

- 11kV DP/FP structure as per KSEB's requirement
- 11kV metering panel
- 11 KV Transformers
- Medium voltage switchgear.

- DG sets.
- UPS with SMF battery
- Light fixtures – internal & street lights
- Wiring devices – switches & sockets
- Earthing.
- Capacitor with control panels and detuned harmonic filters.
- AMF panel.
- Supply, laying and termination of H.T. cables.
- Supply, laying and termination of L.T. cables.
- Distribution Boards / Sub main Distribution Board.
- Providing power supply to mechanical/bio medical equipments
- 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.
- Fire sealant provision for all shafts/cut outs.
- Substation safety equipments.

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 HITES or his authorized 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.

3. 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 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.
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4. 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, KSEB as applicable before commissioning of electrical/DGs.

- Indian Electricity Act.
- Indian Electricity Rules.
- Factory Act.
- Pollution Control Act.
- Works manual – CPWD 2016
- NBC 2016

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.

5. SITE CONDITIONS

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

6. DESIGN CRITERIA

Electrical Details of Incoming Supply

Supply Voltage	11 KV.
Fault level (sym.) at supply of point (designed)	350 MVA (to be confirmed from State Electricity Board by Tenderer).
Neutral Earthing	Solid Earthing
Voltage Regulation	$\pm 10\%$
Frequency Regulations	$\pm 3\%$
Combined	$\pm 10\%$

7. LT POWER DISTRIBUTION SYSTEM

Supply Voltage	415V/240V
Frequency	50Hz
Neutral earthing	Grounded
Short circuit fault withstand capacity	10 KA - 50 KA (1 Sec.) as per B.O.Q. and specification.

CABLE DETAILS

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

8. ACCURACY CLASS OF METERS

Revenue Metres& CT/PT

Ammeter, Voltmeter and Other Instruments.

To be as per the latest requirement from KSEB

Class – I Digital / Analogue as per BOQ.

ELECTRICAL SERVICES

A. DISTRIBUTION TRANSFORMER

11/0.433 KV DRY TYPE TRANSFORMER

GENERAL

The step down double wound core type transformers shall be suitable for indoor mounting with a voltage ratio of 11000/433 volts with a Delta/Star configuration. The transformer shall comply with the I.S. 11171 and ECBC 2017 standards amended up to date.

The transformer shall also comply with BEE guidelines for losses.

TRANSFORMER DETAILED SPECIFICATIONS

11kV/433V, 3 phase, 50 Hz, Delta star, DYn11, Dry type, cast resin, indoor, naturally cooled, copper double wound transformer with Off load tap changer from +5% to -10% in steps of $\pm 2.5\%$, with necessary control cables and other facilities, etc, class F insulation, complete with WTI and scanner for alarm & trip, unidirectional rollers, cable end box for termination of HT cables & LT Cable complete with rating and technical name plate, earthing terminals with lugs, lifting lugs in all respect with all necessary standard accessories and as per IS codes.

Please refer BOQ specification for capacity & other details of dry type transformer

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.

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.

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 re-annealed 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.

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.

INSULATION CLASS

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

TRANSFORMER TAPPINGS

On load tap changing links on HV side. The tapplings to be provided for variation on HV side from +5% to – 10% in steps of $\pm 2.5\%$ each.

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.

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 or bus duct as per the requirement of the project

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.

TRANSFORMER FITTINGS

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

Diagram and Rating plate

Lifting Lugs.

Two earthing terminals on either side of the tank.

Four bidirectional rollers on the under carriage for movement.

Winding Temperature Indicator with alarm contacts for alarm and trip circuits.

Externally operated tapping switch with position indicator & locking arrangement.

Terminal marking plate.

Jacking Lugs.

H.V. cable box for 3 core XLPE cable as required.

L.V. cable box suitable for reception of armoured cables or chamber for receiving bus duct as required.

Space provision for neutral CT.

TRANSFORMER GUARENTEED TECHNICAL PARTICULARS

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

- Core loss
- Load loss
- Percentage Impedance

TRANSFORMER TESTING

Prior to acceptance and dispatch of the transformer, HITES/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 HITES/Engineer-in-charges for approval prior to dispatch.

- Measurement of Winding Resistance
- Ratio polarity and phase relationship
- No load and load losses
- Impedance voltage
- No load and load current
- Insulation resistance
- Induced over voltage withstand
- Separate source voltage withstand

In addition type test certificate for following parameters shall also be submitted to HITES/Engineer-in-charges for record. Any type test if specifically asked for by HITES, shall be carried out on the equipment covered by this contract shall be done at extra cost prior to dispatch.

- Temperature Rise
- Impulse voltage withstands.

INSTALLATION

The transformer shall be installed as per the manufacturer's instruction manual and shall conform to the requirements of IS 10028 latest amended upto date.

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 3043-2018 and statutory authorities

COMMISSIONING TESTS

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

Insulation resistance of the winding between phases and phase and earth on the H.T.side.

Winding resistance of all the windings on all tap positions.

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.

On commissioning of the transformer the following readings shall be taken

- MV side voltages at all tap settings
- Temperature rise under no load conditions

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.

Factory acceptance test of transformer to be carried out as per clauses in the special conditions of contract.

B. L.T. PANELS & SWITCHGEARS

GENERAL

All panels shall be complying with CPRI/ERDA guidelines.

All Switch gears shall conform $I_{cs} = 100\% I_{cu}$ as per IEC 60947-part 1-5

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 throughout 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

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.

All panel boards having MCCB/ACB shall be as per the standards IEC 61439-1 & 2.

The switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc. shall be identical in construction to the assembly which has undergone the type test certification. The drawings of the type-tested assemblies shall be made available for inspection.

Switchboards shall have a short circuit level withstand as per Schedule of Quantities and drawings.

The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.

The switchboard along with ACBs and connections should have been be type tested design at Independent international test house for short circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required.

Panel shall be rated for Impulse withstand capability 12 KV for main circuit ACB and 8kV for MCCB as per IEC 61439 Clause 5.2.4. Panels should be tested for mechanical impact test IK10 as per standards

All ACB, MCCB of main LT panel shall have earth fault protection.

IEC 61439-1 & 2. "Low-Voltage Switchgear and Control gear Assemblies"

Internal arc as per IEC 61641 for 0.4 sec at system design fault level on HBB, VBB and cable chamber.

Certified as per Seismic Zone 4 IEC 60068-3-3/ IS 1893/ICC ES AC-156 requires compliance against acceleration.

Form 4B IP2 X (touch proof) protection even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet/ Hylem sheets shall not be allowed.

NOTE: Copies of the test certificates shall be submitted along with the tender.

CODES & STANDARDS

The design, manufacture and performance of equipment shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Electro 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:4146 Voltage transformers.

IS:4201 Current transformers for metering and protection with classification Part-I, II burden and insulation & III 1964

IS:9224 Low voltage fuse and protection.

IS:3842 Specification for electrical relays for power system protection.

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.

IEC 61439. Assembly of Electrical panel boards

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 IP55. However bus bar chamber shall have IP42 degree of protection in case 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:

Complete enclosed bus bar compartment for running horizontal and vertical bus bars.

Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.

Compartment for power and control cables of at least 300mm width covering entire height provided.

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/drawout type as per BOQ.

Each feeder shall have compartmentalized or non-compartmentalized for MCB feeders only. 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

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 arcing 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 moulded 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.

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 4 pole) 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 non-volatile 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.

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 compliance 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 conform 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 use 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 override 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 device for interlocking the door of switchboard. Following shall be included if specified in the drawing or in the schedule of quantities:

- Under voltage trip
- Shunt trip
- Alarm Switch
- 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 Ie
- Breaking Capacity equal to or more than 8 Ie

For AC4 Duty

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

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 HITES' 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 pre-treated 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 along with 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:

Technical literature giving complete information of the equipment.

Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

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 HITES 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

C. BATTERY & BATTERY CHARGER (if applicable)

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.

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:

1. 1 No. Double Pole ON/OFF MCB at A.C. Input.
 2. 1 No. Pilot Lamp to indicate Charger ON.
 3. 1 No. MAIN TRANSFORMER: Double Wound, naturally air – cooled, having Copper winding.
 4. 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.
 5. 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.
 6. 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.
 7. 1 No. Electronic Controller to automatically changeover Battery Charging from Boost to Float and vice – versa.
 8. 1 No. DC Ammeter and Toggle Switch to read Charger Output Current and Battery Charge / discharge current.
 9. 1 No. Moving Coil DC Voltmeter to read the DC Output Voltage.
 10. 2 Set Potentiometer to adjust the output Voltage during Manual / Auto Float and Boost Modes.
 11. 1 No. Double Pole ON/OFF MCB at Charger Output.
 12. 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 over volt.

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	CHARGING RATING
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24V / 40AH	: 10.0 Amp.
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24V / 60AH	: 15.0 Amp.
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24V / 100AH	: 15.0 Amp.
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24V / 120AH	: 20.0 Amp.
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24V / 150AH	: 25.0 Amp.
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24V / 200AH	: 30.0 Amp.
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D. 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-3043-2018.

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 solder less 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.

8. UPS

9. FP / DP structure

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 HITES' 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 mentioned in the BOQ. 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, check nuts 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 instructions to be given by HITES' authorized 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 HITES 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 HITES' authorized 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. HITES Engineer reserves the right to approve all test results before circuit or equipments are energized for the first time.

E. 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:

- a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.
- b) Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.
- c) 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.

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:

- a) Automatic power factor correction relay.
- b) Step controller with reversing motor.
- c) Time delay and no-volt relays.
- d) Protection MCCB / MCB.
- e) Contactor (AC-6B 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 HITES. Q.A. documents as applicable.

Q.A. involvement will commence at enquiry and follow through to completion 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.

F. H.T. CABLE (XLPE) 11 KV

The cross-linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1988 and (Part-II) 2011. The screening shall be done on individual cover. The armouring 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 1000mm for cable upto 33 KV (E) below the ground level in a trench 800mm 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.

G. L.T. CABLES & WIRE

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 substances in electrical	6 banned materials included Pb (Lead), Hg (mercury), Cr6+ (Hexavalent Chromium), Cd

		and electronic equipment (EEE) and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste EEE.	(Cadmium) and Flame Retardants- Polybrominated Biphenyls – PBB 1000ppm & Polybrominated Diphenyls Esters- PBDE 1000ppm. • <i>Max. conc. value - 0.1% by weight in homogeneous material for Pb, Hg, Cr6+, PBB/ PBDE</i> • <i>Max. conc. value - 0.01% weight in homogenous material for Cd.</i>
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: • <i>Recovery of minimum 60% by weight of the packaging waste</i> • <i>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%</i> • <i>Max. sum of concentration levels of Pb, Cd, Hg and Cr6+ >100 ppm by weight</i>
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.

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 armouring 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.

Technical Requirements:

- i. The cables shall be suitable for laying in racks, ducts, trenches conduits and under-ground 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.
 1. In plant repairs to the cables shall not be accepted.
- xiii. 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 E: 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 D: 2843.
- iv) The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383

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- iv) The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383

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/HITES

- 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.

PVC 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) inside 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 flame mastic 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 is 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

) Quality Assurance

Quality Assurance shall follow the requirements of MoHFW/ HITES 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.

H. CABLE TRAYS

a. 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 HITES/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).

I. INTERNAL ELECTRICAL WORKS

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.

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.

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 HITES.

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 HITES. 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.

Conduit size	20mm		25mm		32mm		40mm		50mm		60mm	
Wire size in sq.mm.	S	B	S	B	S	B	S	B	S	B	S	B
1.50	7	5	12	10	20	14	-	-	-	-	-	-
2.50	6	5	10	8	18	12	-	-	-	-	-	-
4	4	3	7	6	12	10	-	-	-	-	-	-
6	3	2	6	5	10	8	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	-	4	3	7	6	-	-	-	-
25	-	-	-	-	3	2	5	4	8	6	9	7

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 diameters.

J. UPS SYSTEM: SPECIFICATION FOR THE UPS

Quality power Supply

Double conversion, DSP Based, True on line UPS system as per IEC 62040-3 with 415V +/- 15% V,50Hz,3Ph Input & 415V,3Ph,50 Hz , Output, working on 16 Bit microprocessor

Architecture, within built Isolation transformers, RS 232 ports, monitoring software , O/L.S.C. protections & self diagnostic features, LCD Display Panel for Functions & all parameters, complying with IEC standards. Convertors, Invertors, rectifiers & Battery Charger shall utilize PWM technology with 3 level IGBT.

Battery Backup time of 30 minutes with required No of 'SMF Battery with Battery management System, housed in suitable Cabinet /stand, Static By Pass, complete with Internal wiring & all accessories to be provided.

Maximum safety for personal

There should be a feedback protection device in the UPS to prevent any voltage back feed in the upstream distribution board, thus ensuring the maintenance personal.

For Advanced communication there shall be software system which displays the most important information such as the input and output Voltage, the load applied, the remaining back-up time, etc. It should also be able to provide information even in the event of a failure, to support the fault diagnostics.

It should also contain the following hardware interfaces:

- RS232 serial port / as specified in the BOQ
- Dry contacts
- EPO (Emergency Power Off)
- Contact for UPS shutdown using the remote emergency button.

To allow easy and intuitive operation of the UPS There should be Mimic Panel. This helps in accessing the most important parameters: status and alarm, control and commands, input, output, battery measurements (power, current, voltage, frequency and temperature) and settings.

Low Input Harmonic Distortion

This Active filter shall be based on the IGBT's Technologies controlled by the Digital Signal Processor (DSP). This DSP instantly monitors and controls the inputs current absorbed by the UPS in order to eliminate the unlike harmonics and maintain the THDi less than 4%. With the effect of Active Filter the UPS can also be connected to the low loads. These active filters shall be fitted inside the UPS so that no additional footprint is required.

Less harmonics in the UPS input reduces the neutral cable size and consequently the installation cost. Also it gives maximum reliability as any failure of the optional Active Filter has no influence on the power supplied to the load; the only consequence is the increase of current harmonics level rejected to the mains, which gives maximum reliability for the load.

The input requirements of the UPS are as follows:

Voltage	:	400 V three-phase + N
Voltage tolerance	:	± 20% +
Frequency	:	45-65 Hz

Current distortion	:	<4% with active filter
Power factor	:	0.99 with active filter

The Bypass of the UPS are as follows:

Rated voltage	:	400 V three-phase + N
Phases number	:	3 + N
Voltage tolerance	:	10 %
Rated frequency	:	50 Hz
Frequency tolerance	:	± 2%
By-pass	:	Static and manual for maintenance
Transfer time	:	Nil

The Battery for the UPS are as follows:

Type of battery	:	SMF
Battery blocks	:	12 V
Recharge time minimum	:	6 Hr

The Output of UPS are as follows:

Rated power	:	As per BOQ
Active power	:	As per BOQ
Phases number	:	3 + N
Waveform	:	Sine wave
Rated voltage	:	415V
Frequency	:	50 Hz
Dynamic stability	:	± 5%.
Static stability	:	± 1%
Crest factor	:	3 : 1
Overload	:	125% for 10', 150% for 1'
Power factor	:	1
UPS efficiency	:	min.95%
No load losses	:	As per IEC rules.
Input THDi at any load	:	less than 5%
AC volt accuracy	:	+/- 1%
Transient voltage regulation	:	+/- 5%
Transient recovery time	:	< 20 milli seconds
Total voltage distortion	:	< 1% for linear load

Total voltage distortion	:	< 5% for non linear load
Isolation transformer	:	required and to be BIS certified manufacturer
Acoustic noise level	:	< 55dBA at 1 mtr

The System of UPS is as follows:

AC/AC efficiency	:	92% in On-line mode, 98% in Economy Mode / Smart active mode/ Emergency mode.
Noise	:	50-56 DbA at 1 m.
Operating temperature	:	-2° - 45°C
Relative humidity	:	95% non-condensing
Remote controls	:	EPO & Bypass
Remote signals	:	volt free contacts
Protection degree	:	IP20
Communication	:	Double RS232/C + slot for SNMP Adapter.
Colour	:	Dark grey RAL 7024

The Standard of UPS are as follows:

1. Safety EN 62040-1
2. EMC IEC 62040-2
3. EN 50091-2 lev. A
4. Directives 73/23, 93/68, 89/336 EEC
5. EN 62040-3.

Refer particular specification mentioned in BOQ regarding capacities of UPS

K. 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 solder

less 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 niche 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.

Residual Current Circuit Breaker

RCCB shall be 4 pole 415 volts 50Hz, 30-300mA sensitivity. These shall be of approved make. The rating of the RCCB 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 RCCB shall be moulded from high quality insulating material. The material shall be fire retardant, anti-tracking, non-hygroscopic, impact resistant and shall withstand 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 RCCB 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.

L. 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 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 HITES.

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 authorized in writing by HITES. 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 HITES.

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 HITES'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 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 Engineer-in-charge 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.

- a) 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.
- b) 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 HITES's decision with regard to the quality of the material and workmanship will be final and binding, any material rejected by the HITES shall be immediately removed by the Contractor from the site. The HITES 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 Contractor shall submit to the HITES, 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, Exhaust 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 HITES 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 HITES immediately dismiss from the works any person employed there on who may, in the opinion of the HITES, 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 HITES/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 board, 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 contractors 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.

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 HITES'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 HITESs. 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 MoHFW 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 HITES. 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 totaling 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 HITES

M. D.G. SET

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 Cylinders 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
- Lub 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: As specified in the BOQ

Power factor: 0.8

Type of construction: brushless, self excited, self regulated

Voltage regulation : +/- 1% all load between no load to full load

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: 10% for one hour in any 12 hours of operation without exceeding temperature rise limits specified in BS:2613 or BS:5000 when corrected to ambient temperature at site.

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
- Amp Sentry 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.

DIESEL GENERATING SET

DESIGN

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.

The engine/alternator set shall be capable of taking 10% over-load for a period of one hour during any 12 hours period, while operating continuously at full rated load.

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.

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

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.

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.

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 cladded 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 12 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 HITES 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 HITES 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 HITES.

DAY SERVICE TANK

Day service tank shall be of 3mm thick MS sheet fuel oil storage tank of capacity 990 litres 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.

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.

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.

S.No.	ITEMS	TIME AFTER START OF RUN/TEST						
		1 Hr	2 Hr	3 Hr	4 Hr	5 Hr	6 Hr	7Hr
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 time 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

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 EPDN 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) (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 DOESNOT AFFECT STARTING	(PLEASE SPECIFY-min. 60% of the rating)	
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)	1/4 th Full load		
b)	1/2 th Full load		

c)	$\frac{3}{4}$ 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	1hr Minimum	
Prepared by: _____ Name : _____ Date: _____			

TECHNICAL SPECIFICATIONS FOR ELV WORKS

Scope of work

- CCTV system
- Fire Alarm & Detection system
- Public Address System
- Telephone & Data system
- TV 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, RJ 11 pair telephone cable
- Terminal blocks & Floor Junction box
- Multi pair telephone cable
- Main distribution box
- EPABX
- 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	:	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: Code DOT GWIR06/02 C-DOT/VDE: 0815,0816/IEC189/IS5608

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

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 installed above false ceiling, cable support system using anchor fasteners, threaded rods and GI slotted C channel of appropriate size must be used. 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 unarmored 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 consist of metal rack, terminal blocks, cable manager, jumper wires, power supply outlets etc.

6.0 Warranty

As per new GO

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.

B. EPABX

1. Basic Requirements

The proposed bidder should have minimum 5 years' experience in supply, installation, testing and commissioning of model offered or with higher specifications.

The bidder must submit project reference list for consultant's review.

2. System offered should be equipped as follows:

EPABX with the following specifications:

1. 208 Analog Extensions with CLI Expandable to 512 Ports
2. 08 Port analog trunk with CLI and Power Failure Transfer and with Protection modules.
3. 02nos PRI.
4. 02nos Operator Console with 30 Direct selection Keys.
5. 08 Port Voice Guidance to announce Extension Busy status, Wakeup call announcement and other important telephone features, Auto Attendant facility for Welcome message announcement.
6. 02Nos -500 pair MDF (wall mountable)
7. 01 No. Call Billing and monitoring Software.
8. Charger/UPS with Batteries for backup of 30 minutes

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

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 48V DC.

CE, FCC, RoHS and TEC compliant

3. System should offer connectivity for the following:

- Analog Trunk card with CLI facility
- 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.

4. 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 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.
- The analog extensions should have a loop resistance of at least 1800 ohms.
- Exchange should offer connectivity to P.A System.
- Voice assisted features to be provided for following:-
All CO lines (08) to be provided with voice guidance/auto attendant facility
The system should have voice guided feature assistance for system features
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.

5. 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
- Conference

- Wake up call
- Automatic call back
- 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, 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 20 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 Box with adequate protection for over voltage and over current for junction shall be in the supplier's scope.

Warranty: **AS PER NEW GO**

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 07(Seven) years from OEM for the offered EPABX along with tender.

The EPABX should have a valid TEC certificate.

C. DATA SYSTEM

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, RJ45

4 pair UTP Cat 6 data cable

Patch panels

Ethernet switches

Metal racks

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: 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 cables 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 cables 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 installed above false ceiling, cable support system using anchor fasteners, threaded rods and GI slotted C channel of appropriate size must be used. 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.

UTP Cable must be tested by OEM certified engineer

Cat 6 cables 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

As per new GO

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.

D. 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 installed above false ceiling, cable support system using anchor fasteners, threaded rods and GI slotted C channel of appropriate size must be used. 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 interval.

E. FIRE ALARM SYSTEM – ADDRESSABLE TYPE

Standards

UL guidelines : Fire detection and alarm system materials/manufacturing codes material specifications.

NBC 2016 : Fire detection & alarm system installation

CPWD 2013 : Standards for wiring installations

a. Scope of work

The contractor shall engage only authorized agency appointed by OEM to carry out the work. Contractor shall submit OEM's authorization letter before carrying out the work.

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

- Addressable fire alarm control panel with loop cards, network card, built in battery, power supply unit, event logging with real time stamping and provision for connecting to BMS.
- Addressable type smoke detectors
- Addressable type heat detectors
- Addressable type multi sensor detectors
- Response indicators
- Addressable type interface modules

- Addressable type control module
- Addressable type fault isolator module
- Addressable type manual call point
- Addressable type horn/strobe
- Power supply unit of hooter/sounder
- 2 core 1.5 sq mm twisted, shielded pair, armoured, FRLS copper cable
- Cable support system

The control panel shall be intelligent device addressable, analogue detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. Fire Alarm control Panel shall have capability to accommodate minimum 250 devices/detectors in one loop. The panel shall have Alpha numeric QWERTY key pad LCD display to indicate all events with address and shall comply with UL standards.

The panel shall have RS 485 network cards, loop cards, BMS interface module through any protocol available in market (BACnet, Modbus etc.), Printer port, in built battery, power supply unit etc

The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.

All equipment furnished shall be new and the latest state of the art products of a single manufacturer, engaged in the manufacturing and sale of analogue fire detection device

b. Mandatory Requirements

- Addressing / Labelling of detectors and devices

Addressing or Labelling of detectors and devices shall be done by means of using DIP/Rotary switches.

Other means of addressing by employing special tool from OEM or Soft addressing methods are not acceptable.

Replacement of a faulty detector OR refitting the detector or device after cleaning shall not involve re programming / changing the address of the devices and detectors by OEM expert.

- Visible indicators in the Detectors/Devices

Detectors or devices shall be either single LED with two stage OR dual LED type for indicating alarm/fault status.

- Fire alarm control panel

The functional operations, modification procedure and access of the fire alarm control panel shall be achieved by simple steps and to be user friendly from the service and operation point of view.

Except for a major trouble within the control panel, the involvement of OEM expert shall not be anticipated after expiry of Defects Liability Period.

The display of fire alarm control panel shall be of LCD model, with Alpha Numeric, QWERTY type.

LCD screen dimensions shall be as per OEM's recommendations.

The panel shall be provided with suitable battery, charger etc. to work for 24 hours in normal condition and 30 minutes in alarm condition, in case of main power failure.

- Loop capacity

The loop capacity of the proposed system shall be as follows:

1) In a single loop having minimum 250 addressable detectors & devices.

Any loop shall not be loaded for 100% loop capacity keeping an eye on the future addition of devices in the loop.

The system shall be a complete, electrically supervised fire detection system, with a microprocessor based operating system having the following capabilities, features, and capacities:

System shall provide an output port for monitoring purposes by external systems. Communications to an external system shall be Ethernet, RS-232 or RS-485 communications.

The system shall provide the remote access connection via Ethernet to completely program and control the fire detection system.

The local system shall provide status indicators and control switches for all of the following functions:

- Audible and visual notification alarm circuit zone control.
- Status indicators for sprinkler system water-flow and valve supervisory devices.
- Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

Each intelligent addressable device or zone on the system shall be displayed at the Central Alarm Receiving Terminal and the local fire alarm control panel by a unique alphanumeric label identifying its location.

A. Intelligent Addressable Photoelectric Detectors

Smoke detectors shall be microprocessor based, intelligent and addressable devices, and shall connect with two wires to one of the Fire Alarm Control Panel loops. The detectors shall use the photoelectric (light-scattering) principle to measure smoke density. The detectors shall be ceiling mounted type and shall include a twist-lock base.

The detectors shall provide a test means whereby will simulate an alarm condition and report that condition to the control panel. Such a test may be activated remotely on command from the control panel.

