MINISTRY OF HEALTH & FAMILY WELFARE, GOVT. OF INDIA, NEW DELHI

TENDER

FOR

Construction of Housing Complex including external development & services for AIIMS (Under PMSSY) at Raebareli (U.P.)

VOLUME – IV

Technical Specifications

JUNE' 2013

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Tender No. HSCC/AIIMS/ Raebareli /Housing/2013

Technical Specifications

For

CIVIL WORKS

TECHNICAL SPECIFICATIONS

CIVIL WORKS

1.0 GENERAL:-

1.01 The specifications and mode of measurements for Civil and Plumbing works shall be in accordance with C.P.W.D.specifications 2009 Volumes I and II with up to date correction slips unless otherwise specified in the nomenclature of individual item or in the specifications. The entire work shall be carried out as per the C.P.W.D. specifications in force with up to date correction slips upto the date of opening of tender.

1.02 For the item not covered under CPWD Specifications mentioned above, the work shall be executed as per latest relevant standards/codes published by B.I.S. (formerly ISI) inclusive of all amendments issued thereto or revision thereof, if any, upto the date of opening of tenders.

1.03 In case of B.I.S. (formerly I.S.I) codes/specifications are not available, the decision of the Engineer based on acceptable sound engineering practice and local usage shall be final and binding on the contractor.

1.04 However, in the event of any discrepancy in the description of any item as given in the schedule of quantities or specifications appended with the tender and the specifications relating to the relevant item as per CPWD specifications mentioned above, or in drawings the former shall prevail.

1.05 In general the building floor to floor height is 4.00 mtr unless specified otherwise in the drawing. However, the rates for different items of work shall be for up to 4.5 m floor to floor height at all levels, lifts, leads and depths of the building except where otherwise specified explicitly in the item of work or in special conditions appended with the tender. All works above the top most terraces (main) shall be paid under the level existing below (i.e. machine room, mumty etc)

1.06 The work shall be carried out in accordance with the architectural, structural, plumbing and electrical drawings etc. The drawings shall have to be properly co-related before executing the work. In case of any difference noticed between the drawings, final decision, in writing of the Engineer shall be obtained by the contractor. For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the Engineer and nothing extra shall be payable on this account.

1.07 All materials to be used on works shall bear I.S. certification mark unless specifically permitted otherwise in writing. In case I.S. marked materials are not available (not produced), the materials used shall conform to I.S. Code or CPWD specifications, as applicable in this contract.

In such cases the Engineer shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified as "First Quality" by the

manufacturers shall be used unless otherwise specified. All materials shall be tested as per provisions of the Mandatory Tests in CPWD specifications and the relevant IS specifications. The Engineer may relax the condition regarding testing if the quantity of materials required for the work is small. Proper proof of procurement of materials from authentic manufacturers shall be provided by the contractor to the satisfaction of Engineer. Grade of cement used shall be OPC 43 Grade unless otherwise specified explicitly. The contractor shall get the Design Mix for RCC done by the labs approved by OWNER only. Reinforcement Steel used shall be of TMT Fe-500 unless otherwise specified.

1.08 In respect of the work of the sub-agencies deployed for doing work of electrification, air-conditioning, external services, other building work, horticulture work, etc. for this project and any other agencies simultaneously executing other works, the contractor shall afford necessary coordination and facilities for the same. The contractor shall leave such necessary holes, openings, etc. for laying / burrying in the work pipes, cables, conduits, clamps, boxes and hooks for fan clamps, etc. as may be required for the electric, sanitary air-conditioning, fire fighting, PA system, telephone system, C.C.T.V. system, etc. and nothing extra over the agreement rates shall be paid for the same.

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

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

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

1.12 The contractor shall clear the site thoroughly of all scaffolding materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer before the work is considered as complete.

1.13 Rates for plastering work (excluding washed grit finish on external wall surfaces) shall include for making grooves, bands etc. wherever required and nothing extra shall be paid for the same.

1.14 The rates quoted for all brick/concrete work shall be deemed to include making openings and making good these with the same specifications as shown in drawings and/or as directed. No extra payment shall be made to the contractor on this account.

1.15 Rates for all concrete/plaster work shall include for making drip course moulding, grooves etc. wherever required and nothing extra shall be paid for the same.

1.16 Rates for flooring work shall include for laying the flooring in strips/as per sample or as shown in drawings wherever required and nothing extra shall be paid for the same.

1.17 The drawing(s) attached with the tender documents are for the purpose of tender only, giving the tenderer a general idea of the nature and the extent of works to be executed. The rates quoted by the tenderer shall be deemed to be for the execution of works taking into account the "Design Aspect" of the items and in accordance with the "Construction Drawings" to be supplied to the Contractor during execution of the works.

1.18 The quoted rate shall be for finished items and shall be complete in all respects including the cost of all materials, labour, tools & plants, machinery etc., all taxes, duties, levies, octroi, royalty charges, statutory levies etc. applicable from time to time and any other item required but not mentioned here involved in the operations described above. The client/OWNER/Employer shall not be supplying any material, labour, plant etc. unless explicitly mentioned so.

1.19 On account of security consideration, there could be some restrictions on the working hours, movement of vehicles for transportation of materials and location of labour camp. The contractor shall be bound to follow all such restrictions and adjust the programme for execution of work accordingly.

1.20 The contractor has to ensure co-ordination with Institute authorities to maintain the smooth functioning / operation of existing Institute without disruption during the execution of work. This may require working rescheduling the normal working hours, working in restricted period etc. Nothing extra shall be payable on this account.

He shall also ensure that all work sites within the Institute complex are properly cordoned off by means of barricades and screens upto a height of 3.0 m above ground level. The contractor shall use painted CGI sheets which are in good condition mounted on steel props.

1.21 Stacking of materials and excavated earth including its disposal shall be done as per the directions of the Engineer-in-Charge. Double handling of materials or excavated earth if required shall have to be done by the contractor at his own cost.

10.00 Mix Design, Batching Plant/ Ready mix Conctrete

10.1 Following parameters shall be adopted for mix design in moderate exposure.

1.	Nominal Maximum size of aggregate	2Omm angular as Per CPWD pecification
2.	Degree Of quality control	Good
3.	Type of Exposure	Moderate
4.	Maximum water cement/ratio	0.50
5.	Type of cement to be used	OPC 43 grade conforming to IS: 8112
6.	Sand	Coarse Sand as per CPWD specification
7	Use Of Fly Ash in RMC	Strictly not permitted.

10.2 **BATCHING PLANT:** Batching Plant of suitable capacity to be installed within a period of 30 days from award of work. The contractor shall install batching plants (with in 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.

i) It shall be fully computerized.
ii) Facility to pump concrete upto the highest point of the building.
iii) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
iv) 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 Engineer in Charge

10.3 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.

10.4 The concrete mix design with and without admixture will be carried out by the contractor through one of the following Laboratories / Test house to be approved by Engineer.

i) lIT,
ii) Shri Ram Institute of Industrial Research, Delhi
iii) Any other Govt Laboratory as approved by Engineer.

10.5. In the event of all the above laboratories being unable to carry out the requisite design /testing, the contractor shall have to get the same done from any other reputed laboratory with prior approval of the Engineer.

10.6. 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 be taken from the approved materials which are proposed to be used in the work.

10.7. The rate for the item of Ready Mixed Concrete shall be inclusive of all the ingredients including admixtures if required, labour, machine T&P etc (except shuttering which will be measured & paid for separately) required for design mix concrete of required strength and workability.

The rate quoted by the agency shall be net & nothing extra shall be payable in account of change in quantities of concrete ingredients like cement and aggregates and admixtures etc. in the approved mix design.

10.8. 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.

i) It shall be fully computerised.
II) It should have supplied RMC for Govt. projects of similar magnitude.
iii) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.

10.9. The contractor shall, within 10 days of award of the work submit list of at least three RMC plant companies from the approved makes along with details of such plants Including details of transit mixer, pumps etc. to be deployed indicating name of owner/company, its location, capacity , technical establishment, past experience and text of MOU proposed to be entered between purchaser (the contractor) and supplier (RMC Plant) to the Engineer who shall give approval in writing (Subject to drawl of MOU).

10.10. The Engineer reserves the right to exercise over the:-

i) 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.

ii) Calibration check of the RMC.

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

iv) Time of mixing of concrete.

v) 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

10.11. 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.

10.12. 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.

10.13. 43 grade OPC (Conforming to IS-8112) of brand/make/source approved by Engineer shall only be used for production of concrete.

10.14. 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:-

i) 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.

ii) 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,

iii) 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.

iv) 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.

v) TRANSFER AND WEIGHING EOUIPMENT RMC

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

The accuracy of measuring equipment shall be within +2% of quantity of cement +/- 3% of quantity of aggregate, admixture and water being measured.

vi) 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.

vii) PRODUCTION OF CONCRETE
The following precautions shall be taken during the production of RMC at the plant

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

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

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

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

v) Sampling of concrete, testing monitoring of results.

vi) Diagnosis and correction of faults identified from observations /complaints.

The RMC plant produced concrete shall be accepted by Engineer at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

10.15. 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.

10.16 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.

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

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

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

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

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

10.18 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.

14.0 HORTICULTURE WORKS:

14.1 GRASSING

14.1.1 PREPARATION

During period prior to planting the ground shall be maintained free from weeds.

Grading and final nevenne of the lawn shall be completed at least three weeks prior to the actual sowing. Clods of excavated earth shall then be broken upto the size not more than 75mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from this operation shall be removed and disposed of in a manner directed by Engineer. Regular watering shall be continued until sowing by dividing the lawn area into portion or approx 5 mts. Square by constructing small bunds to retain water. These ‘bunds’ shall be nevenn just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that he soil has completely settled.

Slight nevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the final levels by adding suitable quantities of good earth brought from outside, if necessary as directed by the Engineer. In fine dressing, the soil at the surface and for 40mm depth below shall be broken down to particles of size not exceeding 6mm in any direction.

14.1.2 SOIL :

The soil itself shall be ensured to satisfaction of Engineer to be a good, fibrous loam, rich in humus.

14.1.3 SOWING THE GRASS ROOTS :

Grass roots (Cynodon dectylon or a local approved by the Engineer) shall be obtained from a grass patch, seen and approved before hand.

The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.

Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

14.1.4 EXECUTION :

Small roots shall be debbled about 15 cms (or at other spacings as per BOQ item)apart into the prepared grounds. Dead grass and weeds shall not be planted.

Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.

All planting is to be done in moderately dry to moist (not wet) soil and at times when wind does not exceed a velocity of 8 kilometer per hours.

14.1.5 MAINTENANCE OF LAWN

As soon as the grass is approximately an inch high it shall be rolled with a light wooder, roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of announce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine. It should be possible to use the inch above the normal level of the first two or three cuttings. That is to day the grass should be cut so that it is from 1 to 2 inches in length, instead of the ½ to ¾ of an inch necessary for mature grass.

In absence of rain the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.

Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the contractor.

Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the contractor's expense.

The contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

14.1.6 ROLING :

A light roller shall be used periodically, taking care that the lawn is not too wet and sodden. Rolling should not be resorted to, to correct the levels in case certain depressions are formed due to watering

14.1.7 EDGING :

The contractor shall establish a neat edge where planting areas meet grass areas with spade or edging tool immediately after all planting, including lawn planting, is completed. Particular care shall be exercised in edging to establish good flowing curves as shown on the plans or as directed by the Engineer. Edging must be cut regularly and shall be maintained by the contractor.

14.1.8 FERTILIZING :

The lawn shall be fed once a month with liquid manure prepared by dissolving 45 grams of ammonia sulphate in 5 litres of water.

14.1.9 WATERING:

Water shall be applied daily during dry weather. Watering whenever done should be thorough and should wet the soil at least upto a depth of 20 cms to eliminate air pockets and settle the soil. To reduce the landscape/horticulture water requirement sprinkler type garden hydrant shall be installed as per drawings/BOQ item. The treated STP/ETP water may be used for horticulture wherever it is feasible.

14.1.10 WEEDING:

Prior to regular mowing the contractor shall carefully remove rank and unsightly weeds.

MAINTENANCE

The landscape contractor shall maintain all planted area within the landscape 1contract boundaries until the period of one year after the complete plantation. Maintenance shall include replacement of dead plants. Watering, weeding, cultivating, control of insects, fungicide and other disease by means of spraying with an approved insecticide or fungicide, pruning and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape sub-contract area neat in appearance.

PRUNING & REPAIRS

Upon completion of planting work on the landscape sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the results of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of the trees. In general, one third to one fourth branching structure of the plants to be removed to compensate the loss of roots during transplantation by thinning or shortening branches but no leaders shall be cut. All pruning shall be done with sharp tools in accordance with instructions of the consultant. Pruning cuts shall be painted with recommended paints.

TREE GUARDS :

Where tree guards are necessary, care should be taken to ensure that they do not impede movement or restrict growth.

NURSERY STOCK :

Planting should be carried out as soon possible after reaching site. Where planting must, of necessity, be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be healed in as soon as received or otherwise protected from dying out, and others set closely together and protected from the wind. If planting should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly abeled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

PROTECTIVE FENCING :

According to local environment shrubs may have to be protected adequately from vandalism until established.

COMPLETION :

On completion the ground should be formed over and left tidy.

RATE:

The rates quoted for the horticulture items listed in BOQ shall provide for the cost involved in all the operations described above.

15.00 Signages and associated works

General

1. The sign board shall be in both English and Hindi language
2. Suitable pictogram to be provided as per approved samples
3. The colour of signages to be as per discretion of Engineer.
4. All signages details including sizes of sheet, letters, pictogram and border allround to be submitted and got approved priorly from HSCC.
5. The quoted rate shall be for all heights and floor levels.
6. The scope of work include providing and fixing base frame with removable/ interchangeable signages. Which will be paid in respective items

PVC sheet / sun board

1. Sheet to be best available brand of minimum thickness 3mm.
2. Top vinyl film to be best available brands of LG, Samsung or equivalent.
3. The thickness of film without adhesive to be around 75 microns and with adhesive to be 100 microns.
4. The fixing to be done with screws / hanging chains/pipes/rods of approved make & material as per discretion of Engineer.
5. The rates to be quoted per square inch inclusive of pictogram & fixing up to any floor and height, wall fixing or hanging on ceiling.

MS

1. The make of material to be as approved by engineer.
2. The thickness of GI sheet to be at least 18 G.

3. The shop drawings of supporting structural frame and its foundation for signages to be submitted for approval by HSCC.
4. The welding joints to be rubbed and grinded to give a smooth finish. No undulations shall be visible.
5. The MS frame and sheets to be primered and painted with approved make material.
6. The rates shall be inclusive of above and fixing with cement concrete 1: 1.5 : 3 as per approved design.
7. The rate for structural frame to be quoted separately per kilograms and signage sheet in square meters.

Stainless steel

1. The thickness of sheet to be minimum 16 G for plate sign board and 18/20 G for SS letters.
2. The same to be fixed with SS screws.
3. The engraving of letters to be as per standard norms and colours.
4. The individual alphabets/ letters, wherever required to have an inbuilt arrangement for fixing to support base with stainless steel screws complete for all heights and levels. All corners to be smoothly finished & SS welding.
5. The sheet/letters may be shining or mat finish as approved by engineer.

Aluminum

The thickness of sheet to be minimum 3mm.

1. Fixing to be done with SS or appropriate screws to avoid bimetallic action with aluminum.
2. The rates to be quoted per square meter.
3. The hanging aluminum hollow section to be of 100mm and 150mm width & make to be got approved. The powder coating of approved colour to be done and letters of approved specs and design to be pasted on such hanging aluminium hollow sections.
4. The hanging will be done by adjustable MS/GI rods of approved diameter and painting thereafter

SAMPLES OF ALL MATERIALS, LETTERS MATTERS AND DESIGNS TO BE GOT APPROVED by ARCHITECT/ CLIENT BEFORE EXECUTION OF WORK.

16.00 PLUMBING & SANITARY INSTALLATIONS

16.01 Special condition for PHE work: The plumbing work shall be carried out by specialized plumbing agency who has licensed plumber and experience of similar works. For supervising the plumbing work at least one engineer who has rich experience in executing plumbing work shall be engaged full time. Approval of specialized agency shall be obtained from HSCC.

16.02 The provision of adequate sanitary and safety facilities as per the norms of NBC and good engineering practice shall be compliance during construction for construction workers and staff.

16.03 The water use for construction shall be suitable for the same and should be used efficiently and checks and control valves shall be provided to avoid the wastage and leakage.

16.04 To reduce the water consumption of the building, the flushing system of water closet shall be of dual flushing cistern type and plumbing fixture shall be provided which require GRIHA compliance for low flow rate.

16.05 Lab service related to plumbing & fire fighting will be executed by specialized agency who has experience of carrying out similar work earlier. All the lab item shall be detailed out & redesign as per requirement of client , WHO, CDC norms, items given in BOQ are indicative but covered the cost as per the latest requirement of client , WHO, CDC and required approval of client before execution.

16.06 **Wall Caps**

Wall caps shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pass through them. These wall caps shall be chromium plated brass snugly fittings and shall be large enough to cover the puncture properly and shall conform to IS: 4291.

16.07 Pipes, Hangers, Brackets, etc.

Sturdy hangers, brackets and caddles of approved design shall be installed to support all pipe lengths, which are not embedded over their entire runs. The hangers and brackets shall be of adjustable heights and painted with red oxide primer, and two coats of enamel paint of approved make and shade. Clamps, coils and saddles shall be provided to hold pipes with suitable gaskets of approved quality. The brackets and hangers shall be designed to carry the weights of pipes safely. Wherever required pipes may run along ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:

	Vertical	Horizontal
G.I. Pipes	300 cms	240 cms
H.C.I. Pipes	180 cms	120 cms

16.08 Pipe sleeve

Adequate number of sleeves (pipe inserts) of Cast Iron or Mild Steel shall be provided where pipes cross through concrete, masonry and similar work. The pipe inserts shall be provided with removable timber plugs to keep foreign matter out till installation of the services pipe cross the sleeve. The diameter of sleeve should be one size higher than the proposed dia or as instructed by the Engineer.

16.09 Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, contractor shall have a special type G.I. / M.S. inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and hopper inlet socket shall be lead caulked/welded/threaded. Hopper shall connected to a C.I. P or S trap with at least 50mm water seal. Floor trap inlet hoppers and traps shall be set in cement concrete 1:2:4 blocks without any extra cost.

16.10 C.P. gratings

Floor trap and urinal trap shall be provided with 110mm square or round C.P. /stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 3 mm.

16.11 Hot Water Supply

The chase will be closed in cement mortar 1:2 (1 cement : 2 coarse sand). Pipes shall be clamped to the wall inside the chase.

16.12 Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manholes for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

16.13 Water Heater

Water heater shall be automatic pressure type water heater (with pressure release valve) with heavy gauge copper container duly tinned, thermostats, indicator lamp and glass wool insulator. the water heaters shall be fitted with pressure release valve, non-return valve and inlet and outlet stop valves as required. Water heaters to conform to IS:2082, in case the solar hot water has also provided in the building the supply of same shall be connected to inlet of water heater.

16.14 FULLWAY BALL VALVE

The valves shall be of full-bore type and of quality approved by the Engineer. The body and ball shall be of copper alloy and stem seat shall be of Teflon.

16.15 CPVC PIPES: cPVC pipes shall be used in the internal water supply if specified in the Bill of Quantities. These may required to be connected to the existing/ new GI pipes. The pipe and fitting approved make solvent shall be used as per approved manufacture specification.

16.16 SAMPLE AND SHOP DRAWINGS;

All plumbing items shall be provided as per approved sample/data sheet approved by the HSCC. Before placing the order, the contractor shall submit the shop drawings prepared based on tender drawings and BOQ alongwith samples for approval of HSCC. The shop drawings shall have all the details. The contractor has to obtain the approval of external plumbing drawings from DJB/MCD before start of work.

16.17 SS pipe: The SS pipe shall be provided in lab. And specific water supply as per drawings and BOQ. The jointing shall be press type fittings with S-C contour in accordance with DVGW regulation W-524 with fittings for payment only centre to centre total length of composite pipe and fitting shall be measured. A press joint is made by mechanical deformation of the tube and fitting means of special hydraulic tool and cutting of pipe shall also be carried by later cutting tools by authorized agency. An elastomer o-ring is inserted in the recess at the end of the fitting for sealing. When the joint is made, the cross section of the tube becomes hexagonal. A calibration tool is used to ensure that the joint made is up to standard, Clearances from wall, floor and ceiling should be allowed for making the joint refer to the manual of the press tool for clearance requirements.

17.0 BORE WELLS

17.01 Scope of Work

The general character and the scope of work to be carried out under this contract are illustrated in the following specifications. It gives only general guidance as regards design, drilling and construction of tubewells. Before selecting the method of construction to be

adopted ,the contractor shall give due consideration to site condition and Geological data of the site. The construction and testing of tubewells shall be as per IS 2800- 1979 (Part 1 and 2). This contract is an item rate contract. All payments shall be made for the actual work executed. The Contractor shall ensure the required minimum yield. The work shall be carried out as per BOQ item. The details which are not available in BOQ, the details of technical specification are to be adopted.

17.02 Selection of Site

The site where the tubewell is proposed, shall be examined by tenderer, and changes if required shall be discussed with the engineer prior to start of work. Any previous data available with the Contractor regarding nearby tubewells should be made use of to evolve suitable procedure for drilling , developing, testing etc.

17.03 Geological Data

During the drilling operation, contractor shall collect the samples of different strata from suitable intervals or where change in strata is met with. It shall be carefully examined and analysed and the data shall be preserved carefully and handed over to Engineer. The contractor shall make one drilling time log during the execution of work for the bore well.

17.04 Design and lowering of pipe assembly

The length and diameter of the housing pipe shall be selected on the basis of static water level, the drawdown and the discharge expected from the well and the size of the pump to be installed. The size and length of blind pipes and the slotted/ strainer pipes shall be selected according to the expected discharge and the depth of tubewell. The size and distribution of the slots shall be as per IS 8110. After completion of the bore hole the contractor shall assemble the tube well assembly according to the water bearing strata met during boring, after getting the same approved from the Engineer and shall lower in to the drilled hole the same keeping the slotted strainer opposite to water bearing strata from which the water is to be extracted . The bail plug shall rest on firm ground. Before the bail plug is lowered, about one metre depth of the bore hole shall be packed with the gravel to avoid sinking of the assembly. In case part of a bore hole is not proposed to be utilized, it shall be filled with gravel before lowering the assembly. The slotted pipe and other pipes shall be provided with proper guides to keep them in the centre of the bore to ensure uniform gravel packing all around.

17.05 Gravel Packing

All gravel shall consist of hard rounded particles reasonably uniform in diameter and shall be of size, determined after analyzing the character of the water bearing formation tapped. The gravel shroud around the screen shall be uniform. It should be free from dust, dirt and other vegetable matters. Gravel packing once started shall be carried out continuously until it is completed. Pea gravel/Stone Chips shall be thoroughly washed.

17.06 Development of Borewell

The well shall be developed either by surging and agitating or by over pumping and back washing with an air lift and high velocity jetting. The tube well shall be developed as per IS 2800 -1979 or latest by air compressor to be arranged by the contractor as required and stipulated in BOQ to obtain the maximum discharge available from the completed tubewell. Another acceptable method may also be adopted. This development process shall be continued until the stabilisation of sand and gravel particles has taken place. The development shall continue until the gravel should stop sinking, discharge of depression ceases to improve and the sand content is not more than 20parts per million. A record of the hours of working of Air compressor shall be maintained by Employer Engineer which will be signed by the contractor or his authorised representative. Payment for development of tubewell shall be made at the hourly rate indicated in the schedule of quantities for the actual period during which the Air-Condition has worked. A statement showing the quantity of gravel initially filled in the bore and the quantity added during development should be prepared by the contractor and got signed by the representative of the Engineer.

17.07 Disinfection

The well shall be disinfected after completion of test for yield. All the exterior parts of the pump coming in contact with the water shall be thoroughly cleaned and dusted with powdered chlorine compound. In fact it shall be disinfected every time a new pump is installed or the one installed is replaced after repairs.

The stock solution of chlorine may be prepared by dissolving fresh chlorinated lime. For obtaining an applied standard concentration of 50 ppm, 1 litre of the stock solution shall be used to treat 300 litres of water.

17.08 Grouting and sealing

Grouting and sealing of tubewell may be done, if required depending upon the site conditions and the quality of the discharge of the strata encountered. To ensure that the grout shall be provided a satisfactory seal, it shall be applied in one continuous operation. Sealing of the tube well may be done by grouting the annular space between bore and the housing pipe, with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 : coarse aggregate 20 mm nominal size) to a depth of 5m below the grouted level.

17.09 Handing over of the borewell.

The tubewell shall be handed over in complete shape. The housing pipe shall be closed by a well cap for the period between the completion of the tube well and the installation of the pump set.

The following information shall be furnished by the drilling agency on completion of the tubewell :

a) Strata chart of the tube well indicating the different types of soils met with, at different depths.
b) Samples of strata collected , neatly packed and correctly marked in sample bags.
c) Chart of actual pipe assembly lowered indicating the size of pipes, depth ranges, where slotted/ strainer pipes have been used, depth and diameter of housing pipe, reduced level of the top of the housing pipe and the diameter and depth of the bore hole.

d) Position of every joint in the well assembly.
e) Hours of development done by the compressed air, pump sets or by other means.
f) Pumping water level at the developed discharge.
g) Two copies of test certificates of the water samples results from approved testing agency.
h) Results of development along with levels of static subsoil water and depth of draw for steady discharge.
i) Results of mechanical (sieve) analysis of samples of aquifer materials wherever applicable.
j) Yield analysis and recommendation on the safe pumping yield, pump settings and specifications for suitable pumps etc.
k) Verticality tests results to be recorded in accordance with IS:2800-1979

17.10 TUBEWELL DATA/As per BOQ

1. Yield required 500 lpm (Sand free delivery from borewell)

2. Bore - 450 mm dia.

3. Approximate depth – 100 metre

4. Assembly - Blind/ Slotted Pipes – 200 mm dia. Upto complete depth.

5. Material – MS Class "C" pipes (Heavy Class)/UPVC pipe as per IS: 12818

6. Verticality – True verticality as per IS – 2800- 1979

7. Packing – Pea Gravel/Stone Chips

8. Developing – Minimum 72 Hrs or till sand free discharge is obtained.

9. Water for drilling – Contractor shall make his own arrangement for water required for drilling purposes as well for development purposes.

10. The design for the tube well indicating the depth range of the aquifer zones to be tapped shall be given after a detailed study of the data collected during drilling operations.

11. All the casings shall be of ERW steel/UPVC- IS 12818(As per BOQ) quality confirming to IS specifications and carry manufacturer's certificate. The pipes shall have a wall thickness of not less than 7 mm or as per IS 1239. The slotted pipes must have an effective open area of atleast 15% and the slotted size should be 1.6 mm. All pipes shall be painted fresh before lowering. The pipes shall be welded thoroughly all round to prevent leakage and breakage. Centering guides may be used to maintain the verticality of the tube wells which shall be tested in accordance with the norms stipulated in IS 2800.

12. The annular space between the bore well and tube well assembly shall be packed with well-graded pea gravel of good quality, durability and high sphericity.

17.11 Guarantee

On award of the work contractor shall submit a guarantee covering the quality and performance of all material supplied and installed under the contract. This guarantee shall cover each and every material whether manufactured by the contractor or not.

17.12 Rate

The rate quoted for Borewell items shall provide for the cost involved in all the above described operations.

18.00 WATER TREATMENT & PUMPS

1.0 SCOPE OF WORK

Work under this section consists of furnishing all labour, materials, equipment's and appliances necessary and required to supply, install and commission pumping and water filtration as described hereinafter and given in the schedule of quantities and/or shown in the drawings. Tentative raw water characteristics are given in Appendix-1

2.0 GENERAL REQUIREMENTS

2.1 All materials shall be new and of the best quality conforming to specifications and subject to the approval of Engineer.

2.2 All equipment shall be of best available make manufactured by reputed firms.

2.3 All equipment shall be installed on suitable foundations, true to level and in a neat work-man-like manner.

2.4 Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.

2.5 Piping within the pump houses shall be so done as to prevent any obstruction in the movement within the pump house.

2.6 Each pumping set shall be provided with a valve and a flap type non-return valve on the delivery side.

2.7 The contractor shall submit the following documents :

a.Process and hydraulic design calculations for all units.

b. Civil, Structural arrangement , design calculations if included in the scope of work.

c. Plant layout drawings

d. Process flow sheet

e.Design Philosophy

f. All technical brochures,

g.Operation and maintenance manuals and other details of the system offered.

h.Equipments listing & list of consumables.

2.8 The contractor shall supply shop drawings with supporting details for approval from Engineer before procurement of material. The contractor shall also obtain approval from local statutory authority / authorities as applicable at no extra cost.

Four sets of shop drawings shall be submitted for approval showing:

a) Any change in layout from the contract drawings.

b) Equipment layout, piping, wiring diagram and instrumentation.

c) Manufacturer's or contractor's fabrication drawings for any material or equipment.

2.9 COMPLETION 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. Route of all cables and pipes run along with detail sizes and mode of installation.

2.10 The contractor shall also include the cost of supply and execution any other item required for the effective functioning of system but not mentioned in schedule of quantities/ specifications.

2.11 The contractor shall also arrange for the appropriate training for the clients staff.

2.12 PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the Engineer, the Contractor shall furnish a written guarantee indemnifying the Owner 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 Owner.

a. Any defective material or equipment supplied by the Contractor.

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

2.13 A tentative treatment scheme is shown in the drawings.

3.0 WATER SUPPLY PUMPS

3.1 Water supply pumps shall be centrifugal types as given in the schedule of quantities.

3.2 Water supply pumps shall be suitable for clean filtered water, pump shall be single stage pumps with cast iron body and gunmetal/bronze/SS impeller and directly coupled motor suitable for 400X440 volts, 3 phase, 50 cycles A.C. power supply and mounted on single base frame.

4.0 WATER FILTER (MULTI-GRADE)

Water filters shall be sand/gravel and anthracite pressure filters downward or upward flow type suitable for a rate of filtration given in schedule of quantities.

Filters shall be vertical types of a required diameter, the shell shall be fabricated from M.S. plates suitable to withstand a working pressure given in schedule of quantities. The thickness of shell and of dished ends shall be as per IS: 2825. The filter shall have two-pressure tight manhole cover one at the top and other at side shell portion. Each filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary and required. Filters shall be rubber lined with 3mm thick non-toxic, non-leaching rubber. Rubber lining to be tested with Spark Tester for pinholes etc. Primary painting of all exposed surfaces to be done.

5.0 UNDER DRAIN SYSTEM

Each filter shall be provided with an efficient under drain system comprising of collection pipes, polypropylene nozzles of manufacturer's design. The entire under draining system shall be provided on M.S. Plate or cement concrete supports provided by the contractor.

6.0 FACE PIPING

Each filter shall be provided with interconnection face piping comprising of inlet, outlet and backwash complete with diaphragm valves/ball valves. Piping shall be fabricated from mild steel pipes as per IS: 1239.

7.0 ACCESSORIES

Each filter shall be provided with the following accessories:

a) Air release valve with connecting piping.

b) 100mm dia Borden type gunmetal pressure gauges with gunmetal isolation cock and siphon on inlet and outlet.

c) Sampling cocks on raw water inlet and filtered water outlet.

d) Individual drain connection with ball valves for each filter.

e) Connections with valve for air scouring.

f) Rate of Flow Indicators in the raw water inlet line.

g) Quantity meter in the filter water outlet line

8.0 FILTER MEDIA

8.1 Each filter shall be provided with clean and washed filter media, following is recommended.

Coarse Silex Pebbles	6.0 - 10.0mm size	(150mm deep)
Fine Silex Sand	1.4 - 2.5mm size	(600mm deep)
Anthracite	0.80 - 1.6mm dia	(600mm)

8.2 The above filter media arrangement may be altered to suit contractor's own design for the most efficient performance and also keeping the low height available for the installation of these Vessels.

9.0 TEST KITS

9.1 Provide one test kit with initial requirement of reagents for the following:

Residual Chlorine Indicator

Valve

9.2 Details of equipment with literature shall be supplied with the tender.

10.0 VALVES

10.1 Valves 50mm dia and above shall be of cast iron butterfly valves.

10.2 Non-return valves 80mm dia and above shall be cast iron double flanged conforming to IS: 5312, 65mm and below shall be of gunmetal.

10.3 Valves 50mm dia and below shall be cast iron ball valves with stainless steel SS-304, stem and ball (S.S.304 or brass with hard chrome plating) with Teflon seat.

10.4 Suction strainer shall be of cast iron with S.S. Perforated sheet.

11.0 PAINTING AND CLEAN UP

a) On completion of the installation Contract shall be scrub clean all pumps, piping, filters and equipment and apply one coat of primer.

b) Apply two or more coats of synthetic enamel paint of approved make and shade.

c) Provide painted identification legend and direction arrows on all equipment's and piping as directed by Engineer.

d) All M.S. fabricated items M.S. pipe lines structural, vessels for water treatment plant shall be painted with zinc/chromate primer after through cleaning. On completion of the installation Contractor shall scrub clean all pumps, piping, filters and equipment and again apply one coat of zinc chromate primer.

e) On final completion of the work, contractor shall clean up the site and the pump room, pump room of all surplus material, rubbish and leave the place in a broom clean condition.

12.0 MOTOR CONTROL CENTERS

12.1 Switchboard cubicles of approved type shall be fabricated from 2mm thick CRC sheet with dust and vermin proof construction. It shall be painted with powder coating of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following (Switchgear as given in the schedule of quantities):

a) Incoming MPCB of required capacity

b) Isolation MPCB/MCCB, one for each motor

c) Fully automatic DOL/Star Delta starters suitable for motor DOL upto 7.5 H.P.; Star/Delta for 10 H.P. and above H.P. with push buttons one for each motor and On/Off indicating neon lamps.

d) Single phasing preventor of appropriate rating for each motor

e) Rotary duty selector switch

f) Panel type ampere meters one for each motor shall be with rotary selector switch to read line currents.

g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase

h) Neon phase indicating lamps and indicating lamp for each motor and on incoming mains.

i) Rotary switch for manual or auto operation for each pump

j) Fully taped separate aluminium bus bar of required capacity for normal and emergency supply where specified.

k) Space for liquid level controllers and other equipment specified separately in the contract/given in the schedule of quantities

l) The panel shall be pre-wired with colour coded wiring. All interconnecting wiring from incoming main to switchgear, meters and accessories within the switchboard panel. Wiring shall have suitable copper or aluminium ferrules.

12.2 Switchboard cubicle shall be floor or wall mounted type as directed by the Engineer.

13.0 WATER SOFTENING PLANT

Mild steel pressure vessel complete with dished ends, supporting legs and facing pad for pipe connection, internally rubber lined and externally two coats of red oxide primer and two coats of synthetic enamel paint complete with manhole, cover, frontal pipe work fitted with valves provided with inlet, outlet pressure gauges and sample valves and with frontal pipe work complete with manually. Ball Diaphragm for normal operation and regeneration and hydraulically operated erector, initial charge of resin and internals consisting of distributor, collector and regeneration tank to store and measure chemicals for regeneration.

13.1 Hardness Test Kit

Details of test kit with literature shall be supplied by the contractor at appropriate stage.

14.0 REVERSE OSMOSIS (R.O.) PLANT FOR PROCESS AND DRINKING WATER

14.1 On the basis of sample water analysis, the Contractor shall design, supply, erect, test and commission the pre-assembled RO system. The system shall consist of but not be limited to the following:

a) PP wound Micron Catridge Filters in food grade material in combination of 5 & 10 micron rating or alternatively spring type cross filter with manual/auto backwashing system and shall be provided with necessary isolation valves, inlet & outlet pressure gauges etc. Micron filters shall be with differential pressure measurement system and cleaning frequency should not be more than once in a month.

b) Anti-scalent and pH correction system as per feed water quality along with process demanding instrumentation and piping etc.

c) RO module fitted with thin film composite TFC polymide spiral wound element type membrane of adequate area/size & no. encased in SS housing and all necessary accessories/controls to perform the desired duty. Cleaning frequency shall not be more than once in a month.

d) High pressure pump for feeding RO system with necessary instruments like high & low pressure switch, pressure gauges and isolation valves etc.

e) On line panel mounted pH control and conductivity indicators.

f) Suitable NRV at the outlet of Permeate.

g) Electric control panel for the system operation consisting of HP Pump starter with overload protection, manual-auto-off operational selector switch, pre-wired instrumentation panel.

h) Decarbonator unit consisting have packed column of food grade FRP, degasser blower, degassed water tank etc. complete with frontal piping.

i) MS skid frame mounted cleaning in place system for easy movement with polyethylene tank and accessories.

j) In-built flushing system for flushing the deposition of concentrate in the membrane during non-operating period of plant.

k) Electronic type Rotameter for permeate and rejection along with companion flanges.

l) Dosing system having trip interlocks with HP feed pump to RO membrane to get ripped if the HP pump trips.

m) Interconnecting piping & strainers etc.

n) Low/High pressure cutouts

o) Back pressure regulator.

p) Pressure gauges of suitable rang in 4” dial with SS contact parts.

q) Flow meters & control valves

r) Level Indicator/Controller in the R.O. Water Storage Tank for automatic shut off/starting of the plant.

s) Safety relief valves.

t) Instrument & Electrical panel with starter and overload protection.

u) TRFC type motor suitable for 415v, 3 phase, 50 Hz AC supply.

v) Minimum percentage recovery of the system shall be mentioned (and guaranteed by the Bidder).

w) The membrane element shall be suitable for handling 6.5 to 8 pH feed quality and the required service to provide permeate quality of less than 100 ppm TDS. The system shall be provided with stand by cartridge filter arrangement and all parts in direct contact with water in the RO system shall be in SS316 material. The Contractor shall also specify necessary procedure for membrane cleaning along with dosages of chemicals.

14.2 Power & control wiring for the feed pumps & R.O. output water transfer Pump will be as per Electrical drawings approved for the system.

14.3 Solenoid Valve will be provided at the outlet of RO Module.

14.4 Piping shall be as per system requirement.

14.5 Complete Scheme, Equipment Layout, P&I Diagram & Electric circuit diagrams shall be got approved from the owner or its authorized representative before execution of work.

14.6 Water storage tanks for storage of R.O. treated water:

To be constructed from FDA approved food grade polyethylene, completely drinking water with built in UV stabilizer, screw able or lockable lid. Inner layer should preferably in white colour.

14.7 Following items will also be under Contractor's Scope of Work:

a) RO Water Storage Tank.

b) All inter-connecting Pipes within the system battery limits

c) Power & signal cabling & control system with in battery limits

14.8 Hydro Test shall be offered at pressure 1.5 times the operating pressure or 5 kg/sq.cm, whichever is higher for all equipment during shop inspection.

14.9 Warranty: Membranes will be warranted for a period of 36 months.

15.0 Automation for Water Treatment & Water Supply System

Raw water from Tube Wells would be received in the underground Fire Tank (T1) from there it overflows to the underground Raw Water Tank (T2).

There is no consumption of water from (T1) except in case of fire or during trail runs of the Fire Pumps and the above overflowing arrangement is provided to prevent stagnation of Water in Tank (T1).

The Tube Well Pump would be automatically switched on off by Level Controller provided in Tank (T2.) The same Level Controller would give audio/visual alarm in case of reaching very high (HH) or very low (LL) level. (Chlorination to kill bacterial/virus is done in the Filtered Water with a Chlorine Dosing Pump in the line going to OH Tanks.)

Raw Water from Tank (T2) is pumped by Pumps P6 A/B to the Filter Water Tank, after passing though Filter. Raw Water from Tank (T2) is also pumped by Pumps P7 A/B to the Over Head Fire Water Tank (T5) from there it overflows to the Over Head Flushing Water Tank (T6 & T5). Filtered water pump P6 A/B would be automatically controlled by the Level controller provided in tank (T5) and Raw Water Lift Pump P7 A/B would be automatically controlled by the Level controller provided in tank (T6 & T5). These Level Controllers as in earlier cases would also give audio visual/alarm in case of very high or very low level.

Filter Water from Tank (T3) is pumped by Pumps P8 A/B to the Soft Water Tank, after passing though Softener. Filter Water from Tank (T3) is also pumped by Pumps P9 A/B to the Over Domestic Water Tanks (T7 & T12). Filtered water pump P8 A/B would be automatically controlled by the Level controller provided in tank (T4) and Filter Water Lift Pump P9 A/B would be automatically controlled by the Level controller provided in tank (T7 & T12). These Level Controllers as in earlier cases would also give audio visual/alarm in case of very high or very low level.

Soft Water from Tank (T4)s pumped by Pumps P10 A/B to the Over Head Soft Water Tank. Soft Water pump P10 A/B would be automatically controlled by the Level controller provided in tank (T8) These Level Controllers as in earlier cases would also give audio visual/alarm in case of very high or very low level.

Domestic Water from Over Head Domestic Water Tank (T7) shall be go into the R.O. Plant placed on the terrace of super specialty block and from there the RO water would be distributed for bother super specialty block and service block

R.O. Water Plant would be automatically controlled by the Level controller provided in tank (T9) Similarly, R.O. Water Plant on Library Block would be automatically controlled by the Level controller provided in tank (T13) This Level Controller as in earlier cases would also give audio visual/alarm in case of very high or very low level.

Electric Control Panel containing DOL starters for all the pumps described above would be supplied by the Owner. The Automation System Vendor has to provide interface with the contractors of these Pump Motor Starters. There would be enough empty space in the bottom tier of this Electric Control Panel. However, Automation System Vendor has to provide full details of such relays controllers indication lights/ alarms etc. to the Owner for incorporating there in the Electric Control Panel.

16.0 TREATED WATER QUALITY

The out put from Softener shall conform to commercial hardness. Similarly the resultant TDS from RO system shall be less than 100 PPM. Other output parameters from the system shall with in the Desirable limits specified in IS :10500 standards.

APPENDIX - I

Tentative Raw Water Characteristics :

S.NO	PARAMETER	VALUE
1.	Hardness	800 mg/l
2.	Colour	Less than 5
3.	Odour	Unobjectionable
4.	Turbidity	4 NTU
5.	PH	6.5 to 8.5

6.	Total iron	0.1 mg/l
7.	Chlorides	250 mg/l
8.	Total Dissolved solids	1200 mg/l
9.	Coliform organisms at 37o C (MPN)	221 per 100 ml
10.	E-Coli	79/100 ml

Note : The parameters and characteristics of raw water given are tentative only. The contractor shall on his own collect and assess the nature of water available at the site and has to design the system according to that.

19.0 HYDROPNEUMATIC SYSTEM

1. SCOPE

This section of the contract involves the design, supply, installation, testing and commissioning of the complete Hydropneumatic pumping system and other pumping systems complete with all controls and electrical work for domestic water supply. All submersible, drainage pumps for the project are also included in this contract. It also involves testing and commissioning of the pumping system with the domestic water and flushing water supply & distribution.

This specification described the particulars of the contract, designs and systems chosen, and mode of operation.

All installation work shall comply with the latest rules and regulations.

The work embraced by this specifications covers the design, submission to authorities, supply, delivery on site, installation, testing, commissioning and maintenance of the Hydropneumatic pumping system, other pumping system installation of the building in accordance with this specification and associated drawings.

The scope of work shall include the following (list is indicative and not exhaustive) :

- Variable speed pumping units domestic water supply & distribution.
- Suitably sized food grade quality, non-toxic diaphragm type pressure vessels complete with necessary interconnections and controls.
- Control panel for pump control complete with variable speed drives, circuit breakers, fusses, pressure transmitters etc. complete with all interconnections to pumps and electrical supply panels.
- Pump control units complete with pre-programmed micro-processorchip.
- Pump monitoring units to monitor operation of pumps.
- Each Hydropneumatic Pumping unit shall be supplied as a complete set including variable speed pumps, pressure vessels suction and discharge common manifolds, non-return valves, isolating valves, pressure transmitters on the discharge side and level electrode at the suction tank. Each unit shall be provided with electronic microprocessors for unit control and all necessary electrical work for the unit.
- Submersible drainage pumps for plant room drainage complete with electrical panels and necessary accessories with automation for pump operation.

- The Hydropneumatic system supplier shall provide the pumping units in the designated pump rooms as complete units included all necessary piping within plant such that only discharge connections are required to be connected into the unit's discharge manifolds just inside the plant room, by the Plumbing tenderer. The Hydropneumatic system tenderer shall guarantee specified pump performance at various pump speeds and Hydropneumatic pumps must be able to supply at least 2 bar pressure at the highest/farthest fitting.

- Electrical equipment and installation work including the PLC in Control panel.

- Painting and labelling of pipework and equipment;

- Provision of all hold down bolts, spigots struts and the like required to be built in during construction;

- Provision of all level switches, flow switches and other sensing devices for status indication.

- All interfacing work with other trades.

- Testing and commissioning and balancing of the Hydropneumatic & Pumping system;

- Provisions of operating instructions and maintenance manuals;

- Provision of spare parts;

- Training of the employer's staff for proper operation of the entire systems;

- Liaison with Local Authorities to obtain all necessary certificates and approvals, including the completion of all submission drawings, forms and payment of any fees and charges. All the costs for all the tests required by Local Authorities shall be included. To attend to any Authorities inspection regardless of whether this inspection is carried out after the defect liability period;

- Provisions of the necessary installation which include pumping works, pipework within the pumping unit up to suction and discharge manifolds, conduit and control wiring, etc. to form a workable system required;

- All other works and systems as specified in the Contract document and or shown on the drawings.

- All cutting, patching, framing up, furring in, chasing and making good associated with the building construction for the passage of pipes, conduits and the like including providing GI pipes sleeves of required size corresponding to pipe dia, wherever pipes crossing fire rated walls and floors and sealing with glass wool in between and fire sealent compound on either end. Details on shop drawings shall also be provided.

2 GENERAL

Equipment offered for supply and installation shall include the following:

All minor items and incidental work, equipment accessories and materials may not be specifically mentioned but are required for the proper completion of the installations in accordance with the true intent and meaning of this Specification.

Readily accessible, dust-proof lubricating facilities on all moving parts and equipment including provision for cleaning all lubricating lines and bearings and charging same with the correct lubricants after installation but prior to testing and commissioning.

Clearly visible and robust manufacturer's name-plates permanently fitted each and every item of equipment and showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw, etc.

The Tenderer also shall allow provision for the inspection of all plant and equipment by the manufacturer or his licensed representative, at least twice during the course of the installation.

3. PIPING

The pipes and fittings in the domestic Water Treatment plant room shall be GI class `C' (heavy class) conforming to IS: 1239 (Part-I) for pipes and IS:1879 (Part 1 to 10) for malleable cast iron galvanized fittings or specified in the BOQ.

20.0 PUMPS FOR HYDROPNEUMATIC & DRAINAGE SYSTEM

20.1 PUMPS

Pumps shall be vertical, centrifugal, multistage directly coupled to motor. Provision of pump with pump head & base of cast iron and other parts in SS 304 shall be made for pumps required in Hydropneumatic System. Impeller shall be hydraulically balanced and keyed to shaft. Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on a vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer’s instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall be complete with flexible connections, valves, and pressure gauges. The pumps shall include cost of foundation channel complete.

The Tenderer shall supply and install pumps of the type and performance as shown on the drawings. All duties of pumps given in the Tender Drawings shall be checked and where necessary corrected before ordering. All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be of stainless steel construction.

Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. The pump casing so selected shall have ample space to take an impeller one size larger than that capable of performing the design duty.

Pumps of 2900 rpm with high efficiency and low noise motor can be selected and noise data submitted for approval. All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.

Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.

Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable.

Pump curves for all pumps offered shall be submitted. All curve indicating excessive shut-off head will not be approved.

Each pump shall be provided with a gate valve at suction and discharge, approved check valve at discharge, approved strainer at suction, flexible connections at pump suction and discharge, eccentric reducer at suction, concentric reducer at discharge, pressure gauges at suction and discharge, circulation relief valve and automatic air relief valve.

Appropriate neoprene vibration isolation mountings shall be provided for each pump sets.

Vertical Pumps

Multi-stage pumps shall be of centrifugal type and arranged with shafts vertically installed. The impellers shall be of stainless steel mechanically balanced and keyed to shaft. Renewable guide rings are to be provided in the casting, keyed to prevent rotation.

Pumps shall be driven by elevated in-line TEFC squirrel cage motors via extended vertical shafted complete with universal couplings.

The shafts shall be stainless steel. Stainless steel sleeves shall be provided to protect the shaft in the water space and through the sealing glands. The sleeves shall be keyed to prevent rotation and secured against axial movement.

The bearings shall be of ball or roller type protected against ingress of water, dirt and other matter.

Vertical multistage pumps shall have universal flanges. Intermediate bearing, support bearing shall be provided in the pump.

The shaft seal shall be easily serviceable and shall allow for correct adjustment and loading of the seal.. Pump motors above 7.5 kW shall be equipped with a spacer coupling which allows changing of shaft seals without removing the motor. The pump motors shall be of Class "F" insulation and IP55 rating and shall be provided with built-in thermistors for protection against over heating.

20.2 VARIABLE SPEED HYDROPNEUMATIC PUMPING SYSTEM

Variable speed Hydropneumatic pumping units shall be provided for supply of domestic water, flushing water supply for the project. The units shall be selected so as to provide at minimum of 2 bar pressure at the highest/farthest fitting in each plumbing system, the unit serves. The hdyropnematic pumping units shall have the following features ;

20.2.1 System Description

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

The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. Should the water demand continue the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive. However, should the system pressure be still below the preset value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

At peak demand all the pumps operate, Similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cuts-off, followed by stopping of the duty pump.

The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/standards.

The system shall be under the control of an electronic microprocessor unit (EMU).

A pressure transmitter shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.

The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transmitter shall register the actual pressure on the discharge side.

The variable speed drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Speed Drive (VSD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VSD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

Under decreasing hydraulic demand the reverse sequence to the above description shall apply.

The EMU shall ensure alternation of all the duty and standby pumps for even running hours for all the pumps.

The frequency converter shall be linked to the motor of the duty pump for continuous speed adjustment and ultimately the water delivery shall be maintained at constant pressure at the preset value.

20.2.2 Local Motor Control Panel

The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions :

- Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system pre-set delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges.

- Built-in frictional loss compensation factor which will automatically increase the delivery pressure setting, in collaboration with the increase in flow demand. This shall be able to minimise the system pressure differences and provide a more constant pressure along the supply line and also to save the energy consumption of the motor when running at low speed.

- Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps to run at variable speed.

- Built-in clock functions with weekly programming and with switch on system to operate at at least 10 different pre-set pressure points as required.

- When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s). In event of control failure, the pumps shall be able to be start/stopped manually at the local panel by means of pressure switches.

- The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.

- The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps form running dry.

- Automatically starting the pumps when the water level is back to normal.

- In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.

- Functions to limit the no. of start/stop of pumps per hour.

- The system control panel shall incorporate at least the following components :

a. LCD Display

b. Pumps selections for up to 4 pumps so that system controller can control up to 6 pumps

c. Pump status button to display duty pump speed and system capacity

d. Zone status button to display operating parameters for different pumping units

e. Setting button to input preset pressure, system start/stop time etc.

f. ±1 button to key in numeric data such as pressure set point, etc.

g. Enter button for confirmation of input into the system

h. Alarm button to show location of fault - self diagnostic function display

i. Hour Run measurement for each supplied pumpset

j. Buttons for scrolling to select the actual display reading for system configuration, i.e. up and down scroll concept.

k. Necessary devices for programming, supervising and monitoring operation data/system, status shall be incorporating into the control panel.