The detectors shall provide addressable-setting by automatic polling. Systems which use binary jumpers or DIP switches to set the detector address shall not be acceptable. The detectors shall also store an internal identifying code, which the control panel shall use to identify the type of detector.

The detector shall provide dual LEDs or single LED with dual colour, normal & alarm condition shall be identified by separate colours.

The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the data. Systems using central intelligence for alarm decision shall not be acceptable.

The detector shall continually monitor any change in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analogue loop controller for retrieval using a laptop PC hand-held programming tool.

Using software in the FACP, the detectors shall compensate for dust accumulation and other slow environmental changes which may affect their performance.

The area covered by each smoke detector shall be as per IS – 2189/NBC codes

c. Addressable Manual Call points

The addressable manual call points shall monitor and signal to the FACP the status of a switch operated by a “break glass” assembly. They shall be red in colour and suitable for surface or flush mounting. The addressable call points shall be provided with an integral red LED to indicate activation.

The addressable call points shall be capable of operating by means of thumb pressure and not require a hammer. They shall be capable of being tested using a special ‘key’ without the need for shattering the glass.

The addressable call points shall incorporate a mechanism to interrupt the normal addressable loop scan to provide an alarm response within 3 seconds and shall be field programmable to trigger either an alert or an evacuate response from the FACP.

d. Addressable horn/strobe

The loop powered addressable horn/strobe shall be capable of monitoring and controlling two independent circuits of alarm sounders using a single loop address.

The addressable horn/strobe shall be capable of operating both sets of sounders in a pulsing or continuous mode as determined on the module. Each circuit shall be individually programmable. Sounder circuits shall be capable of synchronization.

The addressable horn/strobe shall provide the facility to monitor the wiring to the sounders for open or short-circuit and transmit the necessary fault signal to the FACP. Each sounder circuit shall be separately fused.

The addressable horn/strobe shall provide the facility to monitor for failure of the power supply for the sounders and transmit the necessary fault signal to FACP.

The addressable horn/strobe shall provide a green LED indication when the FACP is polling it.

Horn/strobe shall have a minimum sound output of 95 Db (A) at 3 metre distance, and shall have a maximum current consumption at 24V DC of 30 Ma.

e. Addressable Control Module / interface Module / Monitor Module

The control module / Relay Module / Monitor Module shall provide address-setting and shall also store an internal identifying code which the control panel shall use to identify the type of device. Modules which use binary jumpers are not acceptable. An LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. The addressable monitoring module shall be capable of monitoring two independent voltage free contacts, each normally open or normally closed, using a single loop address.

The unit shall be powered directly from the addressable loop.

The addressable interface module shall be capable of switching two independent relays; either normally open or normally closed, each rated at 24V, 2Amp.

A single input shall provide open and short circuit monitoring facilities, set locally at the unit.

The addressable relay interface module shall use a single loop address.

The unit shall be powered directly from the addressable loop.

The addressable interface module shall provide an LED indication when the FACP is polling it.

The isolator module shall provide protection on the addressable loop by automatically disconnecting the section of wiring between two modules where a short circuit has occurred.

The short circuit isolator module shall derive power directly from the addressable loop and shall provide an LED indication that the module has tripped. A base mounted version is available.

f. Multi-Sensors – Analogue Addressable

The multi-sensor should be capable of monitoring two different sensing elements:

Photoelectric Thermal

The design of the point-type multi-sensor photoelectric smoke detector sensing chamber shall be optimized to minimize the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.

The point-type multi-sensors shall incorporate screens designed to prevent all but the very smallest of insects from entering the sensing chamber, (50 holes per square 167entimetre or more).

The multi-sensors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimize the effect of radiated and conducted electrical interference.

The sensor should be able to operate in the following modes:

Combination Mode:

The sensor should be able to operate as a photoelectric sensor but when the ambient temperature reaches 40 degree C or above, the thermal elements should be capable of sensing the 'Rate of Rise' and adjust the sensitivity of the photoelectric element automatically. The sensitivity of the photoelectric should be increased via an internal algorithm. Photoelectric mode

The sensor should be able to return the analogue value for the photoelectric element during a normal polling sequence.

The sensor should also be able to signal to the FACP if the thermal sensing element exceeds a fixed temperature threshold.

Thermal mode:

The sensor should be able to return the analogue value for the thermal element during a normal polling sequence. The sensor should also be able to signal to the FACP if the photoelectric sensing element exceeds a pre-defined threshold.

The multi-sensor shall incorporate LED's, clearly visible from the outside, to provide indication of alarm actuation. The LED's should be controlled from the FACP if the LED's flash during the normal polling sequence.

The modes of the multi-sensor should be controlled by the FACP, when the FACP changes from one mode to another the FACP should re-calibrate the multi-sensor.

In locations where the detector is not readily visible, remote indicator units shall be provided.

The multi-sensor should have the capability of monitoring both sensing elements, if either and both of the elements fail it should be reported and displayed at the FACP.

g. Response indicator

The response indicator unit shall provide a remote indication for any detector that may be located in an enclosed or locked compartment.

The response indicator unit shall be driven directly from its associated local detector. It shall be either flush or surface mountable.

In addition to built-in response indicator of each detector, secondary response indicator of LED type shall be provided outside the room wherever asked for by the Consultant, for indication of fire through detector in the room.

h. Cable

The cable shall be 2Cx1.5 sq mm, twisted shielded, FRLS type, armoured double insulated copper cable

i. Installation

The entire fire alarm system shall be installed in accordance with BS 5839 / UL/NBC Standards, specifications, approved shop drawings, and to the satisfaction of client, consultant and local approving authority.

Armoured fire alarm cable shall be used to connect the devices in a loop system. Cable when used above false ceiling, shall be installed 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. When cable needs to be terminated in any device located above false ceiling, suitably sized glands and check nuts must be used and fixed on the back box. When cable run on RCC slab, has to be taken to a device located on false ceiling, it shall be dropped down along MS channel fixed on the RCC slab. Cable must be properly attached to the channel by using cable tie.

When cable has to be terminated in devices located below false ceiling at lower levels (e.g., manual call points or in horn/strobe), cable must be drawn through a pvc pipe of minimum diameter 25mm from the nearest device above false ceiling. PVC pipe used to draw this cable must be concealed in block wall from a location 10 cm above false ceiling grid to the back box of horn or manual call points. When cable run along walls or concrete slabs the plumb and line must be maintained to ensure good workmanship.

When loop cable has to be taken from each floor to the central control room, cable trays must be used. Cable tray size must be decided based on the no of cable to be installed on the tray. Cable tray must be installed in the service shaft as shown in the layout. Cable tray must be installed on the wall by means of GI slotted C channels, threaded rods & anchor fasteners. Cables laid on the cable tray must be neatly dressed by means of cable saddles and bolts or by using heavy duty cable ties. Cable shall not run at angles other than 90 degree (vertical or horizontal) to the wall or slab.

When loop cables have to be connected to the control panel, it can be done in one of the following methods:

Provide a GI glanding box of suitable size above false ceiling in the control room, terminate all cables in the box by using glands & lock nuts and drop the cables down in PVC pipes to the back box of the control panel. PVC adaptors must be used to connect the pipes in the back box.

Draw all cables through PVC pipes and terminate cable directly in the panel. PVC adaptors must be used to connect the pipes in the back box.

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

Contractor must submit shop drawings clearly indicating mounting heights of all devices used in the system, which is mentioned in the standard codes. For position/location of devices, contractor must coordinate with other services and architect. All devices of the system must be installed in neat manner keeping an eye on the aesthetic view.

Number of devices in a loop must be decided based on the specification clauses pertaining to the item.

Fault isolator module must be provided in each loop as per the requirement mentioned in the specification clause. It may isolate the faulty part of the loop and keep the other healthy part in the loop so that system may be put back in service.

Monitor module must be provided near fire hydrant/sprinkler shafts of the building to monitor the operation of flow switches/tamper switches provided in the fire protection system by the FPS contractor.

Interface module must be provided to activate close/open/start/stop commands for HVAC or lift equipments. In case of fire signal has initiated in the building, control panel shall generate triggering signal (usually volt free signal) to shut down motorized fire dampers located in HVAC ducts. Also, It will provide command signal (volt free signal) to lifts in the building.

HVAC & Lift contractor must ensure that necessary interfacing facility is provided in their control panels to enable the activation of their equipments in the appropriate mode under FIRE condition.

Contractor must submit and take approval of cause and effect matrix before commencement of the work.

Location of devices to be installed on false ceiling must be finalized after coordination with lighting/sprinkler/speakers/diffusers in HVAC system/ or any other services' contractors.

Fire alarm control panel shall be located in the central control room. Panel shall be installed flush in the wall. All loop cables must be concealed in the wall for exposed portion. Cable must be terminated in the panel by using properly sized glands and check nuts. Location of panel may be decided by coordinating with /Public address/Voice and Data services system installers and keeping an eye on the aesthetic view of the room.

j. System Operation

Contractor must submit cause & effect schedule before carrying out system testing & commissioning

The system shall monitor and act accordingly for the following conditions:

Fire alarm condition:

The system shall enter the fire alarm condition upon:

1. Activation of any manual call point.
2. Receipt of an alarm signal from any individual automatic detector.
3. Receipt of pre alarm signals from more than one detector.
4. Activation of sprinkler pressure switch.
5. Fire alarm signal from sub system.

The fire alarm condition shall:

1. Illuminate the general fire alarm indicator.
2. Be indicated on the control panel display giving details of the device & zone number, alarm type, number of devices in alarm and a programmable location text with a minimum of 640 characters.
3. Sound the control panel internal warning sounder.
4. Activate the required sounders as per the attached cause & effect schedule.
5. Activate the required outputs as per the attached cause & effect schedule.
6. Activate the required detector remote LED outputs as per the attached cause & effect schedule.
7. Display alarm verification concept delay time remaining.

8. Return all lifts to the ground floor.
9. Operate fire dampers as described in the attached cause and effect schedule.
10. Shut down air handling equipment as described in attached cause & effect schedule.

The pre-alarm condition:

The system shall enter the pre alarm condition upon receipt of a pre-alarm signal from any automatic detector.

The pre-alarm condition shall:

1. Be indicated on the control panel display giving details of the device & zone number, number of devices in alarm and a programmable location text with a minimum of 80 characters.
2. Sound the control panel internal warning sounder.
3. Activate the required sounders as per the attached cause & effect schedule.
4. Activate the required outputs as per the attached cause & effect schedule.

The fault condition:

The system shall enter the fault condition upon any short circuit, open circuit on the detection loops, sounder circuits and fire brigade connection equipment.

1. Any earth fault capable of affecting the reliable operation of the system.
2. Any CPU fault as per UL-2.
3. Any power supply fault.
4. Any network fault.
5. Removal of any addressable device.
6. Fault signals from connected input modules.
7. Any fault signal generated by internal monitored functions of addressable devices.

The fault condition shall:

1. Display the device number and/or description of the fault.
2. Sound the control panel internal warning sounder.
3. Activate the required outputs as per the attached cause & effect schedule.
4. Activate fire brigade communication fault output or initiate the fault intervention concept as required in attached cause & effect schedule.
5. Display fault intervention concept delay time remaining.

Degrade mode functionality:

- a. The system shall include a degrade mode functionality such that should a network participant fail or the network cease to function a common fire alarm may still be generated such that the fire brigade communication equipment is still activated.
- b. Software redundancy: The system shall include a software redundancy mode such that in case of failure, a reboot is triggered. Should reboots fail, the panel goes into software redundancy mode. As last resort, the panel goes in degrade mode.
- c. Fire brigade communication: The system shall be connected to a secure fire brigade communication system via separate monitored fire & fault outputs. The system shall also be

capable of receiving a common fault signal from the fire brigade communication equipment.
d. The system shall provide signals to the fire brigade communication system in accordance with the following alarm verification concept:

- Mode Manned – Alarms from automatic detectors will activate the system sounders and initiate a timer (T1) programmable from 10s to 5 minutes. Providing a responsible person acknowledges the panel within this time period no signal will be sent to the fire brigade communication equipment. Upon acknowledgement a second timer (T2) programmable from 10s to 10 minutes will be initiated. Again providing the system can be reset within this time period no signal will be sent to the fire brigade communication equipment.
- Operation of any manual call point will immediately cancel the delay timers and a signal will be sent to the fire brigade communication equipment.
- Mode unmanned – Alarms from any manual call point or automatic detector will immediately send a signal to the fire brigade communication equipment.

3. Submittal

The contractor shall include the following information with their offer:

Power & battery calculations. Battery & power supply size will be a minimum of 125% of the calculated requirement.

Complete product catalogue with manufacturers' data including Quiescent & alarm power requirements, physical dimensions, and finish and mounting requirements.

All necessary installation drawings and as built drawings.

Complete floor plans in a CAD compatible format showing all equipment required to meet this specification as well as interconnecting wiring marked for size & quantity of conductors. Fire alarm function matrix illustrating output events in relation to alarm, pre-alarm, drift application & fault signals.

Full list of all departures, exceptions, variances or substitutions from this specification.

Incomplete submittals shall be returned without review unless with prior written approval.

4. Quality Assurance

Manufacturer Qualifications:

The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.

- a. The manufacturer shall have a minimum of 15 years production experience in the manufacture and design of high sensitivity aspiration-type smoke detection systems.
- b. ISO 9002
- c. FM Global (Factory Mutual (FM)): FM Approval Guide

5. Supplier Qualifications

a. The manufacturer of the supplied products must utilize product distribution on a national basis to be considered for this bid. The manufacturer must have factory branches as well as independent distributors to allow the end user with the ability to utilize factory trained and authorized competitive service providers after system installation and commissioning.

b. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be licensed in the State if required by law.

- c. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
- d. The supplies shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
- e. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.

6. Installer Qualifications

- f. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
- g. The contractor shall submit copies of all required Licenses and Bonds as required in the Country having jurisdiction.
- h. The contractor shall be qualified to certify fire alarm systems. Upon completion of the installation the contractor shall certify the final system meets the country regulation for ongoing maintenance.
- i. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.

Source Limitations for fire alarm equipment: Obtain fire alarm equipment from single source.

Electrical Components, Devices, and Accessories: Listed and labeled as defined by country regulation, by a qualified testing agency, and marked for intended location and application.

Pre installation Conference: Conduct conference at Project site.

7. Delivery, Storage and Handling

Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

8. Project Conditions

Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.

Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and watertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

9. Identification

1.15.1 Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

1.15.2 A consistent color code for fire alarm system conductors throughout the installation.

10. Commissioning

1.16.1 The entire system shall be inspected & tested to ensure that it operates in accordance with this specification and the country requirements. In particular that:

- a. All manual call points & automatic fire detectors function correctly.
- b. All devices carry an accurate identification label.
- c. All manual call points and automatic fire detectors when operated result in the correct text & zone indications at all necessary indicating equipment.
- d. That sound pressure levels meet the country requirements.
- e. That the systems cause and effects match the requirements of this specification.
- f. The siting of all manual call points & automatic fire detectors meet the country requirements.
- g. All auxiliary functions such as lift returns, boiler shut off's and door release mechanisms are functioning correctly.
- h. Secondary supply will be proven by:
 1. A full testing of the secondary power supply is performed by creating a mains failure for 24 hours & simulating a full alarm for 30 minutes.
 2. A full testing of the secondary power supply is performed by creating a mains failure for 48 hours & simulating a full alarm for 30 minutes.
 3. A full testing of the secondary power supply is performed by creating a mains failure for 72 hours & simulating a full alarm for 30 minutes.
- i. All fault indicators and their relevant circuits are checked by simulation of suitable fault conditions.
- j. Readings taken & recorded of all insulation resistance, earth continuity and circuit impedance.

F. TECHNICAL SPECIFICATIONS - PUBLIC ADDRESS SYSTEM

Scope of Work

- Supply, installation, testing and commissioning of public address system including all material and manpower as per the specifications, bill of quantities, drawings, layout and schematic diagram and to the satisfaction of client, consultant.
- Main contractor shall engage only authorized agency appointed by OEM to carry out the work.
- The system utilized to serve the dual purpose of providing back ground music, making general announcement or to transmit evacuation message under fire condition.
- The contractor shall carry out the entire work of the system which consists of following devices/items/works:
 - Ceiling mounted speakers, provided in waiting areas, nurse stations, corridors and lobbies wherever false ceiling is available.
 - Wall mounted column speakers, provided in entry/exit staircases
 - Amplifiers, located in central control room of the building
 - Gooseneck microphone, located in central control room of the building
 - Voice alarm controller located in central control room of the building

- MP3 player with provision to plug in USB device or DVD
- Rack, located in central control room of the building
- Speaker cable armoured FRLS type
- Cable support system

Standards and codes

- IEC 60268-5
- EMC immunity acc. to EN 55103-2
- EMC emission acc. to EN 55103-1
- EN 60065

Technical specification

- Amplifiers

All amplifiers shall be mixing type for combining speech and music.

Power amplifiers shall have adequate continuous (RMS) power output to meet the requirement of the configuration. The unit shall be capable of delivering the rated output watts with less than 1% harmonic distortion in the design band width. The amplifier shall have a broad band frequency response of 20 Hz to 20 KHz. The output voltage and impedance shall meet with the system requirements. Amplifiers shall be protected against over loads and output shorts and a special thermal overload on the heat sink and fan cooling. The distributed audio amplifiers shall be magnetically coupled switch mode type with two input signal sources selectable manually or automatically by the fire alarm system. The amplifier shall incorporate a push-to-talk switch. Output wattage and volts shall be as shown in the schedule of work or as required to meet the needs of the PA system.

Power as well as audio amplifiers shall be mounted in suitable sized metal racks placed in the central control room in the ground floor of the building.

Technical specifications of the power amplifier is attached below and contractor must select the product based on these information. Any deviation may be discussed with consultant before forwarding the material technical submittal.

Rated power output	: 240 watts
Input sensitivity	: 1+- .1Vms/10k ohms
Gain co	: -12db ~ 0dB
High pass filter	: ~ 3dB @100Hz
Output voltage and impedance	: 4ohm/31V, 21ohm/70V, 41ohm/100volt
Operating temperature/humidity	: 0 to 40degree at 95% at non condensing
THD (1kHz@ half rated power)	: less than 1%
Power consumption	: 500W
Dimension	: approximately 88(H)x482(W)x377(D)

- Speakers

Speakers shall be especially designed for broadcasting high quality voice communications and approved by an appropriate authority for use in such situations.

Speakers shall be ceiling or wall mounted as shown in the schedule of work and shall be completed with mounting brackets accessories etc.

Speakers shall be of high efficiency yielding maximum output at minimum power across 200 – 12000 Hz frequency range. Speakers shall have a line matching transformer for direct connection to amplifiers with multiple taps. Speakers shall be mounted in a rugged housing with vandal resistant grille. Speakers shall be interconnected in the zone configuration.

Speakers may be provided in waiting areas, nurse stations and corridors at particular intervals, and fire escape staircase exits.

- Ceiling mounted speakers

The loudspeaker shall have built-in protection to ensure that, in the event of a fire, damage to the loudspeaker does not result in failure of the circuit to which it is connected. In this way, system integrity shall be maintained; ensuring loudspeakers other areas can still be used to inform people of the situation. The speaker shall have ceramic terminal blocks, thermal fuse and heat-resistant, high temperature wiring.

The Ceiling speaker unit shall be a 6 W dual-cone loudspeaker with an integrated circular metal grille and 100 V matching transformer. The speaker cabinet shall be of neutral white color.

The speaker assembly consists of a single-piece, 6W dual cone loudspeaker and frame, with a 100 V, matching transformer mounted on the back. The wide frequency range means better speech and music reproduction. Ceiling speakers are supplied with a 100 V matching transformer with taps on the primary winding for full power, half-power, quarter-power and eighth-power radiation. It has integral spring clamps on the rear which can be used to easily fix the loudspeaker into the false ceiling. Above ceiling part of the speaker may be protected against dust ingress by suitable material. A circular metal grille is an integrated part of the front. The appearance and neutral white color has been selected to be unobtrusive in virtually all interiors. The metal grille can be painted to any color to match the background.

Technical specifications of the ceiling mounted speaker is attached below and contractor must select the product based on these information.

Outside diameter in mm	:	178
Cutout in mm	:	163
Woofer size in inch	:	5.25
Mounting system	:	2 clamps
100V transformer power taps in watts	:	6 - 3
Low impedance dynamic power in watts	:	15
Max SPL 1m in dB	:	96
Main construction material	:	ABS plastic
IP rating	:	54
Applicable in 100V	:	Yes
Depth in mm	:	45
Loudspeaker system	:	dual cone
Woofer cone material	:	coated paper
Colour	:	white
Impedance in ohms	:	8
SPL 1W/1m in dB	:	89
Frequency response in Hz	:	100 - 18K
Grille main material	:	plastic
Applicable low impedance	:	No

Net weight product (kg) : 0.47

- Wall mounted column Speakers

The Wall mounted speakers shall have built-in protection to ensure that, in the event of a fire, damage to the loudspeaker does not result in failure of the circuit to which it is connected. The 14 W bi-directional column loudspeakers shall provide good speech intelligibility and background music reproduction in staircase area.

Technical specifications of the wall mounted speaker is attached below and contractor must select the product based on these information.

Height in mm	:	260
Depth in mm	:	180
Woofers size in inch	:	5.25
Tweeter size in inch	:	1
Colour	:	black / white
Low impedance dynamic power in watts	:	80
Max SPL 1m in dB	:	107
Main construction material	:	ABS plastic
IP rating	:	40
Applicable in 100V	:	Yes
Vertical dispersion angle 1000 Hz	:	180°
Width in mm	:	170
Loudspeaker system	:	2-way
Woofers cone material	:	coated paper
Mounting system	:	U-bracket
Impedance in ohms	:	16
SPL 1W/1m in dB	:	88
Frequency response in Hz	:	70 - 20K
Grille main material	:	steel
Applicable low impedance	:	Yes
Horizontal dispersion angle 1000 Hz	:	180°
Net weight product (kg)	:	2.85

- Call station

The user interface to the entire public address system shall be the Zone Selection Panel. It shall be able to address all zones.

The Panel shall have one Microphone for announcements. The selection of announcement is done through the Panel. The announcement/Fire message can be made zone wise. The Control Panel shall have individual zone selection switches as well as ALL CALL switch.

Controls and indicators:

- PTT-key
- PTT status LED
- Six zone selection keys
- Six zone selection LEDs
- All-call key
- All-call status LED
- Eight DIP switches

Technical specifications of the zone selector is attached below and contractor must select the product based on these information.

Nominal sensitivity	:	85 dB SPL (gain preset 0 dB)
Nominal output level	:	700 mV
Maximum input sound level	:	110 dB SPL
Gain preset	:	+6 / 0 / -15 dB
Limiter threshold	:	2 V
Compression ratio limiter	:	1:20
Distortion	:	<0.6% (maximum input)
Input noise level (equiv.)	:	25 dB SPLA
Frequency response	:	100 Hz to 16 kHz
Speech filter	:	-3dB @ 315 Hz, high-pass, 6 dB/oct
Output impedance	:	200 ohm
No of zones	:	6
Operating temperature	:	-10 °C to +55 °C (14 °F to +131 °F)
Storage temperature	:	-40 °C to +70 °C (-40 °F to +158 °F)
Relative humidity	:	<95%

- Voice alarm controller

- General

The central controller shall be the integrated solution for BGM and emergency voice alarm system (EVAC). The voice alarm system shall be designed for public address and emergency evacuation. All the essential EVAC functionality – such as system supervision, spare amplifier switching, loudspeaker line surveillance, digital message management and a fireman's panel interface – shall be combined.

- It shall have the following functions:

The messages can be merged to allow even more flexible use of pre-recorded announcements and evacuation messages. The controller can be used as a stand-alone system with up to six zones, or expanded to up to 120 zones using additional six-zone routers.

Up to eight call stations can be connected.

Interconnections are made using standard RJ45 connectors and shielded CAT-5 cable.

- Controls and indicators

Front

- LED power meter
- 13 system fault LEDs
- Two fault state buttons
- Two emergency state buttons
- Six EMG zone status LED pairs
- Six EMG zone select buttons
- Six BGM zone select LEDs
- Six BGM zone select buttons
- Six BGM zone volume control knobs
- Two BGM source status LEDs
- Three knobs for BGM volume, treble, and bass levels

- All-call button
- Indicator test button
- EMG state button
- Alert message button

Back

- Three service settings DIP switches
- Calibration switch
- Four system configuration DIP switches
 - Mains voltage selector
 - Power switch
- Power cord socket
- Mic/line level switch
- Three DIP switches for VOX, speech, phantom power
- Microphone volume control knob
- Digital message volume control screw
- Monitoring speaker volume control knob

Interconnections

Front

- Microphone socket

Back

- 12 loudspeaker outputs
- External amplifier input
- Amplifier output (on 100 V)
- Backup power input
- Call output
- Six volume override outputs
- Three status outputs
- 12 trigger inputs
- 24 VDC output
- Two call station connectors (redundant)
- USB 2 connector
- Two DE-9 connectors (reserved)
- External amplifier output
- Line output connectors
- Two BGM inputs
- PC call station input (reserved)
- Two RC station connectors (redundant)
- Connector to LBB 1992/00 (router)

Technical specifications

Electrical

Mains power supply	:	Voltage 230/115VAC, $\pm 15\%$, 50/60 Hz
Current inrush	:	8 A
Max power consumption	:	600 VA
Battery power supply		
Voltage	:	24 VDC, $+15\%$ / -15%
Current max	:	14 A
Performance		
Output power (rms/maximum)	:	240 W / 360 W

Power reduction on backup power	:	-1 dB
Frequency response ref. rated output)	:	60 Hz to 18 kHz (+1/-3 dB at -10 dB
Distortion	:	<1% at rated output power, 1 kHz
Bass control	:	-8/+8 dB at 100 Hz
Treble control	:	-8/+8 dB at 10 kHz
Mic/line input	:	1 x
Connector	:	XLR, 6.3 mm jack
Sensitivity	:	1 mV (mic), 1 V (line)
Impedance	:	>1 kohm (mic); >5 kohm (line)
S/N (flat at max volume)	:	>63 dB (mic); >70 dB (line)
S/N (flat at min volume/muted)	:	>75 dB
CMRR	:	>40 dB (50 Hz – 20 kHz)
Headroom	:	>25 dB
Speech filter	:	-3 dB at 315 Hz, high-pass, 6 dB/oct
Phantom power supply	:	12 V (mic mode only)
VOX trigger level	:	-20 dB (100 μ V mic / 100 mV line)
or via input contact		
Limiter	:	Automatic
Line input	:	(BGM and PC call station)
Connector	:	Cinch, stereo converted to mono, unbalanced
Sensitivity	:	200 mV
Impedance	:	22 kohm
S/N (flat at max volume)	:	>70 dB
S/N (flat at min volume/ muted)	:	>75 dB
Headroom	:	>25 dB
Trigger Inputs	:	12 x (6 EMG, 6 business)
Connectors	:	MC1,5 / 14-ST-3,5
Activation	:	Programmable
Supervision	:	On EMG inputs, programmable
Supervision method	:	Series / parallel resistor
100 V input		
Connector	:	MSTB 2,5 / 16-ST
Power handling capacity	:	1000 W
Tape output 1 x		
Connector	:	Cinch, 2 x mono
Nominal level	:	350 mV
Impedance	:	<1 kohm
Loudspeaker outputs		
Connectors	:	MSTB 2,5 / 16-ST, floating
100 V output	:	700 W rated per zone
Volume overrides types	:	3-wire, 4-wire (24 V), 4-wire failsafe
BGM zone output	:	70 / 50 / 35 / 25 / 18 / 13 V for
Attenuation	:	0 / -3 / -6 / -9 / -12 / -15 dB
		120 / 60 / 30 / 15 / 8 / 4 W
Output Contacts		

Connector Type	:	MC 1,5/14-ST-3,5
Rating	:	250 V, 7A, voltage free
Emergency active relay	:	NO / COM / NC
Call active relay	:	NO / COM / NC
Fault relay (Failsafe)	:	NO / COM / NC normally energized
General purpose relays	:	NO / COM
Operating temperature	:	-10 °C to +55 °C (14 °F to +131 °F)
Storage temperature +158 °F)	:	-40 °C to +70 °C (-40 °F to
Relative humidity	:	<95%
Acoustic noise level of fan	:	<48 dB SPL at 1 m (max output)

All zones shall be individually selectable from the front panel and the BGM output level in each zone shall be individually settable in steps. The BGM output shall be connected to the 70V line, thus it shall be possible to connect a total load of 480 Watts.

The router shall have a set of relays for zone-switching the power amplifier output(s) to different loudspeaker groups. Each of the zones shall be switched between the call channel (upon call-station selection or all-call microphone or emergency activation), the BGM channel (upon front panel selection), or off. The zone power handling capacity of the router shall be 480 Watts.

The call station shall be a stylish high quality call station with a stable metal base, a flexible microphone stem and a unidirectional condenser microphone. It shall be intended for making calls to selected zones. The special design shall allow for neatly flush mounting in desktops. Using dipswitches on the bottom of the call station, the call station ID shall be selectable. The call station shall have selectable gain, speech filter and limiter for improved intelligibility. On each call station it shall be possible to select 6 zones with the possibility to connect a call station keypad to increase the number of zones or zone groups that can be selected.

It shall have LED indications for zone selection, fault and emergency state. The call station extension shall provide seven additional zone and zone group keys.

On each call station it shall be possible to select 6 zones with the possibility to connect up to 8 call station keypads to increase the number of zones or zone groups that can be selected. Selected zones are indicated with LEDs on the call station, three additional LEDs give visible feedback on the active state of the microphone and the system. Green indicates microphone active, amber indicates that the system has detected a fault (IEC 80649) and red indicates that the system shall be in the emergency state.

The power supply voltage range shall be 18 – 24V with a current consumption of less than 50 mA. The nominal sensitivity shall be 85 dB SPL (gain preset 0dB). The nominal output level shall be 700 mV. The maximum allowable sound pressure level shall be 110 dB SPL. The microphone shall have a limiter. The distortion shall be less than 0.6% at maximum input. The equivalent input noise level shall be no more than 30 dB SPLA. The frequency range shall be 100Hz – 16 kHz. The speech filter shall be a 315 Hz, high-pass, 6-dB/oct filter. The output impedance shall be 200 Ohms.

The controller, router, call station, call station keypad, amplifier, volume control, speaker shall be from a single brand System.

- Gooseneck microphone

The gooseneck microphone is a stylish high quality unidirectional condenser microphone, mainly intended for public address applications.

The flexible stem base has a screw fitting, and the microphone comes with a multi-thread adaptor (3/8", 1/2", and 5/8") for mounting onto floor-stands, lecterns, panels or desktops. The microphone runs off the phantom power supply from the amplifier to which it is connected. The on-off sliding switch, not only switches on the microphone, but also provides priority contacts for remote control switching purposes. If the priority contacts are not required, the microphone can be connected to amplifiers with 3-pin XLR-inputs, using the DIN to XLR adapter.

Technical specifications

Voltage range	:	12 to 48 V
Current consumption	:	<8 mA
Performance		
Sensitivity	:	0.7 mV @ 85 dB SPL (2 mV/Pa)
Maximum input sound level	:	110 dB SPL
Distortion	:	<0.6% (maximum input)
Equivalent input noise level	:	28 dBA SPL (S/N 66 dBA ref. 1 Pa)
Frequency response	:	100 Hz to 16 kHz
Output Impedance	:	< 200 ohm

Technical performance data acc. to IEC 60268-4

Cabling

PA system wiring shall be done by 2 core x 1.5 sq. mm FRLS PVC insulated copper twin twisted armoured, shielded cable.

The speakers in each zone are connected in parallel and are connected to the respective output.

The cables from each zone are separately routed and terminated in the Panel.

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.

Armoured PA system cable shall be installed 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. Cable 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 glands & check nuts must be used and fixed on the back box. When cable run on RCC slab, has to be taken to a device located on false ceiling, it shall be dropped down along MS channel fixed on the RCC slab. Cable must be properly attached to the channel by using cable tie.

When cable has to be terminated in devices located below false ceiling at lower levels (e.g., wall mounted speaker), cable must be drawn through a pvc pipe of minimum diameter 25mm from the nearest device above false ceiling. PVC pipe used to draw this cable must be concealed in block wall from a location 10 cm above false ceiling grid to the back box of speaker. When cable run along walls or concrete slabs the plumb and line must be maintained to ensure good workmanship. Cable shall not run at angles other than 90 degree to the wall or slab.

When cable from each zone/floor has to be taken from each floor to the central control room, cable trays must be used. Cable tray size must be decided based on the no of cable to be installed on the tray. Cable tray must be installed in the service shaft for ELV services as shown in the layout. Cable tray must be installed on the wall by means of GI slotted C channels, threaded rods & anchor fasteners. Cables laid on the cable tray must be neatly dressed by means of cable saddles and bolts.

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

Contractor must submit shop drawings clearly indicating mounting heights of all devices used in the system, which is mentioned in the standard codes. For position/location of devices, contractor must coordinate with other services and architect. Back boxes must be installed in neat manner keeping an eye on the aesthetic view.

Number of speakers in a zone must be decided based on the specification clauses pertaining to the item.

Location of ceiling mounted speakers to be installed on false ceiling must be finalized after coordination with lighting/sprinkler/detectors/diffusers in HVAC cameras or any other services' contractors.

Wall mounted speakers may be used in areas where no false ceiling is available, e.g. staircase lobbies. Speakers must be installed with proper mounting brackets and cable must be terminated in the speaker in neat manner by means of proper glands. Cable to the wall mounted box speakers must be concealed.

Amplifiers, digital controller and goose neck microphone shall be placed in metal rack of suitable size in the central control room of the building. All interconnecting cable between amplifiers, router and controller must be included in the scope of work.

The cable from each zone of the building must be taken to central control room to terminate in amplifiers placed in the rack. Cable from false ceiling in the room must be extended up to the rack. For this purpose cable trunking/tray may be used. All cables inside control room must be neatly dressed.

Testing

Entire PA system shall be tested to establish the following:

Functionality of the PA system

Combined systems shall be tested for the overriding feature for prioritizing fire alarm and life safety requirements.

Acceptable audibility of the public address in all spaces and record sound pressure levels of the Public address Vis a Vis the ambient noise levels.

The Provision of speakers is proposed so as to cover the entire area uniformly to have better communication system in the Hospital.

The Speakers shall be distributed in the entire floor and shall be configured in different zones. The announcement can made in zone wise or to all the speakers simultaneously in ALL CALL mode. Fire message shall be announced immediately on receipt of fire signal from the panel to all zones.

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 speakers, amplifiers, routers controller etc. The drawing shall indicate clearly the loop, routing of cable, no of devices connected in a loop. 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 may proceed with installation only after approval of shop drawings from the consultant.

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 only after getting approval of material submittal and shop drawings.

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.

G. IP BASED CCTV SYSTEM

1. Standards and codes

UL 60950-1, emission EN55022 class B

FCC part15 class B

CE standards

ANSI C63.4: 2003

Class A Digital Device 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)

2. Scope of work

Supply, installation, testing & commissioning of IP based CCTV surveillance system as per following details:

- IP based dome camera(fixed & varifocal)
- IP based Bullet camera
- Network Video Recorders
- Storage hard disk
- Server PC
- LED display units
- Core switches
- PoE switches
- Patch Panels
- Racks

Main contractor shall engage only authorized agency appointed by OEM to carry out the work. Contractor shall submit OEM's authorization letter before carrying out the work.

3. 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.

4. 64 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 64 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 x 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

1 self-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	64-ch
		Up to 12MP resolution
	Two-way audio	1-ch, RCA (2.0 Vp-p, 1k Ω)
Network	Incoming bandwidth	256 Mbps
	Outgoing bandwidth	256 Mbps
	Remote connection	64
Video/Audio output	Recording resolution	12MP/8MP/6MP/5MP/4MP/3MP/ 1080p/UXGA/720p/VGA/4CIF/DCIF/ 2CIF/CIF/QCIF
	HDMI output resolution	4K (3840 x 2160)/60Hz, 4K (3840 x 2160)/30Hz, 1920 x 1080p/60Hz, 1600 x 1200/60Hz, 1280 x 1024/60Hz, 1280 x 720/60Hz, 1024 x 768/60Hz
	VGA output resolution	1920 x 1080p/60Hz, 1280 x 1024/60Hz, 1280 x 720/60Hz, 1024 x 768/60Hz
	Audio output	1-ch, RCA (Linear, 1 K Ω)
Decoding	Decoding format	H.265/H.264+/H.264/MPEG4
	Live view/ Playback resolution	12MP/8MP/6MP/5MP/4MP/3MP/ 1080p/UXGA/720p/VGA/4CIF/DCIF/ 2CIF/CIF/QCIF
	Synchronous playback	64-ch
	Capability	4-ch @ 4K, or 16-ch @ 1080p
Hard disk	SATA	4SATA interfaces for 4HDDs
	Capacity	Up to 8TB 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	3 (Front panel: 2 x USB 2.0; Rear panel: 1 x USB 3.0)
	Alarm in/out	16/6
POE Interface	Interface	16 RJ-45 10/100 Mbps self-adaptive Ethernet interfaces
	Power	≤200W
	Supported standard	IEEE 802.3 af/at
General	Power supply	100 to 240 VAC
	Power	≤300 W
	Consumption (without hard disk)	≤20 W (without enabling PoE)

	Working temperature	10 to +55°C
	Working humidity	8 to 90 %
	Chassis	19-inch rack-mounted 1.5U chassis
	Dimensions(W x D x H)	440 x 413 x70 mm (17.5"x 15.3" x 2.8") approximately
	Weight (without hard disk)	≤ 5 Kg (11 lb)

5. IP IR dome camera

Parameter	Dome Network Camera
Image Sensor Type	1/3" 2 MP CMOS sensor - minimum
Min. Illumination	0.03 lux color @ F1.4 (Color, 1/3s, 30 IRE) 0 lux B/W with IR LEDs on @ F1.4
Shutter Speed	1/3(4) – 1/100,000 s
Lens	2.7-12 mm F1.4 motorized focus/zoom lens
Digital Zoom	16x
Day &Night	IR cut filter with auto switch
Digital Noise Reduction	3D DNR
Wide Dynamic Range	120dB
Compression Standards	
Video Compression	H .265/H.264H/Smart Codec/MJPEG (Sub Stream)
HD Recording	Yes
Video Bit Rate	32 Kbps – 8 Mbps
Dual Stream	Yes
Max. Resolution	2688×1520
Night Vision Distance	30 m
Frame Rate	4 MP at 1 – 20fps, 3 MP at 1 – 25/30fps D1/CIF at 1 – 25/30fps
Image Settings	Remote configuration, motorized zoom adjustments and auto focus
Backlight compensation	Yes, zone optional (BLC/HLC/WDR)
Alarm Trigger	Configurable motion detection and camera tamper detection settings, including configurable alarm notifications
General	Fully featured IP cameras that pair perfectly with an 8- or 16-or 64- channel Performance Series NVR. Waterproof (IP66) and IK10 vandal resistant camera housing and remote configuration, motorized zoom adjustments and auto focus through NVR
Communication Interface	1 RJ45 10M/100M Ethernet interface

Power Supply	Built-in PoE (Power over Ethernet) eliminates separate power supply and associated wiring; 12 V DC inputs where PoE power is unavailable
Ingress Protection level	IP66
IR Range	30 meters
Dimensions(mm)	122x88.9 mm
Weight	540g

6. IP IR Bullet Camera

Image Sensor Type	1/3" 2 MP CMOS sensor - minimum
Colour Support	Colour
Lens	2.7 mm -13.5mm, MFZ,F1.4
Digital Zoom	16x
Day /Night	(IR-cut filter) Auto (ICR)/Color/BW
Dual Stream	Yes
Noise Reduction	3D DNR
Wide Dynamic Range	120dB
Compression Standard	
Video Compression	H.265/H.264H/Smart Codec/MJPEG (Sub Stream)
Max. Resolution	2688x1520
Night Vision Distance	30 m
Image Settings	Remote configuration, motorized zoom adjustments and auto focus
General	Fully featured IP cameras that pair perfectly with an 8- or 16- or 64-channel Performance Series NVR. Waterproof (IP66) and IK10 vandal resistant camera housing and remote configuration and auto focus through NVR
Communication Interface	1 RJ45 10M/100M Ethernet interface
Power Supply	Built-in PoE (Power over Ethernet) eliminates separate power supply and associated wiring; 12 V DC inputs where PoE power is unavailable
Ingress Protection level	IP66
IR Range	30 meters
Dimensions(mm)	214.8 x 90.4 mm

7. 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 802.3ab 1000BASE-T

IEEE 802.3x Flow Control

IEEE 802.3af/at

IEEE 802.3ae 10 DTE Power via MDI

Performance Specifications

Forwarding modes: Store-and-forward

Packet forwarding rate: 95.24Mpps

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

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

Addressing: 48-bit MAC address

Acoustic noise: 56.9dB (2*smart fans)

Power Supply

Total power consumption: 436.3 W/240 V

Physical Specifications

Dimensions: (L x W x H)

440 x 308 x 44 mm (17.36 x 12.12 x 1.73 in)

Environmental Specifications

Operating temperature: -5 to 50°C

Storage temperature: -20 to 70°C

Operating humidity: 0% to 95% relative humidity

Storage humidity: 0% to 95% relative humidity

Electromagnetic Emissions

CE, VCCI, FCC, BSMI, CCC

Safety: CB, UL, BSMI, CCC

8. Server PC

Intel i7 processor, 24 inch LED monitor, Gigabit LAN port, USB port, 8GB DDR3 RAM, 1TB HDD, 1GB dual graphic card, 100/1000 LAN ports, optical mouse, Keyboard, DVD Writer. Genuine Win 8.1 Pro - Down grade to Win 7 professional, 24 inch LED monitor

9. 40 inch LED monitor

Screen type	LED
Display size Panel	42 inch
Screen resolution	1920X1080 pixel, full HD
Aspect ratio	16:9
Viewing angle Contrast Interface	178/178 degrees PAL/NTSC/SECAM, TV, VGA, AV, USB, HDMI & audio input

Audio output, wall mount or table mount kit

PIP facility : must be provided

Voltage range : 90 to 270 v ac

Viewing matrix shall be 12 pictures in a single monitor

10. Hard disk

Specifications	8 TB
Formatted capacity	8 TB
Form factor	3.5-inch
Advanced Format (AF)	Yes
RoHS compliant ³	Yes
Performance	
Data transfer rate (max) Buffer to host	6Gb/s
Host to/from drive (sustained)	194 MB/s
Cache (MB)	128
Load/unload cycles ⁴	300,000
Non-recoverable read errors per bits read	<1 in 10 ¹⁴
Limited warranty (years) ³	3
Power Management	
Average power requirements (W)	
Read/Write	6.2
Idle	5.5
Standby and Sleep	0.4
Environmental Specifications	
Temperature (°C, on the base casting) Operating	0 to 65
Non-operating	-40 to 70
Shock (Gs)	
Operating (2 ms, read/write)	30
Operating (2 ms, read)	65
Non-operating (2 ms)	250
Acoustics (dBA)	
Idle	25
Seek (average)	30
Physical Dimensions	
Height (in./mm, max)	1.028/26.1
Length (in./mm, max)	5.787/147
Width (in./mm, ± .01 in.)	4/101.6
Weight (lb./kg, ± 10%)	1.58/0.72

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 products 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 equipment's 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. The cables shall be laid with proper identification tag.

LED monitor shall be fixed on the wall in the control 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 equipment's 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.

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.

CHAPTER E

TECHNICAL SPECIFICATIONS FOR VRF/VRV HVAC SYSTEM

1. SCOPE

The scope of this section comprises the supply, erection testing and commissioning of Variable Refrigerant Flow (VRF)/Variable Refrigerant Volume (VRV) System conforming to these specifications and in accordance with the requirements of Drawing and Bill of Quantities.

STANDARDS TO BE FOLLOWED

LIST OF BUREAU OF INDIAN STANDARDS CODES

IS : 554 – 1985

(Reaffirmed 1996) Dimensions for pipe threads where pressure tight joints are required on the threads.

IS: 659-1964

(Reaffirmed 1991) Air Conditioning (Safety Code)

IS:660-1963

(Reaffirmed 1991) Mechanical Refrigeration (Safety Code)

IS : 732-1989

Code of practice for electrical wiring

IS : 822-1970

(Reaffirmed 1991) Code of procedure for inspection of welds.

IS : 1255-1983

Code of Practice for installation and maintenance of Power Cables up to and including 33KV rating (Second Revision)

IS : 1554 – 1988

(Part – I)

PVC insulated (Heavy Duty) electric cables for working voltages up to and including 1100 volts

IS : 2379 – 1990

Colour code for the identification of pipelines.

IS : 2551 – 1982

Danger notice plate

IS : 3043 – 1987

Code of practice for earthing

IS : 3103 – 1975

(Reaffirmed 1999)

Code of practice for Industrial Ventilation

IS : 3837 – 1976

(Reaffirmed 1990)

Accessories for rigid steel conduit for electrical wiring

IS : 4736-1986

(Reaffirmed 1998)

Hot-dip zinc coatings on steel tubes

IS : 5133-1969
 (Part-I)
 (Reaffirmed 1990) Boxes for the enclosure of electrical accessories.
 IS : 5424-1989
 (Reaffirmed 1994) Rubber mats for electrical purposes.
 IS : 5578
 & 11353-1985 Marking and identification of conductors
 IS : 6392-1971
 (Reaffirmed 1988) Steel pipe flanges.
 IS : 13947-1993
 (Part – V) Control Circuit Devices
 BS : EN:779-1993 Filters

ASHRAE (American Society of Heating Refrigeration & Air-conditioning Engineers) Hand Books

Application 1999 Fundamentals 1997
 Systems & Equipment 1996
 ASHRAE Indoor air quality Standard 62-1982
 IEC Relevant Sections

NATIONAL ACREDITATION BOARD FOR HOSPITALS (NABH 2020)

2. Air-cooled Variable Refrigerant Flow/Variable Refrigerant Volume System Units

a. TYPE

Units shall be air cooled, variable refrigerant volume/ variable refrigerant flow air conditioner consisting of one or more outdoor units and multiple indoor units. The indoor units on any circuit can be of different type and also controlled individually. Compressor installed in each modular outdoor unit shall be equipped with minimum 2 inverter compressors for higher reliability, improved life, better backup and duty cycling purpose. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load. Outdoor unit shall be suitable for mix match connection of all types of indoor units. The refrigerant piping between indoor units and outdoor unit shall be possible to extend up to 175m with maximum 50m level difference without any oil traps. Both indoor units and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant before delivering at site. In the event of failure of an indoor unit, system should be capable of working until the error / complaint is rectified by the technician. After the completion of works system should be commissioned by authorized personnel of the manufacturer.

b. OUTDOOR UNIT

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired tested with all necessary controls. Each modular inverter outdoor shall be DC twin scroll hermetic compressor.

The outdoor units shall have multiple compressors with multi step capacity control and shall be able to operate in case of failure of one of the compressors. The outdoor units shall be capable of connecting all types of indoor units. They shall be provided with duty cycling and starting sequence changing facility for multiple inverter compressor and multiple outdoor units working in one system. The outdoor units shall be of modular construction and should be able to install side by side and shall be provided with microprocessor based control panel with provision for integration with Building Management System using BACNET/MODBUS protocol. The outdoor unit shall be compatible for three phase 415V 50 Hz AC supply. All outdoor units shall have minimum two compressors so that in the event of failure of one compressor, other can work. The outdoor unit shall be delivered with first charge of refrigerant. The outdoor unit should be fitted with low noise, aero spiral design fan with aero fitting grill for C spiral discharge airflow to reduce pressure loss and should be fitted with DC fan motor inverter type for better efficiency. The condensing unit shall be designed to operate safely when connected to multiple indoor units.

Note: The Outdoor machines shall be preferably compact machines for Purpose of space saving and smaller foot print shall be preferred.

c. COMPRESSOR

The compressor shall be highly efficient hermetic scroll type with DC inverter control capable of changing the speed in accordance with load requirements inside the building. The refrigerant used shall be R 410A/ R 407A. All parts of the compressor shall be lubricated and shall have oil separator for stable operation. Oil heater also shall be provided. Forced lubrication may also be employed. Oil heater shall be provided in the compressor casing.

d. HEAT EXCHANGER

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil. The aluminum fins shall be covered by anti-corrosion resin film. The unit should be with e-pass heat exchanger to optimize the path of heat exchanger and for better efficiency of condenser. The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

e. REFRIGERANT CIRCUIT

The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end. The equipment must have in built refrigerant stabilization control for proper refrigerant distribution. All necessary safety devices shall be provided to ensure the safely operation of the system.

Refrigerant should be R410A/R407A Only. The refrigerant piping between indoor and outdoor units shall be constructed from soft seamless up to 19.1mm and hard drawn copper pipes above 19.1 mm with copper fittings and silver soldered joints. All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. After the installation, the piping shall be pressure tested using nitrogen at 20kg/cm² and 10 kg/cm² for low side. The sizing and flow of refrigerant shall be designed as specified by the manufacturer. All refrigerant pipelines shall be properly supported and anchored to the building structure using steel supports/brackets/clamps of adequate size to support the load.

f. SAFETY DEVICES

All necessary safety devices shall be provided to ensure safe operation of the system. The outdoor units shall be equipped with the following safety devices.

High pressure switch.