20.2.3 Operations

Local control panel shall perform as follows :

Auto mode

The desired delivery pressure within the range specified, shall be set at the duty local control panel. The pressure transmitter shall detect the delivery pressure continuously within 1 second and feedback to the microprocessor which will control the variable speed drive frequency converter for speed control of the duty pump. When demand increases, the subsequent pumps in the system will be activated to boost up the pressure. Ultimately the duty pumpset shall be operated fully automatically to maintain the delivery pressure constantly at the desired set value.

Manual Mode

The on/off function of the pumps shall be manually adjusted at the microprocessor located at the local control panel.

Frequency Control By-pass Mode

All the pumpsets shall be started/stopped automatically with the pump output at fixed maximum rotational speed. All the control and protection functions shall remain active. The cut in/cut out pressure shall be internally calculated by the microprocessor for each pump.

20.2.4 System Features

The required performance features of each Hydropneumatic pumping unit shall be as follows :

System Configuration

Variable speed pumps with pressure vessels.

Control panel consisting of the following components :

- Pump Functional Unit (PFU) - control unit c/w pre-programmed microprocessor chip. This unit shall control all pumping unit operations through electronic controller.
- Pumping Monitoring Unit (PMU) - monitor the operation of the pumpsets. This unit shall allow for monitoring and setting of all control parameter.
- Variable Speed Drive
- Circuit Breakers
- Fusses
- Pressure Transmitter

Set Point

Ten separate pressure “set points” shall be able to be programmed into the PMU, and switching between set points is timed by a real time clock when a lower pressure is acceptable during certain periods, for instance after hours or weekends, the set point shall be lowered to minimise power consumption.

An external input shall also be used to switch between set points, or manually adjust a set point at any time.

Friction Loss Compensation

It shall be possible to allow for the friction loss component of the system, calculated at full flow and set as a percentage of the set point which will reduce the working pressure of the pump set depending on the actual no. of pumps in operation. A linear approximation of system resistance curve can therefore be allowed for, and pressure will automatically increase as system flow and subsequent frictional losses increase. As such power consumption shall reduce which is required for the pumping system.

Displays

Through the PMU keypad all variable parameters shall be adjustable, current status of settings and measured values shall be able to display on the 2 line x 24 character liquid crystal display.

Individual menus shall be available for monitoring individual pumps, zones, settings, alarms and ON/OFF functions.

Pump Status

Running hours of each pump

Actual pump status (running, not available, standby, allocated to zone, fault)
Maximum head of pump at zero flow.

Zone Status

This menu shall be the main operating menu where at the setting and operating parameters can be viewed,

Current operating set point
Measured values in the system
Operating capacity in terms of total output
Mode of operation for the zone
Clock programs (relating to set point pressures)
Standby pumps
Pump change over time
Zone configuration
Pressure transducer scaling
Friction loss compensation
Pump priority
Inlet pressure measuring (if required)
System response times
Allowable number of starts per hour for the pumps
Minimum limit (loss of water, burst mains protection)

Setting Menu (Set)

In this menu all parameters for the operation of the pump set shall be able to be adjusted as required.

a Set points (up to 10)
b. On/Off function (used to prevent unnecessary cycling at low demands)
c. Displayed pressure units (Bar, PSI, mBar, kPa)
d. Real time clock programming for any time of the day, week, or weekend
e. Zone configuration
f. Friction loss compensation

Alarm

The alarm menu shall display all faults that occur during operation, logging the time and date of when the fault occurred and when it was corrected, or whether it is still an actual fault, up to 10 faults can be maintained as history in the controller. The following type of faults shall be diagnosed by the controller.

a. Mains failure
b. Frequency converter fault
c. Analogue input (pressure transducer) fault
d. High discharge pressure fault
e. Low discharge pressure fault
f. Motor thermal overload fault

Variable Frequency Drive

Variable frequency drive shall be of a reputable make acceptable to Project Manager and shall be complete with RFI filter and harmonic dampers.

Enclosure

An IP 54 powder coated steel enclosure shall house all the electrical components.

The enclosure can be supplied loose for remote mounting, or mounted on a common base with the pumps, it shall be adequately ventilated for use in conditions up to a maximum ambient temperature of 45 degrees Celsius.

Electrical Componentry

All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the architect. Electrical supply to the pump controller shall be protected using an isolating circuit breaker.

Method of Starting

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/Delta, or using Soft Starters.

Quality and Testing

Manufacture of the pumps, plus design and assembly of the complete packaged Hydropneumatic pumping system shall be factory assembled and the pump station shall be fully tested hydraulically and electrically prior to dispatch to site. Test reports etc. shall be submitted for review before dispatch.

20.2.5 Pump Pressure Vessel

Diaphragm type pressure vessels shall be provided as shown on the drawings. They shall be incorporated into the system so that during normal operation the pump shall not need to be start within 30 seconds of it switching off in order to prevent the pump hunting.

The pressure vessel shall be of adequate capacity to accommodate a considerable fluctuation in water demand by the system with minimum start/ stop cycles of the pumps. The vessel shall be constructed of steel plate built to ASME Standards for Unfired Pressure Vessel. A rubber diaphragm shall be provided in the vessel for separating the water and pre-charge nitrogen. The pre-charge pressure shall be adjustable and charging port with non-return device shall be provided. The adjustable cut-in and cut-off pressure unit for the pumps shall be built-in at the vessel to suit the system.

20.3 FLOATLESS TYPE LEVEL SWITCH IN WATER TANKS

The Tenderer shall supply and install floatless type switch probes in the water tanks as indicated below and shown on the drawings.

Raw Water Tanks at Pump Room
- High level alarm (over-flow);
- Low level alarm;
- Low level cut-out for raw water pumps;
- Earthing probe.

Cooling Tower Make-up
- High level alarm (over-flow);
- Low level alarm;
- Low level cut-out for supply pumps;
- Earthing probe.

Potable Water Tank
- High level alarm (over-flow);
  Low level alarm;
  Low water level cut-out for the domestic hydropneumatic pumps;
- Earthing probe.

Each probe shall be of the correct length for the particular application and tank location. Electrodes shall be of polished stainless steel 20 mm OD. Electrode holders shall be weatherproof in all respect.

The earthing probes shall be connected and wired to the building earth systems of the building.

Each set of electrodes shall be installed inside a 230 mm diameter PVC pipe acting as a wave barrier.

The level switch set shall operate with a stepped down voltage at 24V maximum. Stepped down transformers shall be provided for each set of control probes and shall be installed inside centralised control cubicles inside pump room.

Mechanical steel stuffing boxes shall be used.

Control of Duty / Standby Pumps

Operation of the duty and standby pumps shall be carried out by the following method:

a Automatically by means of pressure sensor (i.e. pressure switches);

b Manually by means of a local start/stop push buttons on pump local motor control panel and emergency stop switch.

The pressure switch shall be installed next to the manual release valve. When the pressure drops to the pre-determined level, a signal will be sent to the pump local motor control panel to start the pump.

Automatic controls shall be operated by electronic, floatless type level switches.

Pump Indicator

The following audible and visible indication shall be provided at the pump local control panels as applicable:

a Red "overflow level" indicator with buzzer for the associated water tanks;

b Amber "extra high water level" indicator for the associated water tank;

c Amber "high water level" indicator;

d Amber "low water level" indicator;

e Red "pump trip" indicator for each pump;

f Green "pump on" indicator for each pump;

g "Pump electrical supply healthy" indicator for each pump;

h Amber "remote/local" status indicator.

21.00 FIRE FIGHTING SYSTEM

21.01 GENERAL

1.1 Work under this contract shall be executed as shown on the drawings and given in the specifications and required at site whether explicitly shown or not.

1.2 Not-with standing the sub-division of the documents into separate sections and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and in to the contract so far as it may be practicable to do so.

1.3 Where it is mentioned in the specifications that the contractor shall perform certain work or provide certain facilities, it is understood that the contractor shall do so without any extra cost to the Employer/HSCC.

1.4 The material, design and workmanship shall satisfy the local fire regulations. The job specifications contained herein and codes referred to where the job specifications stipulate in addition to these contained in the standard codes and specifications, these additional requirements shall also be satisfied.

1.5 Portable fire extinguisher shall be provided in the building as per BOQ which should not contain halogen to minimize the use of ozone depleting substance as per GRIHA.

2.0 SCOPE OF WORK

2.1 Work under this contract consist of furnishing labour, materials, equipment and appliances necessary and required to completely do all works relating to the fire protection system as described here-in-after and shown and the drawings, consisting of:

i) Supply, installation, testing and commissioning of:

Fire hydrant system including fire pumps and ancillary equipment's described later in the Volume.

Fire sprinkler system, as described later in the volume.

Portable Fire Extinguishers

ii) Preparation of plans and getting pre-installation approval by the Local Fire Authority.

Getting tested by and approval of the installation by the Local Fire Authority during the fabrication/construction stage as well as after completion. . 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 owner. Fee payable to the local bodies for such activities shall be borne by the Owner on production of receipts for money paid and the all other expenses barring the fee will be borne by the Contractor.

iv) Supply of necessary spare parts during the commissioning stage.

v) Supply of any other item or services not specifically mentioned anywhere but required by the Local Fire Authority or essential for the completion & operation.

3.0 INTERPRETATION

3.1 In interpretation of specifications, the following order of decreasing importance shall be followed:

a. Statutory Rules & Regulation

b. Schedule of quantities

c. Additional specifications

d. List of approved make of materials

e. General rules and conditions

3.2 Matters not covered by the specifications given in this contract, as a whole shall be covered by relevant and latest CPWD specifications / Indian Standard Codes. If such codes on a particular subject have not been framed, the decision of the engineer shall be final and binding.

4.0 SPECIFICATIONS

4.1 Work shall be carried out strictly in accordance with the specifications attached to the tender.

4.2 Works not covered in the specifications shall be carried out as per relevant latest CPWD specifications/ Indian standard Code of practice specifications of materials.

5.0 EXECUTION OF WORK

5.1 The work shall be carried out in conformity with the contract drawings and within the requirements of architectural, HVAC, plumbing, electrical, structural and other specialized services drawings.

6.0 TENDER DRAWINGS

6.1 For guidance of the bidder, drawings as listed 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 shop drawings based on the working drawings issued to him, 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.

6.2 The Contractor shall examine all specifications, tender conditions and drawings before tendering for the work.

6.3 Information, levels and dimensions given in the tender drawings are supposed to be correct but the contractor shall make independent inquiries and verify the same. No claims for extras shall be admissible in case of any deviations for incorrectness of the information, levels or dimensions.

6.4 The contractor shall obtain all information relating to the local regulations, bylaws, and application of any and all laws relating to him work or profession. No additional claims shall be admissible on this account.

7.0 SHOP DRAWINGS

7.1 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 & Fire fighting 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-ordinated with all disciplines of work.

7.2 Contractor shall verify all dimensions at site and bring the notice of the HSCC any or all discrepancy or deviations notices. The decision of the HSCC in the regard shall be final.

7.3 Large size details and manufacturer’s dimensions for materials to be incorporated shall take precedence over small-scale drawings.

7.4 All drawings issued by the consultants for the work are the property of the Consultants and shall not be lent, reproduced or used on any other works than intended, without the written permission of the Consultants.

7.5 Working drawings shall be approved by the consultant. Four sets of shop drawings shall be submitted for approval showing:

a) Any change in layout from the contract drawings.

b) Equipment layout, piping, wiring diagram and instrumentation.

c) Manufacturer's or contractor's fabrication drawings for any material or equipment.

8.0 COMPLETION 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.

9.0 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.

10.0 MATERIALS

10.1 All materials used on this work shall be new, conforming to the specifications.

10.2 Materials shall conform to the technical specification and/or the latest CPWD Specifications /Indian Standards Specifications as amended up to date and carry certification mark, wherever so required.

10.3 Only approved make of material shall be used. The contractor shall get the samples of all the items approved from the Engineer before commencing the supply.

11.0 TESTING OF MATERIALS

11.1 Contractor shall be required to produce manufacturer's test certificates for the particular batch of materials supplied to him. The test carried out shall be as per the relevant CPWD specifications/Indian Standards.

11.2 Any weights of sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost. The decision of the HSCC shall be final and binding on the contractor.

11.3 The 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.

12.0 INSPECTION AND TESTING

12.1 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.

12.2 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.

12.3 The Engineer may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.

12.4 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.

12.5 All materials and equipment found defective shall be replaced and the whole work again tested to meet the requirements of the specifications, at the cost of the contractor. Contractor has to obtain a performance certificate/approval for the complete layout of piping/equipment erected.

13.0 WELDING

13.1 The welding procedure, types of electrodes etc. shall be in accordance with the following IS specifications.

Welding Procedures IS: 823

Welding Electrodes IS: 814, but of approved makes only

Testing of Welders IS: 817

13.2 Only Welders fulfilling the requirements of IS: 817 and approved by the HSCC shall be employed by the Contractor.

14.0 JOINING MATERIAL (GASKET)

Gasket, for use in between flanged joints, to be of CAF as per IS-2712, thickness as specified in S.O.Q.

15.0 PAINTING

15.1 All above ground pipes, pipe fittings, hose cabinets structural steel work pipe supports etc. shall be painted as per specifications given below.

15.2 Painting shall be done only after the completion of fabrication work and testing.

15.3 The instructions of paint manufacturer shall be followed as far as possible otherwise the work is to be done as directed by the HSCC.

15.4 All cleaning materials, brushes, tools and tackles, painting, material etc. shall be arranged by the Contractor at site in sufficient quantity.

15.5 All rust, dust shall scales, welding slag or any other foreign materials shall be removed fully so that a clean and dry surface is obtained prior to painting. Any other oily containment shall be removed by use of a solvent prior to surface cleaning.

15.6 First coat of primer paint must be applied by brush on dry clean surface immediately or in any case within 3 hours of such cleaning.

15.7 Primer paints - one coat (minimum thickness 100 microns) self-priming epoxy mastic.

15.8 Finishing coats:

a) For Pump Rooms - 2 coats (thickness minimum 50 microns each) of epoxy paint, fire red shade as per IS: 4.

b) For other than Pump Rooms - 2 coats of synthetic enamel paint, fire red shade as per IS: 4.

16.0 COATING WRAPPING FOR UNDERGROUND PIPES

16.1 All underground piping shall be protected by coating and wrapping as per the following procedure.

16.2 The materials and workmanship shall in general conform to IS: 10221, 1982 or as directed by the HSCC.

16.3 Cleaning - The pipes shall be thoroughly cleaned by dust, rust will scales, oil, grease etc. by stiff wire brush and scrappers. The surface shall be coated with the primer immediately after cleaning.

16.4 Priming – Suitable primer shall be applied as an undercoat. The manufacturers recommended procedure would be followed for applying the primer.

16.5 Paste Application - Paste shall be applied to fill up uneven surfaces in order to ensure smoothness for subsequent wrapping with multi-layer tape.

16.6 Tape Wrapping - The tape is to wrap while the second coat of primer is still tacky. Winding is to be done with 50% overlap so that the total thickness of 2.0mm tape would become 4.0mm. It should be ensured while wrapping that air bubbles are not trapped. The ends of tape shall be secured with nylon binding to ensure that the tape doesn't get loosened while handling.

16.7 The total thickness including 2 coats of primer, 50% overlap of tape etc. should not be less than 4.5mm or as per manufacturer recommendations.

16.8 The 'Holiday Test' is to be conducted as per IS: 10221 for detecting any entrapped air or any other defect. The Contractor is to arrange for the Holiday Test and to rectify the defects if found any.

17.0 TRAINING OF DEPARTMENT PERSONNEL

17.1 The Contractor shall train the Owner's personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defects liability period.

17.2 The period of training shall be adequate and mutually agreed upon by the Engineer and Contractor.

17.3 The Owner's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.

17.4 Nothing extra shall be paid to the Contractor for training Owner's personnel.

18.0 PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the Engineer, the Contractor shall furnish a written guarantee indemnifying the Owner 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 Owner.

a. Any defective material or equipment supplied by the Contractor.

b. Any material or equipment supplied by the Owner which is proved to be damaged or destroyed as a result of defective workmanship by the Con0ractor.

21.02 SPECIFICATIONS FOR PUMPS AND ANCILLARY EQUIPMENT

1.0 SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically/diesel engine operated pumps for fire hydrant installations as required by the drawings and specified hereinafter or given in the schedule of quantities.

1.2 Without restricting to the generality of the foregoing the pumps and the ancillary equipment and shall include the following:

Electrically/diesel operated pumps with motors/diesel engine, base plate and accessories.

Pump suction and delivery headers, valves, air vessel and connections.

c) Alarm system, Pressure gauges/Pressure switch.

d) Electrical switchboards, wiring, cabling, cable tray, control panel and properly connecting to earthing system of the Factory.

e) Foundations, vibration eliminator pads and foundation bolts.

2.0 GENERAL REQUIREMENTS

2.1 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.

2.2 Pumps and motors shall be truly aligned with suitable instruments.

2.3 All pump connections shall be standard flanged type with appropriate number of bolts.

2.4 Manufacturer instructions regarding installation connections and commissioning shall be followed with respect to all pumps, switchgear and accessories.

3.0 QUALITY CONTROL

3.1 These shall comply with the IS Codes as specified.

4.0 SUBMISSIONS

4.1 Product Manuals

4.2 Hydraulic Details

5.0 STORAGE

6.0

These shall be stored as delivered in original packings.

6.0 FIRE AND JOCKEY PUMPS

6.1 Pump Sets

i) Centrifugal, split casing, horizontal pump should be selected as per IS. Pump should have following specification.
Materials of Construction

PARTS	
CASING	CAST IRON
IMPELLER	BRONZE IS:318, GR.LTBJ/LTB 2 SS-410
CASING WEARING	CAST IRON
SHAFT	STAINLESS STEEL
SHAFT SLEEVE	SS-410
SHAFT SEAL	MECHANICAL
THRUST BEARING	ANTI-FRICTION OF TITLING PAD TYPE

ii) Pumps shall be connected to the drive by means of spacer type love joy couplings, which shall be individually balanced dynamically and statically.

iii) The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.

iv) Pumps shall be provided with approved type of mechanical seals.

v). 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.

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

vii) Pumps shall be provided with pressure gauge with isolation cock on the delivery side.

viii) In case of motor driven pump the motor rating should be adequate to drive the pump at 150% of rated discharge.

Waterproof PVC coated windings.

6.2 Electric Drive

i) Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running current.

ii) 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.

iii) Motors shall be wound for class B insulation and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fibre insulated.

iv) Motors for fire pumps shall meet all requirements and specifications of the Tariff Advisory Committee.

v) 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. 324.

vi) Motors shall be designed for two start system.

vii) Motors shall be capable of handling the required starting torque of the pumps.

viii) Contractor shall provide inbuilt heating arrangements for the motors for main pumps to ensure that motor windings shall remain dry.

ix) Speed of the motors shall be compatible with the speed of the pump.

x) 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.

6.3 Operating Conditions for Fire & Sprinkler Pumps

	CUT IN	CUT OUT	REMARKS
Operating Pressure	----------	(10M+Head of pump as per BOQ in M). ie 1.0+(H)Kg/Sqm	--------
Jockey Pump	(H-0.5) Kg/Sqcm.	H Kg/Sqcm.	Jockey pump to stop when main fire pumps starts
Main Fire Pump (One No)	(H-1.0) Kg/Sqcm.	Push button manual	To start by pressure switch No. 2 on air vessel
Common Diesel Engine (One NO)	(H-2.0) Kg/Sqcm.	Push button manual	To start by pressure switch No. 3

6.4 Vibration Eliminators

i) Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. 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 details.

6.5 Installation

i) 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.

ii) Pumps and motors shall be truly aligned by suitable instruments.

iii) All pump 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.

iv) Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.

v) 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 Architect or their authorised representative for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the owners.

6.6 DIESEL ENGINE

Diesel engine shall be of 6 cylinder with individual heat assemblies. The engine shall be water cooled and shall include heat exchanger and connecting piping strainer, isolating and pressure reducing valves, by pass line, exhaust pipe, silencer day tank for fuel all interconnected piping etc. complete in all respects.

The speed of the engine shall match the pump speed for direct drive.

c) The engine shall be capable of being started without the use of the wicks, Cartridge heater plugs or either at the engine room temperature 4 deg.C and shall take full load with in 15 second from the receipt of the signal to start.

d) The engine shall effectively (i.e. without any derating) operated at 46 deg.C ambient temperature at 150 meter above mean sea level.

e) Noise level of the engine shall not exceed 90 db (free sound pressure) at 3-meter distance

f) The engine shall be self starting type upto 4 deg.C shall be provided with one 24 volts heavy duty D.C. battery, starter, cutout, battery leads complete in all respects. One additional spare battery leads complete in all respects. One additional spare battery shall be provided. The battery shall have an adequate capacity for cold cranking amperage as recommended by the Engine Manufacturer.

g) An automatic change over system shall be provided so that the spare battery comes into operation in case the engine is not started by its own battery.

h) Pump Control Panel should have visual and audio alarm and indication for battery failure.

i) The working battery as well as battery should have output amperage capacity for at least 3 consecutive cranking/starting of the Engine.

j) Provide a battery charger of sufficient amperage capacity of fully charge the batteries in 20 hours with tickle and booster charging facility and regulators.

k) Arrangement for starting shall be automatic on receiving the signal. But shut-off shall be manual.

l) The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer's design.

m) Engine shall be suitable for running on high-speed diesel oil.

n) The system shall be provided with a control panel with push button starting arrangement also wired to operate the engine by differential pressure switches.

o) The entire system shall be mounted on a common structural base plate with anti vibration mounting and flexible connections on the suction and delivery piping.

p) Contractor shall provide one fully mounted and supported day oil tank fabricated from 6mm thick MS sheet electrically welded with capacity for 8 hours working at full load but not less than 200 ltrs. Provide level indicators - low level and full level in the day oil tank on the control panel through float switches and an air breather. Day oil tank shall also be provided with filling connection (threaded) with

cap, gauge glass indication & cocks, drain cock, inspection/cleaning cover with gasket and nuts/bolts. M.S. dyke to hold 150% of the day tank capacity to be built around the Day Tank.

q) Contractor to provide one exhaust pipe with suitable muffler (residential type) to discharge the engine gases to outside in open air as per site conditions (contractor to check the site).

r) Contractor to provide all accessories, fittings, and fixtures necessary and required for a complete operating engine set. The exhaust pipe shall be taken outside the building with minimum number of bends (approx. length 30 Mts.) and shall be duly heat insulated with 50mm thick glass wool covered with 24 gauge aluminum cladding.

s) Contractor shall submit to the Owner special requirements, if any, for the ventilation of the pump room.

6.7 BASE PLATE

Pumps and motors shall be mounted on a common structural base plate and installed as per manufacturer instructions.

6.8 AIR VESSEL

The contractor shall provide one air vessel fabricated from 8mm M.S. plates with 10mm dished ends and suitable supporting legs. Each air vessel shall be provided with a 80mm dia, flanged connection from pump, one 25mm dia, drain with valve, one gun metal water level gauge and 25mm sockets for pressure switches. The vessel shall be 450mm dia x 1800mm high and tested to 20 Kgs./Sq.cm. pressure.

6.9 CUBICLE TYPE SWITCH BOARDS/L.T. PANEL

6.9.1 Cubicle type switch boards and components shall conform to the requirements of the latest revision including amendments of the following codes and standards.

IS:8623	:	Specification for factory built assemblies of switch- gear and control gear for voltage up to and including 1000-V AC/1200 V-DC.
IS:4237	:	General requirements for switchgear and control-gear for voltage not exceeding 1000-V.
IS:2147	:	Degree of protection provided by enclosures for low voltage switchgear and control-gear.
IS:1018	:	Switchgear and control-gear selection/installation and maintenance.
IS:6005	:	Code of practice for phosphating of iron and steel.
IS:13947-1993/ IE:C947-1989	:	Air circuit breaker/Moulded case circuit breaker.
IS:1248	:	Direct acting indicating analogue electrical measuring instruments and testing accessories.
IS:2705 Part I, II & III 1964	:	Current transformers for metering & protection with classification burden & insulation.

The board shall be metal enclosed single front, indoors, floor mounted free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-52.

The panel height shall not exceed 2350 mm including horizontal main bus bar at top. Keeping in view the operating height of the top switch 1750mm from finish floor. 400-mm clear space shall be left through out the panel at bottom. The cold rolled sheet steel will be of 2mm thick.

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

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

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

ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB etc.

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

All cable alley must be provided with threaded nipples for CO2 flooding system and shall be connected to all compartment with centralized CO2 system

v) The panel shall have 20% spare space duly wired for future use.

The front of each compartment shall be provided with hinged single lead door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators & MCCB/ACBs shall be of fixed/drawout type as described later.

Each feeder shall have compartmentalized construction cable entry shall be from top/bottom (3mm thick gland plate shall be provided) as required.

The panel shall be provided with three phase buses and neutral bus bars of aluminium sections throughout the length of the panel and shall be adequately supported and braced to withstand the stresses due to the short circuit current of 50 KA rms. For 1 sec. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 amp. over an ambient temperature of 50 deg.C.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 25mm minimum bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength type porcelain or polyester fibber glass moulded material.

All bus bars shall be colour coded as per IS: 375 and the current density shall be 1 amp/sq.mm.

G.I. earth bus of 50x6mm size shall be provided at the bottom of the panel through out the length. Similarly 40x6mm G.I. strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

Contractors shall be electro-magnetic types 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).

6.9.2 ACB

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IS: 13947-1993 with a rupturing capacity of not less than 50 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). The breaker shall be provided with microprocessor based releases for over load and short circuit protection.

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

Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes.

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 should be positively earthen when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to preventnal-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 from being made alive without its rack in position.

6.9.3 Moulded Case Circuit Breaker (MCCB)

MCCB shall conform to the latest IS: 13947-1993/IEC 947-1989. The Service Short Circuit Breaking Capacity (ICS at 415 VAC) should be 50 KA.

MCCB shall be Current Limiting and comprise of Quick Make - Break switching mechanism preferably Double Break Contact system are extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable magnetic short circuit pick up.

The trip command shall over ride all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination upto the full short circuit capacity of downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru' energy curves. The MCCB shall not be restricted to Line/Load connections.
The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/TEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

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 colour of the lamp cover shall be red for 'ON' and green for 'OFF.

6.9.4 Motors and Starters for Fire Pumps

The starters shall be of DOL type. The motors should have double sq. cage or other provision to limit the starting current to 4 times the full load current.

6.9.5 Name Plates & Lables

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 lables 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 Owner's approval.

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

6.9.6 Painting of all Steel Work

The steel used for fabrication of electrical/panels/equipment should be stove enameled as per the detailed specifications given below:

a) Degreasing: All the steel components, to be painted, should be effectively cleaned by alkaline degreasing.

b) Pickling: Oxide scale rust formation are to be removed in a hot bath of sulphuric acid. Pitting of the surface is to be prevented by the use of pickling in habitors.

c) Cold Rinsing: The parts are then to be washed with cold water to remove all traces of acidic solution.

d) Phosphating: In order to attain durable paint coating the metal surface is to be given phosphating treatment by development a phosphate layer on the surface. Preferably hot grenadine solution is to be used in the phosphating plant.

Pessivating: This process is to be carried out by using deodilate solution.

Drying: The treated parts should then be dried in a hot chamber in dust free atmosphere to ensure that they are absolutely clear and dry before the paint is applied.

Primer Coating: The treated and dried parts are to be sprayed with high corrosion resistance primer.

Stove Drying: The primer coating is to be backed in an electrically heated, air circulated area type storing oven.

i) Finishing Coat: The finishing paint coat is to be applied by spraying two coats of 15 micron thickness powder coated paint of approved shade.

6.9.7 Wiring

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2.5 sq.mm 2 cross section. The colour coding shall be as per latest edition of IS: 374.

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

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

Not more than 1 (one) wire shall be connected to any terminal block.

6.9.8 Current Transformer

Current transformers shall be of ratio, burden (shall be worked out by panel supplier), class/accuracy specified in Single Line Diagram.

Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resins cast with bar Primary or ring type.

The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.

The current transformer shall preferably be capable of being left open circuited on the secondary side with primary carrying rated full load current, without overheating or damage. Short time current rating and rated withstands time shall be same as corresponding C.B.

CT core laminations shall be of high-grade silicon steel.

Secondary terminals of CT shall be brought out to a terminal block, which will be easily accessible for testing and external connections. Facility shall be provided for short-circuiting and earthing of CT secondary leads through a removable and accessible link with provision for attaching test link.

Rating plate details and terminal markings shall be according to the latest edition of relevant Indian Standard specification.

Generally separate current transformers (core) shall be used for metering and protection.

7.0 CABLES

a) Contractor shall provide all power and control cables from the motor control center to various motors and control devices, of ratings as per IS: 3961.

b) All power and wiring cables shall be FRLS with (inner and outer sheath) aluminium conductor PVC insulated armoured and PVC sheathed of 1.1 KV grade. Control cables and power cables of 2.5 sq.mm or less shall be of copper, FRLS, armoured. Cables and wires shall comply with requirements of IS: 5831, 694, 8130, 7098 (I) & 1554 as the case may be.

c) All cables shall have stranded conductors. The cables shall be supplied in drums as far as possible and hear the manufacturer's identification mark.

d) All cable joints shall be made in an approved manner as per accepted practice.

7.1 CABLE TRAYS

7.1.1 Cable trays shall be 2mm thick GI/CRCA powder coated as per approved shade of client. Sheet steel, ladder type/perforated cable trays including fixing along wall/ceiling complete with M.S. rod/flat hangers directly grouted in walls/ceiling etc as required.

7.1.2 The sizes shall be as follows and as directed by the Owner.

A. PERFORATED CABLE TRAY

a) 150 mm wide 75 mm deep
b) 300 mm wide 75 mm deep

B. LADDER TYPE CABLE TRAY

a) 150 mm wide
b) 300 mm wide

7.2 EARTHING

7.2.1 Fire Fighting Contractors shall have to provide earthing strips (G.I. 25x3mm) or earthing wires (G.I. 8 SWG) as may be required for proper earthing of the equipments supplied by him. Thickness of galvanization to be 75 microns (minimum). Each electrical equipment is to be earthen at 2 points.

21.03 SPECIFICATIONS FOR FIRE HYDRANT SYSTEM

1.0 SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install wet riser fire hydrant system as required by the drawings and specified hereinafter or given in this schedule of quantities.

1.2 Without restricting to the generality of the foregoing, the fire hydrant system shall include the following: -

Mild steel mains including valves, hydrants and all other accessories.

Mild steel pipe fire risers within the building.

Landing valves, synthetic hose pipes, hose reels, hose cabinets, fire brigade connections, connection to pumps, appliances and pressure reducing devices.

Excavation, anchor blocks and valve chambers.

2.0 GENERAL REQUIREMENTS

2.1 All materials shall be of the best quality conforming to the specifications and subject to the approval of the employer. 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.

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

2.3 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.

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.

2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

3.0 PIPES AND FITTINGS

FOR INTERNAL WORK:

a. All pipes within the building in exposed locations and shafts including connections buried under floor shall be ERW mild steel tubes conforming to IS: 1239 (Heavy class) up to 150mm AB and IS 3589 above 150 NB's with screwed or welded joints as specified by the engineer in charge at least 10% of welded joints shall be radiographically tested.

b. Fittings of 50mm or below shall be forged steel with socket weld ends of approved makes. For 65mm and above shall be W.I./M.S. with butt weld ends.

4.0 JOINTING

Gasket, for use in between flanged joints, to be of CAF as per IS-2712, thickness as specified in S.O.Q.

5.0 EXCAVATION

5.1 Excavations for pipeline shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipelines shall be buried to a minimum depth of 1 to 1.5 meter or as shown on the drawings.

5.2 Wherever required contractor shall support all trenches or adjoining structures with adequate supports to prevent land slides.

5.3 On completion of testing and painting, trenches shall be refilled with excavated earth in 15-cm layers and compacted.

5.4 Contractor shall dispose off all surplus earth within the site.

6.0 ANCHOR BLOCKS

6.1 Contractor shall provide suitable cement concrete anchor blocks as may be necessary for overcoming pressure trusts in under ground/external pipes. Anchor blocks shall be of cement concrete 1:2:4 mix.

7.0 VALVES

7.1 Butterfly valves above 65mm shall be of cast iron body and bronze/gunmetal seat. They shall conform to type PN 1.0 of IS: 13095.

7.2 Non return valves shall be of cast iron body and bronze / gunmetal seat. They shall be swing 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.

7.3 Check valves shall be cast iron double flanged conforming to IS 5312-1975 with cast iron steel body and stainless steel internal trims.

Valves on pipes 65mm and below shall be heavy pattern gunmetal valves with cast iron wheel seat tested to 20kg/sqcm pressure. Valves shall conform to IS:778.

8.0 FIRE HYDRANTS

8.1 EXTERNAL HYDRANTS

Contractor shall provide external hydrants. The hydrants shall be controlled by a cast iron sluice valve. Hydrants shall have instantaneous type 63-mm dia outlets. The hydrants shall be of gunmetal and flange inlet and single outlet conforming to I.S.5290-1983 with G.I. duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground.

8.2 Contractor shall provide for each external fire hydrant two nos. of 63 mm dia 15 meter long synthetic fibre non perculating hose pipe with gunmetal male and female instantaneous type couplings machine wound with copper wire hose to I.S. 636 type B and couplings to IS 903 with IS certification), gunmetal branch pipe with 16 mm nozzle to I.S. 903-1984.

9.0 INTERNAL HYDRANTS

9.1 Contractor shall provide on each landing and other locations as shown on the drawings one single headed gunmetal landing valve with 63 mm dia outlets and 80 mm inlet (I.S. 5290-1969) with individual shut off valves and cast iron wheels. Landing valves shall have flanged inlet and instantaneous type outlet as shown on the drawings.

9.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses. Contractor shall provide for each internal fire hydrant station four numbers of 63 mm dia 7.5 meter long synthetic non perculating hose pipes with gunmetal male and female instantaneous

type coupling machine wound with G.I. wire (Hose to I.S. 636 type B and couplings to I.S. 903 with I.S. certification), fire hose reel, gunmetal branch pipe with nozzle I.S. 903 fireman's axe.

9.3 Each hose box shall be, after thorough cleaning of surface, painted as per Section 28 of General Technical Specifications. The words FIRE HOSE to be painted on the inner face of the glass.

10.0 FIRST AID HOSE REELS

10.1 Contractor shall provide standard fire hose reels with 20 mm dia high pressure rubber hose of 36 meters length with gunmetal nozzle with 5mm bore, and control valve, shut of nozzle connected wall mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall conform to IS: 884-1969. The hose reel shall be connected directly to the M.S pipe riser through an independent connection.

11.0 PRESSURE GAUGES

11.1 All pressure gauges shall be of dial type with bourdon tube element of SS 316. The gauge shall be of reputed make. The dial size shall be 150-mm dia and scale division shall be in metric units marked clearly in black on a white dial. The range of pressure gauge shall be 0 to 12 kg/sq.cm.

11.2 All pressure gauges shall be complete with isolation cock, nipples, tail pipes etc.

12.0 PRESSURE SWITCHES

12.1 The pressure switch shall be industrial type single pole double throw electric pressure switch designed for starting or stopping of equipment when the pressure in the system drops or exceeds the pre-set limits. It shall comprise of a single pole changeover switch, below element assembly and differential sprindle.

12.2 All the pressure switches shall have 1/4" B.S.P (f) inlet connection and screwed cable entry for fixing cable gland.

12.3 The electric rating of the switch shall be as under:

Type of supply	Voltage	Non –Inductive	Inductive
A.C.	110-380	10 Amp	6 Amp
D.C.	24-250	12 Watts	12 Watts

13.0 FIRE BRIGADE CONNECTION

13.1 The contractor shall provide as shown on drawing gunmetal four ways collecting head with 63mm dia instantaneous type inlets with built in check valve and 100/150 mm dia. Outlet connection to the fire main grid and for tank filling, collecting head shall conform to IS: 904-1964.

14.0 AIR VALVES

14.1 The contractor shall provide 25 mm dia screwed inlet cast iron single acting air valve on all high points in the system or as shown on drawings.

14.0 DRAIN VALVE

50mm dia black steel pipe conforming to IS:1239 heavy class with 50mm gunmetal full way valve for draining and water in the system in low pockets.

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 250mm. 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 3.5kg/sq.cm. Design of the same shall be given by the Contractor as per location and pressure condition of each hydrant.

15.0 VALVE CHAMBERS

15.1 Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand 10 graded stone aggregate 40 mm nominal size) 15 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling, complete.

15.2 Valve chamber shall be of the following size:

For depths 130 cm and beyond 120x120 cms
Weight of C.I. frame and cover shall be 38 kg.

16.0 PIPE PROTECTION

See Clause 15.0 & 16.0 on 'Painting' and 'Coating/wrapping' under General Technical Specifications).

17.0 PIPE SUPPORTS

17.1 All pipes shall be adequately supported from ceiling or walls by means of anchor fasteners by drilling holes with electrical drill in an approved manner as recommended by manufacturer of the fasteners.

17.2 All supports/clamps fabricated from M.S. structural e.g. roads, channels, angles and flats shall be painted as described in specifications for "Painting" under General Technical Specifications.

17.3 Where inserts are not provided the contractor shall provide anchor fasteners. Anchor fasteners shall be fixed to walls and ceilings by drilling holes with electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

Pipe Support Spacing	Horizontal	Vertical
Pipe upto 50 mm	2 Mtr	3 Mtr
Pipe 65 - 100 mm	1.75 Mtr	3 Mtr
Pipe above 100mm	1.50 Mtr	3 Mtr

18.0 AIR VESSEL AND AIR RELEASE VALVE

Air vessel on top of each wet riser piping shall be installed before execution for approval fabricated out of at least 8mm thick steel to withstand the pressure, with dished ends and supporting legs. This shall be of 300 mm dia and 1m high. 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 galvanized to IS: 4736-1968. This shall be tested for twice the working pressure.

19.0 TESTING

1 All piping in the system shall be tested to a hydrostatic pressure of 11.0 kg/sq.cm without drop in pressure for at least 2 hours.

Rectify all leakages, make adjustments and reset as required and directed.

20.0 HOSE CABINETS

20.1 Provide doors/hose cabinets for internal/external hydrants respectively fabricated from 16 gauge M.S. sheet with double glass front door and locking arrangement, with breakable glass key access arrangement, duly painted red as per specifications given on page 12 para 28.8 fixed to wall/floor as per site conditions. The cabinet shall have a separate chamber to stove a key with breakable glass as per approved design. Hose cabinets shall be hinged double door partially glazed with locking arrangement, painted as per Section 28 of General Technical Specifications with 'FIRE HOSE' written on it prominently. Samples of hose cabinet for indoor and outdoor works shall be got approved from HSCC before production/delivery at site.

20.2 For external hydrants the hose cabinets shall be fabricated from 16 gauge thick M.S. sheet with double shutter glass front door and locking arrangement with breakable glass key access arrangement. The cabinet shall have 'FIRE HOSE" written on it prominently. Sample of hose cabinet shall be got approved from the HSCC before installation at the site.

21.0 MEASUREMENT

21.1 Mild steel pipes shall be measured per linear meter of the finished length along the center line and shall include all fittings (including flanges), welding, jointing, clamps for fixing to walls or hangers, anchor fasteners and testing.

21.2 Butterfly valves, check valves and full way valves shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications/schedule of quantities.

21.3 Landing valves hose cabinets, synthetic non-perculating fire hose pipes, First-aid fire hose reels (with gunmetal full way valves) and gunmetal branch pipes shall be measured by numbers and shall include all items necessary and required for fixing as given in the specifications/schedule of quantities.

21.4 Suction and delivery headers shall be measured per linear meter or finished length and shall include all items as given in the schedule of quantities.

21.5 Painting/wrapping/coating of headers, pipes shall be included in the rate for pipes and no separate payment shall be made.

21.6 Brick masonry chambers shall be measured by number and shall include all items as given in the schedule of quantities/specifications.

21.7 No additional payment shall be admissible for cutting holes or chases in walls or floors, making connections to pumps, equipment and appliances.

21.04 SPECIFICATIONS FOR SPRINKLER SYSTEM

1.0 SCOPE OF WORK

1.1 Work under this section shall consist or furnishing all labour, materials, equipment and appliances necessary and required to completely install the sprinkler system as required by the drawings and specified herein after or given in the schedule of quantities.

a) Sprinkler mains, branch and external piping complete with valves, alarm, hangers and appurtenances and painting.

b) Sprinkler heads with spare sprinklers

c) Connections to risers, pumps and appliances

2.0 GENERAL REQUIREMENTS

2.1 All materials shall be of the best quality conforming to specifications and subject to the approval of the engineer.

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

2.3 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.

2.4 Pipes shall be supported from walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.

2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

2.6 Sprinkler heads shall be approved by the underwriters Laboratories (U.L.) or Fire officers Committee (FOC). The finish shall be as specified in the schedule of quantities. The contractor shall give required tools for removing and fixing of different types of sprinklers free of cost as directed by the HSCC.

3.0 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.

c) Constructions:

i) Bulb: - Bulb shall be made of corrosion free material strong enough to with stand 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 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 colour code shall be adopted for classification of sprinkler according to nominal temperature ratings:

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	15/20 mm nominal bore

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.

4.0 Installation Control Valve:- Installation control valves shall comprise of the following:

a. One man 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 5mtr of tubing and fittings.

e. Alarm stop valve

f. Strainer

g. Drain plug

h. Padlock & strap

i. Wall box for installation of valve

5.0 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.

6.0 INSTALLATION OF PIPING

A. Below ground piping :- Under ground piping shall 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 suitable size hue pipes shall be provided for protection of piping. Underground pipes shall be protected against corrosion with two coats of bituminous painting and wrapped with tarfelt or similar covering. If the piping is to be buried in ground with back filling of earth, a coat of epoxy painting shall be given.

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 etc. and painted to the required finish (with suitable synthetic enamel Paint). The spacing of piping supports shall be as follows:

i)	20mm to 32mm dia	2 mtr
ii)	40mm to 65mm dia	2 mtr
iii)	65mm to 100mm dia	1.75 mtr
iv)	above 150mm dia	1.50 mtr

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) 20mm dia valve for pipes upto 50mm dia
ii) 25mm dia valve for 65mm dia pipes
iii) 32mm dia valves for pipes larger than 65mm dia

c) Piping shall be screwed type upto 50mm dia. Welding of joints will be allowed for pipes of 50mm 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 the 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 Consultant. 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.

7.0 FLOW SWITCH

7.1 Provide one electrically operated flow switch of appropriate dia, at the head of each circuit. Flow switches should be capable of the required flow in the circuit. The electrical cabling for the flow switches and control panel shall be provided by the contractor.

8.0 PUMP SETS

Same as wet riser & Hydrant system specification.

9.0 ANNUNCIATION SPRINKLER PANEL

The equipment for control panel should be compact neatly wired and enclosed in a suitable 14 gauge M.S. sheet/16 CRCA sheet Metal Box which is suitably treated against corrosion. The control panel should be painted with over banked enamel paint. The panel shall consist of:

a) Panel should be made in a modules of 10 zones e.g. Each module will have audible and visual indications and will monitor the circuit conditions.

A.C. Power Supply

Fault and Fire indication lamp.
Alarm acknowledgment push buttons.

b) The circuits provided in the control panel for each zone shall indicate the following conditions:

i) Open Circuit in zone wiring

Short Circuit in zone wiring

iii) Normal conditions
iv) Power failure
v) Low battery

c) The Automatic annunciation panel shall suitable for operation on 24V DC and shall be provided with power supply unit suitable to operate on A.C. mains of 230V with a variation of 10%. The system shall be so designed that in case of failure of A.C. main supply it shall automatically change over to battery supply.

d) Suitable protection may be provided against charging of the battery over and above the specified values.

7.0 BATTERY UNIT

i) The system shall be powered by lead acid storage stationery complete with automatic duel rate charger boost and trick operating from 220V, 50 Hz, single phase, mains supply. The battery capacity should be adequate for operation of the system connected to it for at least 24 hours in the non-alarm state followed by 30 minutes operation of all sounders and other connected equipments after a power (mains) failure.

ii) The automatic charger should operate at the boost charge when the battery terminal voltage is less than about 2.1V 20 per cell, and operate at a trickle charge rate of 100 to 200 HA, when the battery terminal voltage exceeds about 2.25 per cell.

iii) The power unit should have the following:

a) Voltmeter 0-30 V

b) Ammeter of suitable range

c) Indicator lights for mains

d) Indicator lights for DC output

iv) The preferred nominal DC voltage shall be 24 V and shall preferably be isolated. (IF an isolated supply is provided a line earthing indicator should also be provided).

v) The DC system and the detection and sounder circuits shall be protected against their attaining a voltage to earth exceeding 50V.

vi) The connection to the 220V, 50Hz, single phase system shall be through a three pin plug socket especially provided for the connection to the annunciation panel. This connection should in addition utilized for earthling all non-current carrying metal parts of the sprinkler system, except those that are either doubly insulated or mounted at a height exceeding 2.2 meters.

vii) The battery unit shall be housed in a steel cabinet with suitable mounting at least 2.5mm thick suitably painted with two coats of Post Office Red, Enamel necessary vent holes should be provided for proper ventilation.

viii) One battery unit complete with battery charger shall be provided for each control panel.

10.0 TESTING

10.1 All pipes in the system shall be tested to a hydrostatic pressure of 11.0 kg/sq.cm without drop in pressure for at least 2 hours. Rectify all leak ages, make adjustments and retest as required.

11.0 MEASUREMENT

11.1 Black steel pipes shall be measured per linear meter of the finished length and shall include all fittings including flanges, welding, jointing clamps for fixing to walls or hangers and testing.

11.2 Butterfly valves, check valves and full way valve and flow indicating switches shall be measured by numbers and shall include all items necessary and required for fixing as given in specifications.

11.3 Cabinet and the spare sprinkler heads, with spanner etc. shall be measured as per actual item given in the schedule of quantities.

11.4 Sprinkler heads shall be measured by numbers.

11.5 No additional payment shall be admissible for cutting holes, or chases in the wall or floors, making connections to pumps, equipment and appliances.

11.6 Painting and coating/wrapping of pipes shall be included in the rates for pipes and no extra payment shall be made.

21.05 COMMISSIONING OF FIRE FIGHTING SYSTEM

1.0 SCOPE OF WORK

1.1 Work under this section shall consist of pre commissioning, commissioning testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

2.0 GENERAL REQUIREMENTS

2.1 Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

2.2 Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

2.3 All inspection and testing for gauging the efficacy of all equipment would be as per the TAC regulations.

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 carrier out strictly in accordance with the approved drawing.

2.4 The scope of installation work shall include the following, where or not expressly mentioned in the schedule of work.

i. Cement concrete (1:2:4mix) 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 no strong enough to support the pipes, thereby likely to case 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 specifies.

xiii. Cutting and making good the damages for the installation work of the riser system

xiv. Strainers and foot valves for pumps with negative suction and strainers for pumps with positive suction.

xv. All the required control piping, exhaust piping (5m long) from engine, oil piping for fuel oil and lubricating oil for the engine, drain piping from the pumps to the drain pint 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.

xvi. Inter-connecting cable work with controls, control panel, batteries etc. including battery leads.

xvii. Orifice plates at individual hydrants, as required.

Where provision of GI/MS pipe shall below ground become inescapable, it shall be protected from soil corrosion by 2 coats of coal tar hot enamel paint and 2 wraps of reinforced fiber glass tissue or bitumenised horizon.

Each CI pipe/GI pipe shall be subjected to hydraulic pressure test before installation, in presence of the Engineer or his authorised 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 or cast iron structure of size 75cm2 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 40mm size sluice valve.

Internal hydrants at each floor shall be located at about 1m above floor level.

Valve chambers shall be of 1m2 in size, with cover.

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.

3.0 PRECOMMISSIONING

On completion of the installation of all pumps, piping, valves, pipe connections, electrical wiring motor control panels and water level controlling devices the contractor shall proceed as follows:

3.1 TESTING OF M.C.C

Tests to be carried out for motor control centers shall be :

3.1.1 Insulation resistance test with 500 volt merger, before and after high voltage test, on all power and control wiring.

3.1.2 High voltage test at 2000 volts A.C. for one minute on all power and control wiring.

3.1.3 Low voltage continuity test (6 volts) on power wiring of each feeder, between bus bars and outgoing terminals with switches and contractors in closed position.

3.1.4 Low voltage continuity test (6 volts) on all control wiring.

3.1.5 Operation test for all feeders with only control supply made “ON” to ensure correctness of control wiring, operation of the various equipment used, such as push buttons, protective devices, indicating lamps and relays, etc. All contractors shall be checked for the presence of humming and chattering.

3.1.6 Earth continuity test with voltage not exceeding 6 volts between various non-current metallic of equipment, steel work, etc. and the earth bus provided in the M.C.C.

3.1.7 Operation of all instruments and meters provided on the M.C.C.

3.2 FIRE PROTECTION SYSTEM

3.2.1 Check all hydrant valves and close if any valve is open. Check that all suction and delivery connections are properly made.

3.2.2 Test run and check rotations of each motor and correct the same if required.

3.3 PIPE WORK

3.1 Check all clamps, supports and hangers provided for the pipes.

3.2 Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications if any leakage is found. Rectify the same and reset the pipes.

4.0 COMMISSIONING AND TESTING

4.1 FIRE HYDRANT SYSTEM

4.1.1 Pressurize the fire hydrant system by running the main fire pump and after attaining the required pressure shutoff the pump.

4.1.2 Open by-pass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the pre-set pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

4.1.3 Open bye-pass valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump should cut-in at the preset pressure and should not cut-out automatically on reaching the normal line pressure. The main fire pump should stop only by manual push button. However, the jockey pump should cut out as soon as the main pump starts.

4.1.4 Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.

4.1.5 When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant simultaneously and allow the hose pipe to discharge water into the fire tank to avoid wastage. The electrically driven pump should run continuously for eight hours so that its performance can be checked.

4.1.6 Diesel engine driven pump should also be checked in the same manner as given in para above by running for 8 hours.

4.1.7 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 10kg/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.

4.1.8 The open end of the piping shall be temporarily closed for testing.

4.1.9 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.

4.1.10 All leaks and defects in different joints noticed during the testing and before commissioning shall satisfaction of Engineer.

4.1.11 Check each landing valve, male and female couplings and branch pipes for compatibility with each other. Any fitting, which is found to be incompatible and does not fit into the other properly, shall be replaced by the contractor. Landing valves shall also be checked by opening and closing under pressure.

4.1.12 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.

4.1.13 The automatic operation of the system for the various functional requirements and alarms as laid down in his specification shall be satisfactory carried out on as described above.

4.2 HANDING OVER

4.2.1 All commissioning and testing shall be done by the contractor to the complete satisfaction of the engineer /consultants, and the job handed over to the client.

Contractor shall also hand over to the client all maintenance and operation manuals and all items as per the terms of the contract.

21.06 HAND APPLIANCES

1.0 SCOPE OF WORK

1.1 Work under the section shall consist of furnishing all labour, material, appliances and equipments necessary and required to install fire extinguishing hand appliances.

1.2 Without restricting to the generality of the foregoing the work shall consist of the following:

Installation of fully charged and tested fire extinguishing hand appliances CO2, Foam, Dry chemical powder type as required by these specifications and drawings.