Over load relay

Fusible plug

Overload protector for inverter

Over load protector for Fan drive

Oil recovery system

g. OIL RECOVERY SYSTEM

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths. The system must be provided with oil balancing circuit to avoid poor lubrication.

h. INDOOR UNIT

This section deals with supply, installation, testing, commissioning of indoor units confirming to general specification and suitable for the duty selected. The type, capacity and size of indoor units shall be as specified in detailed Bill of Quantities. The address of the indoor unit shall be set automatically in case of individual and group control. In case of centralized control, it shall be set by liquid crystal display remote controller. The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing. The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum

thermal contact resistance with fins. Each coil shall be factory tested at 21kg/sqm air pressure under water. Unit shall have cleanable type filter fixed to an integrally molded plastic/aluminum frame. The filter shall be easily serviceable. Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling or cooling and heating. Each unit shall be with Cordless LCD type remote controller for Hi Wall , Cassette ,Ductable and Concealed units.. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

3. AIR HANDLING UNITS

a. SCOPE

This section of the specification covers the supply, installation, testing and commissioning of double skin construction air handling units along with its accessories, conforming to these specifications and in accordance with requirement of the ‘Schedule of Quantities’, Drawings and ‘Technical Schedule of Equipment’.

b. TYPE

The air-handling units shall be double skin, comprising, filters as per BoQ, DX coil, fan as per details given in Drawings and Schedule of Equipment.

c. CAPACITY

The air handling capacities, maximum motor HP, static pressure shall be as per actual ducting coming in the approved shop drawing, even though the nearby static pressure can be taken from the tender drawing/BOQ. The static shown in BoQ is only indicative. The contractor shall calculate the static as per actual site condition.

d. CONSTRUCTION

i. AHU HOUSING / Casing:

The AHU housing shall be of double skin construction with main structure made of extruded aluminum hollow sections. The panels shall be double skin sandwich type with 0.8 mm pre painted GSS/ pre-plasticized on the outside and 0.6 mm galvanized sheet inside with 40 mm thick 40 kg/m³ PUF insulation or equivalent material injected in between. These panels shall be screwed with soft rubber gasket fixed in built in groove of aluminum frame in between to make the joints airtight. The corner joints shall be nylon glass fiber reinforced.

ii. Drain Pan

The drain pan shall be of 18 G aluminum/stainless steel with necessary slope to facilitate fast removal of condensate. It shall be provided with drain connection of suitable size complete with 25 mm rigid

insulation. Necessary arrangement will be provided to slide the coil in the drain pan.

iii. Cooling Coil

The DX coil shall be of seamless copper tubes not less than 0.5 mm thick and 12mm OD. Coil face areas shall be such as to ensure rated capacity from each unit and such that air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of airflow.

The fins shall be uniformly bonded to the tubes by mechanical expansion of the tube for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 FPI. The coils shall be tested against leaks at a hydraulic pressure of 21-kg/sq cm. This pressure shall be maintained for a period of at least 2 hours. No drop should be observed indicating any leaks.

away from the unit.

iv. Filter Section

Each unit shall be provided with a factory assembled filter as per BoQ. Filters shall have aluminum frame. One stage of filtration consisting of normal washable filters upto 10 micron particle size and Two stages of filtration consisting of Pre-filter & Microvee filter upto 5 micron particle size. Filter face velocity shall not exceed 150 meters per minute. Filter shall fit so as to prevent by pass. Holding frames shall be provided for installing number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

v. FRESH AIR INTAKES

Extruded aluminum construction duly anodized fresh air louver with bird screen and extruded construction dampers shall be provided in the clear opening in masonry walls of the air handling unit room having at least one external wall. Fresh air louver, damper, pre-filters, ducts and fresh air fan with speed regulator (wherever specified in 'Schedule of Quantities') shall be provided. Fresh air dampers shall be of the interlocking, opposed blade louver type. Blades shall be rattle free. Damper shall be similar to those specified in 'air distribution'. Fresh air fans and fresh air intakes shall be as per the requirements of 'Schedule of Quantities'.

vi. ACCESSORIES

1. Double Flexible connection of fireproofs material between the fan outlet and duct.
2. Vibration isolators of at least 90% efficiency.

vii. SAFETY FEATURES

Each handling unit must have safety features as under:

e. PERFORMANCE DATA

Air handling unit shall be selected for the lowest operating noise level. Fan performance rating and power consumption data with operating points clearly indicated shall be submitted and verified at the time of testing & commissioning of the installation.

f. TESTING

Cooling capacity of various air-handling unit models shall be computed from the measurements of airflow and dry and wet bulb temperatures of air entering and leaving the coil.

Flow measurements shall be by anemometer and temperature measurements by accurately calibrated mercury in glass thermometer. Computed result shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

AIR HANDING UNITS – DATA SHEET

1	GENERAL	
1.1	Manufacturer	
1.2	Type of Unit	
1.3	Over All Dimensions (L x W x H) (mm)	
1.4	Weight (Including Water in circulation) Kg.	
1.5	Approximate Noise Level (DBA)	
1.6	Fan Discharge Position	
2.0	FAN SECTION	
2.1	Air Quantity (CFM)	
2.2	Total Static Pressure (mm of WG)	
2.3	Fan Speed (RPM)	
2.4	Fan Diameter (INCH) and no. Of fans	
2.5	Balancing (Static and / or dynamic)	
2.6	BHP	
2.7	Motor HP, RPM, Make & Type	
3.0	COOLING COIL	
3.1	Coil Fin Material (Aluminum or copper)	
3.2	Tube Diameter (INCH) and material	
3.3	no. of circuits	
3.4	Fin Size (INCH)	
3.5	No of Fins / INCH	
3.6	Coil Pressure Drop (ft of WG)	
3.7	Outside Coil Surface (SQFT)	
3.8	Face Area (SQFT) of Coil	
3.9	Rows Deep	
3.10	Air In and Out DB& WB Temp (DEG F)	

4 DUCTING SYSTEM

This section deals with supply, erection, testing and commissioning of all sheet metal ductwork conforming to specifications given below. The ducts shall be of factory fabricated.

4.1 Material for Ducting

All ducts shall be fabricated from galvanized sheet of 120 gm/sq.m (Class VIII) confirming to IS 277-1962 (revised). The fabrication of duct shall strictly conform to ISS 655-1963. The thickness of the sheet shall be as follows:

Maximum size (mm)	Thickness of sheet (mm)	Type of transverse joint connections	Bracing (if any)
Upto 300	0.63 24 G	S-drive, pocket or bar slips, on 2.5m centres	None
301 to 600 601 to 750	0.63 24 G	S-drive, pocket or bar slips, on 2.5m centres S-drive, 25mm pocket or 25mm bar slips on 2.5m centres drive	None 25x25x3mm angle 1.2m from joint
751 to 1000 1001 to 1500	0.80 22 G	40x40mm angle connections, or 40mm pocket or 40mm bar slips, with 35x3mm bar reinforcing on 2.5m centres	40x40x2mm angle 1.2m from joint
1501 to 2250	1.00 20 G	40x40mm angle connections, or 40mm pocket or 40mm bar slips, 1 m maximum centres with 35x3mm bar reinforcing	40x40x3mm angle / 40x40x3mm angle 60mm from joint.
2251 & above	1.25 18 G	50x50mm angle connections, or 40mm pocket or 40mm bar slips, 1 m maximum centres with 35x3mm bar reinforcing	40x40x3mm angle / 40x40x3mm angle 60mm from joint.

The following points shall be also taken into account while fabrication of ducts.

- All ducts shall be as per gauges, etc. indicated on the approved drawings.
- All ducts of size larger than 450 mm shall be cross broken.
- All ducts shall be supported from RCC/truss by means of MS rods, angles, etc.
- The ductwork shall not extend outside and beyond height limits as specified on the approved drawings.
- All ducts shall be reinforced, if necessary and must be secured in place so as to avoid shifting of the ducts on its supports.
- The vanes shall be provided and securely fastened to prevent noise and vibration.
- The rubber gasket shall be installed between duct flanges in all connections and joints.
- The ductwork can be modified in consultation with Purchaser to suit actual conditions in the building.

- i) All flanges and supports should be primer coated on all surfaces before erection and painted with aluminum paint thereafter.
- j) The flexible joints are to be fitted to the suction and delivery of all fans with double heavy canvass. The length of flexible joints should not be less than 150 mm.
- k) All sheet metal gauges and fabrication procedure as given in BIS specification shall be strictly adhered to. The BIS specification shall form part of this contract.

5. Grilles/Diffusers

Material of construction - Extruded Aluminum

Supply air and return air grilles shall be continuous type and shall be fixed as given in the approved drawing. The square/rectangular diffusers shall be flush or step down type to match false ceiling pattern. The diffuser blades shall be die formed, flush mounted with single or double direction airflow. Supply of frames for fixing the grilles/diffusers, if required, is also in the scope of the contractor.

Return air grilles shall be with blanks and return air provisions. The size and appearance shall match with supply air grilles. The supply air grilles shall form part of the continuous return air grilles. The fixing of grilles/diffusers should be done in close co-ordination with false ceiling work and as directed by Purchaser.

The aluminum grilles/diffusers, etc. shall be powder coated of colours to match the interiors. However, successful bidder shall have to obtain prior approval regarding colour, finish, shape, etc. of grilles/diffusers and sample should be submitted to Purchaser for approval.

The complete duct system shall be tested for air leakage and complete air distribution systems shall be balanced in accordance with the approved drawings for achieving designed values inside the building.

6 THERMAL / ACOUSTIC INSULATION

6.1 Material

- Insulation material shall be Closed Cell Elastomeric Nitrile Butadiene Rubber.
- Insulation material shall have anti-microbial product protection. The antimicrobial product protection shall be an integral part of insulation that is built-in during the manufacturing process and the product protection should not allow the microbes to function, grow and reproduce.
- Resistance towards microbiological growth on insulation surface should confirm to following standards: Fungi Resistance – ASTM G21 where the fungal growth on the surface is NIL after 28 days of incubation at 28 – 30° C and Bacterial resistance – ASTM E 2180 where the reduction of bacterial growth is minimum 99.9% after 24 hours of incubation at 34 – 38° C.
- Thermal conductivity of Elastomeric Nitrile rubber shall not exceed 0.035 W/m°K at an average temperature of 20°C in accordance to EN12667
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire

Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990.

- Water vapour permeability shall not exceed 1.74×10^{-14} Kg/m.s.Pa, i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 10,000 according to EN 12086
- Density of Material shall be between 40 to 60 Kg/m³.

6.2 Duct Insulation

External thermal insulation shall be provided as follow:

- The thickness of Nitrile rubber shall be as shown on drawing or identified in the schedule of quantity. Following procedure shall be adhered to:
- Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work. Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension.
- Material shall be fitted under compression and no stretching of material shall be permitted. A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations. The adhesive shall be strictly as recommended by the manufacturer.
- The detailed Application specifications are mentioned separately.

6.3 Insulation of Ducts Exposed Directly to Sunlight

For installations exposed to sunlight, after giving 36 hours curing time for the adhesive apply manufacturer's recommended UV/Mechanical Protection. Please refer the separate detailed guidelines on UV/Mechanical Protection.

6.4 Piping Insulation

All refrigerant and condensate drain pipe shall be insulated in the manner specified herein. An air gap of 25 mm shall be present between adjacent insulation surfaces carrying chilled water or refrigerant. Before applying insulation, all pipes shall be brushed and cleaned. All Pipe surfaces shall be free from dirt, dust, mortar, grease, oil, etc. Nitrile Rubber insulation shall be applied as follows:

- Insulating material in tube form shall be sleeved on the pipes.
- On existing piping, slit opened tube of the insulating material (slit with a very sharp knife in a straight line) shall be placed over the pipe and adhesive shall be applied as suggested by the manufacturer.

- Adhesive must be allowed to tack dry and then press surface firmly together starting from butt ends and working towards centre.
- Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The insulation shall be continuous over the entire run of piping, fittings and valves.
- All valves, fittings, joints, strainers, etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

The detailed application specifications are as mentioned separately. The manufacturer's trained installer should only be used for installation.

6.5 Recommended Adhesive

In all cases, the manufacturer's recommended Adhesive should be used for the specified purpose.

6.6 Acoustic Insulation

Material shall be engineered Nitrile Rubber open cell foam.

The Random Incidence Sound Absorption Coefficients (RISACs) across the octave band frequencies; tested as per ISO 354, and Noise Reduction Coefficients (NRCs) for the Acoustic Insulation should be minimum as per the below chart:

Freq (Hz)	125	250	500	1000	2000	4000	NRC
10 mm	0.03	0.04	0.14	0.40	0.88	1.00	0.40
15 mm	0.01	0.09	0.29	0.74	1.08	0.83	0.55
20 mm	0.04	0.13	0.40	0.90	1.04	0.90	0.60
25 mm	0.05	0.25	0.86	1.14	0.88	0.99	0.80
30 mm	0.07	0.32	0.99	1.16	0.93	1.08	0.85
50 mm	0.23	0.73	1.29	0.99	1.09	1.11	1.05

- The material should be fibre free.
- The density of the acoustic insulation should be minimum 140 Kg/m³
- The insulation should have Microban[®]; Built-in Anti-Microbial Product Protection, and should pass Fungi Resistance as per ASTM G 21 and Bacterial Resistance as per ASTM E 2180.
- The insulation should be non-eroding & should pass Air Erosion Resistance Test in accordance to ASTM Standard C 1071-05 (section 12.7).
- The material should have a thermal conductivity not exceeding 0.047 W/m.K @ 20 ° C

- The material should withstand maximum surface temperature of +85⁰C and minimum surface temperature of -20⁰C
- The material should confirm to Class 1 rating for surface spread of Flame in accordance to BS 476 Part 7 & UL 94 (HBF, HF 1 & HF 2) in accordance to UL 94, 1996.
- Thickness shall be 10mm for Duct Acoustic Lining
- Duct so identified and marked on Drawings and included in Schedule of Quantities shall be provided with internal acoustic lining for a distance of minimum 6 meters (or 30% of the duct length whichever is more)
- Thickness of the insulation material shall be as specified for the individual application. The insulation should be installed as per manufacturer's recommendation.

6.7 Accessories

Adhesive to adhere insulation to the inside walls of the duct shall be from the Insulation manufacturer only.

7 CENTRALIZED TYPE REMOTE CONTROLLER

A multifunctional compact centralized controller shall be provided with the system. It shall be able to control up to 100 indoor units with the following functions:

- a. Starting/stopping of Air-conditioners as a zone or group or individual unit.
- b. Temperature settling for each indoor unit or zone
- c. Switching between temperature control modes, switching of fan speed and direction of airflow, enabling/disabling of individual remote controller operation.
- d. Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, and troubleshooting information.
- e. Display of air conditioner operation history.
- f. Daily management automation through yearly schedule function with possibility of various schedules.

The controller shall have wide screen user friendly display and can be wired

8. FIELD TEST AND INSPECTION

a. Inspection:

Materials, equipment and the completed installation will be inspected by Engineer. Equipment, materials or work rejected because of defects or non-conformance with Drawings and Specifications shall be replaced or corrected by Contractor as directed by Engineer. Start-up air conditioning system, in accordance with manufacturer's start-up instructions, and in presence of the manufacturer's technical representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment, and retest.

b. Tests:

- A. Provide materials and equipment required to perform the tests. Defects disclosed by the test shall be corrected at no cost to Owner.
- B. Tests after installation and prior to acceptance shall be performed in the presence of Engineer and subject to his Approval.
- C. Equipment and material certified as having complied with referenced Specifications and Standards will not require retesting before installation. Equipment and materials not tested at place of manufacture will be tested before and after installation, as applicable, where necessary to determine compliance with referenced specifications and Standards.

9. ROOM THERMOSTATS:

Thermostats shall be compatible in design and appearance and shall be of modern, compact design with option of key locking type conversant concealed temperature set point adjustment. No room thermostat shall operate on Voltage in excess 24 Volt unless the thermostat is controlling a 240V fan or unit heater or unless specifically noted otherwise. Thermostat shall have on/off switch, three speed fan switch and LED's.

10. FREEZE PROTECTION THERMOSTATS:

Sensing element shall be fixed to the front of the coil or wrapped around the pipe to guard against freezing at any point. If the capillary is damaged the thermostat shall cut-out to the safety side.

11. REMOTE SETTING UNITS:

Remote setting unit shall have tough non-flammable plastic case on back plate suitable for surface or conduit box mounting. This unit shall enable control adjustments to be from a position remote from the controller.

12. OUTSIDE TEMPERATURE SENSOR:

Sensing element of sensor shall have a negative temperature coefficient thermistor and housing shall be sealed aluminum tube, alloy head, with plastic cover.

13. ROOM HUMIDITY SENSOR:

The sensing element shall be foil dielectric coated both sides with gold to form a capacitor; sensor shall have 0-10V dc output.

14. UNDER DECK INSULATION:

- Insulation material shall be Closed Cell Elastomeric Nitrile Rubber

- Density of Material shall be between 40 to 60 Kg/m³
- Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.035 W/m²K at an
- average temperature of 0°C
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990
- Material should be FM (Factory Mutual), USA approved.
- Water vapour permeability shall not exceed 0.017 Perm inch (2.48×10^{-14} Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor 'μ' value should be minimum 7000.

Installation procedure:

- The ceiling surface shall be cleaned with brush to remove all dirt, cement etc. If surface is uneven it should be made smooth prior to carrying out insulation work.
- A layer of synthetic rubber adhesive should be applied on the ceiling with the help of brush so that all the pores are filled and surface becomes smooth and allow it to dry.
- Allow an additional 5 mm to the total dimensions while cutting Insulation sheet. Ensure you measure the cutting dimensions on the top surface of the insulation sheet. This can be identified by the products markings; "they are always on the top surface". This surface is the one you will see after installation.
- All Insulation sheet and ceiling surfaces shall have all-over adhesive coverage. Adhesive should be applied on the side that has no product markings and identification printing. This side is the one that curves inwards.
- During installation avoid air bubbles. Always apply pressure while fixing the Insulation sheet, this action will ensure maximum bond strength.
- All cut Insulation sheet edges shall be of a "clean cut nature and not cut rough".
- All seams and joint shall be sealed with synthetic rubber adhesive.
- Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension. Material shall be fitted under compression and no stretching of material shall be permitted. A thin film of adhesive shall be applied on the ceiling with brush and then on to the back of the insulating material sheet with brush/small piece of sheet metal having smooth edges. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond. All joints shall be sealed. The adhesive shall be strictly as recommended by the manufacturer. There is no need to make holes for wires etc. as no supporting wires/screws are required.

While doing installation on the metal roofing, it is important to ensure that metal roof should not face direct sun light, as metal sheets becomes very hot and adhesive may not work.

In such conditions work should be done in the evening / night.

15. FIRE DAMPERS

This section deals with supply, erection, testing and commissioning of fire dampers and box type dampers, conforming to general specification and suitable for duty selected, indicated in schedule of equipment/material.

15.1 Dampers

- a) The fire dampers of at least two hour rating shall be provided in all return air ducts at wall crossing. All fire dampers shall be fire tested by CBRI Roorkee for 120 minutes fire rating as per UL555-1995.
- b) 6G GSS sheet blade and frame with 165mm casing, heavy duty interlocking blades and fully enclosed blade linkage mechanism, SS lateral seal blade seals, self lubricating sintered bronze bushes, fire rating as per UL555-1995 tested as per BS-476 part 20 with 18G extended sleeve 450mm and with fusible link, spring mechanism control panel temp sensor, smoke sensor, limit switch with lever for auto shut off in case of fire/smoke
- c) In the normal position the blades of the dampers shall remain open to allow maximum air to flow. The dampers shall be actuated using fusible link and spring mechanism. The fire damper shall also close due to temperature rise above 74°C.
- d) All fire dampers shall be mounted on wall with a duct sleeve 400 mm long depending on the wall thickness. The sleeve shall be factory fitted on the fire damper. The joint at the sleeve end shall be slip on type. Minimum thickness of GI sheet used for sleeves shall be 18G.

16. Exhaust Air Blowers

line exhaust air flow duct blowers suitable for single phase operations with direct driven class F motor, IP 54 insulation, max 1400rpm, necessary steel frame, and complete with GI box, with an operating sound level not exceeding 60dB at 3m distance.

17. HEPA Filter

Hepa Filter shall be of efficiency 99.97%. HEPA filters shall be aluminium corrugated and Mini pleat style. All filters shall be made up of high quality micro-fine glass fiber media. Filter frames shall be made up of Galvanized steel. Hepa filter shall ensure low pressure drop even at high airflows & with Antimicrobial protection.

All filters shall be made in accordance and tested to EN 1822 / ASHRAE 52.2 standards. These test certificates from OEM's shall be produced. The Hepa filter shall be fixed in a plenum constructed at the AHU mouth.

18. PAINTING WORK

- 18.1** All equipment shall be painted as specified under respective headings. Grilles/ diffusers shall be powder coated as per approved colour matching with interiors. The contractor has to get approval of the quality and colour of paints for all types of painting work.

All pipes for chilled water shall be painted as per standard code of practice and arrows indicating direction of flow of water shall be marked.

19. Colour scheme for the plant and equipment

i) Compressor	.. Battle ship grey
ii) Condenser	.. Battle ship grey
iii) Refrigerant discharge line	.. Red
iv) Refrigerant liquid line	.. Yellow
v) Steel supports	.. Black
vi) Direction of flow of water	.. White arrows
vii) Electrical panels/sub-panel/remote control console approved	.. Light grey or any
viii) Cable trays	.. Black
xi) Supports for ducts/open ducts	.. Black.

20. SUBMITTALS

Product Data: Submit manufacturer's technical data for air distribution equipment, including capacity ratings, fan performance curves with operating point clearly indicated, Finishes of materials, dimensions, weights, furnished accessories, and installation and instructions.

Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, required clearances, installation details and field connection details.

Wiring Diagrams: Submit the manufacturer's electrical requirements for power supply, wiring to the units.

Operation and Maintenance Data: Submit maintenance and lubrication instructions, motor and drive replacement instructions, and spare parts list for each unit.

Spare Parts List: Submit the manufacturer's spare parts list for ventilation equipment for a period of 2 years for the Engineer's review and approval.

21. TRANSPORTATION, HANDLING AND STORAGE

- A. Transportation, handling and storage of materials shall be in accordance with Manufacturer's recommendations regarding transportation, handling and storage of materials.
- B. Deliver materials to the site in manufacturer's original factory wrappings and containers, clearly labeled for identification of manufacturer, brand name and contents. Store materials off ground in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Follow manufacturer's instructions regarding transportation, handling and storage of materials.

22. WARRANTY

Materials shall be provided of standard products of specialist manufacturers who have long experience of manufacturing and installing control equipment specified in this section. The system shall be installed by competent personnel, regularly employed by the Controls manufacturer with full responsibility for proper operation of the Controls including debugging and proper calibration of each component in the entire system. Supplier shall have in-place support facility within 30 km of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment. Submit a written guarantee signed by manufacturer, contractor, and installer agreeing to replace partitions which fail in material or workmanship within a period of 3 years from the date of handing over.

23. QUALITY ASSURANCE

- A. Motors and electrical accessories shall comply with the applicable Indian Standards.
- B. Electrical components and installation shall comply with National Electrical Code.
- C. Test, adjust and balance air conditioning systems during hot season.
- D. Training**
 - 1. Train Owner's maintenance personnel on the troubleshooting procedures and testing, adjusting, and balancing procedures. Review with Owner's personnel, the information contained in the Operating and Maintenance Data.
 - 2. Schedule training through the Project Manager with at least 7 days prior notice.

24. Piping with/without insulation

- a) Piping with insulation shall be measured in running length (meters) for each size of pipe.
- b) The length of piping including accessories and fittings shall be measured along the center line of piping.
- c) No separate measurement of flanges, bends, elbows, reducer, expanders, tees, cross pipe supports, hangers, anchors, sockets for thermometer, pressure gauge, etc. shall be made. All such fittings / accessories shall be treated as normal piping.
- d) All accessories and finishes connected with insulation work shall be deemed to form part of insulation, and no separate measurement shall be made for such items.

25. Equipment Insulation:

No separate measurement for insulation of any equipment shall be made. Insulation of equipment shall be deemed to form part of the equipment. Insulation on equipment shall be done as per specifications provided.

26. ASSOCIATED CIVIL WORKS

The rate shall include all civil works associated with HVAC installation executed in accordance with approved shop drawings under direct supervision of the Project Manager such as PCC foundation blocks for all OUT DOOR UNITS/wall openings etc.

27. PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract. The Contractor shall be fully responsible for the performance of each equipment installed by him at the specified parameters and for the efficiency of the installation to deliver the required end result. The Contractor shall guarantee that the HVAC system as installed shall maintain the inside conditions in the air-conditioned spaces as described under “Basis of Design” included in the specifications.

The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing, commissioning and handing over.

28. BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these specifications and drawings shall take precedence over the said regulations and standards. However, if the drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

29. FEES AND PERMITS

The contractor shall obtain all permits / licenses and pay for any and all fees required for the inspection, approval and commissioning of the installation. It shall be reimbursed by the owner on submission documentary evidence.

30. DRAWINGS.

The HVAC drawings issued with tenders are diagrammatic only and indicate arrangement of various systems and extent of work covered in the contract.

These drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment, controls, grilles and diffusers.

The Contractor shall follow the tender drawings for preparing his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed. Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/ Consultant/ Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost. The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of this work with other services and trades, shall be made with prior approval of the Architect/ Consultant/ Owner's site representative without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is guaranteed.

31. TECHNICAL DATA

Each tenderer shall submit along with his tender, the technical data for all items. Failure to furnish complete technical data with tenders may result in rejection of the tender. Manufacturer's drawings, catalogues and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted. Samples of all materials like grilles, diffusers, controls, insulation, pre-molded pipe section, control wires etc. shall be submitted to the Owner's site representative prior to procurement. These will be submitted in for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation. Where the contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/ Consultant/ Owner's site representative. Delay on such account shall be at the cost of and consequence of the Contractor. Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, if the contractor installs his work before coordinating with other trades, or so as to

cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

32. QUIET OPERATION AND VIBRATION ISOLATION

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owners site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such condition shall be corrected by the contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the specified NC levels.

33. ACCESSIBILITY

The contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his ducting and piping. His failure to communicate insufficiency of any of the above shall constitute his acceptance of sufficiency of the same. The contractor shall locate all equipment's which must be service, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed damper, valve or other devices requiring attendance shall be finalized and communicated in sufficient time, to be provided in the normal cause of the work. Failing this, the contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.

34. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturer's.

35. MANUFACTURER'S INSTRUCTIONS

A Manufacturer has furnished specific instruction, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

36. ELECTRICAL INSTALLATION

The electrical work related to air conditioning services shall be carried out in full knowledge of and with complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the Architect/Consultant. All air conditioning

equipment shall be connected and tested in the presence of an authorized representative of the contractor. The air conditioning system shall be commissioned only after the contractor has certified in writing that the electrical installation work or air conditioning services has been thoroughly checked, tested and found to be totally satisfactory and all in full conformity with contract drawings, specifications, and manufacturer's instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the electrical installation work for air conditioning services, lies solely with the contractor.

37. COMPLETION CERTIFICATE

On completion of the Electrical installation for air conditioning, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority. The contractor shall be responsible for getting the entire electrical installation for air conditioning system duly approved by the local authorities concerned, and shall bear expenses in connection with the same.

38. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of HVAC system the contractor shall submit a draft copy comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

39. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of twelve (12) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

40. MAINTENANCE DURING LIABILITY PERIOD

40.1 Complaints

The contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

40.2 Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of charge to the Owner.

41. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability Period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, power consumption, starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance.

41.1 Schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/ Consultant's review. This shall include the type of service planned to be offered during the Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the management.

42. OPERATION AND MAINTENANCE

Contractor may be required to carry out the operation of the HVAC installation for the defects liability period. Further, he may also be required to carry out operation and all-inclusive maintenance of the entire system for a period of three years beyond the defects liability period.

CHAPTER F

TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING

1.01 FIRE FIGHTING WORKS:

1. SCOPE OF WORK

The scope of work covers the supply, installation, testing & commissioning of Fire Fighting Wet Riser Hydrant & Sprinkler system, Hand Held Fire Extinguishing System and fire signange proposed for the proposed hospital Building. It will be the responsibility of the Contractor to get all approval and completion certificate from the Local Fire Department without which the work will not be taken over by the HITES. Fee payable to the local bodies for such activities shall be reimbursed by the client on production of receipts for money paid and the all other expenses barring the fee will be borne by the contractor.

2. TENDER DRAWINGS

For guidance of the bidder, drawings as listed in Annexure are enclosed with these tender documents. These drawings are broadly indicative of the work to be carried out. The contractor on award of work will furnish detailed stage-wise working drawings as required in advance for approval of Engineer and get the same approved by Local Fire Authority/other statutory bodies. No claim whatsoever shall be admissible on account of changes that may be introduced by the Engineer/ Local Fire Authority.

3. SHOP DRAWINGS

The contractor shall prepare and furnish all shop drawings in quadruplicate at no extra cost for approval by the Engineer before commencing fabrication/ manufacture of the equipment. Such shop drawings shall be based on the Architectural drawings and requirements laid down in the specifications and as per site conditions. The manufacture of equipment shall be commenced only after the shop drawings are approved in writing by the Engineer. Such drawings shall be co-ordinate with all disciplines of work.

4. COMPLETION AS BUILT DRAWINGS

On completion of the work and before issuance of certificate of virtual completion, the contractor shall submit to the Engineer. General layout drawings, drawn at approved scale indicating layout of pump house piping and its accessories "As installed". These drawings shall in particular give the following:

- a. General layout of pump house
- b. Panels and other equipment location and sizes etc.
- c. Complete schematic as installed.
- d. Location of Hydrants, Earth pipes, route of earthling conductors etc.
- e. Route of all cables and pipes run along with detail sizes and mode of installation.

5. DOCUMENTS

The contractor shall submit to the Engineer, the following documents on completion of the work and before issuance of virtual completion.

- i. Warranty for equipment installed.
- ii. Test certificates
- iii. History sheets of the equipments
- iv. Catalogues
- v. Operation and maintenance manuals
- vi. List of recommended spares and consumables
- vii. Reconciliation statement
- viii. All approvals and sanctions

6. SANCTION/ APPROVALS FROM STATUTORY AUTHORITIES/ LOCAL FIRE AUTHORITY

The contractor shall be fully responsible and shall carry out following activities:-

- a. Submission of working drawing
- b. Obtaining the approval of drawings
- c. Arranging inspection of site by officials of the Authority
- d. Obtaining the initial & final no objection/ completion certificate after submitting required documents.
- e. Any other statutory approvals required.

7. MANUFACTURING

The responsibility for ensuring the manufacture of the equipment as per the specifications shall be solely that of the contractor. The contractor shall be responsible for selection of materials as per agreed specifications.

8. MAKE OF MATERIALS

Only approved make of material shall be used. The contractor shall get the samples of all the items approved from the HITES or project incharge engineer before commencing the supply.

9. MANUFACTURER INSTRUCTION

Any specific instruction furnished by manufacture covering the points not mentioned in technical specifications of the tender shall be brought to the notice of project incharge engineer in writing for further instructions in this regard at the time of tendering.

10. MATERIAL TESTING

The project incharge engineer shall have full power to get any material of work to be tested by an independent agency at contractor's expense in order to prove the soundness and adequacy.

11. INSPECTION AND TESTING

- a. All equipment shall be inspected and tested as per an agreed Quality Assurance Plan before the same is packed and dispatched from the contractor's works. The contractor shall carry out tests as specified/ directed by engineer.
- b. Contractor shall perform all such tests as may be necessary to meet requirements of Local Authorities, Municipal or other statutory laws/ bye-laws in force. No extra shall be paid for these.
- c. The project incharge engineer may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.
- d. Approvals or passing of any inspection by the engineer or his authorized representative shall not, however, prejudice the right of the engineer to reject the plan if it does not comply with the specification when erected or give complete satisfaction in service.

12. TRAINING OF DEPARTMENT PERSONNEL

- a. The contractor shall train the client's personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defects liability period (one year after completion & handing over).
- b. The period of training shall be adequate and mutually agreed upon by the engineer and contractor.
- c. The client's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.
- d. Nothing extra shall be paid to the contractor for training client's personnel.

13. PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the engineer, the contractor shall furnish written guarantee indemnifying the Client against defective materials and workmanship for a period of one year after completion and handing over. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the Client.

- a. Any defective material or equipment supplied by the contractor.
- b. Any material or equipment supplied which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

1.02 PIPING FOR WET RISER SYSTEM

1. SCOPE

This section covers the details of requirement of piping used in wet riser system, including the associated auxiliary equipment.

2. GENERAL

The wet riser system shall remain pressurized at all times during operation, and as such the piping work shall be carried out to withstand the same.

3. PIPES AND FITTINGS

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. and all such connecting devices that are needed to complete the piping work in its totality.

Screwed fittings shall be approved type malleable or cast iron with reinforced ring on all edges of the fittings suitable for screwed joints.

Forged steel fittings of approved type with "V" groove for welded joints.

Fabricated fittings shall not be permitted for pipe diameters 50 mm and below. When used, they shall be fabricated, welded and inspected in workshops whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler System under the supervision of Engineer-In-Charge. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

Pipes for Wet Riser system shall be of black steel conforming to IS: 1239 (Heavy Class).

Fittings for black steel pipes shall be malleable iron suitable for welding or tapered screwed threads.

4. JOINTING

4.1 Screwed (50 mm dia pipes and below)

Joint for black steel pipes and fittings shall be metal to metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked.

4.2 Welded (65 mm dia and above)

Joints between M.S. pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Butt welded joints are not acceptable.

4.3 Flanged

Flanged joints shall be provided on:

- a. Straight runs not exceeding 30 m on pipe lines 80 mm dia and above.
- b. Both ends of any fabricated fittings e.g. bend tees etc. of 65 mm dia or larger diameter.
- c. For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as per good engineering practice.

- d. Flanges shall be as per I.S. with appropriate number of G.I. nuts and bolts, 3 mm insertion neoprene gasket complete.

4.4 Unions

Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges. Joint for black steel pipes and fittings shall be metal to screw grid up to 50 mm dia and above 65 mm dia welded joints. A small amount of red lead may be used for lubrication and rust prevention in threaded joints. Hold tight will be use for threaded pipes joint.

All the welding shall be radiographically tested. Joints between MS pipes, valves and other appurtenances, pumps etc. shall be made with M.S. flanges with appropriate number of bolts. Flanged joints shall be made with 3mm thick insertion rubber gasket.

5. DIA OF FLANGE AND HOLE CONFORMING IS:

Size of pipe →	80 mm	100 mm	150 mm	200 mm	300 mm
Dia of flange →	200 mm	220 mm	285 mm	340 mm	445 mm
Dia of bolt →	16 mm		16 mm	16 mm	16 mm
No. of hole →	4	4	8	8	12

6. PIPE PROTECTION

- All pipes above ground and in exposed locations shall be painted with one coat of red oxide primer and two or more coats of synthetic enamel paint of approved shade.
- Pipes in chase or buried underground shall be painted with two coats of hot bitumen, wrapped with wrapping coating as per specifications and finished with one coat of hot bitumen paint.
- Pipe passing through structural members will be provided with M.S. pipes.

7. PIPE SUPPORTS

All pipe clamps and supports shall be galvanised steel. When fabricated from M.S. steel sections, the supports shall be factory galvanised before use at site. Welding of galvanised clamps and supports will not be permitted.

Pipes shall be hung by means of expandable anchor fastner of approved make and design (Dash Fastners or equivalent). The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastner and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encountered. The pipe spacing shall be as per CPWD standards or as per following table

PIPE SPACING TABLE

S.No.	Pipes & Position	<----- Pipe commercial dia. ----->							
		15/20	20/25	32/40	50	75/80	100/110	150/160	200
1	Vertical								

1.1	GI /MS	2.4	2.4	3	3.6	4.5	4.5	5.4	5.4
1.2	CI Pipes IS 1729/3989	x	x	<----- 3 m ----->					
1.3	CI Heavy Duty IS 1536	x	x	<----- 3.6 m ----->					
1.4	uPVC SWR Systems	x	x	0.5	0.7	0.9	0.9	1.0	
1.5	uPVC Water Supply								
1.6	Polybutylene	<--- As per manufacturer's Reccomendations ----->							
1	Horizontal								
1.1	GI /MS	2.0	2.0	2.4	3.0	3.6	4.0	4.5	4.5
1.2	CI Pipes IS 1729/3989			<----- 3 m ----->					
1.3	CI Heavy Duty IS 1536					3.0	3.6	3.6	4.5
1.4	uPVC SWR Systems				1.2	1.8	1.8	1.8	

8. ORIFICE FLANGES

Contractor shall provide orifice flanges fabricated from 6 mm thick stainless steel plates on the branch lines feeding different zones/ floors so as to allow required flow of water at 3.5 Kg/ sq.cm. Pressure. The contractor shall furnish design for these orifice flanges.

9. AIR VESSEL AND AIR RELEASE VALVE

Air vessel shall be installed before execution for approval fabricated out of at least 8 mm thick steel to withstand the pressure, with dished ends and supporting legs. This shall be of 250 mm dia and 1 m high or as specified in BoQ. This shall be completed with necessary flange connection to the wet riser piping and air release valve with necessary piping to meet the functional requirement of the system. The air vessel shall be of continuous welded construction and painted with red Colour. This shall be tested for twice the working pressure.

10. VALVES, GAUGES AND ORIFICE PLATES

Butter-fly or Sluice valves above 50 mm shall be of cast iron body and bronze/ gunmetal seat. They shall conform to type PN 1.6 of IS: 13095,780, valves up to 65mm shall be of gunmetal construction. Valve wheels shall be of right hand type and have an arrowhead engraved or cast thereon the direction for turning open and closing.

Non-return valves shall be of cast iron body and bronze/ gunmetal seat. They shall conform to Class 1 of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

Pressure gauge of suitable range shall be installed on the discharge side of each pump vacuum gauge shall be provided on suction side for pumps with negative suction. The dial size shall be 250 mm or as per BoQ. The gauges shall have brass cocks.

Orifice plates shall be of 6mm thick stainless steel to reduce pressure on individual hydrants to operating pressure of 3.5-kg/ sq.cm. Design of the same shall be given by the contractor as per location and pressure condition of each hydrant.

11. EXTERNAL YARD HYDRANTS

External yard hydrants shall be of 'Stand Post' type conforming to IS: 908 and comprise stand post for single or double(as per specified in boq) outlet, duck foot bend, flange riser and single headed brass/ gunmetal/SS or as per specified in boq, valve conforming type A of IS: 5290.

The stand post column shall be of cast iron, cast in one piece, conforming to grade 20 of IS: 210 or M.S. pipe. The internal diameter at the top shall be at least 80 mm.

The outlet shall be angled towards ground, with instantaneous spring lock type gunmetal female coupling of 63 mm dia or as per BoQ. For connecting to hose pipe.

12. INTERNAL HYDRANTS

The internal hydrant outlet shall comprise single headed/ double-headed double outlet or as per B.O.Q. gunmetal or SS landing valve conforming to type A of IS: 5290. Separate valves one on each of the two heads shall form part of the landing valve construction.

A brass cap with chain is provided on one head of the outlet which will have an instantaneous pattern female coupling for connection to the hose pipe. The landing valve shall be fitted to a tee connection on the wet riser at the landing.

13. FIRST AID HOSE REEL EQUIPMENT

First aid hose reel equipment shall comprise reel hose guide fixing bracket, hose tubing globe valve, stopcock and nozzle. This shall conform to IS: 884. The hose tubing shall conform to IS: 1532.

The hose tubing shall be 19 mm/20 mm dia and 30 m long or as per BoQ. The gunmetal / brass nozzle and globe valve shall be of suitable size.

The fixing brackets shall be of swinging type. Operating instructions shall be engraved on the assembly.

14. HOSE PIPES, BRANCH PIPES AND NOZZLES

Hose pipes:- Hose pipes shall be rubber lined woven jacketed 63 mm in diameter and 15 m long. They shall conform to type A (reinforced rubber lined) of IS: 636 . The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose pipe shall be complete with necessary coupling at the ends of match with the landing valve or with another run of hose pipe or with Branch pipe.

The coupling shall be of instantaneous spring lock type.

Branch pipe: - Branch pipe shall be of copper, gunmetal, SS or aluminum alloy 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

Nozzle: - The nozzle shall be of copper, SS or gunmetal, 20 mm in internal diameter. The screw threads at the inlet connection shall match with the threading on the branch

pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with the nozzle spanner.

End couplings, branch pipes, and nozzles shall conform to IS: 903. Each hydrant point will be provided with two hoses of 15 m each and one gunmetal branch pipe.

15. HOSE CABINET

The hose cabinet to accommodate the hosepipes, branch pipe nozzle and the hydrant outlets shall be fabricated from 1.5 mm thick sheet steel. In case of internal hydrants, this shall accommodate the hose reel equipment also. This shall have lockable, center opening glazed doors.

The scope of work includes provision of masonry or steel frame structure, as specified for installation. The hose cabinet shall be painted red stove enameled.

16. FIRE BRIGADE INLET CONNECTIONS/ DRAW OFF CONNECTION

One set of 2/4 ways collector head Fire Brigade connection shall be provided at under ground tank, sprinkler system.

The inlet to the wet riser sprinkler header shall be with 150 mm dia butterfly or sluice valve and non-return valve. The scope shall include necessary reducers, tees bends and special fittings as required.

It should be provided with M.S. enclosure fabricated from 1.5 mm thick M.S. sheet, front glass locking arrangement supported on M.S. structural members, painting with two coats of postal red enamel.

1.03 ELECTRIC DRIVE, HORIZONTAL FIRE PUMPS

1. SCOPE OF WORK

- a. Work under this section shall consist of furnishing all labour, materials, equipments and appliance necessary and required to completely install electrically operated pumps as required by the drawings and specified hereinafter or given in the schedule of quantities.
- b. Without restricting to the generality of the foregoing, the pumps and ancillary and accessories.
 1. Electrically operated pumps with motors, base plates and accessories.
 2. Alarm system with all accessories wiring and connections.
 3. Pressure gauges with isolation valves and piping bleed and block valves.
 4. M.S. pipes, valves, suction strainers, delivery headers and accessories.
 5. Foundations, vibration eliminator pads and foundation bolts.

2. QUALITY CONTROL

These shall comply with the IS codes as specified.

3. SUBMISSIONS

- a. Product Manuals

- b. Hydraulic Details

4. STORAGE

These shall be stored as delivered in original packing.

1.04 FIRE, SPRINKLER AND JOCKEY PUMPS

1. PUMPING SETS

- a. Pumping sets shall be single/multi stage horizontal split casing/Endsuction/ Vertical inline centrifugal Pumps having single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeve and grease- lubricated bearings or as specified in the BoQ.
- b. Pumps shall be connected to the drive by means of spacer type couplings, which shall be individually balanced.
- c. The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.
- d. Pumps shall be provided with approved type of mechanical seals.
- e. Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of the rated head.
- f. The pump shall meet the requirements of the Tariff Advisory Committee and N.B.C. or N.F.P.A. and the unit shall be design proven in fire protection services.

2. ELECTRIC DRIVE

- a. Electrically driven pumps shall be provided with totally enclosed fan ventilated induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running current.
- b. Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
- c. Motors shall be wound for class F insulation and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fiber insulated.
- d. Motors for fire pumps shall meet all requirements and specifications of the Tariff Advisory Committee. and N.B.C. or N.F.P.A.
- e. Motors shall be suitable for 415 volts, 3 phase 50 cycles a/c supply and shall be designed for 38 deg. C ambient temperature. Motors shall conform to I.S. 325.
- f. Motors shall be designed for two-start system
- g. Motors shall be capable of handling the required starting torque of the pumps.
- h. Contractor shall provide inbuilt heating arrangements for the motors for main pumps to ensure that motor windings shall remain dry.

- i. Speed of the motors shall be compatible with the speed of the pump.

3. AIR VESSEL

- a. Provide one air vessel fabricated from 10 mm M.S. plate with dished ends and suitable supporting legs. Air vessel shall be provided with a 100 mm dia flanged connection from pump, one 25 mm dia drain with valve, one gunmetal water level gauge and 15 mm sockets for pressure switches. The vessel shall be 450 mm dia x 2000 mm high or as per the BoQ and tested to 20 kg/ sq. cm pressure.
- b. The fire pumps shall operate on drop of pressure in the mains as given below. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

4. VIBRATION ELIMINATORS

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors as per Project Engineer's discretion. 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 connector shall be as per manufacturer's details.

5. INSTALLATION

- a. Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete foundations.
- b. Pumps and motors shall be truly aligned by suitable instruments.
- c. All pumps connections shall be standard flanged type with appropriate number of bolts. In case of non-standard flanges companion flanges shall be provided with the pumps.
- d. Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.
- e. Contractor shall provide necessary test certificates and performance charts with NPSH requirement of the pumps from the manufacturer. The contractor shall provide facilities to the Engineer-in-charge or their authorized representative for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the HITES.
- f. Each pump shall be provided with a 150 mm dia pressure, isolation cock and connecting piping, bleed and block valve.
- g. Provide vibration eliminating pad and connectors for each pump.

The contractor shall submit with this tender a list of recommended spare parts for two years of normal operation and quote the prices for the same.

1.05 DIESEL DRIVE, HORIZONTAL FIRE PUMPS

1. SCOPE OF WORK

- a. Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install diesel driven pumps as required by the drawings, specified hereinafter or given in the schedule of quantities.
- b. Without restricting to the generality of the foregoing, the pumps and ancillary equipment shall include the following:
 1. Diesel driven pumps with motors, base plates and accessories.
 2. Alarm system with all accessories, wiring and connections.
 3. Pressure gauges with isolation valves and piping bleed and block valves.
 4. M.S. pipes, valves, suction strainers, delivery headers and accessories.
 5. Foundations, vibration eliminator pads and foundation bolts.

2. QUALITY CONTROL

- a. These shall comply with the IS codes as specified.

3. SUBMISSIONS

- a. Product Manuals
- b. Hydraulic Details

4. STORAGE

- a. These shall be stored as delivered in original packing.

1.06 FIRE, SPRINKLER AND JOCKEY PUMPS

1. PUMPING SETS

- a. Pumping sets shall be single/multi stage horizontal split casing/ Endsuction/ Vertical Inline centrifugal pump having single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeve and grease-lubricated bearings or as per OEM standards.
- b. Pumps shall be connected to the drive by means of spacer type couplings, which shall be individually balanced dynamically and statically.
- c. The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.
- d. Pumps shall be provided with approved type of mechanical seals.
- e. Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of the rated head.

- f. The pump shall meet the requirements of the Tariff Advisory Committee and the unit shall be design proven in fire protection services.

2. DIESEL ENGINE

- a. Diesel engine shall be of multi cylinders (4/6 as per site requirements) with individual head assemblies. The engine shall be water-cooled and shall include heat exchanger/radiator cooled and connecting piping, strainer, isolating and pressure reducing valves, bye-pass line complete in all respects.
- b. Engine shall be direct injection type with low noise and exhaust emission levels.
- c. The speed of the engine shall match the pump speed for direct drive.
- d. The engine shall be capable of being started without the use of wicks, cartridge heater, plugs or either at engine room temperature of 7 deg. C and shall take full load within 15 seconds from the receipt of the signal to start.
- e. The Engine shall efficiently operate at 38 deg. C ambient temperature at 50 m above mean sea level.
- f. Noise level of the engine shall not exceed 105 DBA (free field sound pressure) at 3 m distance.
- g. The engine shall be self starting type up to 4 deg. C and shall be provided with one 24 V heavy duty DC battery, starter, cut-out, battery leads complete in all respects. One additional spare battery shall be provided. The battery shall have a capacity of 180 to 200 ampere hours and 640 amps cold cranking amperage.
- h. Provided a battery recharger of 10 to 15 amperes capacity with trickle and booster charging facility and regulator.
- i. Annunciation panel shall be suitable for working on 24 volts D.C. Arrangement for starting shall be automatic on receiving the signal but shutting off shall be manual.
- j. The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer's design.
- k. Engine shall be suitable for running on high speed diesel oil.
- l. The system shall be provided with a control panel with push button starting arrangement also and wired to operate the engine on a differential pressure gauge.
- m. The entire system shall be mounted on a common structural base plate with ant vibration mountings and flexible connections on the suction and delivery piping.
- n. Provide one fully mounted and supported day oil tank fabricated from 5mm thick M.S. sheet electrically welded with a capacity of 8 hours working load but not less than 600 lit. Provide level indicating gauge glass on the day oil tank and low fuel indication of the control panel.
- o. Provide one exhaust pipe with suitable muffler (residential type) to discharge the engine gases to outside open air as per site conditions.
- p. Provide all accessories fittings and fixtures necessary and required for a complete operating engine set.

- q. Contractor shall indicate special requirements, if any, for the ventilation of the pump room.

3. OPERATING CONDITIONS FOR FIRE & SPRINKLER PUMPS

- a. The diesel pump shall start automatically, on fall of pressure in the pipe line, in the absence of electric supply, but the stopping shall be manual.
- b. Jockey pump shall start and stop through pressure switch automatically.
- c. Jockey pump shall stop when main pump starts.
- d. Main pump shall start automatically on fall of pressure but stopping shall be manual.

4. VIBRATION ELIMINATORS

- a. Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors as per Project Engineer's discretion. 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 connector shall be as per manufacturer's details.

5. INSTALLATION

- a. Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete foundations.
- b. Pumps and motors shall be truly aligned by suitable instruments.
- c. All pump connections shall be standard flanged type with appropriate number of bolts. In case of nonstandard flanges companion flanges shall be provided with the pumps.
- d. Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.
- e. Contractor shall provide necessary test certificates and performance charts with NPSH requirement of the pumps from the manufacturer. The contractor shall provide facilities to the Engineer-in-charge or their authorized representative of inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the Clients.
- f. Each pump shall be provided with a 150 mm dia pressure gauge, isolation cock and connecting piping, bleed and block valve.
- g. Provide vibration eliminating pad and connectors for each pump.

- h. The contractor shall submit with this tender a list of recommended spare parts for two years of normal operation and quote the prices for the same.

1.07 ELECTRICAL INSTALLATIONS

1. SCOPE:

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of electric control panels, wiring and earthing of all pump room equipment, components and accessories, including supply, installation and wiring of remote control-cum-indicating light panel.

2. GENERAL:

Work shall be carried out in accordance with the Specifications, Local Rules, Indian Electricity Act 1910 as amended up to date, and rules issued thereunder, Regulations of the Fire Insurance Company and relevant BIS Code of Practice.

A. POWER AND CONTROL PANEL AND OTHER CONTROL COMPONENTS

1. SCOPE

This section covers the detailed requirements of the power and the control panel for the wet riser system, and also for the various control components in the system.

2. WIRING SYSTEM:

All power wiring shall be carried out with 1100 volts grade PVC insulated, armoured overall, PVC sheathed aluminum conductor cables for sizes above 6 mm². For sizes 6 mm² and below the power wiring shall be of copper conductor only. Cables shall be sized by applying proper derating factor. All control wiring shall be carried out by using 650 volts PVC insulated copper conductor wires in race ways or in conduit. Minimum size of control wiring shall be 1.5 mm² PVC insulated copper conductor wires. Minimum size of conductor for power wiring shall be 4 mm² 1100 volts grade PVC insulated copper conductor wires in conduit.

3. CONSTRUCTION FEATURES:

The control panel shall be metal enclosed sheet steel cubicle, indoor type, dead front, floor mounting/wall mounting type. The control panel shall be totally enclosed and vermin proof. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. Control panels shall be arranged in multi-tier formation. All doors and covers shall be suitable for double padlocking. All mild steel sheets used in the construction of control panels shall be 14 SWG thick for floor mounted and 16 SWG for wall mounting and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding slag grounded off and welding pits wiped smooth with Plumber metal.