2.0 GENERAL REQUIREMENTS

2.1 Fire extinguishers shall conform to the following Indian Standard Specifications and shall be with ISI approved stamp as revised and amended upto date: -

a) Water gas type I.S. 940
b) Dry powder type I.S. 2171-1962
c) Mechanical Foam I.S. 10204
d) ABC I.S. 13849

2.2 Fire extinguishers shall be installed as per Indian Standard "Code of practice for selection, installation and maintenance of portable first aid appliances “I.S. 2190-1962”.

2.3 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.

2.4 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

2.5 All appliances shall be fixed in a true workman like manner truly vertical and at correct locations.

2.6 The contractor has to obtain approval of Fire Department for all fire fighting installations.

21.07 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 multistorey buildings

3. IS 2217 Recommendations for providing first aid and fire fighting arrangement in public buildings.

4. IS 2190 Code of practice for selection, installation and maintenance of portable first aid fire appliances.

5. Part IV, fire fighting 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 934 Specifications for portable chemical fire extinguisher soda acid type.

15. IS 2873 Specifications for fire extinguisher of Carbon-di-oxide.

22. TECHNICAL SPECIFICATIONS OF SOLAR WATER HEATING SYSTEMS

The detailed technical specifications of solar water heating systems, its equipment, components and installation etc. are indicated hereunder:

1.	SYSTEMS CAPACITY	As specified
2	NO of SYSTEMS	As specified
2.	SYSTEM TEMP. OUTPUT	60^{o}C year average basis on clear sunny days
3.	SOLAR COLLECTORS Type Make Applicable IS No. Quantity of Solar collectors Absorption area	 Selectively coated (Cu-cu type) ISI marked Make BHEL/TATA BP /EMMVEE SOLAR SYTEMS Pvt. Ltd IS:12933 As per requirements 2.0 Sqm(MIN)
4.	COLLECTOR/TANK SUPPORT FRAME	MS Angle 35x35x5mm/40X40X4mm minimum adequate for 150 km/hr wind pressure
5.	HOT WATER STORAGE TANKS (INSULATED) Quantity Capacity Material Insulating material Insulating material Density Insulation thickness Waterproof covering Cladding material	 1 No. each As per site requirements 304 Stainless Steel Rockwool/Glass wool 48 kg/cu.m 100mm (Min.) polythene lining Aluminum 22 swg (0.71 mm thick)
7.	Distribution PIPINGS (Extra payable as per actual measurements) CPVCI/Composite Pipe Pipe fittings System Internal piping size Insulating material Insulation thickness covering Weatherproof coating /Cladding material	 ISI marked ISI marked As per site requirements Imported foam pipe section 9mm/10mm thick Fiber Tissue lining Imported resin /aluminium sheet 28 SWG
8	PUMPS	As per requirements JHONSAN/ Kirloskar
9.	TEMPERTURE GAUGE Quantity Type Range End connection	 1 No. each for each system Dial gauge 0-120C

	Make	½" BSP H Guru
10.	STRAINER Material Type Mesh	 Cast Iron Y-type Horizontal Brass
11	ELECTRICAL BACK-UP	As PER REQUIRED Heater ISI Marked
12	HEAT EXCHANGER Material Type Surface area	 Stainless Steel 304 Cage As per site requirements
13	OPERATION GUARANTEE	One year
14	ALLIED CIVIL & ELECTRICAL WORKS	Complete for making the system operational/functional in all respects including wiring upto nearby distribution board.

Manufacturers or their authorized distributors/specialized firms of solar water heating system of BHEL /TATA BP solar system/ EMMVEE SOLAR SYTEMS Pvt. Ltd make. Distributors will be required to produce documents in support of their authorization from the manufacturer. The work shall be carried out by trained authored staff of the company.

Collector specifications: The collectors shall be of Cu-Cu type with Absorber area of 2.0 sq. mtrs. The absorber riser-tubes shall be made of high-grade copper & welded to the copper fins with the State of the Art ULTRASONIC WELDING process to ensure superior conductivity of heat & long life of absorber plate. The absorber plate shall be selectively coated with a very special NALSUN coating for efficient absorption of heat from the Sun-rays. The efficiency of the collectors has been specified as FR (Ta) = 0.72, FROL =3.62 W/Sq. mtr/ ^{0} C. The outer dimensions of the collector box shall be 2080 mm x 1070 mm x 100 mm with Frame made out of Extruded aluminum sections of 16 SWG specifications (powder coated yellow). The insulating material in the collectors would be 50mm (bottom) and 25mm (sides) Rock-wool with thermal conductivity of 0.029W/mk and density 48kg/sq. cm. The top glass would be toughened clear glass of thickness 4.0mm, with 88% transitivity and be of a reputed make like ATUL. The **Collector stands** would be made of 40X40X4mm (min) thick MS angles with enamel paint covering. The Grommet & Glass beading shall be made out of High quality EPDM rubber for long life. All hardware used shall be of SS-304 or Zinc Plated steel. The solar collector shall be arrange on roof in such a way so that the shadow of the collectors/ parapet etc can be avoided. The outer sides shall be having a Powder Coated finish in Yellow colour. The collector should have very high Absorbtivity of > 0.95 % & Emissivity < 0.2 %. Anti-Condensation breather outlet shall be incorporated at rear bottom of collector to drain out condensed moisture if any. This prevents the inner glass surface from Fogging.

Tank specifications: The Insulated Hot Water Tank shall be of the Vertically oriented cylindrical type made out of SS-304. It shall be duly insulated with 100mm thick glass-wool insulation with thermal conductivity of

0.028 to.033 W/mk and density 48 kg/cu.m. This will be covered with Aluminium cladding of thickness #22 SWG along with chicken mesh and thin polythene sheet. There shall be a built in Heat Exchanger of multiple tube type made of SS-304 to transfer the heat to the water in the tank. This closed loop system shall be provided with a make up tank. Also provided shall be a sacrificial anode to prevent Galvanic Corrosion. Electrical backup of as required with SS/Cu Thermostat (range 30-80^{0}C, 15A/250 VAC) shall also be provided.

The hot water from solar heater in case supply to water heater(geyser) the additional heating arrangement by electricity in the hot water storage tank is not required.

23.00 LIST OF APPROVED MAKES : CIVIL WORKS

S.No	Material	MANUFACTURERS
1	Doors & Windows fixtures/ Fittings	*Dorma, Godrej, Ozone, Austavision*
2	Door Closer / Floor spring	*Ozone, hettich, Dorma, Godrej,*
3	Aluminium Sections.	Hindalco, Jindal, *BALCO, Alom*
4	Clear Glass/ Clear Float Glass/ Toughened Glass	Saint Gobain(SG), Modi, *Asahi, Glaverbel*
5	Laminates	Formica, Decolam, Century, Marino, Green*lam*
6	Synthetic Enamel Paints	Berger, Asian, ICI , Nerolac
7	Oil Bound Distemper	Berger, Asian, *ICI* , Nerolac
8	Cement Paint	Snowcem plus, Berger, Nerolac, *Asian, ICI*
9	Plastic Emulsion Paint	*Berger*, Asian, ICI , Nerolac
10	Other Paints/Primers	Berger, Asian, ICI , Nerolac
11	OPC 43 Grade Cement (Conforming to IS 8112)	ACC, Ultratech, L&T, Birla Gold, JK, Ambuja,
12	Reinforcement Steel	SAIL Plants,Rashtriya Ispat Nigam Ltd(Vizag Steel Plant Andhra pradesh),TATA Steel (Jharkhand)
13	Glass Mosaic Tiles	Bisazza, *Mridul*, Itialias, *kenzai,Opio,Eon Ceramics*
14	MS Pipe/ Sections	Jindal Hisar, Prakash-Surya, BST, Kalinga, Tata
15	Polycarbonate Sheets	GE, *Macrolux, Plastic,Vergola,Skyarch,Polytechno*
16	Wooden Fire Check Doors	Navair, Pacific Fire Control, Kutty Promat, Sukri
17	Metal Fire Check Doors	Navair, Shakti- Met, Godrej, Sukri, Pacific Fire Control

18	Sunken Portion Treatment	Choksey, Roffe, Krytone,Sika, CICO, *BASF, MC Bouchemie, Texsa*
19	Admixtures for concrete.	Cico, Vam Organics, Roffe, Pidilite,FOSROC, *MC Bouchemie, Sika, STP, BASF*
20	Ceramic Tiles	Johnson, Somany, Kajaria, Nitco, *Bell, Hindustan, Raja tiles (for hand made ceramic tiles)*
21	Pre-Laminated Particle Board	Novopan, Greenlam, Kitlam, Marino, *Century, Archid ply*
22	Flush Door Shutters	Century, Kitply, Green Ply, *Duro*
23	Glazed Tiles	Bell, Somany, Johnson, Kajaria, *Nitco*
24	PVC Water Stops	*Prince*/Supreme/*Finolex//BASF*
25	White Cement	Birla White, J.K., *Grasim*
26	Powder Coating Material Pure Polyester	Jotun , Berger, Goodlass Nerolac
27	Stainless Steel Screws For Fabrication and fixing of Windows.	Kundan , Puja , Atul
28	Dash Fasteners./Anchor bolts	Hilti, Fischer, Bosch,
29	Stainless Steel Bolts, Washers and nuts	Kundan , Puja , Atul
30	Stainless Steel Pressure Plate screws	Kundan , Puja , Atul
31	Stainless Steel Friction Stay	Securistyle, Earl Bihari
32	E.P.D.M. Gaskets	Anand Reddiplex, Enviro Seals, *Hanu*
33	Weather Silicon	GE/ *Pidilite/ Choksey/* Wacker / *Forsoc/ CICO*/Dow Corning/*Sika*
34	Structural Silicon at butt joints	Dow Corning, Wacker, GE, *Sika*
35	PVC continous fillet for periphery packing of Glazings /Structural glazings	Roop, Anand, Forex Plastic
36	Water proofing / Injection Grouting	*Choksey/ Sika/ CICO/ MC Bouchemie/ BASF/ Texsa*
37	6mm thick Reflective Glass	Glaverbel, Glavermas, Saint Gobain, *Asahi*
38	Door Locks	ACME, Godrej, *Dorma*
39	Door Seal – Woolpile Weather Strip*/ Acoustic seal*	Anand -Reddiplex, *Enviroseal, Viper*
40	Aluminium Grill	Hindalco, Jindal
41	Vitrified Tiles	Naveen, Bell, Kajaria, Somani, *Nitco, Johnson, Euro*
42	Aluminium Cladding sheets	Alstrong , Alpolic, Alucobond, Alucomat, Alu Decor
43	Stainless steel D-handles	D-line, Giesse, Dorma,Dorset, ozone
44	Stainless Steel Pipes/Flats	304 Grade (as approved by Engineer)
45	Structural Steel	TATA, SAIL, RINL, JINDAL

46	Ready Mix Concrete	ACC,BIRLA, *Ultratech, L&T, Lafarge, GMK Concrete*
47	Epoxy Flooring/ wall coating	Fosrock, Beck, Famaflor, *Araldite, STP, Sika, BASF*
48	Acoustic Mineral Fibre	USG-Radar, Armstrong, 21st Century, Acostyle, *Daikin, Daxune Supreme sand stone*
49	Fire Panic bar	Briton, Dorma, *D-Line*
50	Ply board	Greenply, Kitply, Century, Archid, Marino, *Duro*
51	PVC Flooring	LG, Tarkett, Responsive , *Armstrong, Gerflor*
52	SS Railing	*Ozone, D-Line, Jindal,*
53	Interlocking Paver Tiles	*Unistone Products (India) Pvt Ltd,CCC Builders Merchant Delhi Pvt Ltd,Nimco Prefab,Hindustan Tiles,Terra Firma (Now TERRA FIRMA GRC & Concrete Industries),Nitco Hindustan Tiles,Ultra Tiles, NTC*
54	Smoke Seals	Pemko, *Scalz, Lorient, Navair*
55	Fire rated door closer/Mortice Lock/ Door Co-ordinator	Dorma, Becker F.S. Australian or approved equivalent
56	Gyspum Board System	Gyproc (Saint Gobain),Lafarge, Boral, *Hilux,,Aerolite*
57	Adhesive for Door Work	*Fevicol/ Vamicol/ Dunlop/ Pidilite/ Sika/ Thermoshield*
58	Epoxy Paint	*Nerolac/ Shalimar/ cico/ Fairmate/ sika/ BASF/ Berger/ Asian/ Pidilite*
59	Polysulphide sealant	Pidilite/ Fosroc/ Choksey/chematal rai/ cico/ sika, MC Bouchemie, BASF, STP
60	Glass Doors (Motorised)	*DORMA/ Hafle/ Ozone*
61	Calcium silicate boards	*Hilux/ Aerolite, Armstrong*
62	Calcium Silicate Tiles	*Hilux/ Aerolite, Armstrong*
63	Glass wool	As per HVAC works
64	Grass Paver	*Unistone/ Ultra/ Hindustan/NTC*
65	Terrazo tiles	*Nitco/ Hindustan Tiles/ Bharat/ NTC*
66	Texture Paints	*Spectrum/Heritages/ICI Dulux/Asian*
67	Wall care putti	*J.K. White/Birla/Gyproc wall putty*
68	Frameless glass partition fixtures	*Dorma/Hafle/Ozone*
69	Spider fittings/ patch fittings	*Ozone/Dorma/ Hafle*
70	Stone cladding clamps	*Hilti infra pvt. Ltd./Bosch Fischer*
71	Modified bituminous membrane roof waterproofing	*Multiplans standard of integrated waterproofing membrane ltd/super thermolay/polyflex of STP ltd./Lotus-3 of structural water proofing ltd./sika/kemco/krylon buildmat/MBT/fosroc/Texsa*

Note:	**Wherever makes have not been specified for certain items, the same shall be as per BIS and as per approval of Engineer**

24.00 LIST OF APPROVED MAKES : PLUMBING WORKS

Sl.No	Material	Relevant IS Code	MANUFACTURERS
1	Vitreous China Sanitary ware	2556	*Hindware,Paryware*, Cera, Kohler, Roca
2	White Glazed Fire Clay Sink	771	Sanfire, Cera, Neycer, Hindware.
3	Stainless Steel Sink		Jayna, *Neelkanth*, Commander, Nirali
4	Plastic seat cover of W.C	2548	Cera, Kohler, *Hindware,, Roca*
5	Geyser		Racold, Venus, Voltas, Usha Lexus, Jaguar, Havells
6	C.P. Fittings Mixer/Pillar taps Washers, C.P. brass accessories ,CP Angle Valve,Bibcocks,CP waste	1795/4291/4827	Jaquar, Kohler, Aquabath
7	Centrifugally /Sand cast iron pipes & fittings	3989/1729	Neco, Hepco, *SKF*
8	G.I. Pipes	1239 Part I	Jindal-Hissar, Tata, Prakash-Surya
9	G.I. Fittings	1239 Part I	Unik, K.S., Zoloto, R
10	Gunmetal Valves	778	Zoloto, Leader, Castle,*Sant*
11	Brass stop & Bib Cock/Pressure Release valve	781	Zoloto, Sant, Leader, Jaquar
12	Ball valve with floats	1703	Zoloto, Leader, Sant
13	Stoneware pipes & Gully Traps	651	IS Marked pipes
14	R.C.C. pipes	458	IS Marked pipes
15	C.I. Manhole Covers	1726	SKF, NECO,*HEPCO,RIF*
16	Water Tank		Sintex, Polycon, Uniplast
17	Mirror		Atul, Modi guard, *Asahi,Saint Gobain*
18	Hand drier		Kopal, Automat, Euronics,*Utech*
19	PVC flusing cistern		Commander, Parryware, Duralite, *Hindware*
20	Insulation of Hot water pipes		Vidoflex insulation, Superlon, *Thermaflex, Kaiflexkaimenn*
21	PVC Rain Water Pipes.		Supreme, Prince, Finolex
22	D.I pipes		Jindal, Tata, Electrosteel.,*Kesoram*
23	Sluice valve / NRV		Kirloskar, Kilburn, Zoloto,*Leader,L&T,Castle*
24	Water supply pumps		KIRLOSKAR, Crompton (CG), GRUNDFOS, KSB, *Mather&Platt*
25	DI Manhole Cover		*SKF,NECO*
26	Submersible pumps		GRUNDFOS, KSB, Mather & Platt,*CRI, CG, Kirloskar*
27	PVC/UPVC pipes & fittings		FInolex , Prince, Supreme
28	Chlrorinator		*Siemens,Thermax Ltd,Watcon,* Ion exchange,
29	HDPE Solution tank		WATCON, ION EXCHANGE, Water Supply Specilist P (Ltd)
30	C.P Flush Valves		Jaquar, *Marc,Parko*

31	Infrared Sensor operated Faucets/Urinals		Jaquar, AOS-Robo , U-tec, Kholer
32	Gratings, Strainers, Cleanouts etc		Neer Brand (Sage Metals),*ACO*
33	Level controller		*21st Century/ Advance Auto/ Shridhan international/ Minilec/ radar/ Femac/ Switzer*
34	Drainage Pumps		Grundfos, KSB, Mather & Platt
35	Water / Effluent Treatment Plant		Thermax, Geo Miler & Co, Ion-Exchange
36	Decorative bath room fittings		Jaquar (Florentine range), Aquabaths, Kohler
37	R.O System		Thermax, Ion-Exchange, Pentair
38	PE-AL-PE		Kitec, Jindal, PRINCE
39	HDPE pipes and fittings		Oriplast, So-Soon, Finolex, Gebreti, Nosil
40	CPVC pipe,fittings and Solvent		Ajay, Flowguard, Astral, Prince
41	Solar Panel		Tata BP, BHEL, Edwards (Australia)
42	Copper Pipe		Raj Co., Maxflow, *Mehta Tubes*
43	Copper Fittings		Viega, IBP,*Yorkshire, Mehta Tubes, Rajco*
44	Lab drainage		Viega, Duraline, Rex
45	Lab Fittings		Vijay, Viega
46	SS pipe(EN-10312) & press type fitting		Viega, Jindal
47	Oxilyte (Mixed oxident)		Oxybee Solutions, I2M Technologies, Faith Innovations

Note : Wherever makes have not been specified for certain items, the same shall be as per BIS and as per approval of Engineer

25.00 LIST OF APPROVED MAKES : FIRE FIGHTING WORKS

Sl.No	Material	Relevant ISI Code	MANUFACTURERS
1	G.I./M.S. Heavy class pipe	1239/3589	Jindal-Hissar, Tata, Prakash -Surya,
2	Gate Air Valve		Leader, Zoloto, *Castle*
3	Butterfly valves	13095	Audco, *KSB*, C & R, Zoloto, Castle
4	Portable Fire Extinguisher	2171	Minimax, *Safex*, Ceasefire, Newage,
5	First aid Fire hose reels	884	*Minimax, Safex*, *Ceasefire, Newage,*
6	Fire hose pipes	636	*Newage,Minimax,* Safex, *Ceasefire,*
7	Fire Hydrant valves	5290	Minimax, Newage, *Safex, Ceasefire, Superex*
8	Sprinkler Heads		
a	Pendent type		Tyco, *Viking,HD,Grinnel*
b	Side wall type		Tyco, *Viking,HD,Grinnel*
c	Sprinkler Side wall extended through		Tyco, *Viking,*HD,*Grinnel*
9	Sluice and non return/ check valve foot valve strainer		Kirloskar, I.V.C., Kilburn, Zoloto, castle,*KSB*
10	Thermoplastic fire hose pipe	1258	*Minimax,safex,Newage*
11	Rubber hose 12/20mm dia		Dunlop, Good year, Jyoti Eversafe
12	Reinforced rubber lined/canvas		Newage, Jayshree, Eversafe*,Indian Rayon*
13	Standby battery lead acid		Exide, Standard, Amco
14	Horizontal centrifugal/Fire pumps		Kirloskar,Mather& platt(WILO),GRUNDFOS,
15	Diesel engine		Kirloskar Cummins, Ashok Leyland
16	Electric motors		Kirloskar, GEC, Siemens, NGEF, ABB,Crompton
17	Electrical switch gear & starters		As per Electrical Works
18	Cables		As per Electrical Works
19	Flow meter		Scientific Equipment (P) Ltd. Hyderabad , System Sensor /CPWD
20	Suction strainer		Leader, ZOLOTO, AUDCO,Castle
21	Vibration eliminator connectors		Resistoflex,*Kanwal,D.wren*
22	Single phase preventor		L & T, GEC, SIEMENS
23	G.I. Fittings	1239 Part I	Unik, K.S., Zoloto,*R*
24	Yard Hydrant Stand Post,4 way suction		Eversafe, Minimax, Newage
	New Items		
25	DI pipes		Jindal,TATA,Electrosteel,Kesoram
26	Pipe coat material (Pipe protection)		*Pypkote Integrated water proofing co. Madras/ coaltek Rustech products (P) Ltd. Syndcate Enclave, Dabri/Makphall*

27	Fire Man's Axe		*Safeguard/safex/Newage/Gunnebo*
28			
29	Flow switch		*Potter/Safex system sensor/Jhonson control/Rapid flow*
30	Pressure switch		*Indfoss/switzer*
31	Pressure guage		*IS:C3624 (cl-I) H.GURU/Fiebig/BRC/HD*

Note : Wherever makes have not been specified for certain items, the same shall be as per BIS and as per approval of Engineer

Technical Specifications

For

ELECTRICAL WORKS

TECHNICAL SPECIFICATIONS

1.00 GENERAL SCOPE OF WORK

The scope of work shall cover internal and external electrical works for **"Construction AIIMS Like Intuitions At Raebareli"** . The scope of work covers electrical equipments as per BOQ. Also, supply, installation, testing and commissioning of electrical works of the project including the following main items/systems:

i. H.T. Sub-station including VCB panel, Transformers, bus ducts, HT cables etc

ii. Main LT , Capacitor panels (APFC), Rising mains, MV Panels.

iii. DG sets including AMF panels / Synchronizing panel etc.

iv. MCB Distribution Boards.

v. Internal electrification through concealed MS conduit and provide light points, fan points, socket outlets etc. including supplying, installation, testing and commissioning of light fixtures, fans etc.

vi. Conduiting and wiring for telephone points including Main Telephone Distribution Boards (Tag Blocks), telephone outlets etc. complete with telephone cabling from tag blocks to telephone outlets including EPABX, telephone instruments etc..

vii. Addressable Fire Detection & Alarm System consisting of Main Fire Control & Indicator Panel, Smoke & Heat Detectors, Manual Call Points Hooter etc. including conduiting/wiring & cabling complete.

viii Conduiting and wiring for cable TV

ix Conduiting for computer networking

x Public Address System

xi Lightning protection system consisting of lightning arrestor, finial, horizontal and vertical strips, test joints, earth electrodes etc.

xii. Lifts

xiii LT Cabling.

xiv Earthling, safety equipments and misc items required for electrical installation complete in all respect.

xv Out door lighting

xvi CCTV

xvii Testing and commissioning of all electrical installations

xviii Any other items/ works required for the completion of electrical work.

xix These Specifications are drawn to indicate essential requirements and precautions to be taken regarding internal & external electrical installations for ensuring efficient ,safe, economical and practicable use of electrical materials and equipments, in conformity with statutory regulations and easy maintainability of the installations .Enhancement/Sanctioning Electrical Load from State Electricity Board.

xx. Complete work shall be carried out conforming to the provisions of Indian Electricity Act and relevant Indian Standards Specifications (ISS). Wherever these regulations are supplemented by the state electricity Dept., Electricity Undertakings/Boards, Factory inspector and Safety Engineering Dept. , the installation shall comply with these requirements. Wherever these specifications given in this booklet differs from those of the statutory regulations, these specifications shall be followed.

xxi. All wiring diagrams shall indicate clearly in the plan the main switch board, distribution board, the runs of various mains and sub mains and the position of points with their classifications and controls.

All circuits shall be indicated and numbered in the wiring diagram and all the points shall be given the same number as the circuit to switch they are electrically connected. Distribution boards shall also be marked to indicate the circuit number controlled by them.

xxii. The contractor shall prepare the fabrication and detailed working drawings and obtain approval of Electrical Inspector and other local authorities before submitting them for approval of HSCC/Client. All works shall be carried by only on approval of drawings.

Approval of Drawings does not relieve the contractor of his responsibilities to meet the intents of specifications. Wherever service connections are to be obtained from the local supply company, the contractor shall process the application and obtain Power supply, All fees payable to the supply company and Electrical inspector for such service connections will be paid by Client/ reimbursed to the contractor as directed by HSCC/client.

xxiii. Location of all the equipments such as HT , LT ,MV ,Distribution Boards Switch boards Light fitting, Cable Routes, Conduits /Wiring routes , earth pits etc. shall be marked at site and approval of Engineer – in- Charge obtained before proceeding with the installation work.

xxiv. Submission of GA drawings of electrical equipments and getting approvals from Client/HSCC/Owner before manufacturing/fabrication.

xxv. contractor shall submit equipment drawing from manufacturer along with the layout etc. and working drawings for approval from HSCC Electrical Engineer before manufacture / commencement of work at site.

xxvi. Incase, details of any electrical item/ system are left out, then kindly refer the CPWD specifications & approval from Engineer.

2.0 REGULATIONS AND STANDARDS

2.1 All equipments their installation, testing and commissioning shall conform latest CPWD/ IS specifications in all respects. Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian electricity Rules and the Regulations, National Electric Code, National Building Code, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Mode of all measurement will be as per latest CPWD norms/ specifications Some of the applicable codes/standards are as under:

a)	CPWD General specifications for electrical works	Part-I (Internal)- 2005
b)	CPWD General specifications for electrical works	Part-II (External)-1995
c)	CPWD General specifications for electrical works	Part-III (Lifts & Escalators)-2003
d)	CPWD General specifications for electrical works	Part-IV (Substation)-2007
e)	CPWD General specifications for electrical works	Part VII (DG Sets) 2006
f)	CPWD Specification/norms for measurement	Latest revision
g)	Guide for marking of insulated conductors	IS 5578
h)	Guide for uniform system of marking and identification of conductor and apparatus terminals.	IS 11353
i)	Low voltage switchgear and control gear assemblies	S 8623 Part-1 to 3
j)	Specification for low voltage switchgear and control gear	IS 13947
k)	Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC	IS 2675
l)	Code of practice for selection, Installation and maintenance of switchgear and control gear.	ISI 10118 Part – 1 - 4
m)	Low-voltage fuses for voltages not exceeding	ISI13703 Part-1&2

	1000V AC or 1500V DC	
n)	PVC insulated (heavy duty) electric cables	IS 1554
o)	PVC insulated cables for working voltages upto and including 1100V.	IS 694
p)	Conduit for electrical installations	IS 9537
q)	Accessories for rigid steel conduits for electrical wiring	IS 3837
r)	Boxes for the enclosure of electrical accessories	IS 14772
s)	General and safety requirements for luminaries	IS 1913
t)	Code of practice for earthing	IS 3043
u)	Electrical accessories – circuit breakers for over current protection for household and similar installations.	IS 8828
v)	Low voltage switchgear and control gear	IS 13947 part 1 – 5
w)	Residual current operated circuit beakers	IS 12640
x)	Current Transformers	IS 2705
y)	Voltage Transformers	IS 3156
z)	Direct acting indicating analogue electrical measuring instruments and their accessories	IS 1248 part – 1 to 9
A1)	Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages upto and including 1000V ac and 1200V DC.	IS 13947 & IS 1336
B1)	ONAN Transformer	IS 11171

In case of contradiction in specification the priority of the documents shall be as follows:

CPWD/ IS specification, BOQ, drawings, Technical specifications

H.T. SUBSTATION

33 KV VCB HT PANELS

3.01 GENERAL:

This specification covers the design, fabrication, manufacturing, assembling, testing of 33 KV VCB panels suitable for indoor application, complete with relays meters and all necessary accessories for efficient and trouble-free operation as specified here in under.

The switchboard shall be suitable for the following system:

Rated Voltage	:	3 Phases, 33 KV Earthed System
Maximum System Voltage	:	36 KV
Rated Frequency	:	50 Hz
Ambient Temperature	:	$45^{O}C$

3.02 STANDARD & CODES:

Unless otherwise stated, HT switchboard shall conform to the following relevant Indian standards and Indian Electricity Rules and Regulations.

i)	IS-13118	:	VCB Breakers
ii)	IS-3427	:	Metal enclosed switchgear and control gear for voltage above 1000V.
iii)	IS-2705	:	Current Transformer
iv)	IS-3156	:	Potential Transformer
v)	IS-1248	:	Indicating measuring instruments
vi)	IS-722	:	Indicating instruments
vii)	IS-3231/ 8686	:	Electrical Relays

3.03 CONSTRUCTION FEATURES:

The switchgear shall be metal-clad, floor mounted, draw-out design with extensibility suitable for indoor installation. The switchgear panel shall have separate circuit breaker compartment, CT & Cable compartment, Bus bar Compartment and a Separate LV compartment.

The switchgear shall be made out of CRCA sheet steel of minimum 2 mm thickness.

The circuit breaker shall be mounted on a carriage with the operating mechanism located at the front of the carriage. The moving carriage shall be complete with self-aligning primary and secondary disconnecting devices. And shall have three distinctive positions -

a) Service
b) Test
c) Isolated

The switchgear shall be required to operate in the following manner.

a) In "service" position all the power contacts and control contacts shall be maintained and the circuit breaker can be closed and tripped in the normal way.

b) In "test" position, the power contacts shall be disconnected and control contacts shall be maintained. In this position, the circuit breaker can only be closed and tripped from local panel only.

c) In “isolated" position, both the power and control contacts shall be disconnected and the carriage shall be ready for removal.

The switchgear shall be designed in such a way that power contacts of the fixed portion shall be covered by a safety shutter when the moving carriage is withdrawn from the panel.

Each switchgear assembly consisting of all the units shall be mounted and bolted to a common channel. The channel in turn shall be bolted to the foundation at site. All equipment foundation, anchor bolts, etc. shall be furnished.

The standard phase arrangement when facing the switchgear shall be R-Y-B from left to right, from top to bottom and front to back. All relays, instruments, other devices, buses and equipment involving three phase circuit shall be arranged and connected in accordance with the standard phase arrangement.

3.04. BUS BARS:

The switchgear buses shall be rated for specified continuous current as detailed in Bill of Material. Maximum temperature rise of bus bars and connections shall be as per IS 13118 & IS 3427 over an ambient of 45 ^{O}C.

The busbars shall be of hard drawn electrolytic copper/aluminum liberally sized with high safety factor for required current rating and shall be uniform through out the length of the switchgear supported by busbar calculations.

Busbar joints shall be of bimetallic joints to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance. Bus bar Insulators shall be of track-resistance, high strength and non hygroscopic non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar supports made of epoxy resin casts insulator shall be supported in such a way that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the bus bars and all other current 'carrying equipments shall be rated as per relevant Indian standards with due consideration of the specified ambient temperature.

The bus bars shall have the marking, color coding and arrangement according to the relevant IS and shall run in a separate bus bar chamber. The bus bars and joints shall be fully insulated and so enclosed as not to leave any exposed live parts.

3.05. CIRCUIT BREAKERS

The circuit breakers shall be horizontally isolated and horizontally draw out type VCB mounted on the movable carriage.

The switchboard shall be effectively earth and have busbar and cable earthing facilities.

All the circuit breaker shall be provided with motor operated spring charged closing mechanism with spring charged/ discharged indicator. Mechanical and electrical antipumping device shall be provided.

All Breakers shall be suitable for local/remote electrical/mechanical operation. Electrical & Mechanical interlocks shall be provided to prevent any operational hazards.

At least three (3) NO and three (3) NC mechanically operated auxiliary contacts of sufficient rating (in addition to those required for breaker operation) shall be wired out to terminal block for external connection. In addition to the circuit breaker auxiliary contacts provided on breaker trolley for circuit breaker operation, a mechanically operated switch shall be provided on a stationary part of switchgear. This switch shall be positively operated by the breaker mechanism when the breaker is in "service" position but not when the breaker is isolated. The switch shall be provided with at least six (6) normally open and at least six (6) normally closed adequately rated auxiliary contacts for each circuit breaker for inter locking.

In case a switch with six (6) NC contacts cannot be offered as required then a switch with six (6) normally closed and two (2) normally open contacts offered along with an auxiliary relay having four (4) normally open and two (2) normally closed contacts (out of which any four contacts shall be wired out), shall be provided on each feeder cubicle.

3.06. INSTRUMENT TRANSFORMER

3.06.1 Current Transformer

The current transformers shall be of epoxy resin cast type, mounted on stationary portion of the switchgear and shall be easily accessible for maintenance and testing purpose. Manufacturing and testing of the current transformers shall conform to the latest edition of IS 2705.

The current transformers shall be capable of withstanding the short circuit stresses corresponding to a fault level of the system.

The ratio and ratings of the current transformers shall be suitable to meet the requirements of metering and protection of the corresponding feeder.

Facilities for shorting and grounding the terminals shall be provided at the terminal block. All CTs shall have 2 Core, one for metering with Accuracy Class 1.0 with and other for protection with Accuracy Class 5P10.

3.06.2 Potential Transformers

The main incomer shall have of epoxy resin cast type potential transformers. The manufacturing, testing, insulating and temperature rise of the potential transformer shall conform to the latest revision of IS 3156.

A manually operated disconnecting device shall be mounted on the primary side of the potential transformer. This device shall be designed to operate externally without access into the line portion of the switchgear. The high voltage winding of the potential transformer shall be having high voltage fuses, sized to prevent overloading of PT.

The connections from main circuit to potential transformers shall be capable of withstanding short circuit stresses of the system.

The PT shall be of fixed type suitable for both metering and protection of 100 VA.

3.06.2. INSTRUMENTS & METERS

The analogue meters shall be the flush mounted type preferably with the square face of 144 mm sq. as specified. They shall be fully tropicalised, dust/vermin proof and shall conform to the relevant standards.

Marking of the scale shall be black on white background and shall be suitable for direct reading. Zero adjustment shall be provided for the operation from the front of the cases.

The scale range of the AC ammeter shall generally be equal to 1.5 times the rated primary current of the C.T. feeding them. The scale range of the voltmeter shall be about 15% in excess of the normal circuit voltage.

Ammeter for transformer circuits shall be marked with a red mark to indicate the full load current of the transformer.

3.06.3. RELAYS

All relays shall be mounted in separate chamber & totally segregated from the high voltage chamber being metal clad switchgear panel. All relays shall be mounted above 1800 mm. All relays shall conform to the requirement of IS 3231 for Electromechanical relays and IS 8686 for Static relays.

Each breaker shall have the following protections as indicated in BOQ and schematic diagram 2.13 numeric type.

3.07. AUXILIARY AND CONTROL POWER SUPPLY

3.07.1 AC Power Supply for Space Heater and Cubicle Illumination Lamps:

Each carriage control panel including the breaker operating mechanism shall be provided with thermostatically controlled space heater. The thermostat shall have adjustable range. The space heaters shall be rated for 230 volts, 1 phase, 50 Hz. For cubicle illumination, receptacle arrangement at suitable location of each control panel shall be provided so that hand lamp connection may be taken from this receptacle during inspection and maintenance.

Wiring for space heaters shall be suitably grouped so as to form more or less balanced conditions on 230 V, 1 phase, 50 Hz supply. Suitable number of space heaters along with thermostat may be provided.

Each space heater and hand lamp circuit shall be provided with ON/OFF switch and suitable protection.

3.07.2 DC Power Supply:

The power for breaker control and indication shall be taken from 24 V DC power supply Power Pack.

In addition, each cubicle shall be provided with one double pole, single throw switch for its control circuit power supply.

3.07.3 Fuse:

All control and power fuses shall be link type “HRC" fuses. Plug fuses (screw-in type) shall not be accepted.

3.08. SECONDARY AND SMALL WIRING

All wiring for the equipment and devices located on or within the switchgear shall be carried out completely in all respects so as to ensure proper functioning of control, indication, measurement, protection and interlocking scheme.

All the wiring shall be marked in accordance with the relevant standards. Numbered ferrules, reading from the terminals onward shall be provided at both ends of all the wiring for easy identification.

The internal wiring shall be of PVC insulated cable of 1100 grade of minimum size 2.5 sq. mm copper.

3.09. CABLE TERMINATION

3.09.1 Power Cable

Cable pot heads for termination of 33 KV XLPE type insulated cables shall be furnished. All power cable entry shall be from the top/bottom and the cable pot heads shall be self-supported, detachable type.

Where more than one cable pot heads are used per phase, the Contractor shall be required to arrange pot heads in such a way that detachment of any pot head is possible without disturbing the other units.

3.09.2 Control Cable

All control cables shall enter the switchgear from top/bottom. Removable plates at the top/bottom of the panel shall be furnished with compression type cable glands to make entry dust-tight and no weight is transferred on the terminal. The glands shall be suitable for terminating cable suitably.

All connections and accessories required to complete the whole installation shall be supplied by the Contractor.

3.10 TERMINAL BLOCKS

Terminal blocks shall be provided as specified and shall be clip-on type. They shall be shrouded preferably by a transparent acrylic sheet. The terminal block of different voltage classes shall be segregated.

3.11. ACCESSORIES

Following accessories shall be provided for each switchgear:

- Channel base and foundation bolts
- Lifting lugs
- Accessories required for test position of the circuit breaker
- Rack-in rack-out handle for circuit breaker
- Test plug for draw out type relay

3.12. NAME PLATE

Nameplates of approved design shall be furnished at the front of each compartment of the cubicles. Rating plates for each circuit breaker and at each instrument, relay and auxiliary switches as mounted on the face or inside the cubicle shall also be furnished.

Instruments and devices mounted on the cubicle door of the switchgear shall be identified on the rear also with the respective numbers on or adjacent to the instrument or device case.

3.13. GROUND BUS

A ground bus of 50 mm x 6 mm Copper flat shall be furnished along with the full length of the panel. Each stationary unit shall be connected directly to this ground bus.

Grounding terminals at two end of the ground bus shall be provided for connection to station ground grid.

The frame of each draw-out carriage containing circuit breaker shall be grounded through heavy multiple finger contacts at all times except when the unit primary disconnecting devices are separated by a safe distance.

3.14. TESTS:

The switchgear unit shall be completely assembled, wired, adjusted and tested for operation under similar conditions to ensure accuracy of wiring, correctness of control schemes and proper functioning of all equipment.

3.14.1 Routine Test

Each of the following equipment shall be subjected to standard routine tests as per applicable clauses of relevant specifications:

- Circuit breakers
- Bus bar assembly

- Instrument transformers
- Auxiliary relays
- Control switches and indication lamps

3.14.2 Design Test

Type test report for the breakers supplied, conducted on a similar equipments in the past shall be furnished during drawing approval.

- Impulse test
- Power frequency voltage withstand test
- Temperature rise test
- Short circuit test

3.14.3 Test Certificates

Test certificate shall be furnished in required number of copies.

The routine test certificates shall be furnished to the Engineer-in-charge for approval before dispatch of the equipment from the works. The approval in writing shall be required to affect the dispatch of the equipment.

The routine and type test certificates of the bought outs/miscellaneous components shall also be furnished to the Engineer-in-charge for approval.

The report shall furnish complete identification of data including serial number of each equipment.

3.14.4 Performance Guarantee

The performance guarantee figures quoted on the schedule of technical data shall be guaranteed within the tolerances permitted by standard and will become a part of successful Tenderer's Contract.

3.15. DRAWINGS, DATA AND MANUALS:

After award of contract, the successful Bidder shall submit the required number of copies of the following drawings for approval of the Engineer-in-charge:

Confirmed outline dimensional drawing of the various switchgears showing the general arrangement and indicating the following:

- Space required in the front for breaker withdrawal.
- Control cable entry points and termination arrangement.

- Power cable entry points and termination arrangement.
- Bus bar clearance phase to phase and phase to ground.
- Configuration of bus bar with busbar calculations.
- Technical detail of supporting insulator and their spacing.
- Location of instrument transformers.
- Control panel details with equipment layout.
- Terminal block details.

Single line diagram of all switchgears showing instrument transformers control switches, instruments and indication, etc.

Control schematic diagram of each breaker showing all safety and operation interlocks, annunciation, etc.

Transport/shipping dimensions with weights.

Foundation and anchor bolt details including dead load and impact load.

The responsibility of correctness of wiring diagram shall be with the Contractor. The Engineer-in-charge will check the final schematic after submission. If any modification, addition or alteration is considered necessary to comply with the approved schematic drawing as stated herein above, the said modification, addition or alteration shall be carried out by the Contractor either in their works if it is before delivery, or at Site after delivery at no cost to the Owner.

Before starting manufacture of the equipment, the Contractor shall have to take approval of these design drawings from the Engineer-in-charge in writing. Any manufacturing done prior to approval of drawings shall be rectified in accordance with the approved drawing by the Contractor at his own cost and the equipment shall be supplied within the stipulated period.

3.16.0 TECHNICAL PARTICULARS OF 33 kV SWITCHGEAR EQUIPMENT

1.	SWITCHGEAR	
a)	Type	VCB
b)	Reference Standard	As applicable
c)	Voltage (Nom./Max.)	33 / 36 kV
d)	Phase, Frequency	3 , 50 Hz
e)	Short-time for1 sec.	13.1 kArms for 1 Sec
f)	Insulation Level	170kVp / 36 kVrms
g)	Metal-clad construction	Yes
h)	Degree of Protection	IP 4X
i)	Minimum thickness of sheet metal used	As per manufacturer standards

j)	Switchgear completely assembled, wi and tested at factory	Yes
2.	BUS.BARS	
i)	Conductor material	Electrolytic Copper / Aluminum
ii)	Rated continuous current at specifi ambient temperature	
iii)	Rated short time current and its duration	25 KA for 1 Sec.
iv)	One minute power frequency withsta voltage	70kVrms
v)	Impulse withstand voltage	170 kVp
3.	CIRCUIT BREAKERS	
i)	Type of circuit breaker	Vacuum
ii)	Rated voltage and frequency	33 KV 50Hz
iii)	Rated short time withstands current and duration with breaker as housed in t panel.	13.12KA for 3 Sec (Eqvt. To 7 MVA)
iv)	Making current (Peak)	50 kAp
v)	Max. temp.-rise over ambient specified,	As per Table V, IEC : 60694
vi)	Interchangeability of similar equipment	Yes
vii)	Duty cycle	O-3min-CO-3 min-CO
viii)	Type of closing	Spring charged stored energy
ix)	Closing/tripping mechanism	24 V DC
4.	CURRENTTRANSFORMERS	
i)	Type	Cast Resin
ii)	Rated voltage and frequency	36 KV, 50 Hz
iii)	Rated short time current and its duration	13.1 KA for 1 Sec.
iv)	Rated secondary current	5A/ 2.89A
v)	Maximum temperature rise over ambient	As per IS/IEC
vi)	Class of insulation	As per Class E
5.	POTENTIAL TRANSFORMERS	
i)	Type	Cast Resin
iii)	Rated voltage and frequency	36 KV, 50 Hz
iv)	No. of cores	2
v)	Maximum temperature rise over ambient	As per IS/IEC
vi)	Class of insulation	As per Class E
6.	CONTROLWIRING	
i)	Material and size of conductor	Copper
ii)	For CT circuit	2.5 mm^2
iii)	For other circuit	1.5 mm^2
iv)	Material of insulation and sheath	FRLS PVC

v) Voltage grade of control wiring 1100V

3.17 BATTERY & BATTERY CHARGER (Power Pack)

There are three nos of Power Packs for the above 33 KV HT Panels. The Ah for the Ah of the batteries to be suitably selected..

Unit shall comprise a ventilated cabinet supplied complete with charger, meters, high rate charge switch and lock and key.

Unit shall be designed for Sealed Maintenance Free Batteries and shall provide these batteries with means for keeping the charge up to the proper level. Cabinet shall be ruggedly constructed of a minimum of 1.63mm sheet (16SWG), primed and then finished in red. A steel divider shall completely separate the cell from the charger controls. Separator strips between cells shall hold them securely to prevent movement or spillage. SMF batteries shall be provided. The battery backup shall be for minimum 24 hours. Batteries shall be kept on wooden planks. The Cabinet shall be equipped with the Ammeter, Voltmeter and indications lamp. To show the status of the batteries and the incoming AC supply.

3.18 33 KV KV CABLES

3.18.1 GENERAL

The high tension cables shall be aluminium conductor XLPE insulated armoured construction. The conductors shall be made from electrical purity aluminium wire. The conductor shall be sector shaped stranded conductors. The cables shall conform to IS: 7098 Part -II 1985.

3.18.02 Rating

The cables shall be rated for a voltage of 33000 volts. / 11000 Volts.

3.18.03 Core Identification

Core shall be identified by numbers 1,2 &3 printed on the insulation.

3.18.04 Current Rating

The current rating shall be based on the following conditions.

a)	Max. conductor temperature	:	65 C
b)	Ambient Air temperature	:	40 C
c)	Ground temperature	:	30 C
d)	Depth of laying	:	90 C

3.18.05 Short Circuit Ratings

Short circuit rating for the cables shall be as per IS:692 (Latest Edition). However, the rating shall be based on the following.

a) Max. conductor temperature under full load conditions : 65 C

b) Max. S. C. Conductor Temperature : 140 C

3.18.06 Selection of Cables

The cables have been selected considering the following:

a) Max. connected load.
b) Ambient temperature.
c) Grouping of cables.
d) Short circuit level.

3.18.07 Storing, Laying and jointing

H.T. Cables shall be laid in trenches or ducts unless otherwise specified. Generally, laying, jointing and commissioning shall be as per the regulations of local authorities.

a) Storing

On receipt of H.T. Cables at site, cable shall be inspected to detect any damage. The ends of cables shall be in sealed condition. After inspection, cables shall be in stored in a proper place with battens of cable drums being replaced. The cable drums shall not be stored `on flat` with flanges horizontal.

b) Laying: Cable laying in trenches

HT cables can be laid in outdoor trenches, if specifically called for although provision exists for pulling cable in existing ducts.Wherever, cables are laid in outdoor trenches, the depth of the trenches shall no be less than 750 mm plus radius of cable, from upper surface of the ground. Where more than one multicore cable is laid in the same trench, a horizontal internal spacing of 0.25 metres shall be left in order to reduce mutual heating and also to ensure that fault occurring on one cable will not damage the adjacent cable.

Cable shall be laid in asbestos cement pipes encased in concrete or hume pipes at all road crossings. Cable shall be laid in trenches over rollers placed inside the trenches. After the cable has been properly laid and straightened, it shall be covered with 80mm thick layer of sand. Cable shall then be lifted and placed over this sand cushion. Again, the cable shall be covered with a sand layer of 150mm thick. Over this sand layer a course of cable protection tiles of overlap of 50mm on either side of cable markers made of aluminium of cast iron indicating the voltage grade and direction of run of the cables shall be installed at regular intervals.

3.18.08 Cable Jointing

Cable jointing shall be made as per the instructions of the cable manufacturer. Cable jointing shall be carried out only by qualified and competent cables

jointers. A copy of manufacturers recommendations shall be submitted to the consultants for approval of consultant. Cable shall be jointed using standard cable joining boxes with a lead sleeve and MS/CI rectangular box.

Cable shall be jointed using standard cable joint boxes with a lead sleeve and CI protection box. The box shall be of split type with compound filling hole and plug. The lead sleeve shall be free from pores, impurities etc. The cable box shall be provided with holes and lead seals. Cable shall be jointed as per colour coding or numbering of the cores. The cable seal shall not be removed until all preparations for jointing are completed. Jointing the glands and armour clamp shall establish good electrical contact between cable armour, lead sheath and body of the switchgear. The cable box and gland shall be bonded to the main earth bus with suitable size copper tapes.

3.18.09 Testing

a) Insulation resistance of both sections of the cables to be jointed should be checked by 5000 V megger.

b) H.T. Cables shall be pressure tested to withstand a voltage after the jointing is completed. However, the test voltage and duration of test shall be in conformity with local standards. Before carrying out the DC high voltage test, the cable shall be laid in its final position with all the end terminations kept unfinished so that substation equipments are not subjected to the test pressure.

4. GENERAL REQUIRMET OF HT 11 KV INDOOR VCB PANEL

INTRODUCTION

This specification covers the design, manufacture and supply of 11 KV Switchboard incorporating 11 KV draw-out vacuum circuit breaker.

The subject breaker is to be supplied in accordance with State Regulations and requirements.

The 11 KV Switchboard shall be capable of continuous and reliable operation at the full load rating specified where continuity of operation is of prime importance. Workmanship shall be of the highest grade and the entire construction in accordance with the best modern practice. The HT Breaker shall be capable of withstanding the severest stresses likely to occur in actual service and of resisting rough handling during transport.

The HT Switch board shall have incoming feeder and the panel is to be of extendable type for adding load-breaking switch at later date for receiving dual source of supplies, if required.

SYSTEM

THE HT SYSTEM SHALL BE SUITABLE FOR THE FOLLOWING:

Rated voltage	:	11 kV, 3 phase
Rated Current	:	630A
Rated frequency	:	50 Hz Fault
level	:	350MVA

Cubicle Contents : Floor mounted, Free standing, Dust & Vermin - Proof

Bus	-	Copper
Enclosure	-	IP54
Maximum bus-bar temp.	-	85 ° C
Circuit breaker type	-	Vacuum
Operating duty	-	O-3 min-CO-3 min CO
Control voltage	-	110 V AC

STANDARDS

The design, manufacture and testing of the various equipment covered by this specification shall comply with the latest issue of the following standards:

IS 13118 - General requirements of circuit Breaker for Voltages above1000V.

IS 3427 - Metal enclosed switchgear & Control gear (1 kV to 11 kV)

IS 37 - Marking and arrangement of Switchgear Bus-bars

IS 2705 - Specifications for current HT Panels

IS 3156 - Specifications for voltage HT Panels

IS 3231 - Electrical relays for power System Protection

IS 1248 - Electrical indicating instruments

IS 722 - Integrating meters

IS 6875 - Control switches and push buttons

IS 694 - PVC insulated cable with copper Conductor

For Voltages up to 1100 KV for control wiring.

General construction and arrangements:

3.1.1 The switchgear shall be metal enclosed rigid free standing dead front structure made out of standard prefabricated, cold rolled, sheet steel. For doors and opening Neoprene gaskets shall be provided.

The switchboards shall be totally enclosed vermin proof. Opening for natural ventilation shall be louvered with wire mesh. Wire mesh for bus bar compartment shall be such as to protect against objects of 1 mm and above the enclosure protection shall be not less than IPH6 as per IS; 3427 except for bus bar compartment.

3.1.3 Each unit of the switch gear shall have necessary internal sheet metal barrier to form separate components for buses instruments / relays / cable connections etc., Compartment for cable connection shall allow cable pulling, termination and connection work with switch gear energised. Suitable arc propagation barrier shall also be provided. Terminal strip for outgoing control cables connection should be accessible to facilitate working and testing with breaker in test / service condition and while the switch board is energised.

3.1.4 Adequate barriers shall permit personnel to work safely within an empty compartment with the bus bars energised.

3.1.5 The draw out carriage on the switch board shall have three positions viz.,

'Service'. 'Test', and 'Drawn Out'. Automatic safety shutters shall be provided to ensure the inaccessibility of all live parts after the breaker is drawn out. It shall not be possible to draw out the carriage with circuit breaker closed. The breaker / contactor feeder trolley shall remain inside the cubicle even in the 'drawout' position. There shall be distinct overall door for the breaker compartment and it should be lockable. All circuit breaker trucks of the same rating shall be interchangeable. Suitable interlocks shall be provided to prevent faulty operation such as:

'Plugging in' or 'drawing out' of a closed breaker.

'Plugging in' a breaker with earthing isolator closed'.