All panels and covers shall be properly fitted and square with the frame and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an

adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of control panels. Base channel of 75 mm x 75 mm x 5 mm thick shall be provided at the bottom. Minimum clear space of 200 mm between the floor of control panel and bottom most unit (MCB or Bus Bar) shall be provided.

The control panels shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear. Knockout holes of appropriate size and number shall be provided in the control panels in conformity with the location of incoming and outgoing conduits / cables. All equipment such as meters and indicating lamps etc. shall be located adjacent to the unit with which it is associated and care shall be taken to achieve a neat and symmetrical arrangement. Facility shall be provided for termination of cables from top of the control panel. Clamps shall be provided to support the weight of the cables. All power wiring inside the control panel shall be color coded and control wiring ferruled for easy identification. Circuit diagram showing the arrangement of circuits shall be pasted on the inside of panel door and covered with transparent plastic sheet and all labeling shall be provided in engraved anodized aluminum/Bakelite strips on the front face of the panel board.

4. CIRCUIT COMPARTMENT:

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall have steel sheets on top and bottom of compartment. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the 'ON' position. Safety interlocks shall be provided to prevent the breaker or contactor from being drawn out when the breaker is in 'ON' position. The door shall not form an integral part of the draw out portion of the panel. Sheet steel barriers shall be provided between the tiers in a vertical section.

5. INSTRUMENT ACCOMMODATION:

Adequate space shall be provided for accommodating instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker and bus bar.

6. BUS BARS AND BUS BAR CONNECTIONS:

The bus bar and interconnections shall be of aluminum and of rectangular cross sections suitable for full load current for phase bus bars, and half rated current for neutral bus bar and shall be extensible on either side. The bus bars and interconnections shall be insulated with PVC sleeve / tapes and shall be color coded. Alternatively special insulating paints/materials may be used for the purpose.

All bus bars shall be supported on unbreakable, non hygroscopic insulated supports at regular intervals, to withstand the forces arising in case of short circuit in the system. All bus bars shall be provided in separate chamber and properly ventilated. All bus bars connections, in main control panels shall be done by drilling holes with cadmium plated/hot dipped galvanized bolts, nuts and washers.

All bus bars connections in smaller control panels shall be done by drilling hole and connecting by brass bolts and nuts.

All connections between the bus bar and breaker and between breaker and contactor shall be through copper strips of proper size to carry rated current and shall be insulated with PVC sleeves.

7. RACEWAYS:

A horizontal race way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

8. CABLE COMPARTMENTS:

Cable compartment of adequate size shall be provided in the control panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate and proper supports shall be provided in cable compartments to support cables.

9. INDICATIONS

- i. 'ON' lamps shall be provided on all outgoing feeders.
- ii. Cable alley and bus chamber shall be identified on all panels.

10. RUBBER MAT

Rubber mat shall be provided to cover the full length of front of all panels and rear of panels where back space shall be available for working from the rear.

11. MATERIALS:

All materials shall be of the best quality complying with the BIS (Bureau of Indian Standards) specifications. Materials used shall be subject to the approval of the Client/HITES's site representative and samples of the same shall be furnished where required.

11.1 Molded Case Circuit Breaker

MCCB shall comprise of switching mechanism, contact system are 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 stress.

Switching mechanism shall be of Quick Make- Quick Break type and the trip command shall override all other commands. MCCB shall employ maintenance free contact system to minimize the let thru energies while handling abnormal currents.

The handle position shall give positive indication of 'ON' 'OFF' or tripped.

MCCB shall conform to IS- 2516 (Part I & II/Sec.1) 1985.

11.2 Miniature Circuit Breaker

Miniature circuit breakers shall be quick make and break type, and shall conform to Relevant Indian Standards. The housing shall be heat resistant and having high impact strength. The fault current shall not be less than 9 KA at 230 V and shall

be BIS approved. MCBs shall be flush mounted and shall be provided with trip free manual operating lever and 'ON' and 'OFF' indications. The contacts shall be provided to quench the arc immediately. MCB shall be provided with magnetic thermal releases for over current and short circuit protection. The over load or short circuit device shall have a common trip bar in the case of D P, TP and TPN miniature circuit breakers.

11.3 Rotary Switches:

Switches up to 60 amps shall be rotary type with compact and robust construction, built up from one or more stacks with contacts and a positioning mechanism with stop as required. Rotary switches shall have HRC fuse fittings of appropriate rating.

11.4 Selector Switch

Where called for selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

11.5 Starters

Each motor shall be provided with a starter of suitable rating. Starters shall be in accordance with relevant BIS Codes. All Star Delta and ATS Starters shall be fully automatic.

Starter contactors shall have 3 main and 2 Nos. NO/NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta/Reduced Voltage Starters. The insulation for contactor coils shall be of class "B".

Operating coils of contactors shall be suitable for 230/415 $\pm 10\%$ volts AC, 50 cycles supply system. The contactors shall drop out when voltage drops to 90% of the rated voltage. The housing of the contactors shall be heat resistant and having high impact strength. Each starter shall have thermal overload protection on all three phases.

11.6 Over Load Relays

Contactors shall be provided with a three element, positive acting ambient temperature compensated time lagged hand-reset type thermal over load relays with adjustable setting. Hand-reset button shall be flush with the front door for resetting with starter compartment door closed. Relays shall be directly connected for motors up to 35 HP capacities. C.T operated relays shall be provided for motors above 35 HP capacities. Heater circuit contactors may not be provided with overload relays.

11.7 Current Transformers

Current transformers shall be of accuracy class I and suitable VA burden for operation of the connected meters and relays. These shall be resin bonded and epoxy coated.

11.8 Single Phase Preventer

Single phase preventer shall be provided as per Schedule of Quantities and shall be in conformity with relevant BIS Standards. Single phase preventer shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

11.9 Time Delay Relays

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connections.

11.10 Indicating Led (22 mm dia) and Metering

All meters and indicating lamps shall be in accordance with BS 37 and BS 39. The meters shall be flush mounted and drawout type. The indicating lamp shall be of LED type. Each main panel shall be provided with voltmeter 0-500 volts with three ways and off selector switch, CT operated ammeter of suitable range with three Nos. CTs of suitable ratio with three ways and off selector switch, phase indicating lamps and other indicating lamps as called for. Each phase indicating lamp shall be backed up with 5 amps fuse. Other indicating lamps shall be backed up with fuses as called for.

11.11 Toggle Switch

Toggle switches where called for, shall be in conformity with relevant BIS Codes and shall be of 5 amps rating.

11.12 Push Button Stations

Push button stations shall be provided for manual starting and stopping of motors/equipment as called for. Green and Red color push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

11.13 Conduits

Conduits shall be of mild steel and shall be Hard drawn, stove enameled inside and outside with minimum wall thickness of 1.6 mm for conduits up to 32mm diameter and 2 mm wall thickness for conduits above 32 mm diameter. GI pull wires shall be installed in the conduit while laying the conduit.

11.14 Cables

M.V. cables shall be PVC insulated aluminum conductor and armored cables conforming to BIS Codes. Cables shall be armoured and suitable for laying in trenches, duct, and on cable trays as required. M.V Cables shall be termite

resistant. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

11.15 Wires

1100 volts grade PVC insulated copper conductor wires in conduit shall be used.

12. CABLE LAYING:

Cable shall be laid generally in accordance with BIS Code of Practice. Cables shall be laid on 14 gage perforated MS sheet cable trays and cable drops/risers shall be fixed to ladder type cable trays fabricated out of steel angle. Access to all cables shall be provided to allow cable withdrawal/ replacement in the future. Where more than one cable is running, proper spacing shall be provided to minimize the loss in current carrying capacity. Cables shall be suitably supported with Galvanized saddles when run on walls/trays. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layer of soft sifted sand & protected with bricks, tiles. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of cable 1.1 KV cable shall be buried 600 mm below ground level.

13. WIRE SIZES:

For all single phase/3 phase wiring, 1100 volts grade PVC insulated copper conductor wires shall be used. The equipment inside plant room and AHU room shall be connected to the control panel by means of insulated aluminum conductor wires of adequate size. An isolator shall be provided near each motor/equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. PVC insulated single strand aluminum conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification in control wiring.

The minimum size of control wiring shall be 1.5 mm² PVC insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels.

Power wiring cabling shall be of the following sizes:

- i. Upto 5 HP motors/5 KW heaters:- 3 x 4 mm² Cu conductor wires.
- ii From 6 HP to 10 HP motors / 6 KW to 7.5 KW heaters. :- 6 mm² Cu conductor wires.
- iii. From 12.5 HP to 15 HP motors:- 2 Nos. 3 x 6 mm² Cu conductor wires.
- iv. From 20 HP to 25 HP motors:- 2 Nos. 3 x 10 mm² Al conductor armoured cables.
- v. From 30 HP to 35 HP motors:- 3 x 16 mm² Al conductor armoured cables.

- vi. From 40 HP to 50 HP motors.:- 2 Nos. 3 x 25 mm² Al conductor armoured cables.
- vii. From 60 HP to 75 HP motors. :- 2 Nos.3 x 50 mm² Al conductor armoured cables.
- viii. 100 HP motors. :- 1 No. 3 x 150 mm² Al conductor armoured cables.

All the switches, contactors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. The following capacity contactors and overload relays shall be provided for different capacity motors.

	TYPE OF STARTER	CONTACTOR CURRENT CAPACITY	OVERLOAD RELAY RANGE
5 HP Motors	D O L	16 amps	6-10 amps
7.5HP Motors	D O L	16 amps	10-16 amps
10 HP Motors	D O L	32 amps	13-21 amps
12.5HP Motors	Star Delta	16 amps	10-16 amps
15 HP Motors	Star Delta	25 amps	10-16 amps
20 HP Motors	Star Delts	32 amps	13-21 amps
25 HP Motors	Star Delta	32 amps	13-21 amps
30 HP Motors	Star Delta	40 amps	20-32 amps
35 HP Motors	Star Delta	40 amps	20-32 amps
40 HP Motors	Star Delta	40 amps	28-42 amps
45 HP Motors	Star Delta	63 amps	28-42 amps
50 HP Motors	Star Delta	63 amps	28-42 amps
60 HP Motors	Auto Transformers Voltage.	125 amps	45-70amps Reduced
75 HP Motors	-do-	125 amps	90-150 amps
100 HP Motors	-do- Relay	200 amps	operated

14. **Earthing:**

Earthing shall be copper strips/wires the main panel shall be connected to the main earthing system of the building by means of 2 Nos. 25 mm x 3 mm copper tapes. All single phase metal clad switches and control panels be earthed with minimum 2 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthed with two numbers distinct and independent copper wires/tapes as follows:

- i. Motors upto and including 10 HP rating:- 2 Nos 3 mm dia copper wires.
- ii. Motors 12.5 HP to 40 HP capacity:- 2 Nos.4 mm dia copper wires.
- iii. Motors 50 to 75 HP capacity:- 2 Nos 6 mm dia copper wires.
- iv. Motors above 75 HP:- 2 Nos 25 mm x 3 mm copper tapes.

All switches shall be earthed with two numbers distinct and independent copper wires/tapes as follows:

i.	3 phase switches and control panels upto 60 amps rating.	2 Nos 3 mm dia copper wires.
ii.	3 phase switches and control panels 63 amps to 100 amps rating.	2 Nos 4 mm dia copper wires.
iii.	3 phase switches and control panels 125 amps to 200 amps rating.	2 Nos 6 mm dia copper wires.
iv.	3 phase switches, control panels, bus ducts, above 200 Amps rating	2 Nos 3 mm x 25 mm copper tapes.

The earthing connections shall be tapped off from the main earthing of electrical installation. The over - lapping in earthing strips at joints where required shall be minimum 75 mm. These straight joints shall be riveted with brass rivets & brazed in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substance and properly tinned.

15. **Drawings:**

Shop drawings for control panels and wiring of equipment showing the route of conduit/ cable shall be submitted by the contractor for approval of Engineer-in-Charge before starting the fabrication of panel and starting the work. On completion, four sets of complete "As-installed" drawings incorporating all details like, conduits routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the Contractor.

16. **Testing:**

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS Codes and test report furnished by a qualified and authorized person. The entire electrical installation shall be got approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Supervisor.

17. **Painting:**

All sheet steel work shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall then be backed in an oven. The finishing treatment shall be by application of synthetic enamel paint of approved shade.

18. **Label and Tags**

Engraved PVC labels shall be provided on all incoming and outgoing feeders switches. Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel and covered with transparent plastic

sheet. All cables terminations at panels and at equipments shall be provided with tags as approved by Project Manager.

19. All panels to have provision for padlocking and all MCCB's/MCB's to have provision for locking in off position.
20. **Measurement of Electrical Control Panels:** Panels shall be counted as number of units. Quoted rates shall include as lump sum (NOT measurable lengths) for all internal wiring, power wiring and earthing connections from the control panel to the starter and to the motor, control wiring for inter-locking, power and control wiring for automatic and safety controls, and control wiring for remote start/stop as well as indication as per the specifications. The quoted rate for panel shall also include all accessories, switchgear, fuses, contactors, indicating meters and lights as per the specifications.

B ELECTRIC FIRE PUMP SECTION: -

This section shall incorporate the following facilities.

- i. TP &N Moulded case circuit breaker
- ii. Control system components and equipment such as relays, contractors, and timers etc. for automatic operation.
- iii. Starter unit, current transformer and ammeter
- iv. Indication lamps, their fuses, terminal block, push button, control and selector switches etc. as required.
- v. Pump lock out devices due to faults or abnormalities as specified.
- vi. Visual/ audio alarms, indications and communications facility as specified.
- vii. Necessary inter-connection control and power cable work, cable glands, lungs and internal wiring and connections.

C ENGINE SECTION: -

The engine section shall incorporate the following facilities.

- i. Control system components and equipment such as relays, contractors, and timers etc. for automatic operation.
- ii. Instruments, indicator lamps, fuses, terminal blocks, push buttons, control and selector switches etc. as are required.
- iii. Engine shut down and block out devices due to faults or abnormalities as specified.
- iv. Visual/ audio alarm indication and enunciator facility as specified.
- v. Inter- connection control and power cable work, cable glands, lungs, all internal wiring and connection etc.

D AUXILIARY PUMP SECTION: -

Each of the auxiliary pump section for priming pump shall incorporate the following:

- i. TP&N Moulded case circuit breaker
- ii. Control system components such as relays, timers, contractors etc. as are necessary for functional requirements.
- iii. Starter unit, current transformer and ammeter
- iv. Indication lamps, fuses, terminal blocks, push buttons selector, switch etc. as required.
- v. Inter-connections, power and control cable work, cable plants lugs, internal wiring and connections.
- vi. Low water level alarm for terrace tank, where provided.

E CONTROL SECTION: -

This section shall incorporate the following:

- i. Control components integrating the various sections, so as to satisfy the functional requirements.
- ii. Battery charger unit with boost/ float charge facility with voltmeter, capable of independently charging 1 set of battery at a time.
- iii. Visual/ audio alarms not covered in individual sections.
- iv. Lamps healthy test facility.
- v. Instruments, indicating lamps, push buttons, fuse terminal blocks etc. as are required.
- vi. Test facility to stimulate operation of hydrants.

F OTHER CONTROL COMPONENTS

a. Pressure Switches:

Pressure switches shall be provided for switching on and off the jockey pump at preset pressures and also for switching of the fire pump at preset pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure switches shall be totally reliable, sturdy in construction and of long life. The pressure settings shall be adjustable.

G MAINTENANCE MANUAL

- i. On completion of the entire work and successful commissioning, contractor shall hand over four copies of maintenance manuals of all equipment installed by him.
- ii. Maintenance manuals shall include information relating to make, model Number, year of manufacture for all electrical and mechanical equipment with names of local suppliers or manufacturers' agents.

H MEASUREMENTS

- i. Pumping sets, air vessel, switchboard cubicle, pressure switch, fire alarm shall be measured by number and shall include all items necessary and required and given in the specifications.
- ii. Earthing shall be measured as a lump sum item.
- iii. Earthing tape will be linear measurement.
- iv. Cabling shall be measured per linear meter from switchboard to each motor and shall include all items necessary and required and given in the specifications.

1.08 INSTALLATION AND TESTING

1. SCOPE

This section covers the requirements of installation of the various components of the wet riser system.

A survey of the site of the work shall be made by the contractor before preparation of the detailed drawings for submission to the department for approval. The installation shall be carried out strictly in accordance with the approved drawing.

The scope of installation work shall include the following, where or not expressly mentioned in the schedule of work.

- i. Cement concrete (1:2:4 mix) foundation for all pump sets
- ii. Vibration isolation arrangement for all pump sets
- iii. Filling up the hole in flooring with cement concrete, after laying the wet riser pipes
- iv. Necessary supports and clamps for wet riser pump room
- v. Necessary supports and clamps for wet riser plumbing the building
- vi. Supporting bracket/ frame work for the fuel oil tank of the engine
- vii. Excavation of the earth, consolidation and refilling after laying of wet riser piping in ground.
- viii. Provision of necessary brick base or intermediate support as required in approved manner in case of soils which are not strong enough to support the pipes, thereby likely to cause different settlement.
- ix. Necessary anchor block of ample dimensions in 1:2:4 cement concrete at all bends, tee connections, foot of the wet riser, and other places as required to stand the pressure thrust in pipes.
- x. Necessary masonry work/ steel work for supporting hose cabinets near external (yard) hydrants.
- xi. Valve chambers of approved design with external (yard) hydrant.
- xii. Ground level hydrants of approved design, where specified.

- xiii. Cutting and making good the damages for the installation work of the riser system
- xiv. All the required control piping, exhaust piping from engine to outside, oil piping for fuel oil and lubricating oil for the engine, drain piping from the pumps to the drain point in the pump room, overflow piping from priming tank to the sump. The piping work shall include all necessary fittings, valve and accessories for effective functional requirements.
- xv. Inter-connecting cable work with controls, control panel, batteries etc. including battery leads.
- xvi. Orifice plates at individual hydrants as required.

Where provision of MS pipe shall below ground become inescapable, it shall be protected from soil corrosion by two coats of bitumen painting and wrapped with bituminous Hessian cloth and finish with hot bitumen paint.

Each MS pipe shall be subjected to hydraulic pressure test before installation, in presence of the Engineer or his authorized representative.

External (yard) hydrants shall be located at least 2m away from the face of the buildings but not more than 15m and be accessible.

Where external hydrants below ground level are specifically indicated in tender specifications, there shall be enclosed in masonry trenches of size 75sqcm and 8cm above ground level. The hydrant shall be with in 8cm from the top of the enclosure.

Necessary facility for draining the rise pipe shall be provided at ground floor level with 50mm size sluice valve.

Internal hydrant at each floor shall be located at about 1m above floor level.

Valve chambers shall be of 1sqm in size, with cover.

2. HOSES AND HOSE CABINET

All hoses shall be numbered and a record submitted with completion plane. The number and length shall be easily recognizable on each hose pipe.

External hose boxes shall be installed such that the hose is not exposed to sun rays.

3. PAINTING

Painting of the entire wet riser piping over the ground shall be done with anticorrosive primer and 2 coats of approved paint. The color shall be red to shade No. 536 of IS: 5, Paint shall conform to IS:2932.

The pumps and engine shall be painted after installation with a coat of approved paint to similar shade as per original supply.

4. TESTING OF THE SYSTEM

After laying and jointing, the entire piping shall be tested to hydrostatic test pressure. The pipes shall be slowly charged with water so that the air is expelled from the pipes. The pipes shall be allowed to stand full of water for a period of not less than 24 hours and then tested under pressure. The test pressure shall be 12 kg/cm². The test pressure shall be applied by means of manually operated test pump or by a power

driven test pump to be provided by the contractor. In either case precautions shall be taken to ensure that the required test pressure is not exceeded.

The open end of the piping shall be temporarily closed for testing.

Test shall be conducted on each pump set after completion of the installation with respect of delivery head, flow and B.H.P. The test shall be carried out by the contractor at his own cost.

All leaks and defects in different joints, noticed during the testing and before commissioning shall satisfaction of engineer.

Testing of fittings/ equipments shall be carried out either at site or at works in the presence of a representative of the engineer. Test certificates shall also be furnished by the contractor.

The automatic operation of the system and alarms for the various functional requirements, as laid down in this specification, shall be satisfactory carried out in the presence of Engineer-in-charge.

5. APPROVAL BY LOCAL BODIES

It shall be the responsibility of the contractor to obtain the approval of drawings and to get the installation inspected and approved by the concerned authorities as may be necessary as per local by laws, any fee payable to the local bodies for such activities shall also be borne by the Client on production of receipts for money paid and the other expenses will be borne by the contractor.

6. PIPE WORK ASSOCIATED WITH DIESEL ENGINE

Pipe works for fuel system, lube oil system and exhaust system shall be complete with all required supports, clamps, hangers etc. for a complete work.

Fuel feed is by gravity and the fuel tank shall be located at least 60cm above the fuel injection pump.

Fuel pipe of copper shall not be soldered but brazed or welded.

No valves or cocks shall be provided in the fuel feed line to engine from the fuel tank.

Precautions shall be taken to prevent any air locks in any part of the fuel system. No air relief cock shall be permitted and where inescapable, screwed plugs shall be provided for the purpose.

The installation of the fuel supply system shall be such that a completely primed condition is maintained, free from air lock.

Filters shall be provided in fuel oil and lube oil circuits allocations that are easily accessible for maintenance.

7. WET RISER PIPE WORK

The suction line for each pump shall be independent. Puddle flanges may be used in suction lines from the tank.

Butterfly or Sluice valve shall be provided in situation line, where the pump is located below the water level in the sump, strainer at the suction end shall be provided.

Each external (yard) hydrant line shall be controlled by a Butterfly or sluice valve at ground level.

Butterfly or Sluice valves shall be kept in open position and the scope of work includes provision of necessary leather strap and pad lock so as to prevent unauthorized closing of valve.

The installation work includes provision of all clamps, supports, anchors etc.

Spacing between vertical supports shall not exceed 1.5m and horizontally at 2m up to 50mm and 1.5m for higher diameters. Clamps shall be provided on either side of the tee joints for internal hydrants. Necessary anchors/ thrust pads shall be provided as approved at locations of bends, tees etc. as required within the scope of work.

Under ground pipes of the wet riser system shall be laid 1m below ground level and at least 2m away from the face of the buildings. The run of piping shall be preferably along roads and footpaths and shall not be under buildings. Where specifically indicated to cross buildings, these shall be laid in masonry trenches with removable covers. With cut off valves at the entry and exit points.

1.09 TECHNICAL SPECIFICATIONS FOR SPRINKLER SYSTEM

1.0 SPRINKLER HEADS

- a. Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly yoke and the deflector. The sprinklers shall be of approved make and type.

- b. Types

- i. Conventional Pattern

- The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown upwards to the ceiling. The sprinklers shall be suitable for erection in upright position or pendant position.

- ii. Spray Pattern

- The spray type sprinkler shall produce a hemispherical discharge below the plane of the deflector.

- iii. Ceiling (flush) Pattern

- These shall be designed for use with concealed pipe work. These shall be installed pendant with plate or base flush to the ceiling with below the ceiling.

- iv. Side Wall Sprinklers

- These shall be designed for installation along with the walls of room close to the ceiling. The discharge pattern shall be similar to one quarter of sphere with a small proportion discharging on the wall behind the sprinklers.

- c. Constructions

- i. Bulb:- Bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.
- ii. Valve Assembly: - Water passage of the sprinkler shall be closed by a valve assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.
- iii. Yoke: - The yoke shall be made of high quality gun metal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anti-corrosive treatment if the same is to be used in corrosive conditions.
- iv. Deflector: - The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler.

d. Colour Code

The following color code shall be adopted for classification of sprinkler according to nominal temperature ratings:

Sprinkler Temperature Rating	Color of the Bulb
57 deg. C	Orange
68 deg. C	Red
79 deg. C	Yellow
93 deg. C	Green
141 deg. C	Blue
182 deg. C	Violet/ Mauve
204/260 deg. C	Black

e. Size of Sprinklers Orifices

The following sizes of sprinklers shall be selected for various classes or hazards.

Extra light hazard	10/15 mm nominal bore
Ordinary light hazard	15 mm nominal bore
Extra high hazard systems	30 sprinklers

f. Stock of replacement sprinkler

The following spare sprinklers shall be supplied along with the system.

Extra high hazard systems	6 sprinklers
Ordinary hazard systems	24 sprinklers
Extra high hazard systems	36 sprinklers

g. Temperature Rating

For normal conditions in temperature climates rating of 68/74 deg. C shall be used. However the temperature rating shall be as closed as possible to, but not less than 30 deg. C above the highest anticipated temperature conditions.

2.0 PIPES AND FITTINGS

- Pipes for wet riser system shall be black steel conforming to IS: 1239 (Heavy Class).
- Fittings for black steel pipes shall be malleable iron suitable for welding or approved type cast iron fittings with tapered screwed threads.

Jointing

Joint for black steel pipes and fittings shall be metal to metal tapered thread or welded joints. A small amount of red lead may be used for lubrication and rust prevention in threaded joints.

Joints between MS pipes, valves and other appurtenances, pumps etc. shall be made with M.S. flanges with appropriate number of bolts. Flanged joints shall be made with 3mm thick insertion rubber gasket.

Pipe Protection

- a. All pipes above ground and in exposed locations shall be painted with one coat of red oxide primer and two or more coats of synthetic enamel paint of approved shade.
- b. Pipes in chase or buried underground shall be painted with two coats of hot bitumen, wrapped with warapping coating and finished with one coat of hot bitumen paint.

Pipe Supports

All pipes shall be adequately supported from ceiling or walls from existing inserts by structural clamps fabricated from M.S. structurals e.g. rods, channels, angles and flats. All clamps shall be painted with one coat of red and two coats of black enamel paint. Where inserts are not provided, the contractor shall provide anchor fasteners.

Orifice Flanges

Contractor shall provide orifice flanges fabricated from 6mm thick stainless steel plates on the branch lines feeding different zones/ floors so as allow required flow of water at 3.5 kg/ sq.mm pressure. The contractor shall furnish design for these orifice flanges.

Valves

Butterfly or Sluice valves of size 80mm and above shall be double-flanged cast iron conforming to IS: 780.

Check valve shall be of cast iron double flanged conforming to IS: 5312.

Valves on pipes 65mm and below shall be heavy pattern gunmetal valves with cast iron wheel seat tested to 20 kg/ sq.mm pressure. Valves shall conform to IS: 778.

Air Valves

25mm dia screwed inlet cast iron single acting air valves on all high points in the system or as shown on drawings.

Drain Valves

50 mm dia black steel pipe conforming to IS: 1239 heavy class with 50 mm gunmetal full way valve for draining water in the system in low pockets.

3.0 INSTALLATION CONTROL VALVE:-

Installation control valves shall comprise of the following.

- a. One main stop valve of full way pattern with gunmetal pointer to indicate where open/ shut
- b. One automatic alarm valve, fitted with handle and cover.
- c. One hydraulic alarm motor and gong for sounding a continuous alarm upon out-break of fire.
- d. One combined waste and testing valve including 5 mtr of tubing and fittings
- e. Alarm stop valve
- f. Strainer
- g. Drain plug
- h. Padlock & strap
- i. Wall box for installation of valve

4.0 PRESSURE GAUGES:-

Burden type pressure gauges conforming to IS/ BS specifications shall provided at the following locations.

- a. Just above alarm valve
- b. Just below alarm valve, on the installation stop valve
- c. One pressure gauge on delivery side of each pump
- d. Required number of pressure gauges on pressure tank

5.0 INSTALLATION OF PIPING

- A. Below ground piping: -Under ground piping should be installed in masonry trenches with cover or reinforced concrete. The pipe work shall be supported at regular intervals of 2.5m with masonry or RCC supports. Wherever pipes pass through roads/ pavements shall be protected against corrosion with two coats of bituminous painting and wrapped with pypkote or bitumen Hessian cloth and finish with one coat of hot bitumen paint.
- B. ABOVE GROUND PIPING: -
 - a. All above ground piping shall be installed on suitable to pipe hangers/ supports as required. The hangers shall be made of MS angles, channels, channels etc. and painted to the required finish (with suitable synthetic enamel paint). The spacing supports shall be as per CPWD standards or as mentioned previously.

- b. Piping shall be so installed that the system can be thoroughly drained. All the pipes shall be arranged to drain to the installation drain valve. In case of basement and other areas where the pipe work, is below the installation drain valve / auxiliary valves of the following sizes shall be provided.
 - i. 20 mm dia valve for pipes up to 50mm dia
 - ii. 25 mm dia valve for 65 mm dia pipes
 - iii. 32 mm dia valves for pipes larger than 65 mm dia
- c. Piping shall be screwed type up to 50 mm dia. Welding of joints will be allowed for pipes of 50 mm of larger diameters.
- d. The piping shall be pressure tested by the hydrostatic method upto a pressure of 1.5 times the working pressure the piping shall be slowly charged with water so that all the air is expelled from the piping by providing a 25mm inlet with a stop cock. The piping shall be allowed to stand full of water for a period of 2 hours and then the piping shall be put under pressure by means of manually operated test pump or by a power driven test pump. The pressure gauges used for testing shall be accurate and shall preferably be calibrated before the testing is carried out. All the leakages and defects in joints revealed during the testing shall be rectified to the entire satisfaction of the HITES. The system may be tested in sections parts as the work of erection of piping proceeds. The piping shall withstand 1.5 times the working pressure for at least 2 hours.

6.0 PUMP SETS: - Same as wet riser & Hydrant System specification.

1.10 HAND HELD FIRE EXTINGUISHERS

1.0 ABC TYPE DRY POWDER EXTINGUISHER

The Extinguisher shall be filled with ABC grade 40, Mono Ammonium Phosphate 40% from any approved manufacturer. The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS 4308, shall be 4 Kg +/-2% or 2 Kg +/- 3%. The distribution of fire extinguishers to be as per IS 2190 – 1992.

It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as expellant. The Nitrogen to be charged at a pressure of 15 Kg/cm².

Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

The Neck Ring shall be externally threaded - the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzles shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents up to a throw of 4 mtrs, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 4 Kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 Kg/cm² for a minimum period of 2 minutes. The pressure gauge shall be imported and suited for the purpose.

2.0 WATER TYPE EXTINGUISHER (GAS PRESSURE TYPE)

The Extinguishing medium shall be primarily water stored under normal pressure, the discharge being affected by release of Carbon Dioxide Gas from a 120 Gms cylinder.

The capacity of Extinguisher, when filled up to the indicated level, shall be 9 ltr +/- 5%.

The skin thickness of the Cylinder shall be minimum 4.0 mm, fabricated from Mild Steel sheet, welded as required, with dish and dome, being of same thickness, and of size not exceeding the diameter of body. The diameter of body to be not less than 150 mm and not exceeding 200 mm. The neck shall be externally threaded upto a minimum depth of 16 mm, and leaded tin bronze.

The cap shall be of leaded tin bronze, and screwed on the body upto a minimum of 1.6 cm depth, with parallel screw thread to match the neck ring. The siphon tube to be of brass or G.I. and the strainer of Brass. The cartridge holder, knob, discharge fittings and plunger to be of Brass/Leaded tin bronze, and plunger of stainless steel, spring of stainless steel. The cap to have handle fitted to it. The discharge hose shall be braided nylon, of 10 mm dia and 600 mm long, with a nozzle of brass fitted at end.

The extinguisher shall be treated for anti-corrosion internally and externally, and externally painted with Fire Red paint. The paint shall be stove enameled/powder coated. The cartridge shall be as per IS, and have 60 gm net carbon dioxide gas for expelling. The extinguisher, body and cap shall be treated to an internal hydraulic pressure of 25 Kg/cm². It shall have external marking with letter A, of 2.5 cm height, in block letters within a triangle of 5 cm each side. The extinguisher shall be upright in operation, with the body placed on ground and discharge tube with nozzle held in one hand to give a throw of not less than 6 mtr, and continue so for at least 60 secs. The extinguisher body shall be clearly marked with ISI stamp (IS 940).

3.0 CARBON DIOXIDE EXTINGUISHER

The Carbon Dioxide Extinguisher shall be as per IS: 2878.

The body shall be constructed of seamless tube conforming to IS: 7285 and having a convex dome and flat base. Its dia shall be maximum 140 mm, and the overall height shall not exceed 720 mm.

The discharge mechanism shall be through a control valve conforming to IS: 3224. The internal syphon tube shall be of copper aluminium conforming to relevant specifications.

Hose Pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg/cm² and shall be approximately 1.0 meter in length for 4.5 Kg size and 2 Mtrs for 9 Kgs and 2.5 Mtrs for 22 kgs Fire Extinguisher having internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The hand grip of Discharge horn shall be insulated with Rubber of appropriate thickness.

The gas shall be conforming to IS: 307 and shall be stored at about 85 Kg/cm². The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and the total discharge time (effective) shall be minimum 10 secs and maximum 25 secs.

22.5 Kgs CO₂ Fire Extinguishers shall be trolley mounted and shall be placed in electrical panel room & plant rooms.

The extinguisher shall fulfill the following test pressures:

Cylinder: 236 Kg/cm²

Control Valve: 125 Kg/cm²

Burst Pressure of Hose: 140 Kg/cm² minimum.

It shall be an Upright type. The cylinder, including the control valve and high pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by Chief Controller of Explosives, Nagpur and also bear IS marking.

The Extinguisher including components shall be IS marked.

1.11 STANDARDS AND CODES

1. IS 1648 Code of practice for fire safety of building (general) fire fighting equipment and maintenance.
2. IS 3844 Code of practice for installation of internal fire hydrant in multistory buildings
3. IS 2217 Recommendations for providing first aid and firefighting arrangement in public buildings.
4. IS 2190 Code of practice for selection, installation and maintenance of portable first aid fire appliances.
5. Part IV, firefighting National building code
6. IS 5290 External fire hydrants

7.	IS 5290	Internal landing valves
8.	IS 904	2 & 3 way suction collecting heads
9.	IS 884	First aid hose reel
10.	IS 5132	High pressure rubber pipe
11.	IS 1537	C.I. Double flanged pipes
12.	IS 1538	C.I. Double flanged fittings
13.	IS 780	C.I. Sluice valves and gunmetal valves
14.	IS 6234	Specifications for Water type (stored pressure) fire extinguisher.
15.	IS 2878/2190	Specifications for fire extinguisher of Carbon-di-oxide & Dry powder type.
16	IS : 636	Non-percolating flexible fire fighting delivery hose.
17	IS : 884	Specification for first aid hose reel for fire fighting.
18	IS : 901	Specification for couplings, double male and double female, instantaneous pattern for fire fighting.
19	IS : 902	Suction hose couplings for fire fighting purposes.
20	IS : 903	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner.
21	IS : 904	Specification for 2-way and 3-way suction collecting heads for fire fighting purposes.
22	IS : 907	Specification for suction strainers, cylindrical type for fire fighting purposes.
23	IS : 908	Specification for fire hydrant, stand post type.
24	IS : 909	Specification for underground fire hydrant, sluice valve type.
25	IS : 910	Specification for portable chemical foam fire extinguisher.

26	IS : 933	Specification for portable chemical foam fire extinguisher.
27	IS : 1648	Code of practice for fire safety of building (general): Fire fighting equipment and its maintenance.
28	IS : 2171	Specification for portable fire extinguishers dry powder (cartridge type)
29	IS : 2190	Selection, installation and maintenance of first aid fire extinguishers – Code of practice.
30	IS : 2871	Specification for branch pipe, universal, for fire fighting purposes.
31	IS : 2878	Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted).
32	IS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.
33	IS 5714	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.
34	IS : 8423	Specification for controlled percolation type hose for fire fighting.
35	IS : 10658	Specification for higher capacity dry powder fire extinguisher (trolley mounted).
36	IS : 11460	Code of practice for fire safety of libraries and archives buildings.
37	IS : 1309	External hydrant systems – Provision and maintenance – Code of practice.
38	IS : 5514 (Parts 1 to 7)	Reciprocating internal combustion engines: Performance.
39	IS : 1239 (Part 1)	Mild steel, tubes, tubular and other wrought steel fittings: Part 1 Mild Steel tubes.
40	IS : 1239 (Part 2)	Mild Steel tubes, tubular and other wrought steel fittings: Part 2 Mild Steel tubular and other wrought steel pipe fittings.

41	IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and dimensions.
42	IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances.
43	IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes.
44	IS : 3468	Pipe nuts.
45	IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
46	IS : 4711	Methods for sampling steel pipes, tubes and fittings.
47	IS : 6392	Steel pipe flanges
48	IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
49	IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
50	IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
51	IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
52	IS : 3950	Specification for surface boxes for sluice valves.
53	IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves: part 2 Multi door pattern.
54	IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves: part 2 Multi door pattern.
55	IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design

56	IS : 13095	Butterfly valves for general purposes.
57	IS : 27	Pig Lead
58	IS : 325	Three Phase Induction Motors
59	IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
60	IS : 694	PVC insulated cables for working voltages up to & including 1100 V.
61	IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.
62	IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
63	IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1100 V.
64	IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV up to and including 11 KV.
65	IS : 1726	Specification for cast iron manhole covers and frames.
66	IS : 2379	Color code for identification of pipe lines.
67	IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
68	IS : 5455	Cast iron steps for manholes.
69	IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
70	IS : 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
71	IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
72	IS : 10221	Code of practice for coating and wrapping

of underground mild steel pipelines.

73 IS : 11149

Rubber Gaskets

74 IS : 11790

Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.

CHAPTER G

TECHNICAL SPECIFICATIONS FOR ELEVATORS

- 1.1 This section deals with technical requirement of Electric Traction Type & Passenger Elevator, its components, and safety devices. All features shall be of latest International standards such as EN81, European standards, American standards or IS 14665 (part -1 to 5)/NBC-2016 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 lift well 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 lifts.

It is the responsibility of the Lift contractor to obtain all statutory approvals such as Electrical Inspectorates approval. All the necessary administrative procedures are to be taken care by the Lift contractor. The statutory fees required shall be reimbursed to the contractor on submission of necessary fee receipts/ challan in original

1.2 POWER SUPPLY

HITES 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 commissioning of the elevator shall be in the scope of the contractor.

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

1.4.1. Passenger Lifts

Sl.No.	Items	Technical requirement
1	Type of Elevator	Hospital Lift
2	Capacity	1360Kgs (minimum), 20 Passenger Bid Lift
3	Speed	1.00 Mtr/sec
4	Serving Floors	1. 20 Passenger Bed lift (6 stops) -2 Nos 2. 20 Passenger Bed lift (7 stops) -2 Nos 3. 20 Passenger Bed lift (8 stops) -2 Nos
5	Machine	Gearless without Machine room (MRL)
6	Control system	Micro-processor based control with variable voltage variable frequency technology.
7	Operation	Simplex/Duplex
8	Car Enclosure	Mat finish stainless steel (Grade 304) panel on all the four sides & Ceiling for passenger lift.
9	Flooring	Granite flooring
10	Number of Entrance	Entrance at front side on all the serving floors (All stops – Center / side opening).

11	Car & Hoist way Entrance (landing) Doors.	Automatic center/side opening automatic mat finish stainless steel (Grade 304) door. Landing Doors - 1hour fire rated
12	Safety Feature	(i) All safety feature required as per IS / International Standards.
13		(ii) Additional features.
14		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) Anti - Nuisance Home Landing Facility Over Load Bypass Door Nudging/Hold Operation Car Display – 10” LCD Display (Floor and travel directions of lift, Lift status messages, Date / time, Time based pictures/videos) Safe landing operation Next landing operation Car call erase False call cancelling Braille Buttons f) Battery operated alarm bell & emergency light with battery and charger. g) 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, 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 lamps 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.

1.4.2. Dumbwaiter

Sl.No.	Items	Technical requirement
1	Type of Elevator	Dumbwaiter
2	Capacity	100Kg
3	Speed	0.3 Mtr/sec
4	Serving Floors	1. 2 stops(basement and Ground floor) - 1 No 7 stops(basement and Terrace floor) - 2 Nos
5	Machine	MRL Type
6	Control system	Micro-processor based control with variable voltage variable frequency technology.
7	Operation	Simplex.
8	Car Enclosure	Stainless steel
9	Flooring	Aluminium chequered plate
10	Number of Entrance	Entrance at front side on all the serving floors (All stops – Center / side opening).
11	Car & Hoist way Entrance (landing) Doors.	Automatic center opening automatic mat finish stainless steel door.
12	Safety Feature	(i) All safety feature required as per IS / International Standards.
13		(ii) Additional features.
14		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 CFL lamps 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.

1.5 CONTROLLER

- 1.5.1 The control system shall be of microprocessor controller type, incorporating variable voltage variable frequency drive. 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 granite (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 12/16/20 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.

- 3.29.2 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/Duplex 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
MEDICAL GAS PIPELINE SYSTEM (MGPS)

SN	Technical Specification
	The system comprises of
1	Main Oxygen Manifold and Emergency oxygen manifold with automatic control panels
2	Nitrous Oxide Manifold and Emergency NO2 Manifold with automatic control panel
3	Medical Air Supply System (4 Bar & 7 Bar) complete.
4	Medical Vacuum (suction) Supply System Complete.
5	Distribution Piping Complete with Accessories.
6	Area Valve Service System.
7	AGSS system Complete
8	Alarm Systems (Master & Area)
9	Gas Outlets with Probes
10	Bed Head Panels
11	Other associated & Optional works
	RESPONSIBILITY OF BIDDER
1	Bidder shall be responsible for complete design, supply, installation, testing and commissioning including Civil Modification works, demolition and construction as applicable .The bidders are required to survey the site before furnishing the quotations.
2	Bidder shall execute all required civil, electrical, plumbing, fire safety, false ceiling trap door/ cutout and repair(if any) and other works as maybe required for complete installation and trouble-free functioning as a part of the ‘Civil Modification’.
3	Hospital will provide one point electrical supply with isolator and an earth strip in the plant. The internal wiring and earthing, has to be done by the bidder.
4	Electrical Control panel for Vacuum system ,AGSS and Air plant system has to be supplied by the bidder.
5	Bidder will be responsible for other associated work related to installation and commissioning of complete MGPS system.
6	The MGPS bidder has to interconnect all the medical gas lines inside the MOT.
7	Installation and commissioning of area valve service unit and alarm unit for the operation theatre shall be done by the MGPS bidder.
8	Medical gas pipe line inside the minor operation theatre has to be done by the MGPS bidder.
9	The bidder shall be responsible for the complete works including the submission of working drawings, and isometric views, detailed work schedule and materials. Bidder shall be responsible for design, supply, installation, testing and commissioning of medical gas supply system in coordination with respective institute authorities & HLL/HITES.

10	Bidder shall be responsible for free maintenance of all component of Gas pipeline system during warranty period including all filters & consumables.
11	Bidder should provide factory test certificates for the materials used. Bidder should supply complete set of part manuals, service manuals and user manuals for all the systems and subsystems supplied. Final electrical safety test, system test, leakage and calibration should be done by authorized persons using calibrated test equipment as per standards.
12	The Medical Gas Pipe Line System must follow Single Standard any one only from: NFPA 99c/HTM 02-01/ ISO 7396-1/DIN/EN except Copper Pipe, For AGSS Ventury type is not acceptable.
13	All Gas Outlets in OT (i.e. O2, N2O, MA4, MA7, Vacuum, etc. will come with OT Pendants. Bidder has to provide pipe lines inside all the OTs
14	Bidder shall co-ordinate with respective Departments Head for their final Gas Outlets requirement per bed in their wards and should incorporate the same in drawing.
15	The final Payment will be made on the actual consumption of the BOQ Items and ranking will be done with tendered BOQ.
16	Control Panels & Manifold for O2, N2O & CO2,Medical Air Plant,Medical Vacuum Plant,AGSS Plant,Area & Master Alarm,All types Outlets,Oxygen flowmeter,AVSU,Line Isolation Valves ,High Pressure Tubes shall comply with HTM 02-01/NFPA 99C/DIN/EN/ISO-7396-1 standards and bidder should submit valid quality certificates along with the bid.
17	The third party compliance certification after installation to be done for the standard followed i.e HTM 02-01/NFPA 99C/DIN/EN/ISO-7396-1 except copper pipe from the authorised agency. The cost for the same will be borne by the bidder.
18	Bidder must have a satisfactory installation of complete MGPS as per any International standard as asked in tender and demo may be taken for the same.
19	Bidder will be provided after award either AutoCAD or PDF or hard Copy of building Layout drawing for preparation of MGPS drawings.
	Responsibility of Consignee:
1	The institute will provide MGPS plant & manifold room (complete with plastering , painting & flooring)
2	Institute will provide one point elecrical, water and drain connection at the plant & manifold room
3	Institute will provide shaft for MGPS riser
4	Institute will provide temporary storage for storing of raw materials of MGPS system during installation period and the security of the store is the responsibility of MGPS vendor
	<u>Scope and Technical Specification:</u>
1	Oxygen Supply System
1.1	Fully Automatic Oxygen Control Panel
	Automatic control panel should be constructed in accordance with the requirement of international standards. The fully automatic oxygen control panel should comply with HTM 02-01/NFPA 99C/ DIN / EN / ISO-7396-1 standards and the bidder must submit the applicable quality certificates.

	The manifold assembly should provide two stages of pressure regulation. A single stage primary regulator, one for each cylinder bank should be used to initially reduce cylinder pressure and two single stage pressure regulators should be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one should be ready for service in a standby mode. The Manifold control panel should be with digital display, fully automatic type and switches from “Bank in Use” to “Reserve bank “ without fluctuation in delivery supply line pressure. Changeover should be performed by electrically/pneumatically operated valves contained in the control cabinet. In the event of an electrical power failure the valves should automatically open to provide an uninterrupted gas flow. It should be 100% automatic and should not require manual adjustment.
	Indication for changing the cylinders should be clearly identified on the front of the control panel.
	All functional components should be enclosed in corrosion resistant robust material.
	All components inside the Control Panel like Pressure Regulators, piping and control switching equipment should be cleaned for Oxygen Service and installed inside the cabinet to minimize tampering with the regulators or switch settings.
	The Control Panel shall include two pressure relief valves, one high pressure approx. 200/350psi and one low pressure approx. 75 psi.
	The heavy duty control panel should be provided with a flow capacity of 1500 or more LPM at 50 to 60 psi.
	The Automatic Control Panel should be installed in such a way to meet the peak flow requirement of the Hospital/Institute
	Control panel should have Alarm reset switch/Mute /acknowledgement switch to control and monitor the alarm indications by the operator.
1.2	Oxygen Manifold Supply System (without Cylinders)
	The size of Manifolds should be as mentioned in BOQ of respective Institute and it shall be compatible with Class-D type bulk cylinders.
	Manifold shall consist of two high pressure header bar assemblies to facilitate connection of primary and secondary cylinder supplies. Each header bar shall be provided with respective numbers of cylinder pigtail connections to suit cylinder valves as per IS.3224/ BS/ ASME incorporating a check valve at the header connection.
	Each header bar assembly shall be provided with a high pressure shut off valve. Oxygen Manifold should consist of 2 rows of respective numbers of class D-type bulk oxygen cylinders. The manifold should be hydraulically tested to 3500 psig. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non – return valves for easy changing of cylinders without closing the bank. The cylinder should be placed with the help of cylinder brackets and fixing chains which should be galvanized.
1.3	Emergency Oxygen Manifold (without Cylinders)
	The size of Manifolds should be as mentioned in BOQ of respective Institute and it shall be compatible with Class-D type bulk cylinders.

	Manifold shall consist of two high pressure header bar assemblies to facilitate connection of respective numbers of primary and secondary cylinder supplies. Each header bar shall be provided with respective numbers of cylinder pigtail connections to suit cylinder valves as per IS.3224/ BS/ ASME incorporating a check valve at the header connection. Each header bar assembly shall be provided with a high pressure shut off valve.
	Oxygen Manifold should consist of 2 rows of respective numbers of class D-type bulk oxygen cylinders. The manifold should be hydraulically tested to 3500 psig. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non – return valves for easy changing of cylinders without closing the bank. The cylinder should be placed with the help of cylinder brackets and fixing chains which should be galvanized.
1.4	Oxygen Flow meter with Humidifier Bottle
	Back Pressure Compensated flow meter for accurate gas flow measurement with following features:
A)	Control within a range of 0-15 LPM.
B)	It should meet strict precision and durability standard.
C)	The flow meter body should be made of brass chrome plated materials.
D)	The flow tube and shroud components should be made of clear, impact resistant polycarbonate.
E)	Flow tube should have large and expanded 0-15 LPM range for improved readability at low flows.
F)	Inlet filter of stainless steel wire mesh to prevent entry of foreign particles
G)	The humidifier bottle is made of unbreakable & reusable polycarbonate /polysulfone material autoclavable at 121 degree centigrade .
H)	Humidifier Bottle should be covered under warranty & CMC.
I)	Should comply with HTM 02-01/ NFPA 99 C/ EN /DIN /ISO 7396-1 STANDARD and provide the applicable quality certificates.
2	NITROUS OXIDE SYSTEM
2.1	Fully Automatic Nitrous Oxide Control Panel
	The fully automatic N2O control panel should comply with HTM 02-01/ NFPA 99 C/ EN /DIN /ISO 7396-1 STANDARD and the bidder must submit applicable quality certificates.
	The manifold assembly should provide two stages of pressure regulation. A single stage primary regulator, one for each cylinder bank should be used to initially reduce cylinder pressure and two single stage pressure regulators should be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one should be ready for service in a Standby mode. The Manifold control panel should be digital, fully automatic type and switches from “Bank in Use” to “Reserve bank “ without fluctuation in delivery supply line pressure. Changeover should be performed by electrically/pneumatically operated valves contained in the control cabinet. In the event of an electrical power failure the valves should automatically open to provide an uninterrupted gas flow. The manifold should not require any manual resetting or adjustments after the replacements of the depleted cylinders.