'Closing' of earthing isolator with the breaker 'Plugged in'.

Pulling out of auxiliary circuit plug with breaker in service position.

Pushing in breaker to service position with auxiliary circuit plug not in position.

Opening of compartment door with isolating switch in ON position and vice-versa.

3.1.6 Suitable eye bolts for lifting of panel shall be provided. The panel shall be bolted together to form a continuous front switchgear suitable for front operated and for extension at both ends.

BUSBARS

The bus-bars shall be of epoxy moulded or PVC sleeved and made of high conductivity electrolytic grade copper. The current in all current carrying paths should not exceed 1.20 A / sq mm.

The bus bar chamber shall be totally maintenance free.

The switchboard shall comprise of 3 phase main bus-bars. The bus bar shall be of uniform cross-section throughout and shall be sized to continuously carry the rated current without exceeding the temperature rise of 40 ° C over the maximum ambient temperature of 45 ° C. Bus-bars shall be colour coded for easy identification of individual phases.

Bus bars shall be supported at regular intervals and both bus-bars and supports shall be adequately sized and braced to withstand short circuit level, without deformation. All bus supports shall be non-carbonizing material, resistant to acid alkalis and shall have non-hygroscopic characteristics.

For lengthy bus-bars suitable expansion joints shall be provided. Thermal design of the bus-bars shall be based on the installation of the switchgear in poorly ventilated condition.

Bus-bars shall be housed in a separate chamber, which shall be accessible for inspection only with special tools.

The rating of bus-bars shall be same as that of incomer breaker rating.

INSULATION LEVELS

The insulation level corresponding to the rated voltage is:

- Normal Voltage : 11 kV
- Highest system voltage : 12 kV
- One minute Power Frequency Withstand voltage : 28 kV

- 1.2/50 micro second impulse : 78 kV

Air insulated Busbar Clearance

- Phase to phase : 130 mm
- Phase to earth : 90 mm

CIRCUIT BREAKERS

¾ Circuit Breakers shall be triple pole, vacuum circuit breaker, and draw-out type.

¾ The normal current rating of breakers should be at least 1.6 times the maximum loading of circuit it controls. The rupturing capacity of breaker should be at least 1.25 times the calculated fault level of bus-bars.

¾ The breakers shall have motor operated spring charged mechanism with anti-pumping contactor. The control circuit shall be suitable for local as well as remote control.

¾ The breaker sockets and plugs should be heavily silver-plated. It should have adequate auxiliary contacts required by plant control schematics plus 20% spare contacts for future use. Auxiliary contactors or relays should be used to multiply the contacts.

¾ The operating mechanism shall be robust design with a minimum number of linkages to ensure maximum reliability. The operating mechanism shall be such that the breaker is at all times free to open immediately, when the trip coil is energized. It is to be ensured that all the three poles open/close in unison to avoid any eventuality of single-phasing operation.

THE BREAKER SHALL HAVE THE DISTINCT POSITIONS INDICATING:

'Service' Position	: With main auxiliary contacts
'Test' Position	: With power contacts fully disconnected and control circuit
'Isolated' Position	: With both power and control circuit contacts fully disconnected.
Earthing	: While drawing-in the Breaker, **earth** shall Come into contact **before** the test Position. While drawing-out the Breaker, **earth**

shall disconnect **after** the test position.

The breaker trolley shall remain inside the cubicle even in the draw-out position.

The trolley of the circuit breaker shall be so inter-locked that, it shall not be possible to isolate it from the connected position, or to plug it in from the isolated position with the breaker closed.

The circuit breaker can be closed only when it is in one of the three positions or when it is fully out of the panel.

It shall not be possible to open the breaker compartment door unless the breakers drawn to the isolated position or test position.

Inadvertent 'pushing in' of the draw-out circuit breaker in service position, with auxiliary circuit plug not in the position shall be prevented.

Automatic safety shutters shall be provided to ensure the inaccessibility of live parts after the breaker is drawn-out.

The circuit breaker trolley shall be provided with a heavy-duty self-aligning earth contact, which shall make before and break after the main isolating contacts during insertion into and withdrawal from the service position of the breaker. Even in the isolated position, positive earthing contact should exist.

Circuit breakers of identical rating shall be interchangeable.

EARTH SWITCHES

Each breaker shall be provided with independent earth switch (make proof) to earth the cable side terminals. Optionally an earth trolley shall be provided for all the breakers.

CURRENT TRANSFORMERS

The current transformer shall be of cast resin insulated type of adequate capacity and proper characteristics on secondary, as specified. The current density should not be more than 1 amp/ sq mm.

CTs shall withstand stresses originated from short circuit. They shall have ratios, output and accuracy as specified. They shall be mounted on the switchboard stationary part.

The secondary leads of the CTs from all panels should be terminated on the front of the board on easily accessible shorting type terminal connectors so that operation and maintenance can be carried out when the panels are in service.

CT's shall be given the heat - run

CT Shall be of Dual core (Core1-15VA, 5P20 for protection & Core –2 15VA, CL 0.5 accuracy for metering), CT Ratio shall be 200-150/5-5A.

POTENTIAL TRANSFORMER

The Potential Transformer shall be 100VA, 3Ph, Class 0.5 accuracy, 11KV/√3 /
110V/√3 cast resin insulated type. It shall be provided with HT / LT HRC fuses with sealing arrangement.

INDICATING / INTEGRATING METERS

All indicating instruments shall be of flush mounting, Digital type and the size of the
Indicating instruments shall be of 96 x 96 sq
mm

All auxiliary equipment such as shunts, transducers that are required shall be included.

INDICATING LAMPS

Indicating lamps shall be of LED type, low watt consumption, provided with series resistor where necessary and with translucent lamp covers. Bulbs and lenses shall be easily replaceable from the front.

FOLLOWING INDICATING LAMPS ARE REQUIRED ON THE PANEL HAVING LENS COLOURS AS DETAILED BELOW :

RYB Indication Lamps	:	**RED, YELLOW,**
Breaker ON	:	**RED**
Breaker OFF	:	**GREEN**
Breaker racked IN	:	**RED**
Breaker racked OUT	:	**GREEN**
Auto Trip	:	**AMBER**
Trip circuit healthy	:	**WHITE**
Spring charged	:	**BLUE**

Test position : **YELLOW**

All protective relays shall be rear connected, draw-out type, suitable for flush mounting and fitted with dust tight covers. All relays shall be mounted on the front of the panel and shall be specified as per requirement. The current and the voltage coils shall be provided as specified.

All relays shall have built-in flag to indicate operation. It shall be possible to reset the flag without opening the relay case. All tripping relays shall be suitable to operate on the specified voltage.

Two Over current & one Earth fault relay similar to CDG - 61 with instantaneous trip shall be provided with following Plug setting O/L 50-200% and E/F 20-80% relay.

Note:- Trip delay time shall be 1.3 Seconds

CONTROL SWITCHES AND PUSH BUTTONS

Control switches shall be of the heavy-duty rotary type with nameplates duly marked to show the operation. They shall be semi-flush mounting with only the front plate and operating handle projecting. Control switch shall be provided for Trip & Close the VCB with Neutral position. A Push button shall be available to check the healthiness of trip circuit.

INTERNAL WIRING AS PER STATE/LOCAL INSPECTORATE REQUIREMENTS

Internal wiring and inter-panel wiring for all circuit shall be carried out with 1100/650V grade, single core, multi stranded, PVC insulated copper wire of minimum 2.5 sq.mm for CT and other control circuit.

The wiring shall be neatly bunched, adequately supported and properly routed and terminated in the respective terminals with suitable lugs. There shall not be more than two wires connected at a terminal.

Wires shall be identified by numbered ferrules at each end. The ferrules shall be of ring type and non-deteriorating material.

ALL CONTROL CIRCUITS SHALL HAVE HRC FUSES MOUNTED IN FRONT OF THE PANEL AND SHALL BE EASILY ACCESSIBLE.

TERMINAL BLOCKS AND TEST BLOCKS

Terminal blocks & Test blocks for the LT connections shall be of 650 V grade, stud type and of adequate current rating.

The insulating barriers shall be provided between adjacent terminals. Provision shall be made for label inscription on terminal block. Cables should never be terminated directly on components. Provision shall be made for CT terminals shorting links, remote ON/OFF pushbutton, remote ON/OFF indication and remote Ammeter. 20% spare terminals shall be provided on each terminal block.

CABLE TERMINATION

The HT switchboard shall be designed to facilitate 1Run of 3 x 300 Sq mm for incoming and
1Run of 3core x 240 Sq mm. 11KV, XLPE insulated armoured cables for outgoing power connection or as specified.

Ample space for connection of these cables shall be provided at the rear of the Switchboard. The cable termination arrangement shall be of adequate size and design to receive the required number of cables as specified. Proper cable clamping arrangements shall be provided.

Detachable gland plate of 5mm thickness shall be provided for the cable entry into the panel. Sufficient space shall be provided to avoid sharp bending and facilitate easy connection. Suitable shrouds shall be provided to prevent accidental contact with live outgoing terminations of other feeders while carrying out maintenance on one feeder.

LABLES

Nameplates of approved design shall be provided to represent circuit designation for each feeder. Material for nameplates shall be engraved Aluminium Sheet with black background and firmly secured with fasteners.

PAINTING

All metal surfaces shall be chemically cleaned, degreased and pickled in acid to produce a smooth clean surface, free of scale, grease and rust.

After cleaning, phosphating and passivation treatment, the surface shall be given two coats of zinc rich epoxy primer and baked in the oven.

After primer, it shall be given two coats of stoving type Epoxy paint in light gray as per IS- Shade. Sufficient quantity of touch up paint shall be furnished for application at site.

TESTS

The 11 kV switchboard shall be tested for routine tests as per the relevant Indian

Standards. Pre-commissioning Checks and Tests should be done at site by you at

free of cost and

certificate should be issued.

INSPECTION

Stage 1 Inspection : During Assembly of Panel

Stage 2 Inspection : Before Despatch

The readiness should be informed at least fifteen days before the proposed date of
Inspection.

COMMISSIONING

The quoted price shall be inclusive of all necessary commissioning

spares. Commissioning should be done at free of cost by you.

AUXILIARY SWITCHES

Each circuit breaker shall be provided with auxiliary switches to interrupt the supply to the Closing mechanism and complete the trip circuit, when the circuit breaker is in the 'Closed' position and to cover all the necessary indication, interlocking and control facilities.

All secondary connection between the fixed and moving portions of circuit breaker equipment shall be by means of plug and socket connections, arranged so as to eliminate positively any false indication when the moving portion is racked in to the service location.

Each circuit breaker shall be provided with 6 NO + 6 NC auxiliary contacts as spare in addition to the other functional requirements.

DRAWINGS AND MANUALS

Following drawings and manuals shall be submitted in Four sets, for approval:

General arrangement of circuit breaker showing
Overall dimensions
Terminal locations
Total weight
Operating mechanism
Bill of materials
Foundation details

SPECIFICATION AND SCHEDULE OF CONSUMER ISOLATION 11KV INDOOR
4 PANELS HT VCB INCOMER

SL.NO	DESCRIPTION	REQUIREMENTS
1	QUANTITY	As per BOQ.
2	RATING	11KV
3	BREAKING CAPACITY	350MVA
4	CURRENT RATING	630A
4A	CLOSING COIL VOLTAGE	110V AC or as specified in BOQ
4a	TRIP COIL VOLATAGE	110V AC or specified in BOQ
4b	DUTY CYCLE	As per ISO /IEC
4c	HIGHEST SYSTEM VOLTAGE	11KV
5	INSULATION LEVEL	12 KV Peak
6	BUSBARS	COPPER
7	PAINTING (POWDER COATED / EPOXY)	631 of IS5
8	NUMBER OF POLES	3
9	TYPE	HOR.DRAWOUT/HOR ISOLATION
10	CLOSING MECHANISM	MANUAL CUM MOTOR SPRING
11	MOTOR VOLTAGE	110VDC THROUGH POWER PACK
12	AUXILLARY CONTACT	4NO + 4NC SPARE IN ADDITION TO THE PANEL INHERENT REQUIREMENT

13	MINATURE CIRCUIT BREAKER	As required
14	ANTIPUMPING DEVICE	TO BE PROVIDED
15	POWER PACK	TO BE PROVIDED or as per BOQ
16	CURRENT TRANSFORMER	
a.	QUANTITY	3NOS
b.	RATIO	As per BOQ
c.	METERING CLASS	As per BOQ
d.	BURDEN	As per BOQ
e.	SHORT TIME RATING	28KA for 1 SEC
17	POTENTIAL TRANSFORMER	
A	QUANTITY	1 NO
B	RATIO	11KV,√3 / 110V √3
C	CLASS	CL 0.5
D	BURDEN	As per BOQ
18	ACCESSORIES	
A	TRIP / NEUTRAL / CLOSE – SWITCH	TO BE PROVIDED
B	LOCAL REMOTE SWITCH	TO BE PROVIDED
C	INDICATING LAMPS	To be provided
D	ALARM	HOOTER
E	SPACE HEATER WITH ON/OFF SWITCH/ THERMOSTAT	As per requirement
F	CABLE ENTRY	BOTTOM ENTRY FOR BOTH I/C & O/G CABLES.
19	RELAYS	
A	2 OVER LOAD AND 1 EARTH FAULT with Instantaneous high set tripping arrangement.	CDG 61 or EQUIVALENT
B	METER	1 NOS
C	HIGH SPEED TRIP RELAY	1 NOS
D	AUXILLARY RELAY (SIX ELEMENT)	1 NOS
	INPUT	1R x 3C x 300 Sq.mm 11KV XLPE CABLE or As per BOQ
20	Load Manager –(Digital)	To INDICATE PARAMETERS LIKE CURRENT,VOLTAGE, FREQUENCY AND POWER

SL.NO	DESCRIPTION	REQUIREMENTS
		TRIVECTOR CHARACTERISTICS SUCH AS KVA, KW ,KWHR, RKVA,RKW & RKWHR WITH BUILT IN ALARM AND TRIP CONTACTS FOR TRIPPING OF BREAKER IN THE EVENT OF SET EXCEEDING DEMAND AND POWER FACTOR WITH ANNUNCIATION. THE SETTING OF THE ABOVE SHALL HAVE COMPATIBILITY WITH THE STATE METERING.
21	POWER PACK/Battery Charger	As Per BOQ
22	CABLE TERMINATION	SUITABLE TO RECEIVE 3C 300 SQ.MM XLPE CABLE or As per BOQ.

OUTGOINGS

SL.NO	DESCRIPTION	REQUIREMENTS
1	QUANTITY	3 NOS.
2	RATING	11KV
3	BREAKING CAPACITY	350MVA
4	CURRENT RATING	630A
4A	CLOSING COIL VOLTAGE	110V AC
4a	TRIP COIL VOLATAGE	110V AC
4b	DUTY CYCLE	As per ISO / IEC
4c	SYSTEM VOLTAGE	11KV
5	INSULATION LEVEL	12 KV Peak
6	BUSBARS	COPPER
7	PAINTING (POWDER COATED	631 of IS5
8	NUMBER OF POLES	3
9	TYPE	HOR.DRAWOUT/HOR ISOLATION OPERATED
10	MECHANISM	Manual & Motor Spring Charged(store energy)
11	MOTOR VOLTAGE	110V DC POWER PACK

12	AUXILLARY CONTACT	4NO + 4NC spare in addition to panel inherent requirement.
13	MINATURE CIRCUI	4NOS
14	ANTIPUMPING DEVICE	TO BE PROVIDED
15	POWER PACK	Suitable of 110V AC input and 110V DC output for indication circuit and tripping circuit.

16.CURRENT TRANSFORMER	P1	P2	P3	P4
QUANTITY	3NOS	3NOS	3NOS	3NOS
RATIO	75-50 / 5-5A	100-75/ 5-5A	100-75/ 5-5A	100-75/ 5-5A
CLASS	CL 0.5, 5P10	CL 0.5, 5P10	CL 0.5, 5P10	CL 0.5, 5P10
BURDEN	15VA	15VA	15VA	15VA

SL.NO	**DESCRIPTION**	**REQUIREMENTS**		
SHORT TIME RATING	18.3KA for 1 SEC	18.3KA for 1 SEC	18.3KA for 1 SEC	18.3KA for 1 SEC

17	POTENTIAL Transformers with fuses for all sizes each comprising of following	
A	QUANTITY	1 NO
B	RATIO	11KV,√3 / 110V √3
C	CLASS	CL 0.5
D	BURDEN	200VA
18	ACCESSORIES	
A	TRIP / NEUTRAL / CLOSE – SWITCH	TO BE PROVIDED
B	LOCAL REMOTE SWITCH	TO BE PROVIDED
C	INDICATING LAMPS	8 NOS
D	ALARM	HOOTER
E	SPACE HEATER WITH ON/OFF SWITCH/	1 NO
A	CABLE ENTRY	BOTTOM ENTRY FOR BOTH I/C & O/G CABLES. .
19	RELAYS	
A	2 OVER LOAD AND 1 EARTH FAULT with	As per BOQ
A	INPUT	BUSBAR
B	OUTPUT	Each have 1R x 3C x 240 Sq.mm 11KV XLPE CABLE or As per BOQ
20	Multi Function Meter	TO BE PROVIDED
21	BMS COMPATIABILITY	Necessary arrangement shall be provided.

INCOMER
TO BE FILLED IN BY THE BIDDERS
11KV INDOOR 4 PANELS HT VCB

SL.NO	DESCRIPTION	REQUIREMENTS
1	QUANTITY / MAKE	
2	RATING	
3	BREAKING CAPACITY	
4	CURRENT RATING	
4A	CLOSING COIL VOLTAGE	
4a	TRIP COIL VOLATAGE	
4b	DUTY CYCLE	
4c	HIGHEST SYSTEM VOLTAGE	
5	INSULATION LEVEL	
6	BUSBARS	
7	PAINTING (POWDER COATED / EPOXY)	
8	NUMBER OF POLES	
9	TYPE	
10	CLOSING MECHANISM	
11	MOTOR VOLTAGE	
12	AUXILLARY CONTACT	
13	MINATURE CIRCUIT BREAKER	
14	ANTIPUMPING DEVICE	
15	POWER PACK	
16	CURRENT TRANSFORMER	
a.	QUANTITY	
b.	RATIO	
c.	METERING CLASS	
d.	BURDEN	
e.	SHORT TIME RATING	
17	POTENTIAL TRANSFORMER	
A	QUANTITY	
B	RATIO	
C	CLASS	
D	BURDEN	
18	ACCESSORIES	
A	TRIP / NEUTRAL / CLOSE – SWITCH	
B	LOCAL REMOTE SWITCH	
C	INDICATING LAMPS	
D	ALARM	
E	SPACE HEATER WITH ON/OFF SWITCH/ THERMOSTAT	
F	CABLE ENTRY	
19	RELAYS	
A	2 OVER LOAD AND 1 EARTH FAULT with Instantaneous high set tripping arrangement.	
B	METER	
C	HIGH SPEED TRIP RELAY	
D	AUXILLARY RELAY (SIX ELEMENT)	
	INPUT	
20	Load Manager –(Digital)	
21	POWER PACK	

22	CABLE TERMINATION	

OUTGOINGS

SL.NO	DESCRIPTION	REQUIREMENTS
1	QUANTITY / MAKE	
2	RATING	
3	BREAKING CAPACITY	
4	CURRENT RATING	
4A	CLOSING COIL VOLTAGE	
4a	TRIP COIL VOLATAGE	
4b	DUTY CYCLE	
4c	SYSTEM VOLTAGE	
5	INSULATION LEVEL	
6	BUSBARS	
7	PAINTING (POWDER COATED)	
8	NUMBER OF POLES	
9	TYPE	
10	MECHANISM	
11	MOTOR VOLTAGE	
12	AUXILLARY CONTACT	
13	MINATURE CIRCUIT BREAKER CONTROL	
14	ANTIPUMPING DEVICE	
15	POWER PACK	

16.CURRENT TRANSFORMER	P1	P2	P3	P4
QUANTITY				
RATIO				
CLASS				
BURDEN				
SHORT TIME RATING				

17	POTENTIAL Transformers with fuses for all sizes each comprising of following	
A	QUANTITY / MAKE	
B	RATIO	
C	CLASS	
D	BURDEN	
18	ACCESSORIES	
A	TRIP / NEUTRAL / CLOSE – SWITCH	
B	LOCAL REMOTE SWITCH	
C	INDICATING LAMPS	
D	ALARM	

E	SPACE HEATER WITH ON/OFF SWITCH/ THERMOSTAT	
A	CABLE ENTRY	
19	RELAYS	
A	2 OVER LOAD AND 1 EARTH FAULT with instantaneous high set tripping arrangement.	
A	INPUT	
B	OUTPUT	
20	Multi Function Meter	
21	BMS COMPATIABILITY	

2.GENERAL REQUIRMENT OF HT CABLES

Cable shall be capable of satisfactory performance when laid on trays, trenches, conduits, ducts and when directly buried in the ground.

Cables shall be capable of operating satisfactorily under a power supply system voltage variation of +10%, frequency variation +5%, and combined voltage and frequency variation of +10%.

Cables shall normally be laid under the following conditions:

1. In air : Ambient temperature of 45°.C
2. In ground : Ground temperature of 35° C
3. Depth of laying in ground : :1050mm(22&33KV)
4. In conduits : Space factor of not more than

5. In trays :Single layer, touching each other

6. The maximum conductor temperature for operation under Normal rated current carrying conditions and under short Circuit conditions are as follows:

Maximum conductor temperature & Standard Installation Conditions

a) Maximum Conductor temperature at continuous load 90°C

b) Ambient Air temperature 45°C Ground Temperature 30°C

c) Thermal resistivity of XLPE 350˙C cm/W

d) Thermal resistivity of PVC 70˙C cm/W

e) Depth of laying in ground 11 KV Cables 900 mm
22 KV & 33 KV Cables 1050mm

f) 11KV XLPE cables shall rated to carry 18.3 KA FOR 0.5 Seconds.

g) Method of laying - Multi core cables laid Single core cables laid in trefoil Touching / in flat formation

XLPE Construction

h) Voltage grade : 11KV

i) Conductor : Well compacted Aluminium

j) Conductor screen : This shall be extruded shield in the same operation the insulation. The polymer shall be cross liked.

k) Insulation : Shall be cross-liked polyethylene.

l) Laying up : The core shall be laid up with Polypropylene filling and tape.

Innersheath : Shall be extruded PVC Armour: Single galvanized steel wire/strip armour The cable outer sheath shall be extruded ST-2 type PVC.

m) General: The cable shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

n) Operation and Maintenance Manuals

Conductor

The conductor consists of annealed Aluminium wires compacted having a smooth circular shape as per IS: 8130-84.

Conductor screen

The conductor screen consists of a layer of smooth black extruded semi-conducting XLPE compound firmly bonded with the insulation. This eliminates electrical discharges at the interface between conductor and insulation.

Insulation

The insulation consists of super clean XLPE compound. The extrusion process is conducted in clinically clean environment. The insulation thickness conforms to IS: 7098.

Insulation screen

The screen consists of smooth black semi conducting XLPE compound firmly bonded with a smooth interface with the insulation. The conductor screen, insulation and insulation screen are extruded simultaneously in Dry cure process.

Moisture barrier

To make the cable longitudinally watertight a semi conducting tape is applied over the core to prevent water penetration in the cable. The tape is of non-woven material which has non- biodegradable characteristics.

Copper wire screen

Copper wires are applied to carry the necessary earth fault current. A counter open helix copper tape is provided over the copper wires.

Poly –Aluminium foil

Aluminium foil coated with polyethylene used longitudinally as a moisture barrier is designed for making cable lighter in weight.

Jacketing

The jacketing material consists of extruded black PVC or high-density polyethylene (HDPE). A graphite coat is provided over the outer surface of the sheath.

Current ratings of PVC cable shall be arrived on the basis of the circuits being protected by Class 'P' fuses or circuit breakers / contractors with a setting not exceeding 1.5 times the rated current for installation in air, and not exceeding 1.3 times the rated current for installation in ground.

The following letter designations shall be used to specify type of cables (IS

7098): A - Aluminium conductor

2X - XLPE insulation

W - Steel round wire armour

WA - Non-magnetic round wire armor

F - Steel strip armor

FA - Non-magnetic steel strip armor

Ww - Double steel round wire armor

FF - Double steel strip armor

Y - PVC outer sheath

Letter designations for cables shall be indicated in the following

order: Conductor size

Insulation

Sheath Armour

Overall jacket

a) Cables for control circuits shall be of solid Copper Conductor for size of 2.5 sq.mm. Copper Conductor cables shall be designated by the absence of the letter. "A" indicating the Aluminium conductor, which shall be the size of 4 sqmm. for control circuits.

b) Contractor has to work out complete requirement of cables

TESTING OF CABLES TESTS

- Cable Insulation Tests shall be conducted between phases and between phase and earth for each length of cable, before and after jointing. As such all phase cables may be checked before being laid for above tests. On completion of cable laying work, the following tests shall be conducted in the presence of the Consultant/Employer.

Construction tests

Test for conductor and compaction.

Test for aluminium conductor:

1. Tensile test
2. Wrapping test
3. Annealing test
4. Resistance test for both copper and aluminium
5. Conductor Resistive Test
6. Partial Discharge Test
7. High Voltage Test

- Test of eccentricity of insulation.
- Test for thickness of insulation
- Test for laying up along with Polypropylene tape and fillers.
- Virgin material test for PVC insulation.
- Test for thickness of inner sheath

- Test for armouring and armour coverage which should be more than 95%
- Test for thickness of outer sheath
- Insulation Resistance Test (sectional and overall)
- Continuity resistance test.
- Sheathing continuity test.
- Cable size, sequential and manufacturers identification marking on the outer sheath.
- Earth test.

All tests shall be carried out in accordance with relevant Indian Standard Code of Practice and Local Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Consultant/Employer.

LAYING OF CABLES

Cables shall be laid as per the specifications given below:

Cables - Outdoor Trenches

Cables shall be laid in outdoor trenches wherever called for. **The depth of the trenches shall not be less than 1000 mm**, below the final ground level. The width of the trenches shall not be less than 500 mm. However, where more than one cable is laid, a coaxial distance of not less than 450 mm shall be allowed between the cables. The trenches shall be cut square with vertical side walls and with uniform depth. Suitable shoring and propping may be done to avoid caving-in of trench walls. The floor of the trench shall be rammed level. **The cables shall be laid in trenches over rollers placed inside the trench.**

The cable drums shall be laid unrolled in the direction of the arrow marked on the drum

for unrolling.

Wherever cables are bent, the minimum bending radius shall not be less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with 150 mm thick layer of sand. The cable shall then be lifted and placed over the sand cushion. Over this, 450 mm thick layer of sand shall be covered and a course of cable protection tiles or burnt brick shall be provided to cover the cables by 50 mm on either side. Remaining trench shall be backfilled with earth and consolidated as original. Cables shall be laid in hume pipes/stoneware pipes at all road crossings and in GI pipe at the wall entries. Cable route markers to be provided as per standards

Excess depress shall be removed from site with free of cost

JOINING CABLES

All cable joints shall be made in suitable, approved cable joint boxes, and the filling in of compound shall be done in accordance with manufacturers' instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.

ii) All cables shall be jointed **colour to colour (should not be different colours)**; tested for continuity and insulation resistance before jointing. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be commenced and finished on the same day. During the time of joining the cables, sufficient protection from the weather shall be ensured. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

The Cable entries through pipes from outside to inside the building shall run in GI pipes and

shall be sealed water tight with approved type of sealant to avoid water entering the building.

8. GENERAL REQUIRMENT OF CABLE MANAGEMENT SYSTEM - TRAYS

LADDER TYPE CABLE TRAYS:

Shall consist of a Bolted rung assembly of field proven design. It shall consist of side rails of
2.5 mtr standard lengths and Slotted rung spaced 250mm center to center.

Coupler, Coupler fasteners, tray assembly fasteners should form the part of the equipment. The Ladders should be light sheet metal constructions yet robust enough to carry a cable
load of 50 kg/m on a span of 1.25 mtrs.

The design shall be flexible enough to accommodate change of widths at site.

Sections of 1.6/2mm shall be standard for different widths of trays as detailed in BOQ. However where locations demand lighter sections those too shall be detailed in BOQ. Horizontal bends, Vertical internal / external, tees, crosses shall be standard products.

Provision to add on earth flat holding clamps, trays fixing clamps should be part of cable tray design.

Perforated cable trays of 1.6mm / 2mm thickness and standard lengths 2.5 mtrs as detailed in BOQ shall be offered by bidder if required. Finish shall be as specified earlier.

Wire ways of enclosed type with covers, cover screws, coupler, coupler screws of Pre- Galvanized sheet constructions or of powder coated finish with all accessories shall be offered by bidder as detailed in BOQ. Such Wire ways should be suitable for surface laying or on / under floors.

CONSTRUCTION

The cable trays shall be either ladder or perforated type. The cable trays and accessories shall be fabricated out of hot rolled steel sheets, which shall be hot dipped galvanized. The complete assembled cable tray sections shall be corrosion resistant, high strength and with extreme smooth surface. Accessories Cable tray manufacturer shall supply suitable accessories for clamping the cable trays on cable tray supports from ceiling and beams of the building structure. Cable trays shall be supplied with GI

coupler plates, hardware, nuts bolts and washers for joining the standard lengths of cable tray section.

LOAD DEFLECTION CRITERIA

For tray system design in addition to self-load, following criteria shall be applied to determine section and thickness of cable tray.

Support span 2000 mm

Cable load for 300 mm	50 Kg / m
Cable load for 400 mm	75 Kg / m
Cable load for 500 mm	85 Kg / m
Cable load for 600 mm	100 Kg /

In addition to this 70 Kg/m concentrated load at the center span shall be

considered. Allowable mid span deflection < 7 mm

SURFACE PREPARATION

For treatment and preparation of surface of fabricated trays, seven tank process shall be employed comprising of the following cleaning all the members, plates shall be free from grease, paints or any foreign matter. A chemical solvent as trichloroethylene / carbon tetrachloride or a combination of solvent cleaning and heating shall be employed. Immediately after degreasing the material shall be rinsed with hot / cold water. Pickling Hydrochloric acid and sulphuric acid solutions may be used from pickling. After pickling the material shall be rinsed in running water. After surface treatment, cable trays shall be galvanized.

GALVANIZING

Zinc confirming to grade Zn 98 of IS 209 shall be normally used for galvanizing. As far as practicable, the fabricated tray and accessories shall not be sunk to the bottom of the

bath. Tray and accessories shall be galvanized at the lowest possible temperature, which will allow free drainage of zinc from the work piece during withdrawal. The thickness of the coating shall be minimum 100 microns. The zinc deposited shall not be less than approximately 720 gm/sq.m.The thickness shall be checked by a magnetic method as per IS
3203.

Small components handed in baskets shall be centrifuged to remove excess of Zinc immediately after galvanizing while the coating is still in molten condition. Hardware such as nuts and bolts shall be Electro galvanized / zinc passivated.

PAINTING

If necessary at site - only, especially after cutting / jointing. The metal surface after cleaning shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. After preparation the tray surface shall be spray painted with two coats of yellow paints.

TESTING AND INSPECTION

All the cable trays and accessories shall be offered for inspection at the fabricators works to client / consultant. Physical inspection and tests will be conducted on the trays to check its compliance with the specification and approved drawings.

Measurement of the thickness of Zinc coating- Elkometer shall be used to check the thickness of galvanizing. Deflection load test at the manufacturer's works Test span shall be simple bream span with free unrestrained ends.

The cable tray shall be uniformly loaded along the span with cable tray simply supported at the two ends as per the load criteria. Vertical deflection of the tray shall be measured at the two points along the midway between the supports. The average of these two readings shall be considered to be the vertical deflection of the tray. Vertical deflection shall be within the design criteria.

EARTHING

The cable tray /floor raceways shall be provided with brass earth clamps every 3000mm

for connecting suitable copper wire earth continuity.

9. GENERAL REQUIRMENT OF M.V. CABLES - (XLPE)

Scope:

- Supply, installation, storing, laying, fixing, jointing, terminating, testing and commissioning of Medium Voltage PVC sheathed Armoured Aluminium Conductor Cables XLPE insulated, cores laid-up with Polypropylene central filler and tape, extruded PVC inner sheathed, GI wire/strip armored and PVC outer sheathed overall confirming to IS 1554 part I 1988 with latest amendments and specifications given below, laid in built up trenches, directly buried underground, on cable trays, in pipes, clamped directly to wall or Structures.

Type

- Medium voltage cables shall be aluminium conductor, XLPE insulated, PVC sheathed and steel wire flat armoured or steel tape armoured construction. The cable shall have stranded, sector shaped aluminium conductors for cables of 4 Sq.mm size and above.

- The cables shall be rated for a voltage of 650/1100 Volts.

- Core Identifications shall be provided with the following colour scheme of XLPE insulation

  - Single Core: Red/Black/Yellow/Blue
  - Two Core: Red and Black
  - Three Core: Red, Yellow and Blue
  - 3½ or 4 Core: Red, Yellow, Blue and Black

Conductor

- Conductors are made from electrolytic grade aluminium/copper conforming to IS: 8130,are compact circular or compact shaped, solid/stranded circular.

  No of strands to be provided for circular compacted or shaped conductor to achieve better-compacted conductor.

Sl.no	Size in Sqmm	copper	Aluminium
1	1.5	3	----
2	2.5	3	----
3	4	7	3
4	6	7	3
5	10	7	7
6	16	7	7

Sl.no	Size in Sqmm	copper	Aluminium
7	25	7	7
8	35	7	7
9	50	7	7
10	70 to 150	19	19
11	185 to 300	37	37
12	400 to 500	61	61
13	630 to 1000	91	91

Insulation

- XLPE cables use specially made from high-grade cross-linked polyethylene for insulation by extrusion process.

OPERATING CHARACTERISTIC

Max. Conductor temp. for continues operation	90 deg C
Ambient air temp.	40 deg C
Standard ground temp.	30 deg C
Thermal resistivity of soil	150 deg C Cm/W
Thermal resistivity	350 deg C Cm/W
Depth of laying	75 Cm
Minimum bending radius	12D
Max. Conductor temp. during SC	250 deg C
Maximum ambient,air temp	85 deg C

LT-XLPE –Main features

Longer life as compared to conventional PVC cables

Higher conductor temperature rating i.e. 90 deg C

Higher emergency overload capacity 120 deg C

Max. temperature limit under short circuit conditions for LT-XLPE cables is

250deg C Insulation resistance is excellent & superior to identical PVC cables.

High corrosion resistance in polluted atmosphere.

Better properties of resistance to chemical and corrosive gases.

Low installation cost because of lightweight, dimension and are far more

flexible. Better properties to withstand vibrations, hot impacts.

Jointing of cables is easier and quicker.

Inspection

- All cables shall be inspected upon receipt at site and checked for any damage during transit and shall be supplied with complete manufacturer's test certificates. At any cost the cables shall not be accepted without test certificate.

Storing

- All the cables shall be supplied in drums, with manufacturer's seal. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position.

Joints in Cables

- The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing. This apportioning shall be got approved by the Consultant before the cables are cut to lengths.

- Where joints are unavoidable, the Consultant shall be approved the location of such joints and marking shall be done with suitable tags.

TESTING OF

CABLES TESTS

- The cables shall be tested in accordance with the IS: 694/1554/7098. The tests shall include

- PVC insulated cables (for voltage up to 1100V:IS 694

- PVC insulated cables (heavy duty): IS 1554 – Part I.

- Cross-linked polyethylene insulated PVC sheathed cables: IS 7098 – Part I.

- Cable Insulation Tests shall be conducted between phases and between phase and earth for each length of cable, before and after jointing. As such all phase cables may be checked before being laid for above tests. On completion of cable laying work, the following tests shall be conducted in the presence of the Consultant/Employer.

Construction tests

- Test for conductor and compaction.

For copper conductor:

1. Persulphate test for tinned copper only
2. Annealing test

Test for aluminium conductor:

1. Tensile test
2. Wrapping test
3. Annealing test
4. Resistance test for both copper and aluminium

- Test of eccentricity of insulation.

- Test for thickness of insulation

- Test for laying up along with Polypropylene tape and fillers.

- Virgin material test for PVC insulation.

- Test for thickness of inner sheath

- Test for armouring and armour coverage which should be more than 95%

- Test for thickness of outer sheath

- Insulation Resistance Test (sectional and overall)

- Continuity resistance test.

- Sheathing continuity test.

- Cable size, sequential and manufacturers identification marking on the outer sheath.

- Earth test.

- All tests shall be carried out in accordance with relevant Indian Standard Code of Practice and Local Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Consultant/Employer.

CABLE TRAYS, ACCESSORIES AND TRAY SUPPORTS

- Cable racks / trays shall either be run in concrete trenches or on overhead supports, supported from building steel, floor slab etc.

- Cables shall be clamped to the cable trays at regular intervals.

CONDUITS, PIPES AND DUCTS

- The Contractor shall supply and install conduits, pipes and ducts as per requirement. All accessories / fittings required for making the installation complete, including but not limited to, ordinary and inspection tees elbows, checkouts, male and female reducers and enlarges, wooden plugs, caps, square headed male plugs, nipples, gland sealing fittings, junction boxes, pull boxes, conduits, outlet boxes, splice boxes, terminal boxes, glands, gaskets and box covers, saddles and all steel supporting work shall be supplied by the Contractor. Conduit fittings shall be of the same material as the conduits.

- Flexible metallic conduits shall be used for termination of connections to equipment such as motors or other apparatus to be disconnected at periodic intervals. Flexible metallic conduits shall also be used for termination of connections to level switches, level electrodes, limit switch, pressure, pressure switches etc.

- Conduits or pipes shall run along walls, floors, and ceilings, on steel supports, embedded in soil, floor, wall or foundation, in accordance with approved layout drawings.

- Exposed conduit shall be adequately supported by racks and clamps or straps or by other approved means. Conduit supports shall be erected square, and true to line and grade with an average spacing of one support for every 2 meters of conduit length.

- Each conduit run shall be marked with its designation.

- All installed conduits shall have their ends temporarily closed by caps, wooden plugs, or other approved means until cable is pulled. Closures shall be made in such a way that they do not get dislodged easily.

- When one or more cables are trained through a conduit, conduit size shall be such that the total cross sectional area of the cable does not exceed 60% of the internal cross sectional area of the conduit.

- The Contractor shall be responsible for boning of metal pipes or conduits in which cables have been installed to the main earthing system. Joints, metal sheath and armour of cables shall be bonded to the earth system in an approved manner. The entire system of conduit after installation shall be tested for mechanical and electrical continuity throughout and permanently connected to earth by means of a special approved type- earthing clamp efficiently fastened to the conduit. Gas or water pipes shall not be used as an earth medium.

10. GENERAL REQUIRMENT OF CABLING SYSTEM

GENERAL

The cabling system covers the design as per relevant national / international standards. It shall be responsibility of contractor to work out a detailed layout for the complete plate cable system. The layout drawing shall be furnished for the approval of Engineer before commencement of installation including cable trays, cable trays, cable racks, accessories, tray supports, conduit etc.

CABLE LAYOUT

The following points shall be noted while planning cabling system for the plant

Inside the building either cable tray or cable trench shall be planned as per cabling requirement.

Laying of Cables

- Cables shall be laid as per the specifications given below:

Cables - Outdoor Trenches

- Cables shall be laid in outdoor trenches wherever called for. The depth of the

trenches shall not be less than 900 mm (11KV) and 1050mm(22 & 33KV), below the final ground level. The width of the trenches shall not be less than 450 mm. However, where more than one cable is laid, a coaxial distance of not less than 150 mm shall be allowed between the cables. The trenches shall be cut square with vertical sidewalls and with uniform depth. Suitable shoring and propping may be done to avoid caving-in of trench walls. The floor of the trench shall be rammed level. The cables shall be laid in trenches over rollers placed inside the trench.

- The cable drums shall be laid unrolled in the direction of the arrow marked on the drum for unrolling.

- Wherever cables are bent, the minimum-bending radius shall not be less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with 80 mm thick layer of sand. The cable shall then be lifted and placed over the sand cushion. Over this, 300 mm thick layer of sand shall be covered and a course of cable protection tiles or RCC troughs shall be provided to cover the cables by 50 mm on either side. Remaining trench shall be backfilled with earth and consolidated as original. Cables shall be laid in hume pipes/stoneware pipes at all road crossings and in GI pipe at the wall entries. Cable route markers to be provided as per standards.

- Excess debris shall be removed from site with free of cost

Cables - Indoor

- The cables laid indoors should be laid on slotted angle steel cable trays supported on M.S. angles. The cable trays should be routed above false ceilings wherever provided. Suitable clamping with straps and saddles shall be used for keeping the cables in position. Spacing between the cables shall not be less than the overall diameter of the cable.

- The cables on wall surface from panel board up to angle iron shall run in galvanized steel pipes of adequate size.

- The Cables run inside concrete trenches shall be supported on cable trays and shall be neatly arranged and clamped.

- The Cable entries through pipes from outside to inside the building shall run in GI pipes and shall be sealed water tight with approved type of sealant to avoid water entering the building.

LAYING OF CABLES

Cables shall be laid as per the specifications given below:

CABLES - OUTDOOR TRENCHES

Cables shall be laid in outdoor trenches wherever called for. **The depth of the trenches shall not be less than 900 mm (11KV) and 1050mm (22&33KV)**, below the final ground level. The width of the trenches shall not be less than 500 mm. However, where more than one cable is laid, a coaxial distance of not less than 450 mm shall be allowed between the cables. The trenches shall be cut square with vertical sidewalls and with uniform depth. Suitable shoring and propping may be done to avoid caving-in of trench walls. The floor of the trench shall be rammed level. **The cables shall be laid in trenches over rollers placed inside the trench.**

The cable drums shall be laid unrolled in the direction of the arrow marked on the drum for unrolling.

Wherever cables are bent, the minimum-bending radius shall not be less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with 150 mm thick layer of sand. The cable shall then be lifted and placed over the sand cushion. Over this, 450 mm thick layer of sand shall be covered and a course of cable protection tiles or burnt brick shall be provided to cover the cables by 50 mm on either side. Remaining trench shall be backfilled with earth and consolidated as original. Cables shall be laid in hume pipes/stoneware pipes at all road crossings and in GI pipe at the wall entries. Cable route markers to be provided as per standards

Excess depress shall be removed from sit at free of cost

INSTALLATION OF CABLES

- (a)The contractor shall install, test and commission the cabled specified in the technical specification in accordance with Contractor's drawings and approved by the Engineer. Cables shall be laid directly buries in earth, or cable racks, in build up trenches, on cable trays and supports, in conduits and ducts or bare on walls, ceiling etc. as per approved drawing. Contractor's scope of work includes unloading, laying, fixing, joining, bending, and terminating of the cables. The Contractor shall also supply the necessary materials and equipment required for joining and terminating of the cables.

- All apparatus, connections and cable work shall be designed and arranged to minimize rise of fire and any damage, which might be caused in the event of fire. Wherever cables pass through floor or wall openings or their partitions suitable bushes of an approved type shall be supplied and put into position by the contractor. If required by the Engineer, the Contractor shall seal the cables into the bushes using fire-resisting materials to prevent the spreading of fire through each partition.

- Inspection on receipt, unloading, storage and handling of cables shall be in accordance with IS: 1255 and other Indian Standard Codes of Practice.

- Standard cable grips and reels shall be utilized for cable pulling. I unduly difficult pulling occurs, the Contractor shall check the pull required and suspend pulling until further procedure has been approved by the Engineer. The maximum pull tension shall not exceed the recommended value for the cable measured by the tension dynamometer. In general, any lubricant that does not injure the overall covering & does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used to assist in the pulling of insulated cables in conduits and ducts.

- After pulling the cable, the Contractor shall record cable identification and date pulled neatly with waterproof ink on linen tags and shall securely attach such identification tags. Identification tags shall be attached to each end of each cable with non-corrosive wire. The said wire must be non-ferrous material on single conductor power cable. Tags may further be required at intervals on long runs of cable son cable trays and in pull boxes. Cable and joint markers and RCC warning covers shall be provided wherever required.

- Sharp bending and kinking of cables shall be avoided the bending radii for various types of cables shall not be less than those specified below:

- I.11 kV XLPE Multicore armoured cables: 15 times the overall dia of the cable.

- II.650/1100V XLPE insulated cable. : 10 times the overall dia of the cables.

- If shorter radius appears necessary, no bend shall be made until clearance and instructions have been received from the Engineer's Representative.

- Power and control cables shall be laid in separate cable racks/trays.

- Where groups of HV, LV and control cables are to be laid along the same route, suitable barriers to segregate them physically shall be employed.

- When power cables are laid in the proximity of communication cables, minimum horizontal and vertical separation between power and communication cables shall be normally 600mm, but in any case not less than 450mm for single core cables and 300mm for Multicore cables. Power and communication cables shall as far as possible, cross at right angles to each other.

- Where cable cross roads and water, oil, gas or sewage pipes, the cables shall be laid in reinforced spun concrete or steel pipes. For road crossings the pipe for the cable shall be buried at not less than one meter depth

- Cable laid in ground shall be laid on a 50mm riddled earth bed. The cables shall then be covered on top and at their sides with riddled earth to a depth of about 150mm. This is then gently up to a depth of about 100 mm above the top of uppermost cable covers which are placed centrally over the cables. The protective cable covers for LV cables may be of earthenware and for HV cables of reinforced concrete. The specification of protective covers shall be generally as per Appendix 'C' of IS: 1255. the RCC covers shall have one hole at each end, to tie them to each other with GI wires to prevent displacement. The trench is then back filled with the excavated soil and well rammed in successive layers of not more than
300 mm in depth, with the trenches being watered to improve consolidation where necessary. To allow for subsidence, it is advisable to allow a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench.

- Each cable shall be pulled into the particular conduit and shall be taken from the particular reel designated for the run. All cables shall be neatly trained without interlacing. In hand holes, pull boxes or junction boxes having any dimension over 1000mm, all conductors shall be cabled and/or racked in an approved manner care shall be taken to avoid sharp bending or stressing cable beyond manufacturer's recommendations in pulling. Cable shall be protected at all times from mechanical injury and from absorption of moisture at unprotected ends.

- In each cable run some extra length shall be kept at a suitable point to enable on or two straight through joints to be made, should the cable develop a fault at later date.

- Cables on cable racks, on cable trays and in conduits shall be formed to avoid bearing against edges or trays, racks, conduits or their supports upon entering or leaving trays, racks or conduits. Cables shall be racked or laid directly into cantilevered cable trays where practicable, but in some cases it may be necessary that cables are

pulled or threaded into trays. To facilitate visual tracing, cables in trays shall be laid only in single layers and unnecessary crossing of cables shall be avoided. Cables on trays shall finally be clamped in an approved manner.

- Cable splices will not be permitted except where permitted by the Engineer. Splices shall be made by the Contractor for each type of wire or cable in accordance with the instructions issued by cable manufacturers and the Engineer. Before splicing, insulated cables shall have conductor insulation stepped and bound or penciled for recommended distance back from splices to provide a long leakage path. After splicing, insulation equal to that on the spliced conductors shall be applied at each splice.

- At cable terminal points where the conductor and cable insulation will be terminated, terminations shall be made in a neat, workmanlike and approved manner by men specialized in this class of work. The Contractor shall make terminations for each type of wire or cable in accordance with instructions issued by cable manufacturers and the Engineer.

- Control cable terminations shall be made in accordance with wiring diagrams, using colour codes, numbering ferrules approved by the Engineer for the various control circuits, by code marked wiring diagrams.

- When control cables are to be fanned out and cabled together with cord, the Contractor shall make connections to terminal blocks, and test the equipment for proper operation before dabbles are corded together. If there is any question as to the proper connection, the Contractor shall make a temporary connection with sufficient length of cable so that the cable can be switched to another terminal without splicing. After correct connections are established through operating the equipment, cables shall be cut to their correct lengths, connected to terminals in the specified manner, and corded together where necessary to hold them in place in a workmanlike manner.

- Jointing of cables shall be in accordance with relevant Indian Standard Codes of Practice and manufacturer's special instruction. The Contractor shall supply materials and tools required for cable jointing work, including cold setting bituminous compound. Cables shall be firmly clamped on either side of a straight through joint at a distance of not more than
300mm away, from the joints. Indication tags shall be provided at each joint and at all cable terminations.

- Cable seals shall be examined to ascertain if they are intact and that cable ends are not damaged. If the seals are found to be broken the cable ends shall not be joined

until after due examination and testing by the Engineer. Before jointing is commences, insulation resistance of both sections of cable to be joined shall be checked by mugger.

- After installation and alignment of motors, the Contractor shall complete the conduit installation, including a section of flexible conduit between the motor terminal box and cable trench / tray. The Contractor shall install and connect the power, control and heater supply cables as per equipment manufacture's drawings if any. The Contractor shall be responsible for correct phasing of the motor power connections and shall interchange connections at the motor terminal box if necessary, after each motor is test run.

- Connections to recording instrument, float switches, level electrodes, limit switches, pressure switches, thermo-couples, thermostats and other miscellaneous equipment shall be done as per manufacturer's drawings and instructions.

- Metal sheath and armour of the cable shall be bonded to the earthing system of the station. The size of conductor for boning shall be appropriate with the system fault current.

- All new cables shall be megger tested before joining is completed al M.V cables shall be megger tested. 1100/650 volt grade cables shall be tested by 1000 Volt mugger.

- Cable cores shall be tested for

•Continuity

- Absence of croos phasing
- Insulation resistance to earth
- Insulation resistance between conductors.
- Contractor shall furnish all testing kit and instruments required for field-testing.

Jointing Boxes for Cables

- Cable joint boxes shall be of appropriate size, suitable for PVC insulated armoured cables of particular voltage rating.

Joining Cables

- All cable joints shall be made in suitable, approved cable joint boxes, and the filling in of compound shall be done in accordance with manufacturers' instructions and

in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.

- All cables shall be jointed colour to colour (should not be different colours); tested for continuity and insulation resistance before jointing. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be commenced and finished on the same day. During the time of joining the cables, sufficient protection from the weather shall be ensured. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

POWER AND CONTROL CABLE TERMINATIONS

- Cable boxes shall be of approved design with adequate clearances between phases and between phases and earth, in accordance with relevant standards.

- Cable boxes shall be complete with combined armour and earthing clamps.

- Suitable compression type cable glands shall be provided for power and control cables.

- Provision shall be made for earthing the body of each cable box.

- Equipment terminal blocks for power connections shall be complete with adequate phase segregating insulating barriers and suitable

  f Crimping type of lugs for connecting the insulated cable tails.

- Where more than one core is terminated on each phase, unnecessary bending of cable cores shall be avoided, without decreasing the length of the insulated cable tail and the electrical clearances, which would normally be obtained when using one core per phase.
- All switchboards shall, unless otherwise specified, facilitate bottom cable entry.

  Removable gland plates shall be mounted at least 300mm above the base of the panel. If the gland plates are provided inside the switchboards cubicles, entries in the base of the cubicle must be adequately vermin proofed.

- The individual cores of power and control cables shall be neatly dressed and supported at regular intervals inside the switchboards, before connecting them to

the relevant terminals.

4.0 MAIN LT, MV & FLOOR PANELS

4.1 GENERAL

Main/Sub Distribution Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system.

4.2 CONSTRUCTION

Main/Sub Panels shall be:

i. Of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) type.

ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.

iii. Provide dust and damp protection.

iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers in case of Main Panels.

v. All panels shall be front access type.

Main/Sub Panels shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of the following:

i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2 mm thickness and 100 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. A cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

The height of the panels should not be more than 2400 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350mm.

Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main/Sub Panels shall have the following minimum clearances.

i. Between phases - 32 mm
ii. Between phases and neutral - 26 mm
iii. Between phases and earth - 26 mm
iv. Between neutral and earth - 26 mm

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply with those specified in relevant standards.

All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as circuit breakers and moulded case circuit breakers shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall

be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

4.3 METAL TREATMENT & FINISH

All steel work used in the construction of the Main/Sub Panels should have undergone a rigorous metal treatment process as follows:-

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v. Drying with compressed air in a dust free atmosphere.

vi. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.

vii. Paint shade shall be Pebble (light) grey, shade no RAL 7032 unless otherwise specified.

4.4 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 25kA RMS symmetrical for one second. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and Creepage distances shall be provided on the busbar system to minimize possibilities of fault.

The Main/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Capacity of aluminum busbars shall be considered as 0.8 Amp per sqmm. of cross sectional area of the busbar. The main busbars shall have continuous current rating throughout the length of Panels. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity up to 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxillary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

4.5 SWITCHGEARS

Refer subhead 5.00 – LT switchgears

4.6 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. A cable chamber 150 mm. high shall be provided at the bottom through out the length and depth of the MDB/SDB. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

4.7 LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

4.8 TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

4.9 TESTING AND COMMISSIONING

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check.

c) Insulation test: As per CPWD Specifications.

d) Trip tests & protection gear test.

5.00 L.T. SWITCHGEARS

5.01 AIR CIRCUIT BREAKERS

5.01.1 GENERAL

Air circuit breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply.

5.01.2 TYPE AND CONSTRUCTION

Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically drawout type unless otherwise specified) with horizontal drawout carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all draw out mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts 'make before' and break after' the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Interphase barriers shall be provided to prevent flashover between phases.

5.01.3 OPERATING MECHANISM.

Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker

operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately and the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit.
Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

5.01.4 INTERLOCKING AND SAFETY ARRANGEMENT

Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

i. It shall not be possible for breaker to be withdrawn when in "ON" position.

ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.

iii. The breaker shall be capable of being racked into 'testing', 'isolated' and ‘maintenance’ positions and kept locked in any of these positions.

iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.

v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

5.01.05 RATING

The rating of the circuit breaker shall be as per the drawings and schedule of quantities. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per the relevant standard.

5.01.06 ACCESSORIES

The breaker shall be equipped with electronic microprocessor based release to provide over current & earth fault protection. The breaker shall be fitted with following accessories for control, signal and interlocking.

i. Auxillary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.

ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.

iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.

a. Kit for test/isolated indication.
b. Kit for service position indication.
c. Kit for shutter assembly.

iv. Accessories for following interlocking schemes shall be provided.

a. Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.

b. Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.

c. Lockable trip push button.

5.01.07 MOUNTING

Circuit Breakers shall be mounted as per manufacturers' standard practice.

5.01.08 TESTING

Testing of each circuit breaker shall be carried out at the works as per IS 2516 and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

i. Impulse withstand test.

ii. Power frequency withstand test.

iii. Short circuit test.

iv. Temperature - rise test under rated conditions.

5.02 MOULDED CASE CIRCUIT BREAKERS.

GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts. All MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting from 0.4In to 1.0 In.

5.02.01 Technical Specifications

The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ.

MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.

The breaking capacity of MCCB shall be minimum 35KA / 50 KA or as specified in BOQ. The rated service breaking capacity should be equal to rated ultimate breaking capacities (Ics=Icu).

All MCCBs upto 200A ratings should be provided with Thermal Magnetic type release with adjustable Overload and fixed short circuit protections or specified as BOQ. MCCBs of ratings 250A & above shall be provided with Microprocessor based having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G)] with time delay or specified as BOQ.

All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility

MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics confirming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose.

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.

5.02.02 FRAME SIZES

The MCCBs shall have the following frame sizes subject to meeting the fault level.

a.	Upto 100A rating	.....	100A frame.
b.	Above 100A upto 200A	.....	200A frame.
c.	Above 200A up to 250A	.....	250A frame.
d.	Above 250A up to 400A	.....	400A frame.
e.	Above 400A up to 630Aq	.....	630A frame.
f.	Above 630A to 800A	.....	800A frame.

5.02.03 CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBS shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contact trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

5.02.04 BREAKING CAPACITY

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be minimum 25kA.

5.02.05 TESTING

a. Original test certificate of the MCCB as per Indian Standards (IS) 315-C-8370 shall be furnished.

b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

5.03 SWITCH DISCONNECTOR FUSE UNITS

The Switch Disconnector Fuse Units shall be double break type suitable for load break duty (AC 23) quick make and break action. Hinged doors shall be duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in 'ON' position and also prevent closing of the switch when the door is not properly secured. All contacts incoming and outgoing terminals of switch shall be adequately sized to receive proper size of cables. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to so that they have operated. The switch disconnector fuse units shall be manufactured in accordance with IS 13947-3-1993.

FUSE

Fuse shall be of the high rupturing capacity (HRC) fuses links and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. The backup fuse rating for each motor/equipment shall be chosen as the fuse does not operate on starting of motors/equipments.

5.04 MEASURING INSTRUMENTS, METERING & PROTECTION

5.04.01 GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between-10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

5.04.02 Digital AMMETERS

Ammeters shall be standard digital type or specified in BOQ the ammeters shall be calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

5.04.03 Digital VOLTMETERS

Voltmeters shall be standard digital type or specified in BOQ the ammeters shall be calibrated as per the latest edition of IS:1248. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

5.04.04 CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1

Protection : Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

All Current Transformer shall be Cast resin type.

5.05 MISCELLANEOUS

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

6.00 INTERNAL ELECTRIFICATION OF BUILDING

6.1 SCOPE

As specified in subhead 1.00

6.2 GENERAL

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with up to date amendment.

- Specifications for Electrical Works Part-I (Internal) by CPWD – 2005 or latest revision
- Specifications for Electrical Works Part-II (External) by CPWD – 1994 or latest revision

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

6.3 DISTRIBUTION BOARDS.

As a general practice only pre-wired MCB type double door DB shall be used or as specified in BOQ. Pre-wired DB shall have following features:

i) Recess/ surface type with integral loose wire box.
ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.
iii) DIN channel for mounting MCBs.
iv) Arrangement for mounting incomer MCB/RCCB/RCBO/MCCB as required.
v) Copper bus bar.
vi) Earthing terminals.
vii) Wiring from MCBs to terminal block.
viii) Interconnection between terminal block/ incoming switch/ bus bar/ neutral/ terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
ix) Termination block should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
x) Terminal block shall be made of flame retardant polymide material.

xi) Coloured terminal blocks and FRLS wires for easy identification of RYB phases, Neutral and Earth.

xii) Pre-wired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.

xiii) The pre-wired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.

xiv) Detachable plate with knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.

xv) DB shall be of double door construction provided with hinged cover in the front.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of minimum 9 KA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker shall be current operated type and of 30mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn’t have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

Distribution Boards shall be ready for connections and shall be inspected in the factory by HSCC Electrical Engineer before dispatch.

Before procurement of Distribution Boards, MCB's, ELCB's (incomer and outgoings) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the HSCC Electrical Engineer. The whole unit i.e. Distribution Board, MCB's, ELCB's etc. shall come from the manufactures premises/workshop. After inspection and clearance from the HSCC Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately but after the approval of HSCC Electrical Engineer.

6.4 METALLIC CONDUIT WIRING SYSTEM.

6.4.1 TYPE AND SIZE OF CONDUIT.

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32 mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with black stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.

6.4.2 CONDUIT JOINTS.

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.

Cut ends of conduit pipe shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

6.4.3 PROTECTION AGAINST CONDENSATION.

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

6.4.4 PROTECTION OF CONDUIT AGAINST RUST.

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

6.4.5 PAINTING OF CONDUIT AND ACCESSORIES.

After installation, all accessible surface (if any) of conduit pipes, fittings etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

6.4.6 RECESS CONDUIT.

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. Incase of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burring the conduit in mortar before plastering shall form part of point wiring work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and of facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

6.4.7 METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front.

The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes upto 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick

synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

6.4.8 ERECTION AND EARTHING OF CONDUITS.

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 in presence of HSCC Electrical Engineer for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit.

6.4.9 SWITCHES.

All 5 and 15 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on modular metal boxes. All 5 Amp socket shall be 3 pin type and 15 Amp socket shall be 5/6 pin type (unless otherwise specified) suitable for 15/5 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

In case of computer power points, power points, telephone points etc. to be fixed on laminated partition board (furniture), same shall be fixed on laminated board (portion of laminated board meant for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

6.4.10 COVER PLATE.

All modular switches, sockets, telephone outlets etc. shall be fixed modular metal boxes with modular base plates and modular cover plates on top.

6.4.11 WALL SOCKET PLATE.

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

6.5 WIRING.

All PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/cables shall be stranded type irrespective of its size. Cable conductor size and material shall be specified in BOQ.

All internal wiring shall be carried out with PVC insulated wires of 650/1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be

allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switchboard may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated wire for the neutral wires. Bare copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications.

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

Nominal Cross-Sectional area of conductor in Sq.mm.	25mm		32mm		38mm		51mm		64mm	
	S	B	S	B	S	B	S	B	S	B
1	4	5	6	7	8	9	10	11	12	13
1.5	10	8	18	12	-	-	-	-	-	-
2.5	8	6	12	10	-	-	-	-	-	-
4	6	5	10	8	-	-	-	-	-	-
6	5	4	8	7	-	-	-	-	-	-
10	4	3	6	5	8	6	-	-	-	-
16	2	2	3	3	6	5	10	7	12	8
25	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	4	3	5	4

NOTE :

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

2. The columns headed `S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed `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.

6.5.1 JOINTS.

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.

6.5.2 LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

6.5.3 COLOUR CODE FOR CIRCUIT WIRING.

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and yellow/green or green only for earth incase of insulated earth wire.

6.5.4 CLASSIFICATION OF POINTS.

6.5.4.1 General

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I-Internal) 1994.

6.5.4.2 Point Wiring (Modular)

Definition of point wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

Scope of point wiring

Following shall be deemed to be included in point wiring.

(a) Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet. [See also (i) below]
(b) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
(c) Modular Metal boxes for control switches, regulators, sockets etc. recessed or surface type, modular base plates and modular cover plates over the same.
(d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.
(e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
(f) Control modular switch (5/6A) as specified.
(g) Ceiling rose or connector (in case of points for ceiling/exhaust fan point, prewired light fittings and call bells).
(h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
(i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switchboard to subsequent switch board(s).
(j) Protective (loop earthing) conductor (as specified in the BOQ) from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
(k) Bushed conduit where wiring cables pass through wall etc.
(l) Ceiling rose (in the case of pendants except stiff pendants).
m) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre-wired)..
n) Back Plate (in the case of stiff pendants).

Note :- In the case of call bell points the words “from the controlling switch or MCB” shall be read as “from the ceiling rose meant for connection to bell push”.

Measurement of Point Wiring (other than socket outlet points)

i) There shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting,

iii) No separate measurement shall be made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.

6.5.5. Circuit and Submain Wiring

Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board upto the tapping point for the nearest first point of that distribution circuit i.e. up to the nearest first switch box.

Submain Wiring

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

Measurement of circuit wiring and submain wiring

(i) Circuit and submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit, exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement.
(ii) The length of circuit wiring with two wires shall be measured from the distribution board to the first nearest switch box in the circuit irrespective of whether neutral conductor is taken to switch box or not.
(iii) When wires of different circuits are grouped in a single conduit, the same shall be measured on linear basis depending on the actual number and size of wires run.
(iv) When circuit wires and wires of point wiring are run in the same conduit, circuit wiring shall be measured on linear basis depending on the actual number and sizes of wires run in the existing conduit.
(v) Protective (loop earthing) conductors, which are run along the circuit wiring and submain wiring, shall be measured on linear basis and paid separately. This is not applicable if protective conductor is clubbed with the BOQ item of circuit and submain wiring.

6.5.6 Power Plug Wiring

5A Plug Wiring

Wiring for all 5 A Socket Outlets shall be done with 2X1.5 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, from the switchboard or 15A power point as the case may be.

Measurement of 5A point wiring shall be done on Linear basis from switchboard/15A power point to 5A point. Conduit of power SOCKET wiring can also be used for 5A socket outlet wiring, but both phase and neutral wires shall come directly from switchboard/power socketoutlet. Looping of neutral shall not be done.

15A Power Plug Wiring

Wiring for all 15 A Socket Outlets/Gyser point shall be done with 2X4 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board or from one power socket outlet to another in case of computer power points. Looping shall not be done in general 15A power points (other than computer power points).

Measurement of power socket outlet wiring shall be done on basis under following two subheads:

i) Directly from MCB-Distribution Board to the Socket Outlets
ii) From One power socket outlet/computer power point to another (looping)

Wiring for 20A Metal Clad Socket Outlets

Wiring for all 20A Metal Clad Socket Outlets shall be done with 2X6 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board. Measurement of wiring for 20A Metal Clad Socket outlet shall be done on linear basis i.e. complete wiring directly from MCB-Distribution Board to the socket outlet.

No extra payment shall be made on account of minor changes in location of power points (15A or 20A or computer power points) due to change in the architectural layout or change due to any other reason. Height of the power socket outlets shall be 300mm from the finished floor level unless otherwise specified.

6.5.7 CONDUCTOR SIZE.

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

i. Light point. - 1.5Sq.mm

ii. Ceiling /Cabin/Exhaust Fan Point - 1.5Sq.mm

iii. Call Bell Point - 1.5Sq.mm

iv. Plug Point (5 A Outlet) - 1.5Sq.mm

v. Circuit Wiring - 2.5Sq.mm

vi. General Power Point - 4Sq.mm

vii 20A Industrial Socket Outlet – 6 Sqmm

viii Special Power Point – 6 Sqmm

ix A/C Box with 32A MCB- 6 Sqmm

6.5.8 LIGHTING FIXTURE AND FANS

6.5.8.1 GENERAL

a. The Contractor shall supply and install lighting fixtures including but not limited to lamps, ballasts, accessories fixing hardware necessary for installations, as shown on the Drawings, as required, and as herein specified.

b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hanging devices, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.

c. Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule, shall be submitted to the HSCC Electrical Engineer for approval.

d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.

e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the Drawings.

f. Manufacturer's name and catalogue number of light fixtures, fans, switchgears etc. shall be strictly adhered.

g. Fixtures shall bear manufacturer's name and the factory inspection label.

h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.

i. Revamping the fixture shall be possible without having to remove the fixture from its place.

j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.

6.5.9 INSTALLATION

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer-In-charge.

Pendent fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation.

Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.

Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

6.5.10 LAMPS-GENERAL

Lamp shall be supplied and installed in all lighting fixtures listed in the BOQ.

Lamp shall be the part of Fitting no extra Payment will be made

Lamps used for temporary lighting service shall not be used in the final fixture units.

Lamps shall be of wattage and type as shown in the BOQ.

Lamps for permanent installation shall not be placed in the fixtures, until so directed by the Engineer In-charge.

6.5.11 BALLASTS-FLUORESCENT

Ballasts shall be electronic type and having high power factor type.

Ballasts shall have manufacturer's lowest sound level and case temperature rise rating.

Ballasts shall be special cool operated type.

Ballasts for indoor fixtures shall be protected by an integral thermal automatic resetting protective unit, which shall disconnect the ballast in the event of overheating.

Ballasts shall be of the same manufacture as the lamps/fixture.

6.5.12 FIXTURE SAMPLES

Detailed catalogue for all fixtures or if so required by the HSCC Electrical Engineer sample fixtures shall be submitted for prior approval of the HSCC Electrical Engineer before orders for the fixtures are placed.

6.5.13 TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the engineer.

All non-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer In-charge.

6.5.14 CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof members. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook shall be as per CPWD specification. Ceiling fan shall be double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS standards ceiling fan shall be white in colour. Ceiling fan shall be provided with electronic regulator. Electronic Regulator shall be suitable for 240 volts A.C supply 50 Hz and shall be of continuous duty type

6.5.15 EXHAUST FANS

Exhaust fans shall be heavy-duty type with double ball bearing and conforming to IS 2312 (latest revision). Exhaust fan shall be complete with copper wound motor, capacitor, Louver/shutter, frame and mounting bracket. Exhaust fan shall be suitable fan operation on 240 volts single phase A.C supply.

7.00 ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM

7.01 GENERAL

The Contractor shall supply and install the Addressable Fire Detection & Alarm System as per schedule of quantities are as herein specified. The system shall include Addressable Main Fire Alarm Control Panel, battery charger, batteries, addressable heat detectors, addressable smoke detectors, manual fire alarm station, fire alarm bells/hooters, response indicators, conduiting, wiring and all necessary accessories required to complete fire alarm system installation as per IS: 2189-1988. Equipment like control panel, smoke detector, heat detectors etc shall be EN-54/ UL approved or as specified in BOQ.

7.02 FEATURES

The system shall be general alarm electrically supervised type activation of manual fire alarm station or any of the automatic alarm initiating devices shall sound the general alarm bells on all floors and shall give indication on the control panel. The signal shall be continuous unit the station from which it is originated is restored to normal and a reset button on the control unit is operated.

The system shall be electrically supervised against open and ground on both the stations and signal device wiring. Open and ground in the system shall cause a trouble bell to ring at the fire alarm control panel and a trouble lamp to light. It shall be possible to silence the bell but the lamp shall remain lit until the fault is rectified. Incase of power failure the system shall automatically changeover to the battery standby.

7.03 CONDUITING & WIRING

Conduiting & Wiring for FDA system shall be carried out in M.S Conduit with copper conductor PVC insulated wires.

7.04 CONTROL PANEL

The fire control panel has to be addressable type.

The Main Fire Control Panel shall be constructed to sheet steel of red colour, and provided with windows for the alarm and trouble lights. All components shall be of the plug in type, for simple replacement and extension in the future. Control panel shall be wall mounting type conforming to IS 513-1986.

The number of loops is mentioned in B.O.Q. Each loop shall be able to support at least 128 any device addressable analog/digital (as the case may be) sensors and control module etc or as specified in BOQ. The control panel shall have alphanumeric display.

The Main Fire control panel shall be provided with all necessary relays, resistors, fuses, transformers, rectifiers and all other components to assure full and proper functioning of the system. All relays shall conform to the relevant IS Standards. Control panel shall include power include power on lamps, system trouble lamps, audible trouble signal, trouble silence switch with ring back, alarm silence push button with repeat alarm capability, low battery indicator with reset, ground detection indicator, alarm reset, milli ammeter, supervised alarm lamps, zone "Open" test pushbutton, zone alarm test push button, end of line resistors etc.

Each zone shall be equipped with an auxiliary contact for control of a remote annunciation.

Main control panel shall include a power supply model to provide a filtered and regulated source of power to provide additional power wherever supplementary power is required within the system. It shall include an output fuse, key reset switch, provision for automatic transfer to standby power upon primary power failure.

Main control panel shall in addition have audible signal and lamp to indicate as failure of the charge of battery.

Two stages general Alarm shall be provided in which a continuous evacuation alarm is immediately given in zone of fire and its adjoining zones. In other zone intermittent alarm signal shall be provided as per IS 2189-1988.

Repeater Panel shall be of same specification as main control panel and shall have fire/fault indication with audio device.

7.05 CHARGER AND BATTERY

Unit shall comprise a ventilated cabinet supplied complete with charger, meters, high rate charge switch and lock and key in a sheet metal enclosure.

7. 06 ELECTRONIC HOOTERS

Hooter shall be electronic solid-state speaker type having tone for fire, which shall be wailing. Hooter should be loop powered having an output of approximately 6 watt. The audible range shall be around 100m under normal condition. Cable for this in our system shall be 2 cores. The switching shall be provided on the control panel. The outer enclosure of the speaker shall be of MS sheet and shall be suitably oven baked and painted. The speaker shall be 4" heavy magnet type. All hooters shall be on one or more circuits.

7.07 MANUAL ALARM CALL POINT FOR SURROUNDINGS (ADDRESSABLE)

The manual call point shall be electrically compatible with the standard range of automatic detectors so that it can be connected directly into a supervised two-wire zone of the manufacturer's standard range of control units. The manual call point shall be of pleasant, streamlined and flat appearance permitting its use as flush and surface mounted unit. The manual call point shall consist of base plate, insert and cover. The push button shall have minimum one normally closed plus one normally open contacts. The push button shall not be shrouded and the same shall be projected out from the surface of the MS Box. The whole assembly of push button shall be enclosed in the 16 SWG MS Box except from the front side. The front side shall be sealed with breakable glass covering neoprene or equivalent gasket. The glass cover shall be fixed in such a way that the actuating push button is kept depressed (with NC contact open) so long as the glass cover is in contact. In case of fire, when the glass cover is broken to give the fire warning the push button shall be released due the spring action hence giving remote fire alarm through the NC contact. The breaking of the glass must release an alarm. All inscriptions, texts and marks must be on the manual call point front plate, not on the glass, so that the glass can easily be replaced anywhere. The alarm contacts shall be of self-cleaning design to prevent failure after a prolonged period of inactivity in unclean environments.

It shall be possible to test the call point without destroying the seal or removing the cover. The manual call point shall be equipped with a self-holding device to maintain the alarm condition until reset by an authorized person. The complete unit and the push button shall be painted signal Red. The internal surface of the MS enclosure of the box shall painted white colour. The external painting shall be of synthetic enameled paint. Aluminium hammer shall be suspended on a hook fixed to the external MS enclosure by means of a non-corrodible easy breaking of the glass cover.

Manual alarm call point located on the outer walls of the building and/or exposed to weather conditions shall be weather proof type and satisfying the requirement of APB.

7.08 OPTICAL (PHOTOELECTRIC) TYPE SMOKE DETECTORS (ADDRESSABLE TYPE)

The optical type smoke detectors shall be based on light attenuation by smoke/ or light scattering by smoke particles. Smoke detectors shall have an inherently stable sensor with built-in automatic compensation for changes in ambient conditions. All electronic circuits must be solid-state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. The response sensitivity of each detector shall be factory set. A built-in barrier shall prevent entry of insects into the sensor. The detector shall be designed for fast and simple laboratory cleaning.

The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The manufacturer shall produce and provide test equipment allowing to test and exchange smoke detectors upto 7m (23ft) above floor level. The detector shall connect to the control unit via a fully supervised two-wire circuit.

The detector shall be capable of being remotely tested from control panel.

7. 09 HEAT DETECTOR (ADDRESSABLE TYPE)

Heat detector shall be combined rate of rise and fixed temperature type. Heat detectors shall consist of two independent thermistors, designed to automatically compensate virtually hermetically sealed to prevent their operation from being impaired by dust, dirt of humidity. All circuitry must be protected against usual electrical transients and protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. It shall be possible to test the detector in the field. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness. The e detector shall be installed into the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The detector shall connect to the control unit via a fully supervised two-wire circuit.

The manufacturer shall produce land provide test equipment allowing to test and exchange rate-of rise/fixed temperature hear detectors up to 7m (23ft) above floor level.

7. 10 PLUG-IN BASES

The smoke & heat detectors shall fit into a common type of standard base. Once a bases has been installed, it shall be possible to insert, remove and exchange different types of detectors by a simple push-twist movement. The standard base shall be equipped with crewels wiring terminals capable of securing wire sizes upto formation and weakening of contact pressure. The standard base shall be supplied with a sealing plate, preventing dirt, dust, condensation or water from the conduit reaching the wire terminals or the detector contact points. All standard bases shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building. It must allow the check out and certification of the zone wiring before insertion of any detectors. The standard base shall feature a built-in mechanism, which allows mechanical locking of as installed detector head, thus preventing unauthorized removal or tempering while maintaining.

The detector contact points shall be designed to retain the detector safely and to ensure uninterrupted contact also when exposed to continuous severe vibration. All electronic

components of base and modules must be solid state and virtually hermetically sealed to prevent their operation from being impaired by but, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The standard base shall allow snap-on insertion of an (optional) electronic module, it shall be possible to turn a standard base part into an individually addressable detector base with its own unique identification address at the control unit. The standard base shall have a built in alarm indicator which is repeatable by connecting a simple 2 core wire to the base. No changes in the zone wiring shall e required to operate the additional alarm indicator. Removal and insertion of dust covers or detectors shall be feasible by a simple push twist movement, even if the locking device has been activates. Special base assemblies shall be available for use in air ducts and aspiration air-sampling system wherever required.

Contractor is required to submit samples and get approved from HSCC Electrical Engineer of all above mentioned items including Response Indicators, Hooters, manual call points.

8.00 LIFT INSTALLATION

8.01 The scope of work shall cover design, supply delivery, installation, testing and commissioning of passenger lifts/bed lifts. The scope of work shall also include the following item of civil works.

a) Necessary scaffolding temporary barricade in the hoistway required during the erection of the elevators.

b) Minor building work comprising of cutting holes and making good the car and counterweight rail brackets, hall buttons and indicators including laying of sills in position.

c) Steel items such as machine beams, bearing plates buffer support channels, sill angles and fascia plates etc.

d) Suitable trap doors with steel chequered plate covers.

e) Providing and install a suitable vertical iron ladder for access to the pit.

f) Any other item required for successful completion and commissioning of lifts. (including the hoisting beam in the machine room)

8.02 The work shall be done in accordance with regulations of any local code and following ISI codes which govern the requirements of installations.

IS: 1860-1980 code of practice for installation, operation and maintenance of Electric Passenger and Goods Lifts.

IS: 3534-1976 Outline dimensions of Electric Lifts.

IS: 4666-1980 Specifications for Electric passenger and Goods Elevators.

Indian Electricity Act 1910.

Indian Electricity Rules, 1956.

Delhi Lifts Rules, 1942.

8.03 SHOP DRAWINGS AND APPROVAL OF ELECTRICAL INSTALLATIONS :

The selected tenderer shall prepare a furnish shop drawings for approval by The Client, such shop drawings shall be based on the Architectural drawings and requirements laid down in specifications, local laws and regulations etc.

The detailed drawings shall be submitted within one month of placement of order. The successful tenderer shall obtain the approval of electrical Inspector and other local authorities as per requirements before submitting the drawings to Client/ Engineer. The contractor shall not proceed with in installation work till the drawings are approved by the Engineer-in-Charge. Expenses incurred such as license fee etc. towards obtaining the approval of Electrical Inspector, local authority shall be reimbursed to the contractor as per actual on production of documentary proof.

Approval of contractor's drawings shall not absolve the contractor of any of his obligations to meet the requirements of specification under this contract

Five sets of completion drawings operation manual, maintenance manual, spare parts details shall be submitted to the Client/ Engineer after completion of work.

8.04 GUARANTEE

The tenderer shall guarantee the equipment against all defects of materials and workmanship for a period of one year from the date of commissioning of the equipment as certified by the owner. Any defects arising during the guarantee period shall be rectified and replaced by the tenderer, at his own expense, to the satisfaction of the owner.

8.05 PERMITS, INSPECTION & LICENSE FEE

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby. Expenses to be borne by purchaser.

8.06 MAINTENANCE

After the completion of the installation and before handling over of each elevator by the elevator contractor, maintenance service for the equipment furnished shall be provided for a period of twelve (12) months. This service shall include regular examination of the installation by trained employees, and shall include all necessary adjustments, greasing oiling, cleaning supplies and genuine standard parts to keep the equipment in proper operation, except any parts made necessary by misuse, accident or neglect caused by other. Contractor shall provide 24 hours Emergency local call back service facility and shall furnish full details of such facilities available.

8.07 POWER SUPPLY

The apparatus shall be designed to operate on 415 + 10% - 20% Volts, 3 Phase, 4 wires, 50 Hz A.C. Supply for illumination signal equipment shall be 240 Volts single phase 50Hz A.C..

8.08 ELECTRICAL WIRING

The necessary A.C. supply of 3 Phase, 415 Volts 50 HZ shall be made available in the main control switch unit to be provided by the contractor in the machine room. All the electrical works beyond the main supply switch shall be carried out by the contractor i.e. supply and installations of panels for drive motors, switches and control complete with wiring as per system requirement and approval of the Engineer.
The wiring shall be carried out strictly in accordance with Indian Electricity Rules and Indian code of Practice for Electrical Wiring Installation IS-732-1963 System Voltage not exceeding 650 V). For works not covered under any of the above wiring rules, the 13th edition of Electrical Engineers (Condense) shall apply. The cable and conduits to be used shall be of suitable size and grade conforming to relevant IS specification. Wiring for LT switchboard to the motor terminal shall be with heavy duty 1.1 KV grade PVC insulated PVC sheathed, FRLS aluminium cable. All the trailing cables used for control and safety device shall conform to IS: 4289-1967, Specifications for lifts cables. The trailing cable circuits for controls, safety devices, lighting and signaling shall be separate and distinct.

Power wiring between controller and main board to various landings shall be drawn in suitable size heavy gauge conduit stove enameled/painted conforming to I.S specifications.

The Voltage and frequency of the supply shall be subjected to variations permissible under Indian Electricity Acts and Rules.

8.09 PARTICULAR SPECIFICATIONS

8.09.1 TYPE	:	Bed Lifts/Passenger Lifts.
8.09.2 NO. OF ELEVATORS	:	As Per Bill of Quantities.
8.09.3 CAPACITY	:	As Per Bill of Quantities.
8.09.4 SPEED	:	As Per Bill of Quantities.
8.09.5 FLOORS SERVED/RISE	:	As Per Bill of Quantities.
8.09.6 STOP	:	As Per Bill of Quantities.
8.09.7 OPENINGS	:	(All Openings on same side). As Per Bill of Quantities.
8.09.8 OPERATION	:	Duplex/Simplex Collective as per BOQ.

8.09.9 CAR FRAME:

The car frame, which supports the car platform and enclosures, shall be made of structural steel and equipped with suitable guides and a car safety device mounted underneath the car platform. The hoist ropes shall include adjustable self/ aligning hingesThe car shall be so mounted on the frame that vibration and noise transmitted to the passenger is minimized.

8.09.10 CAR SAFETY AND GOVERNER :

Suitable car safety to stop the car whenever excessive descending speed is attained shall be operated by a centrifugal speed governor connected to the governor through a continuous steel rope.

The governor shall be provided with self tensioning device to keep governor rope in proper tension even after rope stretch. Suitable means shall be supplied to cut off power from the motor and apply the brake on application of the safety.

8.09.11 COUNTER BALANCE :

A Suitable guided structural steel frame with appropriate filler weights of cast iron shall be furnished to promote smooth and economic operation.

8.09.12 TERMINAL AND FINAL LIMITS :

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings within permissible over travel and final limit switches shall be provided to automatically cut off the power and apply the brake, should the car travel beyond the permissible over travel. They shall act independently of the operating devices and buffers.

8.09.13 TERMINAL BUFFERS :

Heavy duty spring buffers shall be installed as a means of stopping the car and counterweight at the extreme limits of travel. Buffers in the pit shall be mounted on steel channels which shall extend between both the car and counterweight rails.

8.09.14 CONTROLLER :

A Controller shall be provided to control starting stopping and speed of the elevator motor and also be automatically able to apply the brake if any of the safety devices operate or if power fails from any cause. In case of power failure and again restore of power the lift shall land to next floor and shall not go to basement/lowest level. Suitable software/hardware or rescue device shall be provided.

8.09.15 REVERSE PHASE RELAY :

A reverse phase relay shall be provided on the controller which is designed to protect the lift equipment against phase reversal and phase failure.

8.09.16 GUIDES :

Machined steel tee guides shall be furnished for the car and counterweight. The guide rails should be of steel solid and shall have tongued and grooved joints. Sliding clips shall be used for fastening the guides to allow building settlement without distorting the guide rails. To keep down the noise level and to reduce wear and tear of the sections, only Nylon Ribs shall be used in the guide shoes, after smoothening of the rails. The flanges shall be machined for the fish plate mounting such that rail alignment at joints almost remain constant.

8.09.17 FOUNDATIONS :

The machine shall be placed directly above the hoistway upon the machine room slab provided by the Owner.

8.09.18 ROPES :

The elevator shall be provided with traction steel ropes. Steel wire rope having a tensile strength of not less that 12.5 Ton/cm2 of good flexibility shall be used for lift. The lift rope shall conform to IS: 14665 – (Part-4- Sec-8):2001.

8.09.19 MACHINE :

The machine shall be of the single wrap traction type and shall include a motor, electromechanical brake, steel worm, bronze gear, steel sheave shaft and Farrow-Molybdenum sheave all compactly mounted on a single base or bed plate. The worm shaft shall be provided with ball bearings to take the end trust and roller bearings shall be furnished for the sheave shaft to ensure alignment and ling bearing life. The driving sheave shall be grooves to ensure sufficient traction and minimize rope wear. Shall be provided for all bearings and the worm gear.

8.09.20 BRAKE :

The direct current brake shall be spring applied and electrically released and designed to provide smooth stop under variable loads. The brake should be capable of operation automatically by various safety devices, current failure, and by normal stopping of car. It should be possible to release the brake manually, such releases brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short sties. For this purpose one set of brake release equipment shall be supplied.

8.09.21 MOTOR :

The motor shall be suited to the service proposed and arranged for adequate lubrication. The motor shall be class F insulation and one (1) hour rated squirrel cage induction type having high starting torque. It shall also be provided with Thermisters embedded in the stator windings for the highest degree of thermal motor protection.

8. 09. 22 CONTROL

The control shall be variable voltage variable frequency A.C. variable voltage, closed loop control system using solid state devices and electronic speed pattern generator to command the motor from a velocity transducer and load compensation circuits for a comfortable ride.

In Normal operation, the electromagnetic brake shall only be applied when the lift has come to a complete standstill. The brake shall only be meant for holding the lift in position at every landing, providing stopping without any jerking effect.

Each controller cabinet containing memory equipment shall be properly shielded from the pollution.

MICROPROCESSOR

The control shall employ a microprocessor working on a program such that precision leveling and highly efficient handling of passengers for least possible waiting and reduced travel time is ensured. The microprocessor system should be designed to accept programming with minimum downtime. It should be able to monitor the state of input calls (such as car calls from COP and hall calls from hall fixtures) and output commands such as starting, decelerating and stopping the elevator. It should be able to generate floor location data, thereby, providing a reference position to establish the safety zones for door opening and closing, and also to initiate leveling slowdown.

8.09.23 DUPLEX COLLECTIVE OPERATION

The operation shall be duplex collective with/without attendant for each elevator and shall consist of the following:-

IN THE CAR

There shall be furnished a flush type attractively finished stainless steel panel which contains a series of luminous buttons numbered to correspond to the landings served, an emergency stop switch and an emergency call button connected to a bell which serves as an emergency signal.

AT HOISTWAY LANDINGS

There shall be provided an UP luminous push button and a DOWN luminous push button at each intermediate landing and a single button at the terminal landings.

The car shall not start unless the door is in the closed position and all hoistway doors are closed in the locked position.

If the car is idle and one or more car or landing buttons above the landing at which the car is standing are pressed, the car shall start in the UP direction and proceed to the highest landing for which any button is pressed and stops at intermediate landing for which a car button or up landing button is pressed sufficiently in advance of the car's arrival at such landings to permit these stops to be made. After each stop, the car shall proceed in the UP direction until it reaches the highest landing for which a call is registered. The car shall not stop on the UP trip at any landing in response to a DOWN call.

Similarly, if the car is idle and one or more car or landing buttons below the landing at which the car is standing are pressed, the car shall start in the DOWN direction, proceed to the lowest landing for which any button is pressed and stop at each intermediate landing for which a car button is pressed.

When the car is idle and a button for a landing above the car and a landing below the car are pressed, the car shall start towards the landing corresponding to the button pressed first. The call registered for the landing in the opposite direction from the car shall be answered after the car has responded to the farthest call in the direction established by the button pressed first.

A time relay shall hold the car for an adjustable interval of few seconds at the landings at which stops are made to enable passengers to enter or leave the car.

OPERATION WITH AN ATTENDANT

The regular car operating panel shall include buttons, switches, etc. for the collective-automatic control and shall also include.

A two-position key-operated switch marked to indicate ATT (attendant operation)

A buzzer: UP and DOWN direction light jewels and A non-stop button.

A car operating panel shall also include an UP and DOWN button.

When the key-switch is in the position of WITH ATTENDANT, the direction light and buzzer shall become operative and the UP and DOWN direction button in the regular car operating panel shall be made effective for the attendant operation.

When an attendant operation, the car and hoistway doors shall open automatically at each stop but the closing of the doors shall be subject to the UP or DOWN direction buttons. As a visual signal to the attendant, the UP and DOWN direction jewel shall illuminate upon registration of either car or landing calls to indicate the direction of the travel of the car. The attendant shall operate the elevator normally in the direction indicated by the direction jewel but, if desired, opposite direction travel may be realized by pressure of a car button for a landing in that direction from the car.

The pressure of a direction button shall cause the doors to close and the car to start in the direction desired, provided a call is registered for that direction. If pressure of the direction button is released before the car starts, the doors will re-open and car shall not travel. It shall so arrange the pressure on direction button can be released, once the car has started.

Continuous pressure of the nonstop button shall cause the car to by-pass all landing calls and respond only to registered car calls.

8. 09. 24 CAR ENCLOSURES :

The car enclosures shall be of sheet steel and shall be of an elegant design comprising of the following :

a) Suspended ceiling with light diffuser Perspex ceiling and fluorescent light.

b) Concealed pressure fan with grille in suspended ceiling. The lift shall have sensor so that the fan is operation only when if there is at least one person inside the lift.

c) Ceiling steel painted white.

d) Complete stainless steel car enclosure in plain finish for passenger and Bed Lifts

a) PVC flooring (with 3mm thick tiles of approved shade) for Bed Lifts
b) Mirror on one face (front face when we enter the car)

8.09.25 CAR DOOR

The car entrance shall be provided with stainless steel sliding doors in plain finish giving a clear opening of 1200mm wide by 2000mm high for bed lift. The lift car door shall have a fire resistance rating of one hour.

8. 09. 26 HOISTWAY DOORS :

At each landing, a center/ telescopic opening , stainless steel sliding door in plain finish giving a clear opening as per CPWD general specifications for electrical works –Part-III – Lifts & Escalators, shall be provided.

8. 09. 27 SIGNAL AND OPERATIVE FIXTURES :

The following signal and operative fixtures shall be provided for each lift in stainless steel face plates except in fireman's switch which shall have a glass face plate.

a) CAR OPERATING PANEL

There shall be one (1) No. panel in car, with hinged stainless steel face plate and shall comprise illuminated floor buttons, door open and emergency stop controls emergency call buttons, door open and emergency stop controls emergency call button, two position key operated switch, a Buzzer, UP and DOWN direction light panels, a non stop button, and an integral interphone. The jewels and accentuator shall be of modular construction, face plate mounted, rewired using snap on lugs.

b) HALL BUTTONS AND HALL POSITION INDICATOR

There shall be provided combined signal fixture (one riser) of compact design and of attractive hairline stainless steel face plate at the elevator entrance on each floor which for terminal landings shall have a single luminous push button and for intermediate landings shall have an UP luminous push button and a DOWN luminous push button. The jewels shall be of modular construction mounted on a stainless steel face plate. Whenever a button is pressed, the jewel shall light up to indicate registration of the call and shall remain enlighted till the car arrives.

c) CAR POSITION INDICATOR IN CAR

This shall be of compact design and of attractive hairline finish stainless steel face plate with easy to read digital display of the floors, indicating through which floor the elevator is passing or on which floor the elevator is stopped. This shall also incorporate illuminated arrows showing the direction of travel.

d) BATTERY OPERATED ALARM BELL AND EMERGENCY LIGHT

A solid state siren type alarm unit operated by 2 Nos. 9 volt rechargeable Nickel Cadmium batteries shall be provided which shall give a waxing and waning siren when alarm bell in the car is pressed momentarily.

An emergency light unit using a 9 volt dry battery power pack and incandescent lamp with stainless steel face plate shall be provided inside the car which shall operate automatically in the case of power failure.

e) OVERLOAD WARNING

Overload warning radars with audio-visual indication (visual indication shall show OVERLOADED) with stainless steel face plate shall be installed in the elevator car, so

that when there is overload in the car the sign shall light up a flash indicating OVERLOADED and a buzzer shall operate during this period and the doors shall remain open unit the overload is removed.

f) FIREMAN'S SWITCH

A toggle switch covered by a glass cover shall be provided on the ground floor for each elevator which shall permit a fireman to call the elevator to the ground floor by canceling all car and landing calls. The elevator shall then stop at the ground floor with the door open to permit the fireman to have exclusive use of the elevator without any interference from the landing calls.

g) INTERPHONE

Interphone shall have one master unit in each machine room, one master unit on the ground floor for each 1 (outside hoistway) and one slave unit in each elevator car.

8. 09. 28 ELECTRIC DOOR OPERATOR FOR CAR DOOR AND HOISTWAY DOOR :

An electric door operator for opening and closing the car door shall b e provided. The opening of a car and hoistway doors shall be such that the doors shall start opening meant for so that by the time the elevator stops completely, the elevator and hoistway doors shall be fully open.

The equipment shall consist of a machine on the elevator car operating the car door when the car is stopping at a landing.

The car door and hoistway door shall be mechanically connected and shall move simultaneously in opening and closing.

The car and hoistway doors shall be power opened and closed and shall be checked in opening and closing with an oil cushioning mechanism built into the gear unit.

Each hoistway door shall be provided with an interlock which will prevent movement of the car away from the landing unit.

The doors are closed in the closed position as defined in the ISI codes.

An electric contact for the car door shall be provided which shall prevent car movement from the landing unless the door is in the closed position as defined in the ISI codes. The locking arrangement shall be so designed that the electrical circuit cannot be completed unless the doors are in the closed position and mechanical latching is effected.

Necessary switches shall be provided in the elevator machine room to control the operation of the doors.

The car and hoistway, doors shall open automatically as the car is stopping at a landing. The closing of the car and hoistway door must occur before the car can be started. Doors can be stopped and reversed during their closing motion.

8. 09.29 DOOR HANGER AND TRACKS :

For the car and each landing door, sheave type two point suspension hangers complete with tracks shall be provided. Means shall be provided to prevent the door from jumping off the track and for vertical and literal adjustment of doors.

Sheaves and rollers shall be of steel and shall include shielded ball bearing to retain grease lubrication. Adjustable ball bearings rollers shall be provided to take the upward thrust of the doors. Tracks shall be of suitable steel section with smooth surface. The locking of the two leaf parting type doors should be positive.

8. 09.30 SAFETY SHOE :

A safety shoe (one on each door panel) shall extent to the full height of and project beyond the front edge of the car door.

Should this shoe touch a person or an object while the car door is closing, the car and hoistway doors shall return to the open position. The doors shall remain open until the expiration of a pre-determined interval and then close automatically.

8.09.31 LANDING ENTRANCE MATERIAL'S :

These shall consist of headers, extruded aluminium sills and strut angles.

8.09.32 WIRING :

Complete wiring in the equipment.

8.09.33 AUTOMATIC RESCUE DEVICE :

Automatic Rescue Device to be provided for all the lifts with battery backup so that it can land to the nearest level in case of power failure. Automatic Rescue Device shall have suitable battery backup so that it can operate minimum seven times in a day provided the duration between usage is at least 30 minutes.

9.00 LT CABLES

9.1 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

9.2 MATERIAL

The L.T. power cable shall be XLPE Cable PVC insulated PVC sheathed type aluminium conductor armoured cable and L.T. control cable shall be PVC insulated PVC sheathed type copper conductor unarmoured cable conforming to IS: 1554: 1988 (Part-I) with up to date amendments.

9.3 INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonary ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of HSCC Electrical Engineer. Cable laying shall be carried out as per CPWD specifications.

9.4 INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

9.5 JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

9.6 LAYING CABLES IN GROUND

Cables shall be laid by skilled experienced workmen, using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metre. Cables shall be laid at depth of 0.75 metres below ground level for LT Cables and 1 metre below ground level for HT cable. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius

of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

Cable route marker shall be provided as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

PROTECTION OF CABLES

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Pipes for cable crossing the road shall be laid at a depth of 1000 mm.

EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in - Charge.

LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING

Cable shall be laid on perforated M.S. Cable tray/ladders. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

9.7 TESTING OF CABLES

Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying.
b. After laying.
c. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

a. Insulation Resistance Test (Sectional and overall).

b. Continuity Resistance Test.

c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

10.00 CABLE TRAY

10.01 Ladder Type Cable Tray

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250 mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanised or painted to the desired lengths.

10.2 Perforated Type Cable Tray

The cable tray shall be fabricated out of slotted/perforated M.S. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. These shall be galvanised or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with cross-bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

10.3 Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

10.4 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

10.5 The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

10.6 The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.

10.7 Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -1994). The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

10.8 The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the PMC/Consultant to take the weight of the cable tray with the cables.

10.9 The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

10.10 The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

10.11 The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross-joints, etc, and paid for accordingly.

11.00 EARTHING

11.01 GENERAL

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General Specifications for Earthing work shall conform to Internal) - 1994 and Indian Electricity Rules 1956 amended up to date and in the regulations of the local Electricity Supply Authority.

11.02 EARTHING CONDUCTOR

Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward up to outlet point shall also be of bare copper. Earth continuity conductor connecting Main & Sub Distribution boards to earth electrode shall be with galvanised MS strip.

11.03 SIZING OF EARTHING CONDUCTOR

Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switch board and sub switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury & corrosion by providing GI pipe.

11.04 GI pipe shall be of medium class 40mm dia and 4.5 metre in length. Galvanising of the pipe shall conform to relevant Indian Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2 metre of length from bottom. The electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2metres from the building. The location of the earth electrode will be such that the soil has reasonable chance of remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS frame & cover having locking arrangement at the top.

11.05 PLATE EARTH ELECTRODE

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimensions.

i. GI Plate Electrode : 600mm x 600mm x 6mm thick

ii. Copper Plate Electrode : 600mm x 600mm x 3mm thick

The electrode shall be buried in ground with its faces vertical and not less than 3 metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cash iron or MS frame with cover having locking arrangement shall be provided at top of metres from the building. Care shall be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

11.06 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

11.07 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 5 ohm.

11.08 Advance Chemical Gel Earthing System

The function of an earthing and bonding system is to provide an earthing system connection to which transformer neutrals or earthing impedances may be connected in order to pass the maximum fault current.

The proper earthing system also ensures no thermal or mechanical damage occurs on the equipment, thereby resulting in safety to operation and maintenance personnel. The earthing system also guarantees equipotential bonding such that there are no dangerous potential gradients developed across the system.

As it is stated in the various standards related to earthing, a safe grounding system has two main objectives:

1. To provide means to carry electric currents into the earth under normal and fault conditions without exceeding any operating and equipment limits or adversely affecting continuity of service.
2. To assure that a person in the vicinity of grounded facilities is not exposed to the danger of critical electrical shock.

The technical specification is considered inline to IS:3043-1987 (Reaffirmed 2001) – “Code of Practice for Earthing” issued by BIS (Bureau of Indian Standards), Government

of India. Earthing resistance calculation is prepared in such a way that the earth pits are designed as per IS 3043 of using G.I. & Copper pipe earth electrode along with the carbon based backfill material of Carbofill grounding minerals.

G.I. pipe based earthing electrode shall be for electrical body applications & Copper pipe based earthing electrode shall be for electrical neutral applications. G.I. pipe earthing system: For a system upto a rating of 1000 KVA – the electrode shall be of Dual Pipe Technology chemrode of 3 mtrs long 50mm dia of outer pipe with the 25mm dia of inner pipe of 80-100 microns galvanized filled with highly conducting metallic compounds with the permanent sealings at both the ends with the lead terminal of 32x10mm size at the top. The length of the electrode shall be 3000mm excluding the lead terminal and the length of the lead terminal at the top shall be 100mm. The electrode shall be duly tested and certified by CPRI (Central Power Research Institute), for a RMS short-circuit current withstanding capacity of 30 KA and a peak short-circuit withstanding capacity of 60 KA.

G.I. pipe earthing system: For a system upto a rating of 2000 KVA – the electrode shall be of Dual Pipe Technology chemrode of 3 mtrs long 80mm dia of outer pipe with the 50mm dia of inner pipe of 80-100 microns galvanized filled with highly conducting metallic compounds with the permanent sealings at both the ends with the lead terminal of 50x10mm size at the top. The length of the electrode shall be 3000mm excluding the lead terminal and the length of the lead terminal at the top shall be 100mm. The electrode shall be duly tested and certified by CPRI (Central Power Research Institute), for a RMS short-circuit current withstanding capacity of 30 KA and a peak short-circuit withstanding capacity of 60 KA.

Copper pipe earthing system: For a system upto a rating of 1600 KVA – the electrode shall be of copper pipe chemrode of 3 mtrs long 63mm dia filled with highly conducting metallic compounds with the permanent sealings at both the ends. Top of the earth electrode is compressed to form an extended lead with 2 holes for connecting the strip/wire to the load.

Copper pipe earthing system: For a system upto a rating of 2000 KVA – the electrode shall be of copper pipe chemrode of 3 mtrs long 80mm dia filled with highly conducting metallic compounds with the permanent sealings at both the ends. Top of the earth electrode is compressed to form an extended lead with 2 holes for connecting the strip/wire to the load.

To ensure the moisture content and electrical conductivity, carbon based carbofill compound shall be used as a backfill compound. The carbofill compound shall be of low resistance & high conductivity in nature with carbon as a major content which dramatically lowers ground resistance system in difficult soil situations.

The carbon based backfill should not contain bentonite or concrete components, which in very dry conditions can cause shrinkage around the electrode, thus rendering it ineffective. pH adjusting agent shall maintain the pH value around the grounding

material within the scope of protection. Carbon based compound carbofill should be an environment friendly and does no harm to the underground water.

Minimum 37.5 Kgs of carbon backfill compound shall be used along with each earthing electrode. The chemical backfill compound shall be tested & certiifed by any BIS (Bureau of Indian Standards).

On the ground level, an heavy duty weather proof environment friendly polyplastic earth pit chamber with cover of autolocking facility with the following dimensions - 254mm dia (top), 330mm dia (bottom) and 260mm height. 4 knock-out openings are provided for the easy interconnection of earth strips between the earth pits to form a grid.

At any cost, usage of salt & charcoal is strictly not permitted along with the chemical gel earthing system.

12.00 SAFETY EQUIPMENTS

12.01 DANGER NOTICES

Danger notices shall be affixed permanently in a conspicuous position in Hindi or English and the local language of the district with sign of skull and bones at every overhead lines, transformer, electrical equipments motors, etc.

12.02 FIRST AID BOX

Standard first aid box with all standard contents shall be supplied.

12.03 FIRE BUCKETS

The fire bucket unit shall consist of our galvanised iron baskets, which shall be with round bottom, and of 13 liters capacity. They shall be filled with dry sand. Arrangement shall be made to hang them on GI pipe stand comprising of at least 2 vertical and one horizontal members of 50 mm GI pipe. The stands shall have hooks and locking chain arrangement. The buckets and stand shall be painted with epoxy red paint.

12.04 FIRE EXTINGUISHER

Foam type Fire extinguishers of 9 Kg. capacity and Dry Chemical type Fire Extinguishers of 10 Kg capacity shall be of approved make. It shall be filled with carbon tetrachloride. It shall have horns. Extinguishers shall be fixed on walls/columns with necessary clamps made out of 50 mm x 6mm MS flat and coated bolts and nuts grouted in wall/column.

12.05 RUBBER MAT

Corrugated rubber insulating matting shall be provided in front of all power & motor control centers, push button station and distribution board in the electrical rooms. The width of matting shall be one meter. It shall be as ISI mark.

12.06 INSTRUCTION CHART

Printed instruction chart both in English and Hindi and duly framed with front glass, prescribing treatment to be given to persons having Electric shock, shall be supplied.

13.0 DIESEL GENERATOR SETS

13.1 INTENT OF SPECIFICATION

13.1.1 This specification covers the design, manufacture, assembly, packing, dispatch, transportation supply, erection, testing, commissioning, performance and guarantee testing of Diesel Gen-Sets with Acoustic Enclosure, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

13.2 SCOPE OF WORK:

TECHNICAL SPECIFICATIONS OF DG SETS & ASSOCIATED WORK

The Scope of work shall include under this specification design, manufacture, supply, loading, unloading, storage, installation, testing and commissioning of the Diesel engine alternator sets including labour, tools, tackles and plants, hardware and consumables, steel fabrication and items as prescribed below:

- Diesel engine alternator set complete with base frame and accessories.
- Engine mounted engine control integral panel duly wired upto terminal box for engine safeties with sensors and protection for inter facing with PLC/Microprocessor based relay.
- Fuel oil system including day service oil tank, piping, valves, filters etc. from engine to service day oil tank.
- Lube oil system with piping etc. (Pre-lube oil pump with controller if required).
- Cooling system with radiator, heavy duty suitable for 50^0C operation complete with make up water tank.
- Exhaust emission shall meet EURO II norms without catalytic converter or online scrubber and residential silencer, exhaust piping with mineral wool insulation and aluminum cladding as called for.
- Steel fabricated structure/support/hanger including fixing, grouting and bolting etc.
- Painting of steel work.
- L.T. / Control cabling.

The bidder shall also indicate in his offer the time schedule for routine maintenance / overhauling operations necessary for continuous satisfactory operation of D.G Set.

The item rate shall remain valid for variation to any extent of the estimated quantities given in the Schedule of Quantities.

All equipment shall be of the class most suitable for working under the conditions specified and shall withstand the atmospheric conditions without deterioration.

Minor civil work is included in the contractor's scope of work. However, the responsibility of coordination with the civil and other contracting agencies ensuring completion of turnkey contract rests with the contractor and shall be certified.

Contractor shall co-ordinate with all other agencies working at site for interconnection and safety aspects.

Also the D.G. Supplier will furnish a combined guarantee minimum for one year from the date of successful commissioning for the entire equipment, In case there is any defect the free replacement of any part or in whole will be made immediately at not loss to Owner.

13.03 FEES & PERMITS

The contractor shall obtain all sanctions and permits required for the running of DG sets for all the relevant authorities. All actual fee payable in this regard will be reimbursed against receipt/documentary proof (evidence). On completion of the work, the suppler shall obtain N.O.C from concerned authorities including Chief Electrical Inspectorate, of state in original shall be delivered to the employer through Architect.

13.04 CODES & STANDARDS

The design, construction, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standard (BIS), British Standards (BS), International Electro Technical Commission (IEC) publication, NEMA & VDE standards amended upto date.

Some of the applicable standards are listed below :

BS– 5514/ISO 3046/DIN 6271	Reciprocating internal combustion engines
BS – 4613	Electrical performance of rotating electrical machine
BS – 4999/5000	Applicable parts of BS 4999/5000
IEC–34–1/IS–4722/VDE 0530	Specification for rotating electrical machines.
IS – 4889	Method of determination of efficiency of rotating electrical machinery.
IS – 6491	Degrees of protection provided by enclosures for rotating electrical machinery.
IS – 4729	Measurement and evaluation of vibration of rotating electrical machines.
AIEE – 606	Recommended specification for speed governing (1959) of internal combustion engine generator units.
IS – 2705	Current transformers.

IS – 1248	Electrical indicating instruments.
IEEE – 115	Test procedure for synchronous machine.

13.05 DESIGN

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The equipment offered by the contractor shall be complete in all respects. Any material 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 to the purchaser.

13.06 PERFORMANCE REQUIREMENT

The equipment shall be capable of delivering power continuously at the generator

Terminal, a net output not less than the specified value at 0.8-0.95 p.f. excluding auxiliary power (shall be included over and above), when operating under the site ambient conditions described in this specification. Gen Set should be capable of taking 100 % step load & it should be able to take full load in less than 25 sec. from start. (The set shall be suitable for prime duty).

The design parameters of the generator and excitation system shall be chosen that the set is stable while running at any load between no – load and full load and also during starting of motors. It should also have isosynchronous speed control with load sensing governing system suitable for parallel running of D.G. sets.

Engine should be heavy duty four strokes, turbo charged after cooler 'V' construction/in line electric start. Engine should have minimum lube oil change period 500 Hrs. Bidders are required to offer the Duplex filter system for lube oil and fuel oil in case of non compliance.

The set shall have vibration limit less then 130 microns (as per BS:4999 Part – 142)& noise level shall be (105-110 db (a) at 1 mtr) under all conditions of load. The set shall be dynamically balanced. The set shall be mounted directly on the inertia foundation or with foundation bolts etc. The efficient residential silencer shall be provided with or without catalytic converter on-line scrubber & the set shall meet EURO-II norms for D.G Sets, for the exhaust. Air inlet shall also be provided.

The total harmonies contents should be less than 3% as per IS 4722/1969. The graph & calculation for harmonic distortion shall be submitted.

Contractor to specify and guarantee maintenance contract cost and to give an undertaking to take a comprehensive maintenance contract after expiry of warranty period for which price may be quoted.

The engine shall be stationary, compression ignition, totally enclosed, water cooled, 4 stroke direct injection, cold battery starting, turbo charged and low temperature with after

cooled Radiator Cooled 1500 RPM in accordance to BS 5514 and IS: 10002 complete with all accessories.

The D.G. engine shall be suitable for black start & should be able to pick up 100% load within 25 seconds.

The DG engine & the batteries shall be designed to take up at least six starting attempts beyond which the system shall be protected by means of an over crank relay. Calculations for battery sizing and battery charger capacity shall be submitted for review of the consultants. The successful bidder will submit shop drawing of the equipments/accessories selected for this work for the approval of Consultant/Employer.

13.07 SERVICE INTERVAL AND OPERATION

The set shall be capable of running at full load for not les than 500 hrs continuously. The change period both for the lube oil, lube oil filters shall be minimum 500 Hours of operations, in the event the change period for above consumables false short below the specified time period as above, bidders are required to quote for duplex type filters with oil make up systems.

The time to Top overhaul, major overhaul & maintenance schedules shall be specified by the bidders.

13.08 DIESEL ENGINE - CONSTRUCION

Material of construction of major parts shall e as under or as per manufacturer design.

- M.S. base frame with anti-vibration mountings.
- Crankcase – Aluminium alloys.
- Crank shaft, connecting rods –Forged Alloy Steel.
- Pistion – AL alloy casting.
- Piston rings – Alloy Steel.
- Engine Block – Cast Iron
- Cylinder Liner – Cast Iron

All other material of construction shall be as per relevant standard/code and the copies of same shall be supplied free of cost to Consultant.

One common base frame shall be provided for mounting the engine and alternator complete with electric suspension between D.G set and foundation bolts, leveling lines etc. as required.

All externally mounted hardware shall be high tensile steel only.

The normal speed of the engine shall be 1500 RPM and the direction of rotation shall be clearly marked on the set.

The engine shall be fitted with an exhaust gas driven turbo charger of air / water cooled type complete with its own self contained lubricating system. The turbo-charger shall be positioned at the free end of the engine preferably

The engine shall be fitted with a charge air inter cooler of the air/water type. Air from the turbo-charger compressor passes through the inter cooled and then to the engine manifold. The inter cooler shall be of tubular construction or as per manufacturer design with aluminum bronze tubes, mild sheet steel and cast iron water headers.

Fuel injection and valves shall not require frequent adjustment while in service.

All filters like fuel, lubrication oil, by pass etc shall be provided in the engine and shall be dry, paper element type.

Starting system shall be 24V DC comprising of batteries (25 plates, 360 AH capacity), Voltage regulator and arrangement for initial charging of batteries.

Bed Plate

The bed plate shall be fabricated from M.S. channel. The welding shall be radio graphed, and the entire fabrication shall be stress relieved after welding. The bed plate shall have integral well ribbed diaphragms for supporting the main bearing housings.

Crank Case

The crank case shall be steel construction with heavy steel plates to form water compartments around the cylinder. To facilitate access for purpose of inspection, inspection ports shall be provided.

Lube-Oil Priming Pump

An A.C. motor driven intermittent operation lube-oil priming pump shall be provided. This shall also include necessary piping, fitting instruments etc. for lubrication system along with clock timers if required.

Crank Shaft

The crank shaft shall be made of high tensile strength steel forging, and shall have a suitable flange to which the flywheel shall be bolted.

The bearing journals and fillets shall be induction hardened; and fully balanced.

Main And Big End Bearings

The main and big end bearings shall be detachable shells of high grade bearing material, and shall be pre-finished.

Connecting Rods

The connecting rods shall be of high grade drop forged steel I - beam section, centre to centre length. The rods shall be rifle drilled for pressure lubrication of piston pin. The rod shall be tapered at piston pin end provided to reduce unit pressures. The piston pin of suitable diameter shall be full floating and made of tubular steel, and retained by a snap ring.

Cylinder Liners

The cylinder liners shall be replaceable wet liners, cast iron alloy, and provided with specially machined grooves in their bores to give an oil retaining surface. These liners shall be easily replaceable without re-boring the block.

Piston

The piston shall be made of forged aluminum alloy, cam ground and machined on outer surface. The piston shall be fitted with an oil scraper ring, and compression rings of hardened cast iron alloy. The piston shall be oil cooled.

Camshaft

The camshaft shall be of induction hardened steel alloy with gear drive, and one of this shall be provided for each block of cylinders.

Exhaust Manifold

The exhaust manifold shall be multi-branch, of insulated design utilizing Ni-resist casting.

Flywheel

The flywheel, which shall conform to requirements of NEMA/ASA/BS codes, shall be made of mild steel statically balanced after machining and shall have graduated markings around the periphery / markings for checking of the valves can also be located on the vibration damper. Barring slots shall be provided around the flywheel rim for hand-barring/ alternatively a suitable barring arrangement should be provided.

Governing System

The governor shall be Isochronous, electronic digital type with a steady state frequency variation of + / - .25%. The transient performance shall comply with ISO 8528-5, Class G3 requirements.

It should be possible to adjust the over speed settings on the governor by means of digital signals Manual adjustments for over speed trip settings are not preferred.

13.09 HEAT EXCHANGER

The DG Set should be equipped with a Heat Exchanger for suitable operation.

13.10 ALARMS/TRIP (AUDIO AND VISUAL)

The following Alarm/Trip indications shall be provided as minimum with first stage as pre alarm & second stage as trip:

- ❖ High water temperature.
- ❖ Low lube oil pressure.
- ❖ Low fuel level.
- ❖ Low coolant level.

- ❖ Over crank
- ❖ Over speed

13.11 OTHER AUXILIARY EQUIPMENT/SERVICES

These shall be complete include the following:-

Silencer
Exhaust Silencer shall be residential type to reduce the noise level. Values for Pressure drop across the silencers to be indicated by the vendor.

Cooling
The engine shall be water cooled heat exchanger type. Adequately designed for ambient conditions, 50 deg C.

13.12 DAY SERVICE FUEL TANK

Day service fuel tank shall be made of 3 mm thick MS sheet of 990 litres capacity for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection, trough to collect spilt oil, air vent pipe with air filter, manhole with cover, low level and full level float valve arrangements with all fittings, interconnections between tanks and engine. The tank shall be provided with suitable calibration scale. The Fuel to be used for trials and acceptance tests shall be high speed diesel. First fill of 990 litres HSD per DG set required coolant and lube oil is included in the scope of this contract at no. extra cost.

13.13 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 resistant primer. The finishing treatment shall be of two coats of synthetic enamel paint of approved color. All piping shall be color coded.

13.14 ALTERNATOR

The alternator shall be brushless synchronous and suitable for 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 p.f., 1500 RPM.

The alternator shall be suitable for coupling directly to the diesel engine It shall be Drip proof, screen protected as per IP 21. The alternator shall be single bearing type & self ventilating. The alternators shall be continuously rated and shall have class 'H' insulation with a temperature rise restricted to that of class F designed and built to withstand tropical conditions. It shall generally conform to BS: 5000 (part - 99) / standards listed above. The alternator shall be suitable for sustaining a 10% overload for 1 hour in any 12 hour period without injury. The terminal arrangement for alternator shall be suitable for Cable connections of adequate size to deliver the full load of the alternator.

The alternator shall also have a solid state type digital voltage regulator (D.V.R.) suitable for single running with control limits of 1% from no load to full load under normal load changes. It shall be of static type and complete with cross current compensation. The

regulator shall be provided with voltage adjusting potentiometer, and shall be complete with all alarm contacts, internal wiring, etc.

The Engine and Alternator shall be direct coupled and mounted on a common rigid fabricated steel base frame with suitable vibration isolation system.

EXCITOR

Self excited, self regulated and providing alternator output regulation at plus or minus 0.25%. The alternator shall be provided with a pilot-excited, permanent magnet-excited generator (PMG) for superior short circuit capabilities. Bidders to specify sustained short circuit current capabilities for up to 10 seconds.

The alternator shall be provided with sealed Barings to give minimum service life of 40,000 Hours. The Bidders to specify the maximum rating of the motor that can be started direct on line without any base load, with 50% base load, restricting the Voltage depth to 20%.

INSTRUMENTATION

Instrumentation shall be provided and mounted on the Generator Set to monitor the following:

- Engine Speed
- Oil Pressure
- Oil Temperature
- Water Temperature.

A Gauge Board shall be provided with all the indicators grouped together. The generator shall be provided with a microprocessor-based controller with a facility for remote start, remote annunciation , auto / manual synchronizing and remote communication capability through the telephone /GSM network .It should be possible to monitor the parameters of the engine and the alternator and display the status of the faults on the DG set if any and generate a complete report on the PC individually or on a network. The following minimum monitoring & protection is required for the alternators.

Alternator Monitoring

- Current. (I1, I2, I3)
- Frequency
- Voltage (L-L & L-N)
- KVA
- KVAR
- Power Factor
- Percentage alternator duty heavily i.e. actual load / KW rating.

The Generator shall be protected against the following electrical faults

- Overload and short circuit
- Ground fault

- Over current
- Over frequency
- Under frequency
- Under Voltage
- Over Voltage
- Locked Rotor
- Reverse power protection.

It should be possible to read the data i.e. Parameters and Shutdown status locally on the D.G Set. All the above Parameters should be displayed on The Local Control Panel through appropriate meters and status on faults should be indicated through a facia annunciator. It should be possible to display all the functions as above on a personal computer.

13.15 EXHAUST SILENCER PIPING

The exhaust silencer piping system shall be of heavy duty MS pipes confirming to Class - B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. Exhaust pipe along with silencer inside the building shall be provided with mineral wool insulation with chicken mesh wrapping and 26 SWG aluminum cladding. All terminal connections and pipes joint shall be of welded construction. The terminals of sizes 2" and above shall be butt welded, and of sizes 1.5" and below shall be socket welded, complete with flanges, jointing and fasteners. This welding shall be done as per relevant ASME/ASA codes. The Contractor will have to indicate beforehand the welding procedure he proposes to use. After confirmation by the Project Manager the procedure which is finalised shall be strictly adhered to.

13.16 TESTS AT MANUFACTURER'S WORK

The following tests shall be performed at manufacture’s works prior to packing and dispatch to site.

On DG Set

- Maximum power load capacity.
- Maximum motor starting capacity
- Endurance test.
- Fuel consumption at full load, 50% load, 75% load and 25% load.
- Engine - Alternator cooling air flow
- Load acceptance Test

On the Alternator

- High voltage tests on stator and rotor windings.
- Insulation resistance of stator and rotor windings.
- Temperature rise test.
- Measurement of resistance of stator and rotor windings.

- Measurement of losses.
- Mechanical balance.
- Load rejection and over speed tests.
- Stator voltage and current tests.
- Stator phase sequence check.

On the Excitor

- High voltage tests on stator and rotor winding.
- Insulation resistance of stator and rotor windings.
- Temperature rise test.
- Measurement of resistance of stator & rotor winding
- Measurement of losses.
- Response ratio test.
- Over speed test.
- Mechanical Balance test.
- On the Automatic Voltage Regulator
- Sensitivity test.
- Response time test.

All routine test as per IS/BS codes shall be conducted on alternator, exciter and AVR.DG Panel shall be part of main L.T. Panel, supplied by the Owner. However DG supplier shall do the coordination and provide all the inputs required for successful operation.

13.17 INSPECTION AND TESTING AT SITE

All pre-commissioning and commissioning test and checks shall be carried out at site. The Contractor shall be required to produce manufacturer's test certificate for the particular batch of materials supplied to him by the manufacturers. The test carried out shall be as per the relevant standards. For examination and testing of materials and the works at site, the Contractor shall provide necessary testing and gauging equipment as required. All such testing and gauging equipment shall be tested for calibration at any approved laboratory as required by the Project Manager. The Contractor shall give notice well in advance to the Project Manager before commencement of any site testing. All materials like consumable stores, fuel oil grease, lubricating oil etc. required for the trails shall be arranged by the contractor. The Contractor shall make all necessary hook-ups to carry out tests at site and shall furnish necessary fuel. The complete installation should be initially started and checked out for operational compliance by manufacturer's representative.

13.18 TRIALS (AT SITE)

Preliminary Trials

After completion of erection of generating sets and before carrying out main trials, preliminary site trials shall be conducted in the presence of the Project Manager. Such trials shall include the checking and adjustments of all instrument relays, timers, interlocks and meters. Insulation resistance of stator, rotor and exciter windings shall be checked and reading recorded. A check shall be made for the satisfactory working of all auxiliary motors and their starting accessories supplied with the set.

Main Trials

The main trials shall include over 8 hours continuous run at full load. D.G. Panel shall be tested for automatic operation by injecting proper current and voltage by a separate source. The satisfactory working of automatic operation shall be tested and necessary adjustments shall be done for relays in the presence of the Project Manager 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 3% shall be allowed on the fuel oil consumption to cover possible errors in 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: 5514. Alternator insulation resistance and commutation check shall be as per BS: 5000. Starting time of sets shall be tested at least five times after sufficient time intervals to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment checked. Any further reasonable trial as suggested by the Project Manager 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 PROJECT MANAGER.

13.19 TEST WITNESS

Tests shall be performed in the presence of Project Manager. The contractor shall give at least thirty (30) days advance notice of the date when the tests are proposed to be carried out.

13.20 PERFORMANCE REQUIREMENT

The D.G. set shall operate upto 110% of rated speed, without undue vibration and noise. The unit shall be capable of delivering rated output at 0.8 p.f. at the generator terminals (after derating of the engine due to site conditions).As soon as the set attains rated speed the transient voltage drop at the generator terminal shall not exceed 10% of rated value.

GURANTEED TECHNICAL PARTICULARS OF DG

1.1	ENGINE Rating i) Minimum Engine Rating ii) Altitude (m) iii) Air humidity iv) Air temperature (°C) v) Duty vi) Standard	 Matching Less than 1000m above mean sea level 30% Min. 95% Max. Minimum 42 Maximum 50 Average 40 Continuous rating duty at specifi ambient air Temperature of 35°C BS 5514 and IS 3046
1.2	Overload capacity for one hour	10% over the continuous rating. In hours of continuous running.
1.3	GOVERNOR	Electronic Isochronous digital type
1.4	Starting i) Method ii) No. of auto starts iii) Selectivity	 Electric 3 (three) Auto/Manual/Test
1.5	Cooling System i) Heat exchanger	 Yes
1.6	Exhaust System i) Silencer ii) Flexible connection iii)Scrubber	 1 No or more as required Residential typ 1 No for each exhaust pipe near the engi Nil.
1.7	Safety Controls Instruments i) Two-point thermostat ii) High water temperature iii) Low oil pressure iv) Fuel level low v) Oil Pressure gauge	 Audible & visible alarm Trip engine with trip indication Audible visible alarm Trip engine Audible & visible alarm Yes, required

	vi) Water temperature gauge vii) Hour counter	Yes, required Yes, required
1.8	Sundry fittings i) Vibration mounts	 Yes, required with vibration, isolation efficiency up to 95% or more.
2.0	ALTERNATOR	
2.1	Rating at 40 Deg. C (ambient air Temp.) Continuons duty	Alternative - I 1500 KVA, (1200 KW), 1010 KVA (800 KW)10% over load for 1 hour in 12 hours
2.2	Minimum efficiency %	94.00
2.3	Enclosure	IP – 21 or better
2.4	Winding	Class H
2.5	Cooling	IC 01 IS-6362
2.6	Excitation System	Brush less exciter with rotating dic assembly
2.7	Over speed %	120
2.8	Transient response & Response voltage dip	Bidders to specify largest motor to started on DOL with no base lc & with 50% base load, TVD to be restricted to 20%.
2.9	Sustained short circuit	Bidders to specify maximum SC capabil for 10 seconds
2.10	Terminal Box	Suitable for Al / Cu Bus duct deliver the rated current.
3.0	FUEL OIL FACILITY	
3.1	Day tank (14 SWG steel)	990 litres complete with, over flow, drain, filter and gauge glass and level controller etc.
3.3	Piping	From day tank to engine set
4.0	COOLING	Heat exchanger type
5.0	ACOUSTIC ENCLOSURE DETAI	
	Structure	MS Press bent 3 mm

5.1	PANELS	
	Type	Steel Fabricated double wall insulat panels
	Panel Thickness	75 mm thick
	Outer Sheet	1.75 mm thick minimum CRC Sheet
	Inner Sheet	1.00 mm thick CRC Perforated Sheet
	Frame & Stiffener	2mm thick CRC Sheet
5.2	INSULATION	
	Type	Rock wool of reputed make.
	Thickness	75 mm thick
	Density	96 Kg/m^3
	Anti droning	HDPE Sheet
	Thickness	6mm thick
5.3	AIR CIRCULATION SYSTEM	
A	AIR Intake	
	Type	Axial Flow Fan
	Make	Techno Mac or Equivalent
	RPM	1440/2800
	Motor	KIRLOSKAR/SIMENS/ABB Equivalent
B	Air Exhaust System	
	Type	Axial Flow Fan
	Make	Reputed Make
	Speed	1400/2800 RPM
	Motor	KIRLOSKAR or Equivalent
	Qty.	1 No. For Air Exhaust
5.4	SILENCER HOOD INTAKE	
	Type	Air Intake Hood
	Qty	2 Nos.
	Design	With Acoustic Splitter & Baffles Insulated Hood Cover
	FINISHING	Weather Proof " POWDER COATED "
	Sound Reduction (min)	70 DB at one mtr.

5.5	Protection CT's for each DG set	
	3 nos of cast resin CT's requires at t alternator side including the bus b extension and the box for different protection .	
	3 nos spare CT's to be supply by the vendor of the same specificati a.	

Notes: Deviation if any, from the data sheet shall be specifically brought out by the tenderer and no extra payment will be made if any deviation .

13.21 COOLING TOWERS AND WATER CIRCULATING EQUIPMENT

13.21.1 GENERAL

The various items of the water circulating system shall be complete in all respect and comply with the specification given below. The total sound intensity with all fans in operation shall not practically exceed 65 db at the distance of 3 mtrs, from all around the cooling towers.

13.21.2 COOLING TOWERS (FRP CONSTRUCTION)

The cooling towers shall be of FRP, Vertical induced draft type complete with FRP basin FRP body, fan and motor assembly, fill media, distribution pipes etc.

13.21.3 GENERAL CONSTRUCTION

The body shall be made of FRP (Fibre glass reinforced plastic) section of equal segments, all bolted together. The surface on both inside and outside shall be smooth, for minimum air resistance. The fan deck shall form an integeral part of the body. The structural strength of the body shall be sufficient to withstand wind velocities upto 60 m / sec. Vibrations and earth quake.

The water basin shall also be of F.R.P. Having an auxiliary suction tank, at the bottom. The basin shall be complete with conections for drain, overflow, makeup water, quickfill and float valve, plus hot dipped galvanized stainer.

The support structure for the tower shall be of mild steel duly hot dipped galvanized.

The water fiffusion deck shall of rigid PVC fill in Honeycomb design, arranged in a suitable pattern for ease of replament. PVC fills shall be of high efficiency.

The colour of the cooling tower body shall be of the owner / srchitect choice.

13.21.4 WATER DISTRIBUTION SYSTEM

The hot water shall be distributed through a sprinkle system consisting of PVC sprinkler pipes, which shall be mounted on the top of the main supply stand pipe.

Each cooling tower shall hve twin header system coupled with gravity flow distribution system.

13.21.5 FAN ASEMBLY

The fan shall be of axial flow type with cast aluminium multiple blades of aerofil design and adjustable pitch. The fan assembly shall be statically balanced. The fan outlet velocity shall not be less than 10 m/ s and the tip speed shall be below 4500m / minutes.

The fan shall be directly mounted on the motor or through speed reduction gears. In the latter case, the housing shall be of heavy cast iron, construction with large oil reservoir.

The fan motors shall be totally enclosed fan cooled squirrel cage type confirming to I.P. 55 Protection for outdoor operation.

The fan guard shall be hot dipped galvanized with wire mesh screen to prevent bird nesting during idling period.

13.21.6 LADDER

All towers, whose height exceeds 2.5 mtrs, shall be provided with a ladder, made out of hot dipped galvanized M.S. Tubes.

13.21.7 PUMP SETS

The pump sets shall be monoblock type with end suction and top discharge flanged conections directly mounted on the dripproof squirrel cage induction motors and suitable starter as specified.

The impller shall be of Bronze, single entery shrouded design, and properly balanced.

Water seal shall be of mechanical type to minimized water leakage and should be easily serviceable in the field.

Motor and strter shall confirm to relevant specifications and of rating given in ‘ schedule of quanities’.

13.21.8 MISCELLANEOUS

The following items to be provided:

Water pressure gauge at inlet and outlet of each pump complte with gauge cocks and connected tubing.(To be priced seperately)

Vibration isolation pads for each pumps.

Drain line from each pumps upto drain pilt,(priced saperately).

13.21.9 INSTALLATION AND TESTS

The cooling towers shall be mounted on the beam/ steel structure member, provided Contractorand shall be unconnected with the roof slab. All nuts / bolts etc. for mounting shall be provided by thE Contractor.

On installation of the capacity of the cooling towers shall be checked by measuring water flow rate, water IN and OUT temperature and the ambient W.B. Temperature and then computing the capacity and efficiency.

The pumps sets shall be mounted on cement concrete foundation which shall be provided by HVAC contractor including grouting nuts, bolts, channels etc. shall be provided by the contractor.

On installation the capacity of the pumps shall be cheked by measuring water flow. Motor current and pressure difference at inlet and outlet. The reading shall be recorded to compare actual performance with the specified data.

Magnetic level switches shall be provided for low level alarm, in each cooling tower.

13.21.10 PIPE WORK

General :

All piping work shall confirm to quality standards and shall be carried out as per specifications and details given hereunder:

Pipes

All pipes in sizes 200 shall M.S. E.R.W. tube (black steel) heavy class as per I.S. 1239-79, Part -1 with amendment-I of January ’81. All pipes above 150 mm dia shall be minimum 6.4 mm thick.

Fittings :

The dimensions of the fittings shall conform to I.S. 1239/69 Part-II unless otherwise indicated, in the specifications.

All bends in sizes upto and including 150 mm dia, shall be ready, made of heavy duty, wrought steel of appropriate class.

All bends in sizes 200 mm and larger dia, shall be fabricated from pipes of the same dia and thickness, with a minimum of 4 sections, and having a minimum centre line radius of 1.5 diameter of pipes.

All fittings such as branches reducers etc. in all sizes shall be fabricated from pipes of the same dia. And thickness and its length should be at least twise the dia of the pipe.

The branches may be welded straight to the main line without making a saprate fitting, where specified on drawings or required by engineer-in-charge.

Blank ends are to be formed with flanged joints and 6 mm thick blank between flange pair for 150 mm and over, in case where, a future extension is to be made otherwise blan and discs of 6 mm thickness are to be welded on, with additional cross stiffners from 50mm x 50mm M.S. Heavy angles, for sizes upto 350mm. All ends larger than 400 mm dia shall have dished ends.

Flanges.

All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flangs thickness shall be to suit class-II pressures.

Flanges may be tack welded into position, but all final welding shall be done with joints dismounted. 3 mm thick gaskets shall be used with all flanges joints. The gaskets shall be filre reinforced rubber as approved by the Engineer-in-charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

Flanges shall be used as follows :-

Counter flanges for equipment having flanges conections.

Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. Pumps, refrigeration machines air handling units etc.

All thread valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main line for repair/replacement.

Valve :

Butterfly Valves

The butterfly valve shall consist of cast iron body preferably in two piece contruction.

The discs shall consist of disc pivot and driving stem shall be in one piece centrally located.

The valve seat shall be synthetic material suitable for water duty. It shall line the whole body.

The discs should move in slides bearing o both ends with ‘o’ ring to prevent leakage.

The handle should have arrangement for locking in any set position.

All gate valves and check valves upto & including 65 mm dia shall be of gunmetal screwed type, conforming to class 2 of I.S. 778. and shall be with I.S.I marking and certification.

All gate valves and check valves upto 80 mm dia and above shall be of cast iron flanged type, conforming to class 2 of I.S. 780/69 (for sizes upto 350 mm) and of I.S. 2906/69 (for sizes 350 mm and above) marking and certification.

All guage cocks shall be of gunmetal plug type, complete with siphon (brass chrome plated).

All drain valves shall be of gunmetal with a hose union connection of one hand.

All valves o the supply of fan coil units shall be of gunmetal ball type with integral water stainers, having (BSP) fpt inlet and flare type MPT outlet connection.

All valves on the return line of fan coil units shall be as in 5.6 but without integral water strainer.

Balancing Valves :

The balancing valves upto 80 mm dia shall be of gunmetal screwed type confirming to B.S. 5154 or equivalent specifications.

The valves shall be cast gunmetal ASTM B-62 and complete with non rising spindle. PTFE disc seal cast metal hand wheel.

The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

The valves shall be complete with two ports for connection to a mercuary manometer, to measure the pressure drop, as well as a drain port.

The spindle shall have shielded screw to set the flow at the desired level.

The valves shall be used wherever specified.

Strainers :

The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, tested upto pressure applicable for the valves as shown on the drawings.

The strainers shall have a perforated bronze sheet screen with 3 mm perforation and with a permanent magnet, to catch iron fillings.

Pot strainers shall be provided with flanged conection and 'Y' strainers shall be provided with flanged ends.

The strainers shall be designed to facilitate east removal of filter screen for ceaning without disconnection of pipe line.

Jointing

All pipes line shall be welded type.

Square cut plain ends will be welded for pipes upto and including 100 mm dia.

All pipes 125 mm dia or larger will be beveled by 35 deg before welding.

Miscellaneous :

Provide all pipe work as required to make the apparatus connection complete and ready for regular and safe operation. Unless otherwise noted, connect all apparatus and equipment in accordance with manufacture's standard details, as approved by Engineer-in-charge.

Unless otherwise specified, pitch the lines of piping as follows:-

All condensation drainage, including air handling unit and fan coil unit shall be pitched in the direction of flow to ensure adequate drainage, with an adequate trap seal to prevent

leakage of air due to static pressure developed by airconditioning units. Pitch, 20 mm per meter wherever possible, but not less than 10 mm per meter.

Drains from other equipments shall be pitched similary without trap seal.

Provde valves and capped connections for all low points in piping system, wherenecessary or required for draining system. Provide isolating valves & drain valves in all risers to permit repairs without interfering with the rest of the system.

Support piping independently of all equipment so that the equipment is not stressed by the pipi ng weight or expansion.

To facilitate the maintenance, repair and replacement.

Provide shut-off valves where indicated and for individual equipment, units at inlet And outlet, to permit unit removal for repairs, without interfering with theremainder of The system. Additional shout-off valves shall be provided as reqired to enable all systems to be fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.

Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.

Cut the pipes accurately according to measurements, established site & Work into plase without springing or forging.

Pipe suppots shall be adjustablefor height and primecoated with rust preventive paint & finish coated with grey paint, both as approved by engineer-in-charg. The spacing of Pipe supports shall not be more than that specified below:-

Nominal pipe size mm	spacing (meters)
15 … …	1.25
20&25 … …	2.00
32,30,50,&65 … …	2.50
80,100,&125 … …	2.50
150&Above … …	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stresses on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic approved dash fasteners.

Insulated piping shall be in such a manner as not to put undue pressure on theinsulat- ion, such as providing teak wood block between pipe and support.

Where pipes are to be buried under ground, they should be coated with one coat of bituminous paints. The top of the pipes shall not be less that 75 cms. From the ground level. Where this is not practical permission of engineer-in-charge shall be obtained for buring pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushion of not less than 15 cms. After the pipes have been laid and top sand cushion proved, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the contractor.

Hangers & Supports :

Hangers & supports shall be provided and installed for the piping and tubing wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and support shall be provided to prevent vibration or excessive deflection of piping and tubing.

All Hangers & supports shall be made of steel or other durable and non-combustible material, givan two coat of primer red oxide and then painted with aluminium colour paint. Wood wire or perforted strap iron shall not be used as permanent hangers or supports.

Hangers shall be supported from structural steel, concrete inserts & pipe racks, as specifically approved.

No hangers shall be secured to underside of light weight roof decking and light weight floor glass.

Mechanical equipment shall be suspendent midway between steel joists and panel points.

Drilling or punching of holes in steel joist members will not be permitted.

Sleeves :

Where pipes pass through floors, walls, etc provide Galvanized steel pipe sleeves 50 mm larger than outside diameter of pipe. Where pipes are insulated, sleeves shall be large enouth to ample clearance for insulation.

Where pipes pass through outside walls or foundation, the space between pipe and sleeve shall be caulked with lead wool and oakum.

The centre of pipes shall be in the centre of sleeves, and sleeves shall be flush with the finished surface.

Expansion or Contraction :

The contractor shall provide for expansion and contraction of all piping installed by the use of swing connection and expansion loops.

Arrangement and alignment of Piping :

All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge.

The piping shall be installed in a uniform mannar, parallel to or perpendicular to walls or ceiling, and all changes in directions shall be made with fittings. The horizontal piping

shall be run at right angle and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room.

All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer-in-charge

All piping shall be carefully installed to provide for proper alignment, slope and expansion

The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle

Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor Excessive in length, but shall be neatly, carefully bent at all change in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

Testing:

In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, appliance be subjects to pressures exceeding their test ratings.

The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blankoffs or flanges.

After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fitting shall be cleaned of all dirt, filling and debris.

All piping shall be tested yo hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq. cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to thw satisfaction of the engineer-in-charge, without any extra cost.

All the piping system shall be tested in the presence of the engineer-in-charge or their authorized representative. Advance notice of test dates shall be given all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by engineer-in-charge in order to avoid hindrance in the work of the insulation contractor.

All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq.cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.

Miscellaneous piping, tests with air at 10.5kg/sq.cm for a minimum of 24 hours without drop in pressure.

The contractor shall make sure that proper noiseless circulation is achieved; the contractor shall bear all expenses for carrying out the rectification work including finishing of floors, walls and ceiling damaged in the process of rectifications.

The contractor shall provide all labours and materials to make provision for removing water and throwing it at the proper place, during the testing or/and after the testing to avoid damages to employer or other contractors properties. Any damages caused by the contractor to the employer or other contractor' properties, shall be borne by the contractor.

Painting:

All pipes supports, hangers, etc, shall be given two coats of red oxide primer.

All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as per ISI code.

13.21.11 EXHAUST SILENCER PIPING

The exhaust silencer piping system shall be of heavy duty MS pipes confirming to class B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendation of the manufacturer. MS screws flanges and bends shall be used as per site requirements. Exhaust pipe inside the building shall be logged with heat resistive glass wool of 48 kg / mtre cube and then cladded with Al. foil all along the pipe.

13.21.12COOLING TOWER CAPACITIES

The cooling towers of adequade capacity to be installed at the terrace of the complex from where the common header of the cooling towers shall be brought down to the DG

room in the basement. Soft water is reuiqred to be filled up in make up water tank for closed circuit cooling of engine.The contractor has to obtained the data from the Manufacturer for the requirement of the cooling tower capacity of the DG sets. The data for the Cummins engine is as followed:

DG Rating	Raw water Flow	Cooling Tower capacity	Reccommended pipe size.
1500 KVA	1300 ltr / minute	150 TR	125mm
1010KVA	900 ltr / minute	125 TR	100mm dia.

The inlet temperature to the cooling tower shall be of 43.3 degree C.

The inlet temperatue from cooling tower shall be of 32.3 degree C.

There shall be two common cooling tower for the DG sets. On the basis of data the size of common header and Pups size min two nos with third no. standby shall be designed.the common header shall have temperature meters and butter fly/ Non return valves as required. While desgining the Header of DG set shall be taken from the manufacturer.

13.22 Synchronisation System

13.22.01 The synchronisation panel shall be complete in all respects for auto operation of D.G.Sets as specified in BOQ. The minimum requirement for D.G. set operation shall be as detailed below, however, the vendor shall indicate in details the additional features and facilities being offered by them.

13.22.02 The parallel operation of D.G. set in Synchronisation mode shall be completely through Power Control Center Module (PCCM). The PCCM shall be mounted on DG SETs outside the Building (the supplying and fixing of the PCCM is in the scope of Supplying and fixing of DG vendor Set). The PLC for the further operation shall be mounted on the Synchronising panel with SLC 5/03 processor, kw transducer & suitable input /out put card,8 channal analog card Power Monitors – IV . The wiring between the DG Sets, PCCM and Synchronising Panel is in the scope of DG Vendor.

13.22.03 During the parallel operation, the system take care of the load sharing i.e. active and reactive both for all the D.G. sets. and issue soft commands for voltage / frequency raise / lower,

13.22.04 Depending upon the load requirements, the the system shall start / stop the D.G. sets.

13.22.05 Monitoring & logging of the electrical datas and events through existing P C.This will be achieved by using microprocessor based PC controller or equivalent networking kits & required hardware like GCM,modlon convertor ,communication cable.

13.22.06 Alarms and necessary remedial commands for D.G. and electrical system fault.

13.23 D.G synchronizing panels . Local Control and Manual Synchronisation

(Common for all D.G.Sets Part of the Synchronising Panel)

The minimum equipment shall be as follows:

a. D.G selector switch

b. PLC / manual selector switch

c. Double scale voltmeter

d. Double scale frequency meter

e. Synchronoscope

f. Check synchronisation relay

g. Synchronisation lamps

h. Solo parallel selector switch

i. Manual synchronisation circuit “ON”/”OFF” selector switch

j. Push buttons & indicating lamps

k. Control P. T

l. Mimic

13.23.1 The following components shall be provided for each DG Set :

a. Breaker control Switch except for DG Incomer.

b. Automatic battery chrger having inbuilt Trickle /boost facility selector switch for battery charger

c. DC digital Ammeter and Voltmeter selector switch

d. Auto/Manual selector switch for priming pump

e. Breaker control switch (only for one number bus-coupler required)

f. Indicating lamps (LED type) for following:

g. R_1Y_1B, phase indication

h. D.G breaker "ON"/"OFF" spring charged

i. Neutral contactor "ON" /"OFF"

j. Engine running

k. Battery charger "ON"

l. Control supply healthy

m. Priming pump "ON" /"OFF"

n. Speed raise /low joystic

o. Voltage raise / low joystic

p. 12 window annunciator with alarm Accept/Test/Reset push buttons, Hooter.

q. Temperature Scanners for RTD and BTD

r. Becon light

s. Hour meter

t 5 Nos Under voltage relay for mains feeder "

t. 5 Nos Over Voltage relay for mains feeder "

u. Stand by Earth fault relay ''

v. Reverse power relay (reactive) "

w. Trip circuit supervision relay "

x. Master trip relay "

y. 5 H.P, DOL starter for oil priming pumps for D G Set

z. Power factor meter (Analog)

aa. Frequency meter (Digital)

bb. Ammeter (Digital)

cc. Voltmeter (Digital)

dd. KW and KVA meter (Digital)

ee. Kwh meter (Digital)

ff. D.C. Ammeter (digital)

gg. D.C.Voltmeter (digital)

hh. Breaker Control Switch for bus coupler

ii. Battery Charger on / off switch with boost and trickle charger facility

jj. Trickle / booster charger selector, switch

kk. Push buttons (lot)

ll. P. T

mm. Aux. Contactor (lot)

nn. transducers

13.23.2Automatic Generator Sequencing

a) Automatically start & stop gensets based on plant load or bus on process demand.
b) Configurable plant bus demand start / stop levels and timers.
c) On line engine priority sequence configurability from any synch. Unit or PC to equalize run time of all DG sets.

13.24 SYNCHRONISING PANEL

The technical specification and details of the microprocessor based PLC controller for the DG set synchronizing and load sharing shall be as follows:

The microprocessor based PLC panel shall be suitable for use with AVR and electronic speed governor to protect and monitor DG sets.

Double Frequency Meter and Double Voltmeter shall be provided in synchronizing panel.

Synchro check relay also shall be provided.

The PLC shall be provided with following features and audible alarm:

- Engine pre glow control
- Fuel solenoid control
- Engine starter control
- KVA controlled cool-down timer
- Speed monitoring
- Over speed protection
- Oil pressure monitoring, alarm and shutdown of the engine.
- Water temperature monitoring, alarm and shutdown of the engine
- Battery voltage monitoring
- Over speed monitoring and alarm.
- 3 attempt start failure alarm
- Under/Over Frequency
- Reserve Power (Inverse time delay)
- Loss of excitation
- Over current (inverse time delay)
- Loss of utility power detection
- Load surge
- Current unbalance
- Voltage unbalance
- Mains Protection (vector shift, df/dt ROCOl)
- True RMS power calculations accurate control
- Configurable loading/unloading ramp rates
- Isochronous load sharing of up to 4 units using percentage based load sharing
- Base load control for optimum fuel efficiency
- Import export control using a watt transducer
- Soft utility transfer function
- Digital signal processing to eliminate harmonic issues
- Adjustable phase window, Voltage and dwell time
- Safe dead bus closing logic internal to the control
- Synchronization across generator and mains breakers

- Multiple short re-closing with adjustable time delay
- Manual voltage and speed adjusts for manual synchronizing
- VAR sharing on isolated busses using percentage based reactive load sharing
- Power factor or VAR control when base loaded
- Externally adjustable VAR or PF set point levels.
- The DG set shall start and stop automatically based on plant bus demand.

The PLC system shall be provided with built in relays for protection of the following:

- Reverse Power
- Reverse KVAR
- Over current
- Under and over voltage
- Under and over frequency
- Synchronization check and earth fault relay.

The PLC system shall be suitable for load sharing by sensing active and reactive power.

The PLC system shall comprises of the following:

- Main processor unit
- Power module for power supply to the processor and the system
- Power monitor to monitor voltage, KVA, KVAR, KW, KWH, KVAH, KVARH.
- 16/32 channel Digital input module
- 16/32 channel Digital output module
- EEPROM for main processor unit
- Computer to PLC communication card with necessary cables.
- Window based operator interface Software Package
- Mounting chassis for the equipment

The microprocessor based main processor of the system shall be suitable for 128 digital I/P and 128 O/P and comprises of the following:

The main processor unit shall be suitable for operation on 24 Volts DC with integrated memory. The integrated Ram memory shall be 20 K Words for program, data and constants plus data memory and flash EP ROM of 16 K works for backup application program, communication card and real time clock.

4 Nos. discrete combination module (Input/output Module) shall be provided and the same shall be suitable for operation on 24 volts DC system. Combination module shall be with 16/32 inputs and 16/32 output channels as per the actual requirement.

- 1 No. 2 slot extension rack
- 1 No. Ram back up battery unit
- 8/4 Nos. digital input module
- 8/4 Nos. digital output module

The CPU display unit shall be suitable for 4 lines of 40 characters. The display shall be with back lit LCD. Clarity shall be not less than 5 x 7 pixels. The height of the characters shall be not less than 5 mm. The data entry shall be with the help of 24 function keys. In addition to this there shall be 10 service keys and 12 alphanumeric keys.

The system shall be provided with RS 232 communication port.

13.25 OPERATION AND COMMUNICATION

The PLC shall monitor the bus bar load continuously. In event of mains failure the PLC shall give signal to select and start the generator, which is closer to the load sensed during the last 60 seconds. In case the load at the time of main failure is more than the highest rating DG set, the PLC shall give command to start 2 Nos. DG sets to suit the load, synchronize the sets and give command to close the breaker on the main LV panel.

If load starts reducing the PLC shall give command to turn off the DG sets through cool down timer. On restoration of main power supply, the PLC shall check the voltage and frequency and if they are stabilized and with in the permissible tolerances, the PLC shall give command to shut down the DG sets through cool down timer.

The control and monitoring of the cooling tower and fan and feed pump shall be done through PLC control system. Necessary control wiring between cooling tower, pumps and PLC panel shall be carried out within the scope of work.

13.26 SYNCHRONIZING MODULE

The synchronizing module shall be a microprocessor based intelligent unit, which shall monitor the electrical parameters and shall able to communication with the PLC control unit in the process of synchronizing and load management. The system shall be suitable for dynamic synchronization. The synchronizing module shall be suitable for programming and set the preferred difference between DG set and bus bar.

The synchronization module shall monitor and fulfill the following conditions before the system synchronizes the DG set to mains.

Feed bank signal from the DG breaker on main LV panel that the breaker is in open condition.

- Bus bar voltage is present
- Generator voltage is present

The frequency regulator in the system shall start when the generator voltage and the bus bas voltage is over 50% of normal voltage. The voltage regulator in the system shall start when the frequency is within 90% of the normal system frequency.

The system shall close the breaker on the power panel with out carrying out synchronization when all the below mentioned conditions are fulfilled.

Feed back signal from the DG breaker on main LV panel that the breaker is in closed condition.

- Bus bar voltage is present
- Generator voltage is present

The synchronizing module shall transmit all monitored electrical parameters to the PLC unit and the PLC unit shall start controlling the synchronization of the DG sets and its load management. The data logging, monitoring and controlling shall be through a PC based SCADA station.

14.00 PROCUREMENT, INSPECTION OF EQUIPMENT & APPROVALS

Approved list of makes and vendors are given in the end of technical specifications. The makes of equipment/materials supplied shall be strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. All equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorised agents.

HSCC Electrical Engineer shall have access to the manufacturer's premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer's works.

Based on the inspection certificate, HSCC Electrical Engineer reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection.

It is the responsibility of the contractor to ensure that all electrical works are carried out as per the IE Rules & regulations, National Building Code and IS Codes & Standards. All necessary drawings and details as required by Electricity Board, Electrical Inspector, Fire Department and other Local Statutory agencies, shall be prepared by the contractor. The contractor is responsible to submit the drawings and other details as required to the Local Authorities (refer above) and obtain necessary approvals including sanction of load/enhancement of electrical load from SEB before energizing and commissioning. All official fee required for getting the approval will be reimbursed on account of Client on submission of original documents.

15.00 BUS TRUNKING

15.01 SCOPE

This section covers manufacture, supply, installation, resting and commissioning of sandwich insulated bus trunking. And rising mains, indoor/ out door type.

15.02 Supply voltage

415/ 440 Volt, 3 pahse, 4 wire, 50 Hz AC supply.

15.03 Standards for compliance:

IS:8623/ 1993 I & II and IEC 60439/ I & II.

15.04 Construction:

The enclosure will be made from 16 SWG GI/ CRCA sheet steel powder coated of approved shade. Bus bars would be of high conductivity aluminium in "Sandwich" construction and the conductors will be individually insulated with halogen free, fure retardant class–B & F – insulation. No drilling of Bus bar is permitted. Length of the section will be limited to maximum three metre. Bus bar of one section will be connected to bus bar of adjacent section by uni-block joint system removable as separate sub-assembly, so that it can be inserted or removed with out disturbing the adjacent sections.

15.04.1 Technical Parameters:

Bus trunking shall be designed to withstand short circuit current of 50 KA /75KA for one second.

Bus bar system should be designed for high temperatures withstand capability of 55 degree Celsius over 50 degree Celsius as normal operating temperature.

Insulation voltage 1.1 KV
Bus trunking will be suitably chosen to give permissible voltage drop.

Rated impulse withstand voltage 12 KV at 1000 volt.

Single bolt bridge system to be incorporated.

Plug in boxes

Plug in boxes will be of draw out type. Contacts will be of silver plated copper and spring loaded. Earth connection will be the first to make and last to break during insertion and withdrawl. Pluf in boxes will be made from 1.6 mm CRCA sheet steel powder coated.

Inside the plug in Boxes MCCB or SFU with the fuses will be located as per requirements. The operating handle will be interlocked with plug in box cover so that MCCB can be operated only with the suitable cover in closed position. The plug in box will be interlocked with bus bar trunking so that it can not be inserted or removed with the plug in box lid open. MCCB/ SFU will be of 4 pole type unless otherwise specified in BOQ. Short circuit breaking capacity of MCCB in PIB should be same as that of bus trunking i.e. 50 KA.

15.05 List of test to be carried out:

15.05.1 Routine tests:

i. Verification of insulation resistance.
ii. Inspection of assembly, interlocks, locks etc.
iii. Dielectric test.

Copies of the following certificate should be submitted:

i. Verification of temperature rise limits
ii. Verification of di-electric properties.
iii. Verification of short circuit strength.
iv. Verification of degree of protection.
v. Insulation resistance test with 500 volt megger. The insulation resistance shall be not less than 100 mega ohm.

16.00 CAPACITOR PANEL

16.01 SCOPE

Supply, installation, testing and commissioning of medium voltage capacitors and Automatic Power Factor Correction Panel (APFC) for improvement in power factor of electrical system. It will be connected to main LT panel. It shall improve power factor up to 0.98 legging from initial power factor. Capacitor panel shall be provided with day/ night mode selector switch and double ratio C.Ts, for day/ night mode. Day/ night mode shall be selected based on estimated day / night load requirement.

16.02 RATING

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors.

16.03ENCLOSURE

The panel shall be indoor, floor mounted and free standing type with IP-42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure and shall be finished with powder coating in the approved colour shade. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided. The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors (7%). The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

16.04APFC Relay

Microprocessor based APFC relay, (intelligent VAR controller) of suitable steps as mentioned in the BOQ, shall sense the PF in the system and automatically switch ON/OFF the capacitor unit or bank to achieve the preset target PF. The controller shall have digital settings of parameters like PF, switching time delay, step limit etc, indication of PF, preset parameter, minimum threshold setting of 1% of CT current.

16.05 CAPACITORS

The capacitor shall generally confirm to IS:13341-1992 and 13340-1993 and IEC 60831-1 &2.

General specification: three phase, delta connected, 50 Hz.

i. Voltage: Must be designed to with stand system over voltage, increased voltage due to series reactor and harmonics.
ii. Capacitor type: The capacitor unit shall be super heavy duty mix dielectric type or as specified in BOQ. The dielectric should be made of metalised tissue paper. These

elements shall be combination of capacitor tissue paper and BOPP film impregnated with non PCB bio-degradable impregnant or film foil capacitor manufactured using Poly Propylene film placed between 2 layers of metal foil and winding. Capacitor should be fitted with safety device like pressure sensitive disconnector. The capacitor should be low loss type (total losses should not exceed 0.45 W/ KVAR).

iii. Temperature category: -25 degree C to 70 degree C.

iv. Over voltage +10% (12h in 24 hours), +15%(30 minutes in 24 hours), +20% (5 minutes) and 30% for I minute as per clause 6.1 of IS 13340-1993.

v. Over current: 2.5x In

vi. Peak inrush current withstand: 350 x In

vii. Capacitor shall be provided with permanently connected discharge resistors so that residual voltage of capacitors is reduced to 50 volts or less within one minute after the capacitors are disconnected from the source of supply.

viii. Each capacitor bank shall be provided with a terminal chamber and cable glands suitable for AYFY cable as specified.

ix. Two separate earthing terminals shall be provided for earth connection of each bank.