	The Control Panel shall include two pressure relief valves, one high pressure approx.200psi and one low pressure approx.75 psi.
	The control panel should also have heaters to prevent ice formation on the regulators at high flow rates.
	The Control Panel should be made to provide Heavy Duty and have a flow capacity of 500 LPM or more at 50 to 60 psi.
	The Automatic Control Panel should be installed in such a way to meet the peak flow requirement of the Hospital/Institute
	Control panel should have Alarm reset switch/Mute / acknowledgement switch to control and monitor the alarm indications by the operator.
2.2	Nitrous Oxide Manifold (Without Cylinders)
	The size of Manifolds should be as mentioned in BOQ of respective Institute and it shall be compatible with Class-D type bulk cylinders.
	Manifold shall consist of two high-pressure header bar assemblies to facilitate connection of primary and secondary cylinder supplies. Each header bar shall be provided with respective number of cylinder pigtail connections to suit cylinder valves as per IS.3224/ BS/ ASME incorporating a check valve at the header connection. Each header bar assembly shall be provided with a high pressure shut off valve. The manifold should be hydraulically tested to 3500 psig. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The cylinder should be locked with the help of cylinder brackets and fixing chains which should be galvanized.
2.3	Emergency N2O Manifold (Without Cylinders)
	The size of Manifolds should be as mentioned in BOQ of respective Institute and it shall be compatible with Class-D type bulk cylinders.
	Manifold shall consist of two high-pressure header bar assemblies to facilitate connection of primary and secondary cylinder supplies. Each header bar shall be provided with respective numbers of cylinder pigtail connections to suit cylinder valves as per IS 3224/ BS/ ASME incorporating a check valve at the header connection. Each header bar assembly shall be provided with a high pressure shut off valve. Nitrous oxide manifold should consist of 2 rows of respective numbers of cylinders.
	The manifold should be hydraulically tested to 3500 psig. The manifold should be so designed that it shall suit easy cylinder changing and positioning. The system should have non – return valves for easy changing of cylinders without closing the bank. The cylinder should be placed with the help of cylinder brackets and fixing chains which should be galvanized.
3	Medical and Surgical Air System (Package Unit) - Tolerance of +/-5% is acceptable on plant flow capacity
	Air-cooled Oil-free compressors for continuous duty application with highest output of compressed air, low power consumption and very low vibration resulting in low noise level.
	The medical air plant shall fully comply with the requirements of the HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 and the bidder must provide applicable quality certificates.
3.1	Air Compressor Modules

	It should be Oil-free Screw Compressors /Scroll Compressors to produces the plant output of { minimum Liters Per Minutes(LPM) Plant capacity } as mentioned in BOQ of respective institute as primary and same as standby.
	Medical quality air shall be delivered at a nominal pressure of 400 kPa (4 bar) and 700kPa(7 bar) gauge for supply of the hospital medical air and surgical air.
	Compressor plant should be designed in such a way that compressors will switch on in a sequential manner as per flow demand.
	The compressors should be standalone ones with independent power supply.Each Compressor should be suitable for both continuous and frequent start/stop operation at a nominal plant pressure of 10bar or more.
	The duty compressors shall be automatically rotated by the plant control system to ensure even wear. Compressors shall be supplied and installed. Desiccant dryer shall be provided with a dew point sensing switch that shall provide an alarm on the plant control panel a when the water concentration in the delivered air rises above the limit. Duplex desiccant dryer and filtration modules shall be provided with three or more individual stages of filtration as follows:
	Stage 1: Coalescing filter upstream of the desiccant dryer for removing liquid water particles down to 1micron.
	Stage 2: Particulate filter after the desiccant dryer for dust protection and removing particles down to 1 micron.
	Stage 3: Bacteria filter for removing particles down to 0.01 micron.
	Purity should be tested as per the American Pharmacopeia / European Pharmacopeia standard.
	The plant control and power management system shall monitor the safe operation of the plant, providing signal into the alarm system as per the requirements of the standard.
	Pressure Reducing Station: for 4 bar and 7 bar should fully comply and meet with the requirements of the standard. Simplex pressure reducing station shall comprise as in-line pressure regulator, with downstream pressure gauge. Isolation valves and pressure release valves should be provided as per the standard. Duplex pressure reducing station to have two branches, connected to the MGPS in parallel in order to allow maintenance on the components of one branch, while the gas flow is maintained in the other branch.Ball Valves - Full bore which operate from fully open to fully closed position with a quarter turn of the handle.Complete pressure reducing station with base plate mounted for ease of installation.
	Padlocks available to allow locking of the valves in both open and closed positions and must have easy to read pressure gauges. Base plate mounted and supplied with copper stub pipes for ease of installation using inert jointing procedures.
	The compressor system should have-
1	Intake filter Delivery pipe
2	Mounting on air tank along with all standard fittings viz. safety valve, pressure gauge, delivery valve, drain valve etc.
3	Bidder shall provide all electric control panels, starters etc required for proper functioning of motor.
4	Desiccant Air Dryer – 2 nos.(Duplex)

5	2-Stage or more Breathing Air Filters – 2 sets(Duplex)
6	Outlet pressures for drills/equipment and ventilators should be a minimum of 7 bar and 4 bar respectively.
7	Duplex pressure reducing station
	The compressor should be heavy duty, reliable with long Mean Time Between Failures. Each compressor cylinder is to be protected by a temperature switch, which will stop the drive motor and provide an alarm signal in the event of abnormal discharge air temperature. Each compressor module should include an inline filter with particle retention of 10 microns, inlet isolation valve, discharge isolation valve, and pressure relief valve. The capacity should be capable to take care of total load of all the outlets.
3.2	Vertical Air Receiver
	Total air receiver capacity shall be at least 50% of the primary plant capacity (capacity as mentioned in the tender) in 1 minute in terms of free air delivered at normal working pressure. Each air receiver shall be protected by a pressure relief valve, a fusible plug and include a pressure gauge with isolating valve and a drain cock.
	The corrosion resistant coated receiver is to be equipped with tested safety pressure relief valve, sight glass pressure gauge, automatic drain, three-valve by-pass and source isolation valve. Should be fabricated as per ISO/ASME/BS
3.3	Air Treatment Module
	The air treatment module should include dual dryers, dual filtration system and a dewpoint transmitter with local audible and visual signals and dry contacts for remote monitoring. The components should be mounted on a common base with interconnecting copper/brass piping and upstream and downstream isolation valves. The isolation valves must allow either set of components to be serviced without shutting down the system.
	Dryers should be of heatless desiccant design and sized to provide for the peak calculated demand. The desiccant dryers should be equipped with dew point dependent switching feature to minimize the need for purge air.
	The dual filtration system should remove liquid and particulate matter, consisting of 0.5micron coalescing filters with differential pressure indicators and automatic drain, airline pressure regulators with gauges, final pressure relief valve, and sampling valve.
	Each bank should consist of three stage treatment. Digital dew point monitor is to be supplied with alarm contacts as per requirement of the standard.
3.4	System Controls
	The “Continuous on Demand” feature will stop the operation of the motors during periods of low or no demand. The control include individual self-protected combination motor controls with short circuit protection, single phase and thermal overload protection, individual control circuit with transformers primary and secondary protection, pressure sensors, temperature switches with reset buttons, and an electronic controller to automatically change the operating sequence of the compressors. The cabinet shall have status display to include system pressure, dew point pump operation, accumulated time, maintenance interval, fault conditions, and silence button, lighted Hand-Off-Automatic selector switches and safety disconnect operating handles. All

	required local alarm functions shall be integrated in to the packaged system.
	The system should be designed to function even if the programmable controller fails.
3.5	Accessories
	Accessories including for job site installation such as inlet and discharge flexible connectors, vibration mounting pads, and source isolation valve should be supplied.
	All the filters should be covered under warranty period and CMC Period.
4	VACUUM SYSTEMS (Package unit)
	The vacuum system shall fully comply with the requirements of the HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 and the bidder must provide applicable quality certificates. Undertaking from manufacturer must be submitted for using the same control panel in the system offered)and should comply with HTM 0201/ NFPA 99 C / EN /DIN/ISO 7396-1
4.1	Vacuum Pump Module
	It should be Oil Sealed Rotary Vane Type to produces the plant output of { minimum Liters Per Minutes(LPM) Plant capacity } as mentioned in BOQ of respective institute as primary and same as standby
	Designed flow capacity should be minimumof LPM capacity as mentioned in BOQ of respective institute. The vacuum plant shall comprise air-cooled, oil lubricated rotary vane vacuum pumps suitable for both continuous and frequent start/stop operation at inlet vacuum levels between 500mmHg and 660 mmHg.
	The control system should normally employ automatic rotation of the lead pump to maximize pump life and ensure even wear.Vacuum pump inlets shall include a wire mesh filter and integral non-return valve to prevent oil suck back and pressure increases in the vacuum system.
	Each vacuum pump shall be fitted with anti-vibration pads between the pump foot and mounting frame. The plant shall be fitted with duplex bacteria filter system.
4.2	Vacuum Receiver
	The vacuum receiver shall be made of rust free corrosion resistant steel and fabricated as per ASME/BS/ISO for a vacuum pressure of 760mmHg. It should include bypass valves, manual drain valves, vacuum gauge. Vacuum reservoir shall have total volume of at least 100 % of primary plant output (capacity as mentioned in the tender) in one minute in terms of free air aspired at normal working pressure.
4.3	System Controls

	The control include individual self-protected combination motor controls with short circuit, single phase and thermal overload protection, individual control circuit transformers with fuse less/fused primary and secondary protection, pressure sensors, temperature switches with reset buttons, and an electronic controller to automatically change the operating sequence of the compressors. The system should have a status display to show the system pressure, elapsed time, maintenance interval, fault conditions, and silence button, lighted Hand-Off-Automatic selector switches and safety disconnect operating handles.
	All required local alarm functions should be integrated into the packaged system. The circuitry should be designed so that the audible signal can be silenced and the visual indicator will remain until the fault has been cleared and the reset button resets. Local alarm functions should be annunciated for reserve pump in use
4.4	Bacterial Filters
	The filters should be designed for removal of solid, liquid and bacterial contamination from the suction side of vacuum pump systems, preventing damage to the pump and the potential biological infection of the surrounding environment. The dryer should be particulate filter dryer with ability to remove particles as small as 1micron.
	Each individual filter shall have the capacity to deliver full design flow such that one set is designated duty and the other will be standby. Bacteria filters shall have efficiency at least 99.999% when tested by the sodium flame method in accordance with BS 3928:1969/as per required standard utilising particles in the 0.02 to 2 micron size range. The pressure drop across each clean filter at 50% of the system design flow should not exceed 25 mm Hg (3 kPa) at a vacuum of 475mm of Hg (63 kPa). Bacteria filters shall be marked with the legend 'Bio-Hazard'.
	Each bacteria filter shall be provided with a transparent sterilizable collection jar to collect condensate. The total water capacity of the pressure vessels shall be at least 100% of the design flow rate of the plant in 1 minute in terms of free air aspired.
4.5	Accessories
	Accessories included for job site installation are inlet and discharge flexible connectors, vibration mounting pads, and source isolation valve, inlet check valve, thermal malfunction switch and vacuum control switch. Flexible connectors on inlet and exhaust of each pump, exhaust tee with union as well as copper tubing with Shutoff-cock for gauge/bypass valve and vacuum switch etc.
	All the filters should be covered under warranty period and CMC Period.
5	Ward Vacuum Units
	It must consists of the following:-
1	1no of Suction Regulator and 1no of 1000 ml polysulfone /polycarbonate collection jar.
2	Suction regulator should be supplied with a safety jar, including and antibacterial filter and an anti-overflow safety device. Should have wide membrane continuous suction controller

3	Should have vacuum levels: 0-750 mm Hg or more
4	Should have vacuum gauge fitted with a protective bumper device.
5	Should have on/off knob allowing for the quick restoration of a readjusted vacuum level.
6	Must have central adjustment knob with a color coded for 0 to 750 mm Hg or more. Should have Polysulfone/ polycarbonate 100cc safety jar, autoclavable at 121° C at 5mins, unbreakable, fitted with an anti-overflow safety device and equipped with antibacterial filter. It should be totally transparent, to ensure perfect sucked liquid visibility.
6	Theatre Vacuum unit for OT
	It must consist of the following: -
1	Suction Regulator and 2nos. 1500ml or more polysulfone/ polycarbonate collection jar and both to be mounted on a trolley.
2	Suction regulator should be supplied with a safety jar, including an anti-bacterial filter and an anti-overflow safety device. Should have wide membrane continuous suction controller
3	Should have vacuum levels : 0-750 mm of Hg or more
4	Should have vacuum gauge fitted with a protective bumper device.
5	Should have on/off knob allowing for the quick restoration of a readjusted vacuum level.
6	Must have central adjustment knob with a color coded for 0-750 mm Hg or more. Should have polysulfone/ polycarbonate safety jar, autoclavable at 121° C, unbreakable, fitted with an anti-overflow safety device and equipped with antibacterial filter.
7	Collection jar should be totally transparent, to ensure perfect sucked liquid visibility.
7	AGSS (Anesthetic Gas Scavenging System) Plant -
	Anesthetic Gas Scavenging System (AGSS) shall fully comply with the requirements of HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 and the bidder must provide applicable quality certificates.
	The package should consist of blower type/rotary vane/claw type vacuum pumps (Dry/Oil free only), a control panel, and mounted on a common base frame.
	AGSS pump: AGSS pump shall operate completely dry . Each pump should be completely air cooled and have absolutely no water requirements. The suitable wiring from OTs to AGSS plant for remote control/suitable reservoir (as applicable) is the responsibility of the bidder.
	System in-line non-return valves should allow individual pump servicing. Active anesthetic gas scavenging systems should be designed to safely remove exhaled anesthetic agents from the operating environment and dispose of them to atmosphere from the highest point of the hospital building, thus preventing contamination of the operating department and providing a safe and healthy workspace for the personal. AGSS design should be dependent upon flow rate and pressure drop characteristics of the individual components of systems. It is essential that terminal units, remote controls (If required) and pump units work in synchronized manner after connection of workstation to the AGSS System.

	Installation should be on roof top/suitable location. Piping, Non-Return-Valves (NRVs), and inlet nozzle should be suitably placed. Connecting hose suitable to fit with anesthesia workstation should be provided.
8	DISTRIBUTION PIPING
8.1	Piping specifications
	Copper pipe should be as per standard BS: EN 13348:2008/ ASTM B819 standards, Solid drawn, seamless, deoxidized, non-arsenical, half hard (hard can be accepted only for sizes 54mm or more), tempered and degreased copper pipe conforming to the standard. All copper pipes should be degreased & delivered capped at both ends. The pipes should be accompanied with manufacturers test certificate for the physical properties & chemical composition.
	Copper pipe must have reputed third party inspection certificate (Eg. Lloyd's or TUV or SGS).
	Fittings should be made of copper and suitable for a working Pressure of up to 17bar and especially made for brazed socket type connections. All valves shall be pneumatically tested for twice the working pressure and factory degreased for medical gas service.
	Copper fittings should comply with EN 1254:1 factory degreased and brazing filler metals should comply with EN 1044. Fitting should be degreased, individually packed for medical use.
	The minimum thickness of copper pipes of 35mm and above outer diameter, should be 1.2mm and the thickness of copper pipes less than 28mm outer diameter, should be 1mm as mentioned in respective Institute's BOQ.
8.2	Installation & testing
	Installation of piping shall be carried out with utmost cleanliness. Only pipes, fittings and valves that have been degreased and fittings shall be used at site. Pipe fixing clamps shall be of nonferrous or non-deteriorating plastic suitable for the diameter of the pipe.
	Inert gas welding technique should be used by passing oxygen Free Nitrogen Gas inside the copper pipes during silver brazing, in order to avoid carbon deposition inside the copper pipes. Only copper-to-copper joints are permitted on site except threaded or flanged joints may be made where pipelines are connected to items such as valves and control equipment. No flux shall be used for joining Copper to Copper joints and on for joints made on site. Copper to copper joints shall be brazed using a 5% silver-copper phosphorous brazing alloy CP104. A total of 5 joints shall be cut out for examination to establish the quality of the joints being made on site. The insides shall be clean and free from oxides and particulate matter and the minimum penetration of the brazing alloy at any point shall be three times the wall thickness of the tube. If the joints examined do not conform to these requirements, then adjacent joints shall be cut out and examined until the extent of faulty workmanship has been made good. Copper-to-brass or gunmetal joints shall only be made under controlled conditions off site. The joints are ordinarily used to join short copper pipe tails to brass, gunmetal or bronze fittings to permit their connection into the pipeline. The sub-assemblies shall be degreased and individually sealed in bags or boxes before delivery to site.

	Adequate supports should be provided while laying pipelines to ensure that the pipes do not sag. Suitable sleeves shall be provided wherever pipes cross through walls / slabs. All pipe clamps shall be non-reactive to copper.
	After erection, the pipes are to be flushed with dry nitrogen gas and then pressure tested with dry nitrogen at a pressure equal to twice the working pressure or 150 psig, whichever is higher for a period of not less than 24 hours.
	Length and quantity of individual items (Copper pipes, AVSUs, Alarm panels, Isolation valves, Outlets, pendants etc.) are mentioned. However quantity will be calculated and paid at actuals. Bidder should quote unit price for all the items as detailed
	Maximum interval between supports (Horizontal and Vertical)
	(12mm Pipe - 1.5m, 15mm pipe - 1.5m, 22mm pipe – 2m, 28mm pipe-2m, 35mm pipe- 2.5m, 42mm pipe -2.5m, 54mm pipe - 2.5m, 76mm pipe – 3meter)
8.3	Painting
	All the pipes from manifold/plant upto the outlets should be painted with two coats of synthetic enamel paint and colour codification should be as per standards followed and with consultation with competent authorities of the Institute.
9	GAS OUTLETS
	Terminal Units (Gas Outlets) with probes/Adaptors for O ₂ , N ₂ O, Compressed Air 4, Air 7, AGSS, Vacuum
	The Medical gas outlets shall conform to HTM 02-01/ NFPA 99 C/EN/DIN/ ISO 7396-1. Front Loading Type Terminal Outlets should be designed to dispense medical gases (or an inlet for medical vacuum) to the secondary equipment (flow meters, Suction regulators, etc.) at the point of use and is gas specific so that secondary devices cannot be “attached” to the wrong gas. When not in use the gas in a non-flowing state within the Outlet (Terminal unit) sealed by “O” ring. The adapter when inserted pushes the poppet inside and the gas starts flowing and sealing is ensured by the “O” ring or a seat. The Outlets are Quick Connect Type and gas specificity is accomplished by "Pin indexing." The outlets should have following features:
	• Push to insert and press-to-release mechanism for probes.
	• Allows plugging of probes from front.
	• Self-sealing valve on disengaging the probe (Quick disconnect)
	• Smooth quite action.
	• Non return valve for on line servicing/ repairing
	• Indexed to eliminate inter-changeability of gas services
	• Color-coded gas specific front plate
	• Totally leak proof, safe & easy to operate
	• Configurations possible: surface, flush & Bead-head.
	• Outlets shall fully comply with the requirements of the HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 and the bidder must provide applicable quality certificates.
	•All outlets should have respective labels (i.e.O ₂ / N ₂ O / CO ₂ / Air ₄ / Air ₇ /Vacuum/AGSS/etc.) displayed accordingly.

10	AREA VALVE SERVICE UNIT
	Area valve service units should fully comply and meet with HTM 02-01/NFPA 99C/EN/DIN/ISO7396-1. It should provide a zone isolation facility for use either in an emergency or for maintenance purpose The Area Valve Service Unit should incorporate a ball valve in a lockable box with emergency access. It should be reliable and easy to operate, easy purge, sample & pressure testing and emergency supply system.
	Medical gas/vacuum services should be fixed copper, piped to and from their respective area valve service units. A color coded service identity label should be fitted behind the valve handle. The unit should provide a zone isolation facility. Gas Flow direction should be indicated.
	The box shall be made from extruded aluminium to prevent corrosion. All wetted parts (except seals and gaskets) should be brass or copper. Each unit assembly should be factory tested for gas tightness. Rubber pipe grommets should be provided to ensure any leaking gas does not escape from the unit into a wall cavity. All visible aluminum surfaces should be powder coated.
11	ALARM SYSTEM
11.1	Master Alarm (Digital)
	Shall fully comply with the requirements of the HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 and the bidder must provide applicable quality certificates.
	Complies with HTM 02-01 / NFPA 99C/EN/DIN/ ISO 7396-1 Standards.
	Each Master Alarm should be modular in design and be fitted with required number of master alarm modules. The master alarms should be capable to monitor minimum 40 Point.
	Each point represents an alarm condition that the source equipment might have. When an alarm condition exists, a red light flashes and the audible alarm sounds. If several alarm conditions occur simultaneously, the most recent alarm light should flash, while the other alarm lights should remain lit. When an alarm condition is created, an audible alarm should be actuated. A dry contact module should be available to interface with a building management system.
	The box material should be of gauge steel of requisite thickness and equipped with mounting brackets. The emissions from alarms should conform with applicable standards.
	Master alarm management system should be designed to display alarm conditions from the source supply units indicating the broad status of the source equipment and manifolds as well as the master distribution status from the source supplies. Depending on the alarm priority, a visual and audible alarm should be initiated to indicate an alarm condition.
	Each panel shall display and/or input up to forty point alarms. Panel should be ready to use with BMS system.
	The master alarm must be able to monitor the following source alarm conditions.
	· Oxygen Source Empty/Fault
	· Oxygen Cylinder Bank Empty/Fault
	· Oxygen Emergency Bank Empty/Fault

	· Air Compressor Faulty/Operation
	· Vacuum Pump Faulty/Operational
	· Vacuum Deficiency Vacuum Reservoir
	· And Other MGPS Signals & Alarms
	Bidder shall be responsible for all cabling from local alarm panels to master alarm panel .
	Master alarm should be integrated with BMS/HIS
11.2	Medical Gas Area Alarm
	The medical gas central alarms should be capable of monitoring up to 5 medical gas services (As specified in BOQ of respective institute) by means of pressure sensors which detect deviations from the normal operating limits of either pressure or medical vacuum. The area alarm should have a digital display of pressures. The medical gas area alarm should fully satisfy the HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 requirements and shall fully comply with the requirements of the HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 and the bidder must provide applicable quality certificates.
	An audible warning should sound simultaneously with any failure indication and a mute facility should be provided. "
	Note: The bidder may offer combined unit of AVSU & alarm, bidder has to match the quantity of AVSU/Alarm whichever is higher
12	Line Isolation Valves
	The Lockable line valves must degreased and complete valve with stuffed pipe & fittings, factory tested and complies with HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1 standard.
13	Supply of O2 Cylinders – Class D Type
	Should be as per BIS/IS/ASME Standard
14	Supply of N2O Cylinders – Class D Type
	Should be as per BIS/IS/ASME Standard
15	Horizontal/ Vertical Bed Head Panel
	It shall confirm to HTM 02-01/ NFPA 99 C/EN/DIN/ISO 7396-1. The design should be approved by the respective institute before installation and it is responsibility of the bidder after getting order they have to discuss with respective institute and finalized the Bed Head Panel (Vertical/Horizontal) as per site condition.
	It should have following features:-
	Efficient, Safe & Robust design in extruded aluminium section.
	Smooth curved surfaces, and choice of base colour and fascia plates.
	Unit should have integrated rail system to mount accessories
	The headwall system should be constructed of aluminium extrusions joined together to form a carcass to suit the particular application. Unit should be factory assembled for electrical and mechanical components.

	Segregation of services i.e. Low voltage supplies, High Voltage supply and Medical gases should be maintained with 2 tier/2 channel arrangements.
	Front fascia plate should be removable individually to access for respective service.
	It should have one rail for mounting Accessories.
	Each bed-head unit shall be supplied with electrical and electrical outlets pre-fitted, wired and certified. (Wired up to the distribution box provided with leakage protection & proper earthing arrangements)
	Note: Gas Outlets quantities are already taken in consideration of quantities of respective outlets in BOQ
	Should have per unit as under :
	Oxygen – 2
	Vacuum – 2
	Medical Air-1
	Holder for vacuum collection jar –1
	Nurse call switch – 1 (not in the scope of MGPS Vendor only space for same has to provide)
	Infusion pump mount pole with adapter for mounting at least two infusion pumps
	5 /15A combined Electrical outlets – 8 Nos. or more
	RJ-45 socket/ Ethernet -01
	Two spare spaces
	Monitor Bracket
16	High pressure tubes for O2, N2O, Compressed Air,& Vacuum
	It should be colour coded for individual services i.e. white for Oxygen, Blue for N2O and Yellow for Vacuum, Black for air. Antistatic rubber tube should be as per ISO standards. It should have applicable certification. (The 200m Hose- Gas wise requirement should be taken from respective institute before supply total lengths should be 200m inclusive of all type. If institute requires more than payment will be made on actual basis as per finalized BOQ rate)
17	Electrical Wiring with Electrical Panels –
	All wiring inside the Manifold Room and Plant room required for MGPS equipment and General electrification. Institute will provide one point supply only. Other are under the scope of bidder. All the work should be as per BIS standard and material used should be reputed make only.
18	Site Modification –
	i. Bidder should be responsible for antistatic ironite/cota/any heavy duty flooring in the manifold room and thickness of flooring not less than 1 inch.
	iii. Bidder should be responsible for all necessary arrangements for the installation of Medical Air plant, Vacuum Plant & AGSS Plant.

19	Manufacturer Authorization
	The bidder should submit a mandatory letter of authority from the manufacturer, with name of the manufacturing company for major products quoted by them such as:
1	Oxygen Supply System
2	Nitrous oxide system
3	Medical Air plant (package unit) including electrical control panel
4	Medical Vacuum Plant (Package unit)
5	Duplex AGSS System
6	Gas outlet points/ Terminal units with probe
7	Medical gas alarm panel
8	Copper Pipes

(End of Volume IV)