16.06 SWITCHGEAR & PROTECTION:

Incomer switchgear will be as specified in BOQ. Suitable contactor for each step shall be used and must be capable of capacitor switching duty. Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports.

Power cable used shall have superior mechanical, electrical and thermal properties. Internal wiring between main bus bars, contactor, capacitor etc shall be made with 1100 volt grade PVC insulated FRLS copper conductor of appropriate size by using suitable copper crimping terminal ends etc suitable bus links for input supply cable termination shall be provided.

Control circuit shall be duly protected by using suitable rating MCB. An emergency stop push button shall be provided to trip thr entire system (22.5 mm dia, mushroom type, press to stop and turn to reset). 440 Volt caution board shall be provided on the panel.

16.07 TESTS AT AMNUFACTURER'S WORKS:

All routine and type tests as per IS:2834 relevant to capacitor bank s as amended upto date shall be carried out at manufacturer's works and test certificates to be submitted to HSCC.

16.08 TEST AT SITE:

Insulation resistance with 500 V DC Megger shall be carried out and test results should be recorded.

Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute. Each discharge resister shall be tested for its working.
Drawings and Instruction manual:

16.09 INSTALLATION:

Capacitor bank shall be installed at least 30 CM away from the walls on suitable frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to main capacitor panel earth bus with 2 nos 8 SWG copper or 6 SWG GI earth wire.

Contractor shall submit four copies of the following certified drawings:

i. General arrangement of capacitor bank and control panel indicating main dimensions, type of mounting, location of various devices etc., including foundation details.
ii. Schematic diagram for automatic sequential switching with terminals and ferrules numbers.
iii. Wiring diagram of control panel indicating terminal blocks and various apparatus.
iv. Final list of components of control panel.

Contractor shall also submit four sets of installation and maintenance manual.

17.00 ROAD LIGHTING

17.01 GENERAL

Road lighting shall be done by 4.0 metre high GI pole with Post top lantern globe shaped light fixture with SPSV lamp. The poles shall be provided along the internal roads and pathways and internal courtyards. The light shall be partly on emergency supply as indicated in the respective control wiring layouts.

17.02 LOW HEIGHT LIGHT POLE

Light pole made of 4 metre high Class-B GI pipe with base plate 300mmx300mmx6mm welded to the pole and painted with approved steel primer with final paint as per schedule of quantities.

OCTAGONAL GI POLES

SCOPE

The scope of this specification covers the manufacture, installation, testing and commissioning of the 8 mtr high ,4mm thick Octagonal pole complete lighting system, including the Civil Foundation Works. The Purchaser shall only provide the supply point and the feeder cable of the required size, up to the bottom of the pole. The octagonal Poles shall be designed to mount street light luminaries
with weight aprox. 15 Kg. Each. The octagonal poles shall be Hot Dip Galvanized to give average 65 micron thickness. The octagonal poles are designed for max. wind speed of 50 m/s (180 km/hr). The octagonal Poles of length up to 8 meters are manufactured in single section The Octagonal poles diameter shall be of 150mm indicates the dimension across face (above floor level). The junction box shall be used only for octagonal poles having base dia 150mm (A/F) or as specified. Position of the door shall be of 500 mm above the base plate.

TECHNICAL SPECIFICATIONS OF STANDARD OCTAGONAL POLES

Design	The octagonal poles shall be designed to withstand the maximum wind pressure as per IS 875 Part III. The top loading i.e. area and the weight of fixture are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN: 40-3-3:2003/BS: 5649.
Pole Shaft	The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by submerged arc welding (SAW) process.

All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified process.

Door opening — The octagonal poles shall have door of approximate 400 mm length and suitable width at the elevation of 500 mm above the base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

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

Material

Octagonal poles	Conforming to grade S355JO/ BSEN 100 25 Or equivalent (IS 2062).
Base Plate	Fe 410 conforming to IS 2062
Foundation bolts	6.8 Gr. As per IS 1367

Welding — The welding shall be carried out confirming to approved procedures. The welders shall also be qualified for welding the octagonal shafts in accordance with ANSI/AWS.D1.1(96) Section 4

Pole sections — The octagonal poles up to the length of 8 meters shall be in single piece with single longitudinal welding joint. There shall not be any circumferential weld joint.

Galvanization — The poles shall be hot dip galvanized as per IS 4759/BSEN 1461 standards with average coating thickness of 65 micron.

Fixing Type — The octagonal poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.

Top Mountings — The galvanized arm shall be supplied along with the octagonal poles for installation of the luminaries.

17.03 Highmasts

The High mast shall be of 16 mtrs high the vendor shall be capable of every aspects of project design from engineering and manufacturing to construction and installation. The vendor capabilities include in-house engineering team of civil & structural designers quickly provide engineering solution tuned to customers need.

Scope of Work:

The Scope of work is design, manufacture, supply & erection of highmast lighting system.

- Highmast with its accessories.
- Raising lowering mechanism with integral power tool.
- Foundation Bolts
- Light fixtures
- Control Panel
- Construction of Civil foundation
- Erection & Commissioning of Highmast Lighting system.
- Earthing
- Erection of control panel.

Specification of high mast:

HIGHMAST STRUCTURE

a)	Standard Height of Highmast	:	16 Mtr.
b)	Highmast Type	:	Polygonal Continuously Tapered
c)	Material construction	:	BS EN 100025 or equivalent.
d)	No. of Sections	:	1/2/3 as per design
e)	Length of each section	:	Max. 12 Mtr
f)	No. of longitudinal welds /section	:	One
g)	No. of circumferential welds/ section	:	None
h)	Cross section of highmast	:	20 sided polygon
i)	Type of joints.	:	Stress fit at site.
j)	Metal protection treatment for Highmast	:	Hot Dip Galvanized.
k)	Average thickness of galvanisation (as per BSEN ISO 1461)	:	85 Micron.
l)	Earthing arrestor & AOL arrangement	:	Mounting at the top.

DYNAMIC LOADING AS PREVAILING AT SITE

a)	Max. wind speed	:	As per IS 875 part 3
b)	Max. gust speed time	:	3 seconds.
c)	Factor of safety for wind load	:	1.25
d)	Factor of safety for other load	:	1.15

FOUNDATION DETAILS

a)	Type of foundation	:	Open raft shallow footing.
b)	Size of foundation	:	As per Design.
c)	Design safety factor	:	As per IS –456
d)	Considered wind pressure (Kg/Mt2)	:	As per IS-875-1987

DETAIL TECHNICAL SPECIFICATION FOR HIGH MAST LIGHTING.

SCOPE:

The scope of this specification covers the manufacture, installation, testing and commissioning of the complete lighting system, using Raising and Lowering type of High mast Towers, including the Civil Foundation Works. The Purchaser shall only provide the supply point and the feeder cable of the required size, up to the bottom of the high mast.

APPLICABLE STANDARDS :
The following shall be the Reference Standards for the design of the High mast system:

Code No.	Title
a) I.S.875 (Part III) 1987.	Code and practice for design loads for Structures.
b) BS EN- 100 025	Grades of Special Steel Plates or equivalent
c) BS. 5135.	Welding.
d) BS.ISO 1461.	Galvanizing.
e) TR. No.7 1996 of ILE, UK.	Specification for Mast and foundation.

HIGHMAST:

Structure:

The High mast shall be of continuously tapered, polygonal cross section, 8-20 sided, fabricated from special steel plates. The mast shall be delivered at site in sections and joined together by slip-stressed-fit method. No site welding or bolted joint shall be done on the mast. The minimum over lap distance shall be 1.5 times the diameter at penetration. The mast shall be provided with fully penetrated and welded flange.

Dynamic Loading for the Mast:

The mast structure shall be suitable to sustain an assumed maximum reaction arising from a wind speed as per IS 875 (three second gust), and shall be measured at a height of 10 metres above ground level. The design life of the mast shall be a minimum of 25 years.

Door Opening :

An adequate door opening shall be provided at the base of the mast to permit clear access to equipment like winches, cables, plug and socket, etc.

Lantern Carriage:

A fabricated Lantern Carriage shall be provided for fixing and holding the required number of flood light fittings and control gear boxes. The entire Lantern Carriage shall be hot dip galvanized after fabrication.

Junction Box.

Weather proof junction box shall be provided on the Carriage Assembly as required, from which the inter-connections of luminaries shall be made.

Winch:

The winch shall be completely self sustaining type, without the need for brake shoe, springs or clutches. The winch shall be self-lubricating type by means of an oil bath. The winch drums shall be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. It shall be possible to operate the winch manually by a suitable handle and by an integral power tool The driving spindle is positively locked when not in use by means of automatic gravity activated pawls.

Power Tool for the Winch:

A suitable, high-powered, electrically driven, internally mounted power tool, with manual over ride shall be supplied for the raising and lowering of the lantern carriage for maintenance purposes. Each mast shall have its own power tool motor.

Head Frame:
The head frame is designed, as a capping unit of the mast, shall be of welded steel construction, galvanized both internally and externally. The top pulley shall be of appropriate diameter, large enough to accommodate the stainless steel wire ropes and the multi-core electric cable. The pulley block shall be made of non-corrodible material, and shall be of die cast Aluminum Alloy (LM-6). Self-lubricating bearings and stainless steel shaft shall be provided to facilitate smooth and maintenance free operation for a long period.

Stainless Steel Wire Ropes :

The two/three wire rope suspension system consist of only non-corrosive 'marine grade' (AISI 316) stainless steel wire ropes (7/19 Construction) of suitable diameter. The end constructions of ropes to the winch drum shall be fitted with talurit.

Electrical System, Cable and Cable Connections :

The electrical connections from the bottom to the top shall be made by special trailing cable of reputed make. The cable shall be EPR insulated and PCP sheathed to get flexibility and endurance. The trailing cables shall be terminated by means of specially designed, metal clad, multi pin plug and socket provided in the base compartment to enable easy disconnection when required.

Earthing Terminals & Lighting Finial:

Suitable earth terminal using 12 mm diameter stainless steel bolts shall be provided at a convenient location on the base of the Mast. One number lighting finial shall be provided for each mast.

CONTROL PANEL

Highmast shall be provided with a control panel fabricated out of 14/16 SWG CRCA sheet comprising incoming MCB Isolator, Copper wiring, suitable timer-contactor to switch on the luminaries at a pre-set time and control arrangement for the operation of the power tool-motor.

LUMINAIRES

Luminaries shall be specially designed with suitable lamp housing and control gears for 250/400 W HPSV/MHT Lamps as per the requirement.
Suitable Aviation Obstruction Lights of reputed make shall be provided.

FOUNDATION BOLTS

Manufactured from special steels along with nuts, washers, anchor plate and template.

18.00 11 KV TRANSFORMERS (OLTC TYPE)

GENERAL

The transformer shall be double wound core type, oil naturally cooled suitable for indoor installation. The transformer shall be designed shall be designed and manufactured as per IS specification and having no load voltage ratio as 11000/433v.

SPECIFICATION
STANDARD

Unless otherwise stated below, transformer & transformer oil shall conform to IS 2026 & 335 respectively.

SYSTEM OF SUPPLY

KV 3 phase, 50 Hz system

NO LOAD RATIO

11000/433 volts

KVA RATING

Transformer shall be suitable for continuous rating as stated in BOQ and on drawing.

TYPE

Out door

WINDING

The transformer shall be copper wound.

CORE

The magnetic core shall be made up of cold rolled grain oriented low loss steel stampings.

COOLING

Natural oil cooling by means of pressed/round tubes around transformer tank (ONAN)

FREQUENCY

50Hz plus minus 3%

RATED VOLTAGE

Transformer shall operate at its rated KVA at any voltage plus minus 10% of rated voltage of that particular tap.

VECTOR GROUP

Corresponding to the vector symbol Dyn-11

CONNECTIONS

H.V side of transformer shall be provided with suitable size cable box for 3 core XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable.MV side of transformer shall be suitable for bus duct connection arrangement.

TAPPING

ON load tap changing arrangement on 11kv side. The range for circuit taps, which shall be provided on H.V. side, shall be plus 5% & minus 15% in steps of 1.25%

TEMPERATURE RISE

The transformer shall conform to the requirements of temperature rise specified in IS: 2026(PartII) 1977.Continuously rated for full load, temp. rise not to exceed 50 degree C by thermometer in oil (55degree C by resistance)

INSULATION LEVELS

The insulation levels shall be in accordance with IS 2076(Part III) 1977.
TERMINAL MARKINGS, TAPPING & CONNECTIONS

The terminal marking, tapings 7 connections shall be in accordance with IS 2026(Part1V) 1977.

REQUIREMENTS WITH REGARDS TO ABILITY TO WITHSTAND SHORT CIRCUIT.

As per IS 2026 (part I) 1977

IMPEDANCE VOLTAG

As per table 3 of IS 2026 (part I) 1977

ON LOAD TAP CHANGING SWITCH

On load tap changer with RTCC panel and AVR

PARALLEL OPERATION

Transformer shall be suitable for parallel operation with similar unit of same rates.

GENERAL REQUIREMENTS OF TRANSFORMERS

Transformer shall be suitable for operating at rated capacity continuously at any of the taps under ambient conditions and with the voltage and frequency variations indicated without exceeding permissible temperature rise and without any detrimental effect to any part.

Transformer shall be designed to be loaded as per IS:6600.

On Load tap changer shall be provided in the transformer with RTCC panel. The range of OLTC will be -15% to +5% in the steps of 1.25% as per BOQ.

All windings shall have uniform insulation resistance to earth.

Disconnecting chamber shall be air filled. Suitable cable end box shall be provided for termination of cables. Gland plate for single core cables shall be non-magnetic.

Transformer shall be able to withstand electrodynamic and thermal stresses due to terminal short circuit of the secondary, assuming the primary side is being fed from an infinite bus. All leads and windings in cores shall be properly supported. Short circuits withstand and duration shall be 2 secs. As per IS: 2026.

Short circuit test results for similar transformers shall be furnished.

There shall be a marshalling box for gathering all alarm signals. All alarm shall be wired up to terminal strip provided in marshalling box. 20% spare terminals shall be provided. Armoured cable of 2.5 sqmm cu shall be provided along with suitable size glands for terminating these contacts in marshalling box.

Guides shall be provided to facilitate tanking and untanking of the core with the coil assembly. The details of anchoring of core and coils assembly of tank shall be furnished.

Radiators shall be provided on the tank to facilitate cooling. These shall be detachable type and shall be provided with isolating valves at ends, drain plugs and air release plug. Radiators of 1.2 mm thickness seamless steel tubing or pressed sheet steel.

Means for lifting and jacking of transformer shall be provided.

Class-A insulating material specified in IS:1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, wherever used, shall be well seasoned and treated.

The mineral oil shall comply with IS: 335. 10% extra oil in seal tins/ drums shall be supplied.

All valves shall be of globe type. Valve body of carbon steel and trim of 135 cr. Steel.

Oil temp. Indicator for measuring top oil temp. Shall comprise 150mm dial type thermometer pocket and capillary tube jacketed with PVC sleeve. Thermo-meter shall have 2 sets of contacts, one for alarm and the other for trip, and set points can be set by hand. Contacts shall be wired up to marshalling box.

Buchholz relay shall be provided as per IS: 3637. It shall be double float type with two sets of contacts for alarm and trip with facility for testing by injection of air by hand pump and with cock for draining and venting of air. Relay shall be provided with shut off valves on conservator side as well as on tank side.

Alarm and trip contacts shall be suitable for 1A 230 AC.

A marshalling box shall be provided to accommodate all auxiliary devices except those which are to be located directly on transformer. It shall be of dust, weather and vermin proof type of sheet steel 2mm thick and shall have sufficient apace for ease of cabling. 20%extra terminals shall be provided.

All steel surfaces exposed shall be treated with suitable anti –trust, anti –corrosive paints

Bushing insulator shall be rated for max. System voltage and shall be as per IS. Bushing shall be enclosed in terminal box and shall be detachable from outside the tank. Separate neutral bushing shall be provided for earthing the neutral. When LT cable box is provided, a neutral bushing shall be brought out for solid earthing.

Transformer efficiency shall not be less than 98% at full load at 08 pf (lag).

Transformers shall have same percentage impedance & other characteristics with foundation plan parallel operation as per IS: 10028

FITTINGS

The following accessories and fittings shall be provided with the transformer

i. LIFTING LUGS: The arrangement of lifting the active part of the transformer along with the cover of the tank by means of lifting lugs without disturbing the connections. Also complete transformer lifting lugs shall be provided.

ii. ROLLERS: The transformer to be provided with 4 Nos. rollers fitted on cross channels to facilitate the movement of transformer.

iii. OIL CONSERVATOR: The transformer to be provided with a conservator with welded end plates. It is to be bolted to the cover and can be dismounted for purposes of transport. It has to be provided with oil gauge with marking for minimum level and an oil filling hole with a cap which can be used for filtering of oil. For draining purposes a plug is to provide. A connection pipe between the conservator and tank is to be provided, which projects inside the conservator.

iv. AIR RELEASE VALVE: An air release valve shall be provided on top of the tank cover to facilitate of the entrapped air while filling of oil.

v. BREATHER: The transformer shall be provided with an indicating dehydrating silica gel breather of sufficient capacity.

vi. DRAIN VALVE WITH PLUG: The transformer to be provided with drain valve with plug at the bottom of the tank.

vii. DIAGRM WITH RATING PLATE: One diagram and rating plate indicating the details of transformer connection diagram vector group tap changing diagram etc.

viii. THERMOMETER: Dial type thermometer (150mm dia) with maximum set pointer 75 degree C electrical contacts for electrical contacts for electrical alarm at high temp.

ix. EXPLOSION VENT: Explosion vent or pressure relief device shall be provided of sufficient size of rapid release of any pressure that may be generated within the tank and which might result in damage in the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank.

x. FILTER VALVE: Filter valve on the top of the tank.

xi. BUCHOLTZ: Oil actuated relay equipment shall confirm to IS 3637-1966(amended up to date) and shall be double float type having contacts which close following oil surge or under incipient fault condition. Bucholtz relay shall have contacts for alarm / trip.

xii. WINDING TEMPERATURE INDICATOR :

xiii. Winding temperature indicator with electrical contact for alarm/ trip

xiv. OIL TEMPERATURE INDICETOR: Oil temp. Indicator with alarm & trip contacts.

xv. MARSHALLING BOX: the transformer shall be provided with suitable size marshalling box to terminate the control cables of thermometer and bucholtz relay.

xvi. CONTROL CABLING: all control cables required from Marshalling box to H.T panel board for Trip/alarm of winding temp. Indicator, oil temp indicator, Buckholz relay etc. shall be provided and deemed to be included in the rate of transformer equipments.

xvii. TRANSFORMER OIL: First filling of oil.

xviii. EARTHING: Two separate earthing terminals are to be provided at the sides of the tank on both the sides for earthing.

xix. ON LOAD TAP CHANGER; High speed resister type OLTC shall be provided along with RTCC and AVR.

SOAK PIT

Soak pit for oil filled transformer shall be made are per IS 10028 (Part II) 1981 with up to dated amendments. Sump shall be formed in the transformer room and shall be connected to soak pit outside the transformer room with a pipe. All the civil works required for the soak pit shall be done by the contractor and the cost shall deemed to be included in quoted rates of the transformer item.

INSTRUMENTATION MANUAL

The successful bidder shall submit three copies of manual of complete instructions for the installations, operations, maintenance and repair, circuit diagrams, foundations and trenching details shall be provided with the transformer.

SHOP DRAWINGS

The selected supplier shall prepare and furnish shop drawings for the approval by the consultant/client before commencing fabrications/ manufacture of the equipment. Shop drawing shall be based on the requirement laid down in the specifications. The manufacture of the equipment shall be commencing only after the shop drawings have been approved in writing by the consultant. Transformer shall be manufactured conforming to specification of Local supply authority.

INSPECTION

i) The transformer shall be inspected on arrival as per the inspection manual of the supplier
ii) Shall be examined of any sign of damage and special attention shall be given to the following parts.

Oil tank and cooling tubes
Bushes crakes or broken
Oil sight glass

INSTALLATION

i) The transformer shall be installed as per transformer manual of the transformer supplier and conforming to Indian standards.
ii) The transformer is to be erected on suitable size M.S channels embedded in the cement concrete flooring including providing & fixing the channel. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.
iii) The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement of the transformer.
iv) The transformer cable end boxes shall be sealed to prevent absorption of moisture.

v) The transformer natural earthing and body earthing shall confirm to Indian Standard.

FACTORY TEST

The transformer shall be subjected to test as laid down in IS 2026 (Part I) 1977 at factory/manufacturing unit prior to dispatch of the transformer to the site.
All original test certificates shall be furnished.

TESTING AT SITE

Prior to commissioning of the transformer the following tests shall be performed
i) Insulation resistance of the winding between phases and earth of H.V and M.V side.
ii) Winding resistance of all the winding on all tap positions shall be taken.
iii) The supplier gives sufficient advance information about the test schedule to enable the owner to appoint his representative.

HIGH SPEED RESISTOR ON LOAD TAP CHANGER

GENERAL

High speed resistor on load tap changer shall be provided with the transformer wherever specified. The high speed resistor OLTC shall be for rated voltage up to 11KV rating current of 100 Amp, 3phase, 17step conforming to Indian standard with AVR & RTCC panel.

TYPE AND CONSTRUCTION

OLTC shall be a compact unit for use with three phase distribution transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprise of
1. Tank
2. Selector Switch
3. Driving Mechanism
4. Barrier Board
5. Local control Gear
6. Control cable Terminations
7. AVR & RTCC panel

TANK

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, driving mechanism and Local control gear. Access to the compartments

shall be made easy by means of removable covers and a weather proof door. Anti-condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

OPERATION MECHANISM

An impulse is received either from a remote control panel or from a local manual operation switch, which energies the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energized seals itself via its own contact and the driving motor commences to run. At a predetermined point a directional sequence switch closes, taking over the handling duties of the contactor whose original hold circuit shall be isolated. At the completion of the tap changer the directional sequence switch opens and de- energizes the driving motor. The arrangement ensures that a short period initiating pulse shall be accepted by the control gear.

CONTROL CABLE TERMINATION

A detachable undrilled gland plate and the terminal station for all the external connections shall be provided in the driving mechanism compartment of the tap changer.

AUTOMATIC VOLTAGE REGULATOR

Solid state automatic voltage regulator shall be provided for the regulation of the secondary voltage of the power transformer with on load tap changer (OLTC). The band width control shall allows the dead band to be set in the terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limit around a particular nominal value with a specified sensivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulations shall reset automatically after voltage correction. Solid state lamps (LED) shall be provided to indicate voltage outside the preset limit & control relay operation.

RTCC PANEL

RTCC panel shall be provided to operate OLTC from control room located in substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete. A.C supply ON/OFF lamp indicator & AVR relay operated operation indication. Cubical panel shall be totally enclose, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All the sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergone a regrious metal treatment process

consisting of effective cleaning by hot alkaline degreasing solution followed by the cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphating process , passivating in deoxidize to retain & augment the effects of phosphating, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coatof stoving

18.02 11 KV/0.433 KV TRANSFORMER (DRY TYPE TRANSFORMER)

18.01 GENERAL

Power transformer shall be dry type for indoor use having capacities indicated in the schedule. The supply is 11KV/433 volts, 50 Hz and 3 phase. All the transformers shall be with ON LOAD TAP CHANGER type.

The design manufacture and performance of transformer shall comply with all performance of equipment status, regulations and safety codes in the location where the transformers will be installed. Transformers shall conform to the latest applicable standards.

18.02 CODES AND STANDARD

Transformers shall comply with the latest edition of Indian Standards No. IS 2026 Part I to Part V (Power Transformer) and IS11171 for Dry Type Transformer . In case the Provision of Indian Standards are not directly applicable to dry type Transformer , the provision of Latest IEC-726 and any other relevant IEC shall apply. Latest Stadards as applicable shall be followed the Insulating materials, Bushing, Installation and Maintenance of the Transformer.

18.03 SERVICE CONDITION

Altitute	Less than 1000 meters.
Maximum Ambient Temperature	50 deg. C
Minimum Ambient Temperature	0 deg C
Relative Humidity	100 %
Installation	Corrosive, dusty, humid and t ropical.

18.04 RATING AND TYPE

The Transformer shall have core type construction, 3 phase and shall be suitable for Indoor service under the climatic conditions prevailing at site. The Transformer shall be capable of withstanding thermal and mechanical effects of short circuit at terminals of any winding with full voltage maintained on other winding as per IS: 2026.

18.05 WINDING

The primary and secondary winding shall be of electrolyte copper conductors. The high and low voltage winding shall be totally encapsulated and should be cast under vaccum in moulds with fiber glass reinforce epoxy resin laminate. Both HV and LV winding of each phase shall be separately cast as arigid tubular coil with no mechanical and electrical connection between their co- axial arrangement. The Transformer shall be free of partial discharges at least upto 1.1 times the rated voltage.

The winding shall absorb no. moisture under the worst tropical conditions collection of moisture and dust over the winding shall not any way affect the insulation strength of the winding.

18.06 CORE

The transformer core shall be build upb with high non-aging low and high permeability CRGO Silicon steel lamination. CRGO sheet shall be coated with inorganic material or equivalent insulation to reduce eddy current to minimum. After shearing, the laminations shall be treated to remove all burrs and shall be annealed to remove all the residual stresses.

Coreframe work and clamps shall be arranged and tighteded to securely hold lamination in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits. All the Iron parts except the core shall be galvanized and treated with high temperature resistance paint. Core Fastening shall be insulated to reduce losses and avoid spots. Transformer shall be designed to witstand 10 % overfluxing corresponding to rated voltage.

Suitable lugs shall be provided for lifting the complete core and coil assembly of the transformer.

18.07 INSULATION

Tnterturn and intercoil insulation shall be designed such that di - electric stress is uniformly distributed throuout the winding under all operating conditios. The winding shall be provided with Class ‘F’ Insulation.

18.08 TEMPERATURE RISE

The Temperature rise of the winding shall not exceed 90deg by resistance on continous full load above maximum ambient temperature of 50 Deg C and in no case shall reach value that may damage the core itself or other adjacent part.

18.09 TAP CHANGING:

"ON LOAD" circuit tap changing with AVR arrangement on H.V side is to be provided. The tapping is to be provided for variation on high voltage side from + 5% to - 15% steps of 1.25% each. Automatically operated STEPLESS "ON LOAD Tap Changing Switch"

having a position indicating lights & Locking device and complete with Automatic Voltage regulator and its Control panel shall be provided separately.

18.10 VECTOR GROUP:

Transformer shall have the vector group of Dy 11.

18.11 IMPEDENCE

The desired impedence shall be as mentioned in the IS:2026.

18.12 FLUX DENSITY

The Maximum flux density at any point in the winding shall not exceed 2.2 Amp. Per sq.mm at the rated full load, voltage and frequency.

18.13 CURRENT DENSITY

The maximum current density at any point in the winding shall not exceed 1.6 Tesla on the normal rated tap voltage and frequency.

18.14 COOLING

The Transformer shall be designed for natural cooloing (AN)

18.15 ENCLOSURE

Transformer shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protectopn of enclosure shall be IP 21 for indoor installation and IP 33 for outdoor installations. The sheet steel thickness of enclosure shall be minimum 2mm.

18.16 CABLE TERMINATION

The low voltage side of the transformer shall be suitable to receive Aluminium Bus Duct of suitable capacities from the top of the Transformer. A suitable size of flange to be provided for connecting the overhead bus trunking in the LT Box.

H.T. sides of the transformers shall have cable end boxes to receive 3 C X 240 sq.mm desired size of 11KV cables.

All cable end boxes shall have bore holes to match the opening for each cable specified and shown in the single line diagram.

18.17 EARTHING

Two main earthing terminals shall be connected to the terminals provided for transformer.

18.18 FITTINGS AND ACCESSORIES

Rating and Terminal Marking Plate of the Transformer including the details of OFF circuit changing voltage of the links.

Earthing terminal with Lugs.

Transformer Neutral Earthing terminal.

Marshal Box with wiring and terminal and temperature scanner.

PT 100 type temperature scanner and its connection with marshal box.

Neutral CT 2000/1 Amp. And its connection with marshal box for 2000 KVA Transformer only.

Limit switch in all hinged door fix door and wiring till marhal box.

HV cable end box at primary.

LT bus Trunking box at secondary.

4 nos Plan bi- directional rollers.

Inspection windows shall be provided in the cover.

Lifting lugs for both the transformer and core shall be provided.

18.19 INSTALLATION OF TRANSFORMER

Installation of transformer shall be carried out in accordance with manufacturer's instructions and/or as directed by purchaser.

All power/control connections and mechanical joints shall be completed, checked and adjusted to ensure safety and satisfactory operation of the transformer.

Transformer shall not be placed on bare ground during unloading but it shall be placed on wooden sleepers. After placing on foundation, alignment, leveling etc. shall be carried out in best workman like manner.

For the power/control cabled projecting above the ground, the termination to cable box shall be run in GI conduits of suitable cross section and the same shall be supported properly and pipe ends shall be sealed with bitumen compound.

The cable box of detachable type of the transformer shall be supported properly so as to facilitate taking out of the transformer for repair without disturbing the cables.

18.20 TEST CERTIFICATES.

Test certificate shall be furnished in required number of copies for approval.

The routine, special and type test certificate of the transformer shall be furnished for approval before the delivery of the equipment from the factory.

The routine and type test certificates of miscellaneous components shall be furnished or approval.

18.21 ROUTINE TESTS

During manufacture and on completion the transformer shall be subjected but not limited to the following Routine Tests as laid down in the latest revision of the IS 11171 IEC - 726

i) Applied voltage test
ii) Induced voltage test
iii) No-load loss and excitation current tests
iv) Impedance voltage and load loss tests
v) Resistance measurement
vi) Ratio tests
vii) Polarity and phase relation tests
viii) Insulation resistance tests
ix) Insulation power factor tests

18.22 TYPE TESTS

The type test certificates for the following type tests carried out on similar capacity rating shall be submitted along with the routine test certificates.

i) Heat run test
iii) Impulse test

18.23 FIELD TEST

After installation a site, the transformer shall be subjected to the following field test:

i) Construction inspection
iv) Ratio tests
v) Polarity test
vi) Tap change operation test.

18.24 ELECTRICAL & PERFORMANCE REQUIREMENT :

a) Transformer shall operate without injurious heating at the rated KVA at any voltage within variation of +/- 10% of the rated voltage of that particular tap.

b) Transformer shall be designed for 110% continuous over fluxing withstand capability.

c) The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.

d) Overloads shall be allowed with in the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap changers or other auxiliary equipment shall apply.

e) Temperature Rise for continuous full load application shall be guided by Maximum temperature rise clause of IS 2026. The temperature rise shall not exceed 45 degree C by

thermometer in oil or 50 degree C for winding over an ambient of 45 degree C. (Please note maximum ambient temperature shall be considered 50 degree C).

18.25.0 DRAWINGS AND O&M MANUALS:

18.25.1 Four copies of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers. List of spare parts shall also be indicated.

18.25.2 Two copies of the drawings incorporating the following particulars shall be submitted with the offer for preliminary study.

a) GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.

b) Crane requirements for assembly and dismantling of the transformer.

c) Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.

18.25.3 The drawings in (four sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.

a) GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, crane lift for untanking, oil quantity, H.T./L.T. clearances etc.

b) Drawings of Bus duct termination arrangement.

c) HV cable box arrangement & disconnecting chamber GA drawings.

d) Name plate and terminal making and connection diagram.

e) Assembly of OLTC gear mechanism & details of mechanism parts, limits, contours of wearing parts, timing gear adjustments etc.

18.25.4 Reproducible copy of the above drawings for records

19.00 TELEPHONE SYSTEM

19.01 Telephone point wiring

(a) The point wiring shall be carried out with two pair telephone wire/cable, unarmoured, PVC insulated, 0.61 mm dia annealed tinned copper conductor (IS: 2532-1965)in suitable size conduit (one pair always remaining spare for one point)

Minimum Dia of Conduit for Internal/External Telephone Wiring - 20mm.

If more than one telephone point has to be provided at one point, multicore, unarmoured telephone cable shall be used (pairs required are equal to 2 No.of points) in suitable size of conduit.

(b) The point shall commence from the main telephone tag box/sub tag box and would terminate at outlet box of point. Connection at both ends included in point wiring.

(c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.

(d) Joint in telephone wiring (between main tag box/sub tag box and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.

(e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent PVC insulated telephone wire of suitable pairs shall be used for external, internal and intercom.

(f) To identify each pair of multipair telephone wire/cable, PVC indication numbers shall be put on both ends of pair just before termination.

19.02 Telephone Tag Boxes

These shall be of MS sheet 2 mm thick with connector suitable for telephone connection (as approved by ITI). It shall have hinged MS sheet cover.

20.00 WHITE-LED (W-LED) BASED SOLAR STREET LIGHTING SYSTEM

A stand alone solar photovoltaic street lighting system (SLS) is an outdoor lighting unit used for illuminating a street or an open area. The Solar Street Lighting System consists of solar photovoltaic (SPV) module, a luminaire, storage battery, control electronics, inter-connecting wires/cables, module mounting pole including hardware and battery box. The luminaire is based on White Light Emitting Diode (W-LED), a solid state device which emits light when electric current passes through it. The luminaire is mounted on the pole at a suitable angle to maximize illumination on the ground. The PV module is placed at the top of the pole at an angle facing south so that it receives solar radiation throughout the day, without any shadow falling on it. A battery is placed in a box attached to the pole.

Electricity generated by the PV module charges the battery during the day time which powers the luminaire from dusk to dawn. The system lights at dusk and switches off at dawn automatically.

BROAD PERFORMANCE SPECIFICATIONS

PV Module	12V /250W (125*2) MNRE Approved
Battery	Lead acid Tubular Flooded or Tubular GEL / VRLA 12V- 200 AH (100*2) MNRE Approved
Light Source	White Light Emitting Diode (W-LED)
Light Out put	Minimum 15 Lux when measured at the periphery of 4 meter Diameter from a height of 4 meter. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred.
Mounting of light	Minimum 6 metre pole mounted
Electronics Efficiency	Minimum 85% total
Duty Cycle	Dusk to dawn
Autonomy	3 days or Minimum 42 operating hours per permissible discharge

TECHNICAL DETAILS

PV MODULE

(i) Indigenously manufactured PV module should be used.

(ii) The PV module should have crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory. In case the certificate for the offered module is not available, a test certificate for higher capacity module produced by the same PV module manufacturer should be available.

(iii)The power output of the module(s) under STC should be a minimum of 40 W at a load voltage* of 16.4 ± 0.2 V.

(iv) The open circuit voltage* of the PV modules under STC should be at least 21.0 Volts.

(v) **The module efficiency should not be less than 12 %.**

(vi)The terminal box on the module should have a provision for opening it for replacing the cable, if required.

(vii) The PV module must use a RF Identification tag (RFID), which must contain the following information:

i) Name of the manufacturer of PV Module
ii) Model or Type Number
iii) Serial Number
iv) Month and year of the manufacture
v) I-V curve for the module
vi) Peak Wattage of the module at 16.4 volts
vii) Im, Vm and FF for the module
viii) Unique Serial No and Model No of the module

Until March 2013, the RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions. **However, from 1st April 2013 onwards RFID shall be mandatorily placed inside the module laminate.**

viii) **A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.**

*****The load voltage and Voc conditions of the PV modules are not applicable for the system having MPPT based charge controller

BATTERY

i) Lead Acid, tubular positive plate flooded electrolyte or Gel / VRLA Type.
ii) The battery will have a minimum rating of 12V, 40 Ah at C/10 discharge rate.
iii) 75 % of the rated capacity of the battery should be between fully charged and load cut off conditions.
iv) Battery should conform to the latest BIS/ International standards.

LIGHT SOURCE

i. The light source will be a white LED type.
ii. The colour temperature of white LED used in the system should be in the range of 5500°K–6500°K.
iii. W-LEDs should not emit ultraviolet light.
iv. The light output from the white LED light source should be constant throughout the duty cycle.
v. The lamps should be housed in an assembly suitable for outdoor use.
vi. The temperature of heat sink should not increase more than 20^0 C above ambient temperature during the dusk to dawn operation.

ELECTRONICS

i. The total electronic efficiency should be at least 85%.
ii. Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year.
iii. The idle current consumption should be less than 5 mA.
iv. The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.
v. The PCB containing the electronics should be capable of solder free installation and replacement.
vi. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.

ELECTRONIC PROTECTIONS

i. Adequate protection is to be incorporated under "No Load" conditions e.g. when the lamp is removed and the system is switched ON.
ii. The system should have protection against battery overcharge and deep discharge conditions.
iii. Fuse should be provided to protect against short circuit conditions.
iv. Protection for reverse flow of current through the PV module(s) should be provided.
v. Electronics should have temperature compensation for proper charging of the battery throughout the year.
vi. Adequate protection should be provided against battery reverse polarity.

vii. Load reconnect should be provided at 80% of the battery capacity status.

MECHANICAL COMPONENTS

i. A corrosion resistant metallic frame structure should be fixed on the pole to hold the SPV module.
ii. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that the module can be oriented at the specified tilt angle.
iii. The pole should be made of Galvanised Iron (GI) pipe.
iv. The height of the pole should be 4 metres above the ground level, after grouting and final installation.
v. The pole should have the provision to hold the luminaire.
vi. The lamp housing should be water proof and should be painted with a corrosion resistant paint.
vii. A vented, acid proof and corrosion resistant metallic box with a locking arrangement for outdoor use should be provided for housing the battery.

INDICATORS

The system should have two indicators, green and red. The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
Red indicator should indicate the battery "Load Cut Off" condition.

QUALITY AND WARRANTY

i. **The street lighting system (including the battery) will be warranted for a period of five years from the date of supply**.
ii. **The PV module(s) will be warranted for a minimum period of 25 years from the date of supply.** The PV modules must be warranted for their output peak watt capacity, which should not be less than 90% at the end of Ten (10) years and 80% at the end of Twenty five (25) years.
iii. The Warranty Card to be supplied with the system must contain the details of the system**.**

OPERATION and MAINTENANCE MANUAL

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar Street Lighting System. The following minimum details must be provided in the Manual:

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Street Lighting System – its components, PV module, battery, electronics and luminaire and expected performance.
- Type, Model number, Voltage & capacity of the battery, used in the system.

- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.
- About Charging and Significance of indicators.
- Clear instructions about erection of pole and mounting of PV module (s) and lamp housing assembly on the pole.
- Clear instructions on regular maintenance and trouble shooting of the Solar Street Lighting System.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance, in case of non-functionality of the solar street lighting system

LIST OF APPROVED MAKES FOR ELCTRICAL SYSTEM

Contractor shall use the materials of approved make as indicated below unless specified in BOQ or as approved by the HSCC electrical incharge. The contractor shall ensure the correct selection of the approved make meeting the specifications and application duties. Before placing order for procurement, the sample of approved make shall be got verified for its suitability to the specification and application duty. However, HSCC electrical engineer (approving authority) reserves the right to opt for the best preferred listed make. The contractor shall quote the rate for the material and equipment as per the list of approved makes and equipment as per the list of approved makes. In the event of the contractor wants to use alternate makes other than those stipulated for any reason , the contractor can send a proposal after ensuring that what he proposes at the least meets both the quality and safety standard of the stipulated makes, and the financial benefit that will accur to the client. He shall also stand full guarantee to his alternate proposal. The alternate makes can be used only after an approval accorded by the client/HSCC., whose decision will be final in this matter. Any financial implication incurred related with inspection will be borne by contractor.

S.No.	Item Description	**Make list**
1	Main LT Panel/Main HVAC Panel	Siemens/L&T/ABB/ GE/Schneider/C&S
2	11 KV VCB Panel Board	Siemens/L&T/ABB/Schneider/ Kirlosker/Andrewyule/ Crompton Greaves
3	Transformer	Siemens/ABB/ Crompton/GE/Kirlosker
4	Cast resin current Transformers:	AE/ Kappa/Control & switchgear/L&T/Gillbert & Maxwell
5	Selector Switches:	L&T/ Salzer/KAYCEE/ Siemens/BCH
6	Push button, Indicating Lamps LED:	L&T(Esbee)/Siemens, Schinder/BCH/Veshno/Teknik/RAAS
7	Rubber Mats:	Jyoti or Equivalent
8	Diesel Engine(DG Set):	Cummins/ Caterpiller/ MTU/Kiroskar/Greaves cotten
9	Alternator:	Stamford/ AVK-SEGC/ Marathan/ Leroysomer, NGEF/ Crompton
10	Anti-vibration mounting:	Gerb or equivalent make

11	Dry Battery:	Panasonic/Hitachi/Mistubushi/Cummins/Exide
12	Automatic Battery Charger:	Max Power/ Cossel/ Statcon/ Voltstat, Amarraja/HBL Knife
13	MV panels/Fire panel/AHU Panel Synchnisation panel/Capacitor panel Feeder piller	Tricolite/Adlec system (P) ltd. (Mundka)/Jacksons Engineers (p) Ltd./SPC electrotech Ltd./Advance control & Switchgear (Haridwar) and also manufacturer of above LT Panels.
14	ACB	L &T 'U' Power(Omega)/ Siemens 3WL/ ABB/ Legrand(DMX) Schneider (MG- Master Pact)/ GE-Entelliguard
15	Moulded case circuit Breaker	L &T – D Line / GE/ Siemens/ ABB/ Schneider Compact Design) (MG-NS)/Legrand/C&S
16	Power/auxiliary Contactors, timers	ABB/ Schneider/ L&T/ Siemens/GE
17	AMF Relay	Control & switchgear/wood ward or approved by engineer incharge.
18	SFU with HRC	L&T/ GE/ Siemens/Control & Switchgear/ ABB, Merlin-Gerin/ Crompton Greaves/HPL(SOCOMECH)
19	Change over switches/Isolators	Merlin Gerlin/ Crompton/ Siemens/ABB/HPL/GE
20	Instruments (analoge)	L&T(Rishab)/ AE/ MECO
21	Digital Meter	Enercon/ AE/ Secure/ Allan Bradely/L&T Motwane/Dukati (Imported) Meco/HPL/Trinity/Minilec
22	Timers in Distribution board	Legrand/ Hagar/ Siemens/ ABB/ GE
23	Battery (Maintenance Free VRLA Battery)	HBL Nife/ Exide/ Standard/Amar Raja/ Furakawa/ Panasonic
24	MCB distribution Boards	L &T /Hager/ MDS/Legrand/ Siemens, ABB/GE/ Schenieder (MG)
25	MCB	L &T /Hager/ MDS/Legrand/ Siemens, ABB/GE/ Schenieder (MG)
26	HRC Fuses	Merline Gerin-multi 9, Legrand, Hager, Siemens
27	Rewirable porcelain wire	CPL, KEW

28	Data and Voice wire	Finolex,Delton,Skyton,Anchor,L&T,AT&T, Avaya
29	RCCB	L & T Hager/ Legrand/ Siemens , GE/Schenider (Merlin –Gerin)
30	ELCB/ELMCB	Merlin Gerin-multi 9, Legrand, Hager, Siemens
31	11 KV LT XLPE cables	RPG/ Polycab/ NICCO/ UNIVERSAL/Rallison/KEI/Skytone/ Havells
32	Copper Control cable	Finolex/ Polycab/ NICCO/ Universal/ National/ Rallision/RR Cable / Tyco
33	Compression Glands & Lugs 11KV grade cables(Double compression gland)	Peeco/ Comet/ Dowells/ Siemens/Lotus
34	Copper/ Aluminum(Crimping Type cable lugs for 11KV cables	Asian/Dowells /Crystal/Jointwell or equivalent make
35	Cable Joints (Heat Shrinkable) HT cable termination	Raychem/3M/Cabseal
36	Cable Trays	Steelways/ Bharti/ Unitech /Maheshwari/or approved by HSCC
37	Galvanized/PVC Raceways and raceways accessories	Steelways/ Bharti/ Schneider(MG)/Legrand
38	Light fitting	Philips/ GE/ Crompton Greaves
38(A)	fancy LIGHT FITTING	Anchor(Panasonic)/ Twinkle/Decon/Ankur
39	Lamps	Philips/ Osram/ GE/Anchor (Panasonic)/Perlite
40	GI / MS conduit ISI marked	BEC/ AKG/ Steel Kraft
41	PVC conduit	BEC/ AKG
42	Steel conduit accessories (ISI as approved sample)	Sharma sales corporation, super sales corporation or equivalent.
43	Modular Metal box for switch /socket	Havells/ MK/MDS/Anchor Roma/Northwest
44	Copper conductor FRLS PVC insulated wires ISI marked	National/ Skyline/ Finolex/ Havells/ L&T/KEI R R cable/Rallison/Skytone/lap/Bonton

45	Modular Switches & sockets Outlets	Havell's (Crabtree)/ MK-Wraparound/Hagger/Wipro Legrand (Myrius/ Anchor-Roma(Tersa,woods,viola)/ Northwest
46	Metal clad Socket outlets With boxes	L & T Hager/ Siemens/ Merlin Gerin/ ABB MDS / BCH /Havells
47	Lighting protection	Erico/Galaxy electrode /Earth plus/JK earthing or equivalent
48	Lighting Arrestor	Indlec, Gersom, Helitta,MDS,Hager,Duval,Messin,JK Earthing
49	UPS system	PCI LTD/Hitachi/ Siemens/ Amarraja / Etone powerware/Emerson/APC (Schneider)
50	Street Light poles	Jindal/ Bombay poles/ Bajaj /Twinkle
51	Electronic Ballast	Philips/ Wipro/Osram / Bajaj
52	Ceiling fans	Crompton Greaves/ Bajaj/ Orient/ Alastom/ Usha
53	Main PC with CPU monitor	HP/ Compaq/Del
54	Auto manual changeover switches (3Way)	Kaycee/L&T/ Schnieder
55	Public address system	Bosch/ Bose/ Haristasa/Honey well /Harman/JBL/Shure
56	CCTV camera	Honeywell/ Schnider electric (Pelco)/DVTEL/Bosch/Siemens/Johson control
57	Fire Detection System	Honeywell- Notifier/GENT/ Thorn/Bosch/Siemens/Hochiki
58	Portable fire extinguisher	Minimax/Agnidevices/Superex/Ceasefire/Eversafe
59	EPABX system	Avaya/ Siemens/Alcatel/Erricsion/Panasonic
60	Telephone cables /communication cables	AT & T/ Fusion /Polymers/Finolex/Delton Skyline/Skytone
61	Nurse Call bell system	Omnitech / Honeywell automations/Process care system or equivalent as per spect
62	PVC Tape	Steel Grip

63	Compound	Shalimar No.-6
64	Connector	Connectwell, Elmex
65	Batton Holder,Angle holder, Ceiling Rose	Anchor
66	Telephone Tag Block	Krone,MK, Clipsal,ITL
67	Capacitor	Epcos, Datar, Shreem, L&T,DUcatti
68	Relay	Alstome, ABB,EE
69	Heavy Pipes should be 6 kg. / sq. cm.	Jyoti
70	Exhaust Fan with Gravity Louvers	Usha Lexus/Orient/ Crompton/Industriel-Almonard/ GEC
71	TV Cable- Co axial	Finolex, airtech, bhansali
72	HT Cable	Polycab, CCI, Universal, KEI,NATIONAL
73	Bus Duct/Rising Main	L&T, ABB, Siemens, Schneider, C&S electric & switchgear.
74	Chemical Earthing	Ashlok, Erico, Pioneer, Nimbus,JK Earthing
75	LCD/LED Monitor	Sony, Panasonic, Samsung
76	Lifts	Otis,Kone,Mitsubishi,Scheindler,Johnson
77	SOLAR LIGHTING	TATA BP, ARSH ELCTRONICS,SHARP,PHILIPS OR MNRE APPROVED

END OF TECHNICAL SPECIFICATION

Technical Specifications

For

HVAC WORKS

DETAILED SPECIFICATIONS

SYSTEM DESIGN DATA

1.0 General

The system design, basis of design, estimated requirements and other relevant data are outlined in this section. The specifications and specific requirements are outlined in the subsequent sections.

2.0 Location

Proposed 'Dining Blocks & Director's Bungalow' for AIIMS Raebareli.

3.0 Scope of work

The work proposed under this tender includes Supply, Installation, testing & commissioning of High Wall Split, Windows type and Ductable Split type Air-conditioning system for proposed AIIMS at Raebareli.

4.0 Basis of design

4.1 Assumptions

Following assumptions have been made for calculation of air conditioning cooling load of the building Areas.

i. All exposed roof of A/C areas will be thermally insulated with 50 mm thick expanded polystyrene or equivalent insulation.

ii. Construction of walls will be:

External walls	:	9 inch thick brick masonry, plastered inside and outside.
Internal walls	:	4.5 inch thick brick masonry, plastered inside and outside.

iii. Glazing : Single pane transparent glass 1/4 inch thick

iv. Lighting load : 2W/ sq.ft

v Fresh air : As per ASHRAE 62.1-2007

vi	Occupancy	:	App.60- 100 Sq.ft per person or as per actuals.
vii	Equipment Load	:	As per standards
viii	Electrical power supply:		415V/3 Ph/ 50 Hz, AC power supply

4.2 Outside Ambient conditions

Season	Dry Bulb temp (deg. F)	Wet Bulb temp. (deg.F)
Summer	109	79
Monsoon	94	83
Winter	48	43

4.3 Inside Conditions AC areas of buildings: 75+/-2 deg F DB, 50-60% RH

5.0 System Design

5.1 To meet the air conditioned load during summer & monsoon, it is proposed to provide, Ductable Split Type Air Conditioner.

5.2 Where ever used, the Unitary Air Conditioners will meet IS:1391 (part-I), Split Air Conditioner shall meet IS:1391 (Part-II), Packaged Air Conditioner shall meet IS:8148 .

6.0 Duct mounted inline/axial fan motors shall also be interlocked with the central fire alarm system of the building such that in case of detection of smoke or fire by the fire alarm system, the units shall automatically start.

7.0 Items to be provided by other Agencies free of cost to AC contractor

7.1 Civil works such as trenches for piping, cables and making foundations of equipment etc.

7.2 Main 3 ph, 415 v, 50 hz, A.C. supply power supply upto each panel of Ductable Split AC.

7.3 Main 1 ph, 220 v, 50 hz, A.C. supply power supply within 1 metre for Window & Split AC.

7.4 Any kind of false ceiling, boxing.

7.5 Making frames for fixing grilles & diffusers in false ceiling, boxing or in walls.

8.0 Drawings

The drawings forming part of these specifications provide a feasible scheme for locating the equipment and it is for the reference purpose only. The contractor may re-arrange the equipment for improving the layout and meeting the site conditions. All such changes shall however be subject to the architect's approval. These drawings are not meant to be working drawings which shall be prepared by the contractor as required.

9.0 Test Data

The complete HVAC system shall be tested as per the specifications given elsewhere and complete test data shall be furnished on prescribed data sheets:

10.0 Technical Data

The contractor shall furnish complete technical data, on the equipment offered as required under the heading `Technical data'

11.0 Performance Guarantee

11.1 The contractor shall guarantee that the air conditioning plant shall maintain the desired inside temperature within +/- 2 % tolerance for the rooms supplied with Package AC.

11.2 The contractor shall guarantee that the capacity of various components as well as the whole system shall not be less than specified.

11.3 The contractor shall ensure that the system shall be free of vibrations and disturbing sounds.

DUCTABLE SPLIT UNITS WITH AIR COOLED CONDENSERS

1.0 Scope

The scope of this section comprises the supply, installation, testing and commissioning of factory built self contained air cooled condenser type ductable split air conditioners complete in all respects and generally in conformity with these specifications, requirements of drawings Schedules of equipment and Bill of Quantities.

2.0 Components of Machines

Each ductable split air conditioners shall be complete with hermetic type compressor/s, DX type air cooled condenser, evaporator/ chiller, compressor motor, interconnecting refrigerant piping with valves and strainers etc. refrigerant controls and accessories, gauge panel, motor starters and electrical controls, safety controls and devices and first charge of refrigerant, oil etc.

3.0 Condensing Units

3.1 Each condensing units shall be complete unit with hermetic compressor/s, air cooled condenser, condenser fans with motors, internal piping , switches and internal wiring and shall be enclosed in a weather proof outdoor type housing.

3.2 The compressor shall be hermetic, with enclosed gas cooled motor. The compressors shall be suitable for R-134a / R-410a / R-407c.

3.3 The condenser coil shall be air cooled type with aluminium fins and copper tubes and necessary refrigerant connections. The copper tubes shall not be less than 3/8" O.D.

3.4 The condenser air fans shall be propeller type direct driven, each complete with motor. The air quantity and area of the condenser shall be adequate for working in the specified out door conditions.

3.5 The casing shall be fabricated from galvanized steel, zinc phosphated and finished with baked enamel paint. The casing shall make the whole unit fully weather proof suitable for outdoor installation.

3.6 The unit shall include a remote control assembly with thermostat and starting and speed switches.

3.7 The necessary charge of refrigerant gas and lubricated oil shall be provided to run the system.

4.0 Ductable Cooling Unit:

4.1 The cooling unit shall be matched to the respective condensing unit and shall consist of cooling coil, blower, filters, outer casing, drain pan, accessories etc.

4.2 The cooling coil shall have copper tubes of not less than 3/8" o.d. and continuous aluminium plate fins with integral collars. The tubes shall be staggered in the direction of the air flow.

4.3 The fan section shall comprise of aluminium centrifugal blower/s, statically and dynamically balanced, motor, drive package, mounting arrangement etc.

4.4 The unit casing shall be made of galvanized steel, the casing shall be insulated to lower the noise level and eliminate condensation.

5.0 Refrigerant Piping

5.1 The condensing unit and evaporator unit shall be interconnected by type'1' seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit.

5.2 Valves used in the Refrigerant piping shall be of the packed, back seated type and shall be of forged /cast brass/bronze construction. All joints of steel to steel piping shall be welded and steel to Brass/Copper shall be silver brazed. Care shall be taken to remove the burr and dirt from the pipe ends and form proper `V' at the mating ends before welding.

5.3 Flare type compression fittings shall be allowed upto 15mm piping diameter only for which annealed copper tubing shall be used.

5.4 Refrigerant piping shall be complete with the following accessories (but not limited to)

5.4.1) Hot Gas line muffler.

5.4.2) Liquid line strainer cum drier with disposable type of cover, with a bypass line with valve.

5.4.3) Liquid line sight glass.

5.4.4) Liquid Line solenoid valve.

5.4.5) Thermostatic expansion valve.

5.4.6) Liquid line Refrigerant Grade valves as required.

5.4.7) Shut off valves on compressor.

5.5 Refrigerant Suction Gas to liquid heat exchanger, if provided, shall be tube in tube type fabricated out of M.S. heavy class seamless pipes conforming to IS 1239.

5.6 The suction line shall be insulated with 6mm rubber foam insulation.

6.0 Fresh Air Take Arrangement

An adjustable manual damper of M.S. sheet along with bird screen, air inlet louvers shall be provided for fresh air entry.

7.0 Miscellaneous

7.1 The unit shall have control panel, housing the starting switches, contactor, relays etc.

7.2 Isolation pads shall be provided under the units

7.3 Drain line shall be provided from indoor unit upto drain point

7.4 Suitable M.S. angle iron supporting frame shall be provided for the condensing units and supporting arrangement for the indoor units.

7.5 Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit and cabling between the main control panels to the units

8.0 Testing and Commissioning

8.1 The refrigeration system shall be thoroughly tested for any leaks by pressurising with dry nitrogen to a pressure of 350 PSIG. Each joint and flare connection shall be checked for any leakage with soap solution. Any leaks shall be rectified and the above process shall be repeated till no leak is detected. The pressure in the system should stand for 1 day.

8.2 The system shall then be vacuumized to 7.6mm Hg absolute and maintained at this level for 4 - 6 hours. Thereafter the vacuum pump shall be stopped and vacuum maintained for 24 hours. Pressure rise should not exceed 2.5mm of water absolute.

8.3 The vacuum shall then be broken with dry nitrogen and system again vacuumized to 7.6mm Hg maintained for 4 hours. This procedure shall be repeated for a third time before charging refrigerant gas.

8.4 The contractor shall set all safety and capacity controls and interlocks, properly and a record of all settings shall be furnished before commissioning the plants.

8.5 Testing and commissioning shall be carried out in the presence of Architect/Consultant or his representative to his entire satisfaction.

9.0 Painting

All equipments, including mounting frames and interconnected piping etc shall be painted with two coats of approved enamel paint.

AIR COOLED SPLIT AIR CONDITIONER

1 SCOPE

Scope of this sub-section comprises the supply, erection, testing and commissioning of Air-cooled split air conditioners confirming to these specifications and in accordance with the technical 'schedule of equipment' and 'bill of quantities'.

2. TECHNICAL SPECIFICATIONS

The split type air conditioners shall have an actual operating capacity as required in the specifications. The tenderer shall clearly indicate the MAKE/MODEL/ACTUAL capacity of the units under actual working conditions and also enclose the manufacturer' literature and clearly mark the models of the units and complete selection data.

3. CONDENSING UNITS

The condensing unit will be provided with single or two serviceable hermetically sealed compressors suitable for 415 ± 10% volts, 3 phase, 50 HZ. The unit will be capable of providing the specified design minimum refrigeration capacity at design ambient conditions, without the help of any addition of water. The unit should be suitable for location in the open exposed roof outside weather without any damage/rust in the casing and other parts.

The compressor shall be hermetic, with enclosed gas cooled motor. The compressor's shall be suitable for R-22.

The condenser coil shall be air cooled type with aluminium fins and copper tubes and necessary refrigerant connections. The copper tubes shall not be less than 1/2" O.D.

The condenser air fan(s) shall be propeller type direct driven, each complete with motor. The air quantity and area of the condenser shall be adequate for working in the specified outdoor conditions.

The casing shall be fabricated from galvanised steel, zinc phosphated and finished with baked enamel paint. The casing shall make the whole unit fully weather proof, suitable for outdoor installation.

The necessary change of refrigerant gas and lubricated oil shall be provided to run the system.

4. EVAPORATIVE UNIT

The evaporative unit shall be as specified in Technical Schedule of Equipment complete with cooling coil of adequate size, synthetic fibre cleanable filters minimum 25 mm thick with face velocity not exceeding 106 mpm, centrifugal blower. the casing shall be heavy gauge sheet smoothly finished and fully protected against rusting.

5. REFRIGERANT PIPING

The condensing unit and evaporator unit shall be interconnected by type '1' seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit.
The suction line shall be insulated with 6 mm rubber foam insulation.

6. MISCELLANEOUS

The unit shall have control panel, housing the starting switches, contactor, relays etc.

Isolation pads shall be provided under the units.

Drain line shall be provided from a coil up to drain trap.

Suitable M.S. angle iron supporting frame shall be provided for the condensing unit and supporting arrangement for the indoor units.

Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit

7. INSTALLATION

The proposed location of the condensing units and the evaporative units as shown in the tender drawings are tentative. Actual location will be decided in consultation with the architect and the refrigerant piping of lengths as required will be provided by AC contractor within the quoted price. The installation shall be carried out in accordance with the best engineering practices to the complete satisfaction of the consultant to ensure proper return, and installation free from vibration and noise considered objectionable. Apart from other operational and safety controls provision will be made for manual reset with HP/LP cut out and for non-recycling control relay.

8 TESTING

The actual refrigeration capacity of the evaporative unit as tested at site shall not be below the capacity under the specific conditions as contained in the manufacturer's literature forming a part of the contract - but in no case less than the capacity specified in the tender.

9. PAINTING

The AC contractor shall be responsible to restore the equipment to original condition in case of any scratches or damages to the equipment up to the time of the handing over the same to the owner.

10. TECHNICAL DATA TO ACCOMPANY BIDS

Tenderer shall submit with tender complete technical data for selection of various components supported by the relevant literature

VENTILATION FANS

1.0 Codes and Standards:-

The design, materials, construction, manufacture, inspection, testing and field performance of the centrifugal fans shall comply with all currently applicable international / national codes / safety regulations. In particular the equipment shall conform to latest editions of all applicable codes and standards listed below.

AMCA-201 - Fans and systems - Application guide
AMCA-203 - Field performance measurement of fan systems
AMCA-210 -Laboratory Methods of testing Fans for Aerodynamic performance rating.
AMCA-2404 - Drive arrangements for centrifugal fans
BS:848, Part-1 - Fans for general purposes - Methods of testing performance
BS:4675, Part-1/ ISO-2372 - Mechanical vibrations in rotating and reciprocating machinery

2.0 Centrifugal Fans:-

2.1 Design Requirements:-

The design parameters for the centrifugal fans shall be as specified in Data Sheet-A (Filled up Data Sheets is enclosed in the Tender package). In the event of conflict between the requirements of this specification and Data Sheet or drawing, the later shall govern

2.2 Design and Constructional Features:-

a. General

a.i Centrifugal fans shall be DIDW / SISW in simply supported arrangement (i.e. Bearings on both the sides) construction complete with access door, squirrel cage induction motor, outlet damper, base frame, canvass connection, V belt drive set, belt guard, foundation bolts, nuts, slide rail and vibration isolators. Direction of discharge / rotation and motor position shall be as per the Good for construction shop drawings. All centrifugal ventilation fans shall be AMCA (Air Movement and Control Associates Incorporation of USA) certified for air & noise performance. Critical speed of the fan shall be minimum 125 % higher than the operating speed. Centrifugal Exhaust fans / motor and other accessories for toilet exhaust system shall be suitable for outdoor applications.

a.ii The Fans shall be AMCA Certified and performance certificate for the particular model of fans being supplied shall be submitted by Contractor.

b. Housing:-

b.i Housing shall be of welded construction, fabricated from carbon steel material with suitable reinforcement for rigidity. It shall be rigidly reinforced and supported by structural angles. Split casings shall be provided for large size fans, however neoprene packing shall be provided through split joints to make it airtight. Cut-off shall be designed to give smooth and quiet airflow from the outlet. Fan housing shall be of welded construction and provided with flanges at outlet for duct connection. Thickness of casing shall be as per manufacturer's standard & factory practices but casing thickness shall not be less than 2.0 mm for side plate and 1.2 mm for back plates.

b.ii The distance between blade tips and cut-off shall be optimally fixed to reduce pressure pulsation. Inlet and outlet shall be flanged.

b.iii Housing shall be provided with standard clean out door with handles and neoprene gasket.

b.iv Inlet cone shall be spun to have deep smooth contour. Close tolerance shall be maintained between inlet edge and the impeller shroud. Inlet cone profile shall ensure a smooth flow of air to blades. Inlet screens shall be provided for open inlet fans. Inlet guards shall be of 18 gauge galvanized wire mesh with 5 mm sieves. Inlet guards shall allow access for lubrication as required.

c. Impeller (Rotor):-

c.i The impeller shall be backward curve or aerofoil sectioned blades of non – over loading type. The Impeller blades shall be welded to back plate/center and shroud all along the length. Shroud shall be spun to have a smooth contour. Shaft sleeves shall be furnished as required. The impeller, pulley, and shaft sleeves shall be positively secured to the shaft. The locking device shall be designed to take the full torque due to momentum of impeller when the shaft suddenly gets arrested while running at operating speed. Air passages shall be free of interference.

c.ii Maximum operating speed of the fans shall be selected to maintain the fan outlet velocity of 2000 FPM (10.15m/s) and Noise level shall not exceed 75 db(A) at 1 mt. Distance from the equipment. The impeller along with driven pulley shall be balanced statically and dynamically after assembly. Balancing shall conform to minimum G 6.3 grade (as per ISO-1940) or Superior grade.

d. Shaft:-

d.i Shaft shall be properly sized for single piece hollow or solid construction of hot rolled steel and it shall be turned, ground and polished. Fan shaft shall not pass through its first critical speed at rated speed.

d.ii Fan shaft shall be of EN8, SAE-1040, SAE-1035 or equivalent .

e. Bearings:-

Fans shall be equipped with amply sized taper roller or ball or spherical roller anti friction or self aligning pillow block type bearings with integral dust and grease seals. Bearings shall be charged with grease. The grease capacity of the bearings shall be such that the fans are suitable for continuous operation for at least 12 months before re-greasing is required. Bearings shall be selected for a life of 50,000 hours and same shall be as per IS-3824. Grease fittings shall be alemite 6mm button head type.

f. Drive Motor:-

The fan motor, suitable for the centrifugal fan drive shall be supplied by the contractor and the same shall be as per the specification. Motors shall be designed for continuous duty

operation and shall have high efficiency. Drive motor shall have minimum 20 % margin over the fan limit load horse power. Motor shall be designed specially for quiet operation and motor speed shall not exceed 1440 rpm. The same shall be capable of accelerating to the rated rpm within safe stall time. The contractor shall submit the motor and fan torque characteristic curves along with other details for fan and motor in support of the selection. The fan and motor combination selected for particular required performance shall be of most efficient and shall be for quiet running characteristics and high efficiency. Fan motor selected shall be in such a way that sound level is lowest (max. 75 db) while running. The power and efficiency factor for all motors shall be submitted along with offer. Motor shall be capable of running continuously with a 5 % drop in rated phase to phase voltage at 15 % increase in design power. Motor of 0.75 KW and over shall be fitted with integral positive temperature coefficient thermistors selected to afford class 1 protection. Motors below 0.75 KW shall be fitted with inherent over heat protection. The Motors shall be TEFC type with IP-55 Protection & Class 'F' Insulation. Motors shall be designed for 415 V + 10% & 50 HZ + 3 %

g. Drives:-

Fans may be direct or belt driven. In case of belt driven fans, there shall be a minimum number of two belts per drive. All belt driven fans shall be equipped with fully enclosed belt guards with speed measurement openings and shall be easily removable. Belts shall be of oil resistant type. Belt guards shall not impede the airflow to the fan inlet. All belts shall be selected based on a service factor of 1.5 as applied to the drive motor kW rating. Should one belt fail the remaining belt(s) should be capable of carrying the full load. All belts shall be sized for 150% rated horsepower. The minimum number of belts to be provided will be as follows:

BHP	**NO. OF BELTS**
BHP < 5	2 Nos.
BHP >= 5 But < =10	3 Nos.
BHP > 10	4 Nos.

In case of direct drive, a hypoid gear coupling or flexible coupling of standard design shall be used. Pulleys shall be selected to provide the required speed. They shall be multi-groove type, with section and grooves selected to transmit 33% more load than the required power and shall be statically balanced. The belt guards shall be of M.S. sheet with angle iron reinforcements and 18 gauge expanded metal screen

2.3 Accessories:-

a. Common Base Frame:-

Mounting skid of structural steel shall be provided for supporting the fan & motor base frames. Mounting skid shall be bolted / welded with the embedded plates provided on the floor. Fans shall be fixed on mounting skid with vibrations isolators mounted in between.

b. Access Door and Drain Connection:-

Access door shall be provided for periodic inspection or cleaning. The door can be either toggle clamp fixed or as per manufacturer's standard design. Drain point with plugs or valves

shall be provided if specified.

c. Outlet Damper:-

Fan shall be provided with a damper at outlet. Dampers at outlet of centrifugal fan shall be manually operated multi-louvered type with neoprene edging on blades for tight shut off. Each blade shall be provided with bronze/gun metal bearing at each end of spindle. Operating lever along with the necessary linkage shall be provided at an accessible position for operating the dampers. Suitable fixing device for locking the damper at desired position should be provided.

d. Flexible Connection:-

Flexible connections shall be provided on the suction / discharge ends of the fan as specified. The flexible connection shall be of heavy gauge double canvas / Neoprene impregnated glass fiber of length not less than 150mm.

e. Nuts & Bolts:-

All bolts, nuts & locknuts shall conform to IS: 1367. Self-tapping screws shall not be used.

2.4 NOISE & VIBRATION:-

a. The vibrations measured at bearings in both radial and axial direction shall not exceed the specified range in the "Good to very Good region" of General machinery vibration chart of VDI-2056. The vendor shall furnish along with their offer the overall fan sound power level for each fan and motor operating at the duty conditions.

b. Vibration isolators of proven design for specified isolation efficiency shall be provided. Double deflection rubber in U shear or Cushy foot vibration isolator or Spring type isolators shall be provided for each fan. Rubber bushes, washers, wherever needed for the vibration isolators shall be included in the supply. Sufficient number of such isolators shall be provided to ensure isolation of foundation from vibration of the equipment. At the commissioning stage the vibration amplitudes shall be measured to ensure that the vibrations are within the permissible limit of 30 microns. Generally fans / motors shall be selected to run at very minimum vibration level in accordance with the standards and the fans which are to be mounted on the terrace floor should be selected in such a way that it will not transmit any vibration and sound to the office floors below.

2.5 Painting:-

Fans shall be painted on exterior and interior with two coats of red – oxide zinc chrome primer confirming to IS: 2074 or superior, over which 2 coats of synthetic enamel of approved shade shall be applied on all surfaces. Centrifugal fans / accessories which are to be installed on the terrace floor shall be suitably painted on exterior and interior surface to avoid corrosion. If these fans are to be installed on the terrace floor in the open ambient temperature / climate. Hence these fans / accessories are to be specially treated to take care of the adverse weather condition.

2.6 Accessories

All necessary accessories shall be provided for proper operation and shall also include **(As part of Unit Price).**

a. Dunlop cushy foot vibration isolators for the blowers.
b. Double canvass connections at the outlet of each fan.
c. Nuts, bolts, shims etc. as required for the grouting of the equipment.
d. Slide rails for mounting the motor and belt adjustments.
e. 18 gauge galvanized wire mesh bird screens in the Inlet.
f. Outlet damper.

3.0 Axial Flow Fan:-
a. Impeller:

The impeller shall be of die cast aluminium alloy with integrally cast aerofoil sectioned blades and hub. Impeller shall be fixed to motor shaft by a thrust plate and bolt reverse to direction of rotation, in addition to key lock. The critical speed of impeller shall be minimum 1.5 times of the operating speed. The impeller shall be statically and dynamically balanced to G 6.3 grade as per ISO: 1940.

b. Casing:-

Casing shall be of 2mm thick MS for impeller dia up to 600mm and 2.5mm thick MS for impeller dia above 600mm. Casing shall have flanged connection on both ends for ducted application. It shall be provided with suitable supports. Access door shall be provided in the casing for easy access to motor and impeller. Suitable arrangement for mounting of motor shall be provided.

c. Guide Vanes:-

In case of vane axial fans guide vane shall be provided on the discharge side.

d. Guards:-

Suitably designed guards shall be supplied.

e. Drive Motor:-

Motor shall be of totally enclosed fan cooled type squirrel cage induction of IP-55 protection and class-F insulation suitable to run on 415+10% Volts, 50+3% Cycles, 3-phase AC power supply. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit. Fan motor shall be selected in such a way that sound level is lowest (max. 75 db at 1 m distance) while running. The motor shall be rated for continuous duty. The power and efficiency factor for all motors shall be submitted along with the offer. Motors shall be capable of running continuously with 5 % drop in rated phase to phase voltage at 15 % increase in design power. Motor of 0.75 KW and over shall be fitted with integral positive temperature coefficient thermistors selected to afford class 1 protection. Motors below 0.75 KW shall be fitted with inherent over heat protection.

f. Speed:-

The speed of the fan shall not exceed 960 RPM for fan with impeller diameter above 450mm and 1440 RPM for fan with impeller diameter 450mm and less.

g. Painting:-

Fans and accessories shall be painted with two coats of red-oxide primer zinc chrome primer confirming to IS: 2074 or superior, over which two coats of synthetic enamel of approved shade shall be applied.

4.0 Propeller Fan:-

Propeller fans shall be direct driven, three or four blade type, mounted on a steel mounting plate with orifice ring. The blades shall be of steel and designed such as to give maximum volume at minimum noise level for minimum power consumption. The impellor shall be directly coupled to a purpose designated motor for efficient operation. Fan / motor shall be suitable for continuous duty and shall perform satisfactorily in ambient temperature of above 50 deg. C. The contractor shall furnish along with their offer the overall fan sound power level for each fan and motor operating at the duty conditions.

a. Mounting Plate:

Mounting plate shall be of steel construction, square with stream lined venturi inlet (reversed for supply applications) coated with backed enamel paint. Mounted plate shall be of standard size, constructed of 12 to 16 gauge sheet depending up on the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air with out turbulence and to direct the air stream.

b. Fan Blades:-

Fan blades shall be constructed of mild steel. Fan hub shall be of heavy welded steel construction with blades to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works. Impellor hubs and blades, fan supports, wire guards and internal surfaces of fan chambers shall have smooth finish.

c. Shaft:-

Shaft shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed through the full range of specified fan speeds.

d. Motor:-

Motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with pre – lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 38 cm dia or larger and 1440 rpm for fans 30 cm dia and smaller. Motor for larger fans shall be suitable for 415 + 10% volts, 50 cycles + 3%, 3 phase power supply and smaller fans shall be suitable for 220V +10%, 50 cycles + 3 % single phase power supply. Motors shall be suitable for either horizontal or vertical services as indicated on drawings / Schedule of quantities. Motor selected shall fully comply with the specifications mentioned elsewhere. Fan / Motor selection shall be for

continuous and quiet operation and the measured noise level shall not exceed 50 db (A) at 1 meter distance from the equipments. Motors shall be TEFC type with IP-55 protection & class 'F' Insulation.

e. Accessories:-

The following accessories may be required and provided with propeller fans, as indicated in Schedule of quantities.

Wire guard on inlet side and bird screen at the outlet.
Fixed louvers built in to a steel frame.
Regulators for controlling fan speed for single phase fan motors.

5.0 Inline Fans:-

a. Inline fans shall be complete with centrifugal impeller, casing, direct driven motor, vibration isolators, direction of discharge and rotation position shall be as per the job requirement and shall be marked on the fan assembly.

b. Housing shall be constructed of hot rolled 16g GSS sheet metal construction. Housing metal parts shall be either spot-welded or screwed or mounted together with rivets. Indication showing rotation arrow and make, model number and duty conditions of the fan shall be available on the housing.

c. Casing shall be with wide hinged doors which open easily inspection doors with handle and neoprene gasket shall also provided. Casing shall have flanged connection on both ends for ducted applications. Casing shall be primed and finish coated with synthetic enamel paint. Extended grease leads for external lubrication shall be provided.

d. Fan wheel shall be forward curved type, statically and dynamically balanced.

e. The fan shall be provided with ball bearings can be used in any mounting position at maximum indicated temperature. The bearing lubricant shall be suitable for a minimum ambient temperature of minus 150C (admissible for a short time without reaching dew point at minus 300C). For applications at maximum indicated ambient temperature life expectancy shall be 40000 hours minimum.

f. Fan motor, fans shall be supplied with built-in-thermal contact (TK) at the critical high temperature point ("B" = 1300C. The thermal contact shall open and break the power supply to the fan, Fan motors have insulation class "F" and protection class IP55.

g. Motor shall be squirrel cage, totally enclosed, fan cooled standard round frame, constant speed, continuous duty, single winding, suitable for single phase supply. (220V+/-10%,50 Hz+/-3%). Motor shall be specially designed for quiet operation and lead wires from the motor to be conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.
h. Fans shall be direct driven type.

i. All fans are hot dipped galvanized.
j. The assembly of fan and motor shall be suspended from the ceiling by spring type vibration

isolators.

6.0 Fire Rated Smoke Exhaust Axial Fan:

a. The fire rated smoke exhaust fans shall be axial type suitable for 250oC for minimum 2 hours.

b. The blades shall be of aluminum alloy fixed on an aluminium hub-flange assembly suitable for multiple blades which shall be adjustable when the fan is stationary.

c. The collar shall be constructed of rolled steel and joints welded. The flanges shall have suitable holes for fixing the fans, ducts etc. The collar and flanges shall be galvanized for protection.

d. The collar shall be long to cover fan and motor.

e. The fan shall be supplied with factory mounted TEFC motor suitable for 250oC for minimum 2 hours. The motor shall be foot mounted.

f. The fan shall be approved for 250oC for 2 hours by International / national authorized agency.

g. The speed of the fan shall not exceed 960 RPM for fan with impeller diameter above 450mm and 1440 RPM for fan with impeller diameter 450mm and less.

7.0 Fire Rated Centrifugal Fan:-

a. Fire rated centrifugal fan generally shall be as described above and may have varied construction features as required.

b. The fan shall be supplied with factory mounted TEFC motor suitable for 250oC for minimum 2 hours. The motor shall be foot mounted.

c. The fan shall be approved for 250oC for minimum 2 hours by International / National authorized agency.

8.0 Limitation:-

a. The air velocity limits shall be as per Schedule of Equipment and/or BOQ but in no case exceed.

b. Velocity at blower outlet shall not exceed 10.16 M/s (2000 FPM).

c. Inlet Velocity shall be limited to 5.08 M/S (1000 FPM).

8.1 Life of Ventilation & Smoke Exhaust Fans:-

Ventilation & Smoke Exhaust Fans shall be capable of providing Average Service Life of 25 years.

MOTOR & SWITCHGEARS
MOTOR STARTERS CONTROL PANELS

1.0 General

The motors and switchgears required for various items shall generally be as per specifications given below. All electric motors shall be suitable for 3 phase, 50 cycles 415 volts A.C. supply.

2.0 Control Panel

2.1 These panels should be floor/wall mounted, sheet steel clad, modular construction, cubicle design, compartmentalised .These panels shall comprise of incoming & outgoing feeders (circuit breakers, fuse switch units/switch fuse units, contactor starters with overload relays, single phasing preventor etc. as indicated in the drawings.

2.2 The panels shall be provided wherever necessary with necessary interlocks designed to prevent incorrect operation and to ensure safety of operating personnel and equipment.

2.3 All feeders are to be operated from the front and they shall be interlocked suitably. Padlocking arrangement and interlock defeating device shall also be provided. Each module shall have separate door and partition plate. The feeder incomer switches shall be interlocking with the door so that the door can only by opened when switch is in `off' position. The doors and covers shall be provided with thick gaskets to make it dust tight. All the door covers shall be provided with synthetic rubber gaskets to make it dust tight. Feeder name tags shall be provided.

2.4 **Air Circuit Breaker and Fuse Switch Units**

The circuit breaker shall be air break fully draw out type equipped with arc chutes and their face barriers of proper design. The continous current rating of the circuit breakers shall be as given in the detailed technical specifications. The circuit breakers shall have a breaking capacity of 31 MVA at 415 volts, 50 hz ac & they shall be able to withstand full fault current for one second.

2.5 The circuit breaker shall be provided with manually operated spring closing mechanism. The operating mechanism shall be trip-free throughout the breaker travel. The breaker shall be equipped with inside `on' & `off' position indicator mechanism and so located that the position of the circuit breaker i.e. whether closed or open, is indicated on the front door of the compartment. The `on' & `off' trip indicating lights shall also be provided for each breaker feeder.

2.6 The moving portion of the circuit breaker shall be so interlocked that it is not possible to isolate it and draw out from the service position or to plug it in from the isolated position when the circuit breaker is closed. The interlock being provided shall be such as to prevent operation of a circuit breaker unless it is fully plugged in or fully isolated and is locked correctly in either of the two position.

2.7 The circuit breaker compartment doors shall be so interlocked as to prevent access to the breaker while in the plugged in position. However special means shall be provided for undoing this interlocked in an emergency.

2.8 The draw out feature shall clearly provided three distinct positions of the circuit breaker viz., `service', `test' & isolated. Inadvertent withdrawal of a circuit breaker removable unit too for beyond its supports shall be prevented by a suitably interlock, the design shall provide for the testing of breaker in the test positions i.e. when the breaker's moving unit is in fully disconnected position and the secondary circuit remains connected or energised. The secondary connections between the fixed and removable units shall be provided with means of spring loaded sliding type contacts to make the breaker fully draw out type.

2.9 The circuit breaker unit shall be provided with complete range of releases including the overload releases and release for short circuit protection.

2.10 The circuit breaker shall be provided with necessary auxiliary contacts with 2 No. spare contacts. All contacts shall be wires upto the terminal board.

2.11 The fuse switch unit shall be of load break heavy duty, industrial design and of double break pattern with quick make and quick break mechanism, however, the design shall be such that it shall ensure positive opening even if quick break action is lost due to spring stretchening or breaking.

2.12 The `on' and `off' position of the switch handle shall be distinctly indicated and inter locks shall be provided to ensure that switch cover can not be opened unless the switch is in the `off' position.

2.13 The fuse switch units shall be provided with non-deteriorating type of HRC cartridge fuse link and having rupturing capacity not less than 31 MVA at 415 volts.

2.14 All alive parts inside switch shall be properly shrouded and inter phase barriers shall be provided. Design of the switch handles shall be such that they do not protrude out of the panel in the manner so as to prevent free passage of operating personnel. Design with normal conventional position of switch handle up in `on' position & down in `off' position shall be preferred.

2.15 **415 Volts Bus Bars**

The 415 volts main bus-bar shall have continuous current rating as indicated in the specification or equivalent standard rating of at least 50 percent of these of the phase bus bars. The bar and its connections shall be so arranged and supported as to withstand without any damage or deformation, the specific short-circuit current. The bus bars shall be braced and supported on reinforced fibre glass support and shall be of electrolytic grade type E 91e of IS: 5082. These bus bars shall withstand 43.12 ka for one second during short circuit conditions. The bus bars shall be colour coded with PVC tapes or insulating painting for identification purposes. The bus bars shall be sleeved with special type heat shrinkable PVC sleeving.

2.15.2 The main three phase and neutral horizontal bus bar shall be located in top isolating chamber extending throughout the length of the switch board. Bus bars shall have withstand capacity of 43.12 ka RMS and shall be mounted on reinforced fibre glass supports at intervals suitable for prescribed conditions of short circuit and other standards. The neutral bus bar shall run all along the length of the board.

2.15.3 Power shall be distributed to the outgoing or incoming control units in each section by a set of vertical bus bars three phase and neutral. The vertical bus bars shall be isolated from control compartments by suitable metallic barriers or by insulating sleeve on each bus and supported in liberally designed reinforced fibre glass insulating plates spaced as per standards suitable joints shrouds detachable type shall be provided on bus bar joints.

2.15.4 Bus supports shall be resistant low absorption type moulded insulation of high impact strength and high creep age surface.

2.15.5 All bus work shall be braced to withstand without damage a short circuit current of 43.12 ka symmetrical for one second.

2.15.6 The vertical bus bars for different sets of panels shall be connection should not be painted.

2.16 **Instruments and Meters**

2.16.1 Current transformer shall comply with the requirements of IS: 2705. They shall have ratio outputs and accuracies as specified or required as shown in single line diagram.

2.16.2 All indicating instruments shall be of industrial pattern and should be provided as shown in the single line diagram.

2.16.3 All instruments shall be switch board type flush mounted with proper scale dimensions so as to be clearly visible to the operators standing on the floor. The instruments shall be provided with front of board zero adjuster shall be not preferably be mounted at heights lower than one meter and higher than two meters above the floor level.

2.16.4 The operating handles, meters, instruments etc. shall be mounted at the front of the switch board. Approved means shall be provided for locking the control switch/operating handles in the open position. For fuse switch gear section of the switch board, meters where specifications shall be mounted in such a manner that it is possible to readily identify the meters for individual units and the arrangements does not create hindrance to maintenance of individual units without having to shut down the bus.

2.16.5 All wires carried within the switch gear enclosure shall be PVC insulated and shall be neatly arranged to be readily accessible and to facilitate easy replacement. Only PVC copper cables shall be used for all power and control inter connections. The cables of 660 volts shall be used. Trained copper cables lugs shall be used. All small wires shall be colour coded and provided with numbered ferrules for easy identification of circuits. As for as possible, each essential circuit shall be connected within the

respective switch gear unit. Control wiring terminal shall preferably be near the panel.

3.0 Cable Termination

3.1 The cables entries and terminals shall be provided in the switch board to suit the number, type and size of aluminium conductor cables as given in the line diagrams. Cable entries shall be so designed as to avoid damage to cables and there shall be sufficient space to avoid short bending of cables. The positions of the cable lugs and terminals shall be such that the cable could be neatly drawn and connected through one meter deep trench below the switch gear and the jointing carried out in a convenient and satisfactory manner. The cable entry, design panel, cable boxes and terminals and their locations will have to be approved by the engineer/owner. However the access for cabling shall preferably be from the back of the switch board. The panels shall be provided with control transformers of suitable VA rating along with control bus and hr fuses from control supply to contractors.

3.2 The cables socket shall be of copper and of crimping type. Cables risers shall be adequately supported to withstand the effects of rated short circuit current without damage.

3.3 Cable glands of sizes as required shall be provided at all cable entry paints in the bottom plate. The glands shall form part of switch board.

4.0 Indication

Each incoming and outgoing feeder units shall be provided with `on' `off' indicating lamps of standard conventional colour coding.

5.0 Subsidiary Panels

Subsidiary panels shall be provided wherever required such as AHU room, air washer room. The construction of these panels should be similar to the main panel and shall have all related accessories.

6.0 Contactor Starters

6.1 **Star Delta Starter**

The star delta starter shall be air break automatic contactor starter provided with main contactor, star contactor, delta contactor, timer and automatic change over from start to delta, bimetallic over load relay, operating coil, start/stop push button, single phasing preventor, auxiliary make and break contacts, indicating lamps etc. The contactor shall quick make, quick break, double break consisting of robust silver contacts. The coil voltage shall be 415 volts ac at 50 hz. The starter shall be provided with trip indication light and overload reset push button for overload relay.

6.2 **DOL Contactor Starter**

The contactor shall be air break type coil operate, dol contractor starter, provides with

cables entries, ambient temperature compensated bimetallic over load relay, single phasing preventor, solenoid coil, start and stop push buttons, 8 auxiliary make and break contacts, indicating lamps etc. The contactors shall be quick make quick make and quick break, double break type consisting of robust silver contacts. The coil voltage shall be 440 volts at 50 c/s. The starter shall be provide with trip indication light and over load reset bush button for overload relay.

PIPE WORK

1. **General:**

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder: -

2. **Arrangement and Alignment of Piping:**

2.1 All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge.

2.2 The piping shall be installed in a uniform manner, parallel to or perpendicular to walls or ceilings, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angles and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room.

2.3 All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer-in-charge.

2.4 All piping shall be carefully installed to provide for proper alignment, slope and expansion.

2.5 The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle.

2.6 Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

2.7 Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor excessive in length, but shall be installed neatly, carefully bent at all changes in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

2.8 The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

3. **Testing:**

3.1 In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, equipment or appliances be subjected to pressures exceeding their test ratings.

3.2 The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blank-offs or flanges.

3.3 After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fillings and debris.

3.4 All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq.cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the engineer-in-charge, without any extra cost.

3.5 All the piping systems shall be tested in the presence of the engineer-in-charge or their authorised representative. Advance notice of test dates shall be given and all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by engineer-in-charge in order to avoid hindrance in the work of the insulation contractor.

3.6 All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq. cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.

3.7 Miscellaneous piping, tests with air at 10.5 kg/sq.cm for a minimum of 24 hours without drop in pressure.

3.8 The contractor shall make sure that proper noiseless circulation is achieved through all piping systems. If due to poor bond, proper circulation is not achieved, the contractor shall bear all expenses for carrying out the rectification work including finishing of floors, walls and ceiling damaged in the process of rectifications.

3.9 The contractor shall provide all labours and materials to make provision for removing water and throwing it at the proper place, during the testing or/and after the testing to avoid damages to employer or other contractors ' properties. Any damages caused by the contractor to the employer or other contractors' properties, shall be borne by the contractor.

4. **Copper Piping:**

4.1 Heavy gauge soft copper tubing, type m shall be used to make connections to equipment, wherever required or specified by engineer-in-charge.

4.2 Flare fittings e.g. flare nuts, tees, elbows, reducers etc. shall all be of brass.

5. **Refrigerant Piping:**

5.1 The refrigerant circuit piping shall be heavy class m.s the fittings shall be heavy class. The pipes and fittings shall be connected by means of welded joints. The connections to gauges, controls etc. shall be with soft copper tubing and flare fittings.

5.2 The refrigerant valves, required in the circuit shall be as follows.

	Valve Size	Valve Material	Type of Connections
5.2.1	up to 12 mm	brass/packless type	flare fittings
5.2.2	16mm & above	brass/steel packed type	brazed/welded

Note :- all valves shall be tested against leaks upto 20 kg/sq.cm.

5.3 The strainers for the refrigerant liquid line shall be `y' type with gun metal body and bronze filter screen of fine mesh. The filter screen shall be easily removable type without dismantling the strainer from the circuit.

5.4 The moisture indicator in the liquid line shall have leak proof glass on opposite sides to permit easy inspection of the liquid refrigerant.

6. **Drain Piping:**

6.1 The drain piping shall be medium class galvanised steel as per is 1239/1979.
6.2 The fittings shall be of `R' brand or equal forged with screwed connections.

6.3 The gate valves shall be of gun metal as described earlier.

6.4 Pipe crosses shall be provided at bends, to permit easy cleaning of drain line.

6.5 The drain line shall be provided upto the nearest drain trap and pitched towards the trap.

6.6 Drain lines shall be provided at all the lowest points in the system, as well as at equipments, where leakage of water is likely to occur, or to remove condensate and water from pump glands.

7. **Painting:**

7.1 All pipes supports, hangers, etc., shall be given two coats of red oxide primer.

7.2 All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as approved by the engineer-in-charge.

INSULATION

1.0 General

The insulation of water piping, air handling units, ducting, chillers etc., shall be carried out as per specifications given below:

2.0 Materials

The materials to be used for insulation shall be as follows, unless some other material is specifically mentioned elsewhere.

2.1 Pipe Insulation

The insulation for chilled water/ hot water and drain piping, chillers, pump etc. shall be carried out from `TF' quality expanded polystyrene having a `K' value of 0.014 kcal/hr/^{o}C at mean temperature of 10^{o}C and a density of 20 to 24 kgs/ cub.m.

2.2 Other Insulation

2.2.1 The material for acoustic treatment of ducts, rooms, roofs etc. shall be resin bonded fibre glass, as described earlier, conforming to I.S. 8183 of 1976. the density of fibre glass shall be 32 kg/cub.m and the material shall be in the form of slabs of uniform density. The `K' value at 10^{o}c. shall not be less than 0.028 kcal/mhr/^{o}C. Facing shall be provided with 0.5 mm perforated aluminium sheet held with G.I. nuts bolts or nailed to the batten work as required.

2.2.2 The materials for duct insulation shall be resin bonded glass wool, as described earlier but conforming to I.S. 8183 of 1976. The density of insulation shall not be less than 24 kg/cub/m. and material shall be in the foam of blankets/rolls of uniform thickness. The `K' value at 10^{o}c. shall not be less than 0.03 kcal/m hr/deg.C.

3.0 Air Handling Units

3.1 The casing of the sheet metal type air handling unit from the beginning of the fan section till the end of the coil section, including the drain pan, shall all be insulated.

3.2 The insulation shall be 12 mm polyethylene flexible sheets.

3.3 The insulation shall first be fixed to the casing by applying cold sticking compound both to the surface and the insulation and all joints shall be sealed completely.

4.0 Cold Equipment Insulation

4.1 The complete shell of the Chiller as well as its two heads, the chilled water pumps, and high pressure AHU's shall all be insulated.

4.2 The insulation shall be `TF' quality expanded polystyrene as below:

i)	Chillers	-	100 mm
ii)	High pressure AHUs	-	50 mm
iii)	Chilled water pumps	-	50 mm

4.3 All insulation excepting Chiller heads shall be covered with 0.63 mm12 mm wire netting and finished with 12 mm thick sand cement plaster.

4.4 The insulation on the two end heads of the Chiller shall be covered with 0.80 mm G.I. casing to permit easy removal.

4.5 **Insulation (Chiller)**

4.5.1 The cooler surface shall first be cleaned with wire brush.

4.5.2 Then one layers of cold setting compound shall be applied.

4.5.3 The insulation shall then be fixed in two layers, staggering the joints and sealing them with cold setting adhesive.

4.5.4 The insulation shall then be covered with 0.63 mm 19 mm mesh wire netting which shall be fixed to the insulation with brass `U' nails.

4.5.5 The final finish shall be12 mm sand cement plaster which shall be applied in two layers of 6 mm each and trovelled to a smooth round finish.

4.5.6 After the insulation is fixed on the head as above, it shall then be covered with a properly shaped jacket of 0.80 mm G.I. sheet. Pump casing shall be finished with aluminium cladding.

4.6 **Insulation (Others)**

The AHUs and the chilled water pumps shall be insulated as above in 4.5 and finished with plaster excepting that the insulation of 30 mm shall be fixed in a single layer.

5.0 Chilled/Hot Water Piping/Drain Piping

5.1 The chilled/hot water and drain pipes shall be insulated with `TF' quality expanded polystyrene. The thickness of the insulation for chilled/hot water pipes will be 50 mm and for drain pipes will be 25 mm.

5.2 Preformed pipe sections shall be used for pipes upto and including 350 mm dia.

5.3 Pipes above 350 mm dia. shall be insulated with insulation slabs cut in mitred sections.

5.4 **Installation**

Chilled/Hot Water and Drain Piping

5.4.1 The pipe shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.

5.4.2 The pipes shall be treated with a coat of cold setting compound.

5.4.3 The insulation preformed section shall be fixed tightly to the surface taking care to seal all joints.

5.4.4 All joints along the circumference of the pipe sections shall be sealed with adhesive.

5.4.5 The insulation than shall be covered with 0.63 mm x 19 mm mesh wire netting than finally finished with 12 mm sand cement plaster in two layers of 6 mm each and given to a smooth round finish.

5.4.6 Insulation on pipes in areas exposed to weather or underground shall additionally be covered with tar-felt sheets manufactured by shalimar tar products (1935) ltd. and fixed with G.I. wires of 1.0 mm. The tar felt sheet shall be stuck with bitumen r 85/25.

6.0 Refrigerant Piping

6.1 The suction line of refrigerant piping shall be insulated with 50 mm thick expanded polystyrene as specified for chilled/hot water pipe lines.

7.0 Ducting

7.1 The air handling ducts shall be insulated with resin bonded glass wool with density not below 24 kg/cub.m.

7.2 Duct insulation thickness shall be as follows:

Duct in conditioned space	-	25 mm thick
Duct in unconditioned space	-	50 mm thick
Duct with treated fresh air	-	50 mm thick

7.3 **Installation**

7.3.1 Clean the surface with a wire brush and make it free from rust and oil.

7.3.2 Apply one coat of cold setting compound.

7.3.3 Wrap the duct with insulation blankets of the thickness mentioned in item 7.2 above and then with 250 g polythene sheet and covered with 0.1mm thick .aluminium sheet using 50 mm wide aluminium adhesive tape of Johnson make.

7.3.4 Reinforce and tie with G.I. wire of 1.0 mm at intervals of 450 mm.

7.3.5 The ducts in areas exposed to the weather shall be additionally covered with one layer of tar felt b.h. the tar felt shall be stuck with bitumen r 85/40 or 80/25.

8.0 Acoustic Lining

8.1 The acoustic lining shall consist of 25 mm resin bonded glass wool board of density 48 kg/cub.m (min) then it shall be covered by 0.5 mm perforated aluminium sheets having 3 mm perforation at 6 mm centres.

8.2 Installation

8.2.1 The duct surface shall first be cleaned from inside.

8.2.2 The insulation boards shall be wrapped in glass cloth of 7 mil thickness with the end stitched.

8.2.3 Then the boards shall be fixed inside the duct.

8.2.4 The insulation shall then be covered with 0.5 mm perforated aluminium sheets.

8.2.5 The sheet and the insulation shall be secured to the duct by means of cadmium plated bolts, nuts and washers. The ends should be completely sealed off, so that no insulation material is exposed.

1.0. **General**

1.1 The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, exhaust system ready for operation as per drawings.

1.2 Except as otherwise specified all duct work and related items shall be in accordance with these specifications.

1.3 Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

2.0 Duct materials

2.1 The ducts shall be fabricated from galvanized steel sheets class VIII GSS sheets conforming to IS:277-1962 (revised) or aluminium sheets conforming to IS:737-1955 (wherever aluminium ducts are specified) .

2.2 All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in is: 655-1963 with amendment-i (1971 edition)

The thickness of the sheet shall be as follows: -

	size of duct	**sheet thickness**		**type of joints**	**bracing if any**
		GI	**Aluminium**		
2.2.1	Upto 750mm	0.63 mm	0.80 mm	GI flange	
2.2.2	751 mm to 1000 mm	0.80 mm	1.00 mm	25x25x3 mm angle iron frame with 8 mm dia. nuts & bolts.	25x25x3 mm at the rate of 1
2.2.3	1001 mm to 1500 mm	0.80 mm	1.00 mm	40x40x5 mm angle iron frame with 8 mm dia. nuts & bolts.	40x40x3 mm at the rate of 1
2.2.4	1501 mm to 2250 mm	1.00 mm	1.50 mm	50x50x5 mm angle iron to be cross braced diagonally with 10	40x40x3 mm at the rate of 1.2

				mm dia nuts & bolts at 125 mm centre.	
2.2.5	2251 mm and above	1.25 mm	1.80 mm	50x50x6 mm angle iron frame with 10 mm nuts & bolts at 125 mm centre.	40x40x3 mm at the rate of 1.6

2.3 The gauges, joints and bracings for sheet metal duct work shall further conform with the provisions as shown on the drawings.

2.4 Ducts larger than 450 mm shall be cross broken, duct sections upto 12 00 mm length may be used with bracing angles omitted.

2.5 Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 deg. Angle from the axis of the main duct unless otherwise approved by the engineer-in-charge.

2.6 All ducts shall be supported from the ceiling/slab by means of M.S..rods of 9 mm (3/8") dia with M.S. angle at the bottom.

3.0. **Installations**

3.1 During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of engineer-in-charge.

3.2 Great care should be taken ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.

3.3 All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. all joints shall be tight and shall be made in the direction of air flow.

The ducts shall be reinforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

3.4 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration. All ducts shall be fabricated and installed in accordance with modern design practice the sheet metal gauges and fabrication procedures as given in IS specifications shall be adhered to and shall be considered as an integral part of these specifications.

3.5 The duct work shall be varied in shape and position to fit actual conditions at building. All changes shall be in accordance with accepted airconditioning duct design and

subject to the approval of the engineer-in-charge. The contractor shall verify all measurements at building and shall notify the engineer-in-charge of any difficulty in carrying out his work before fabrication.

3.6 Sponge rubber of approved equal gaskets shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. sheet metal connections shall be made to walls and floors by means of galvanized steel angles anchored to the building structure with anchor bolts and with the sheet bolted to the angles. sheet metal connections shall be as shown in the drawings or as directed by engineer-in-charge.

3.7 The ducts shall be supported from the structure by means of suitable supports grouted in the R.C.C. work. The type of support should meet the approval of the engineer-in-charge and should involve minimum damage or breakage. In no case the duct will be rested upon the false ceiling/boxing or on supports grouted in the wall.

3.8 Flanges and supports are to be black, mild steel and are to be primer coated on all surfaces before erection and painted with aluminium thereafter. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

3.9 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by engineer-in-charge.

3.10 Joints requiring bolting or riveting may be fixed by hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All fixing must have a permanently non-corrosive finish such as cadmium plating or galvanizing as appropriate. Spot welds and bronze welds are to be coated on all surfaces with zinc rich paint, as approved by engineer-in-charge.

3.11 The flexible joints are to be fitted to the suction and delivery of all fans the material is to be normally double heavy canvass or as directed by engineer-in- charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.

3.12 The flexible joints are to be not less than 75 mm and not more than 250 mm between faces.

3.13 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

4.0 Dampers

4.1 At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than gauge of the large duct, and shall be rigid in construction to the passage of air.

4.2 The volume dampers shall be of an approved type, lever operated and complete with

locking devices which will permit the dampers to be adjusted and locked in any positions.

4.3 The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 mm (18) gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm angles shall not interface with the operation of dampers, nor cause any turbulence.

4.4 Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.5 mm steel and blades shall not be over 225 mm wide. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with fine mesh spacing.

4.5 Wherever required for system balancing, provide a volume balancing opposed blade damper with quadrant and thumb screw lock. Provide damper rod and damper block with upset screws.

4.6 After completion of the duct work, dampers are to be adjusted and set to deliver the required amounts of air as specified on the drawings.

4.7 The fire dampers shall be provided wherever shown on the drawings. The damper shall be multi blade type as per drawings. The blades shall be minimum 1.6 mm thick mild steel. The frame shall be of 1.6 mm thickness. Other materials shall be as per the drawings attached and shall include return spring, locking device, fusible link etc.

5.0 Access panel

A hinged and gasketed access panel shall be provided on duct work before each reheat coil and at each control device that may be located inside the duct work.

6.0 Miscellaneous

6.1 All ducts above 450 mm are to be cross broken to provide rigidity to the ducts.

6.2 All duct work joints are to be true right angle or approaching with all sharp edges removed.

6.3 Sponge rubber gaskets also to be provided behind the flange of all grilles.

6.4 Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

6.5 Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by engineer-in-charge.

6.6 Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.

6.7 Proper hangers and supports should be provided to hold the duct rigidly, to keep them

straight and to avoid vibrations additional supports are to be provided where required for rigidity or as directed by engineer-in-charge.

6.8 The ducts should be routed directly with a minimum of directional change.

6.9 The duct work shall be provided with additional supports/hangers, wherever required or as directed by the engineer-in-charge, at no extra cost.

6.10 All duct supports, flanges, hangers and damper boxes etc. shall be given 2 coats of red oxide paint before installation and one coat of aluminium paint after the erection, at no extra cost.

6.11 All angle iron flanges to be welded electrically and holes to be drilled.

6.12 All the angle iron flanges to be connected to the GSS ducts by rivets at 100 mm centres.

6.13 All the flanged joints, to have a 4 mm thick felt packing stack to the flanges with shellac varnish. the holes in the felt packing are to be burnt through.

6.14 The G.S.S. ducts should be lapped 6 mm across the flanges.

6.15 The ducts should be supported by approved type supports at a distance not exceeding 2.4 metres.

6.16 Sheet metal connection pieces, partitions and plenums required, shall be constructed of 1.25 (18 gauge) sheet thoroughly stiffened with 25 mm x 25 mm angle iron braces and fitted with access doors.

7.0 Grilles

7.1 The supply and return air grilles shall be fabricated from aluminium extruded sections the supply air grilles shall have single/double louvers. The front and rear louvers shall be of extruded section, fixed/adjustable type the return air grille shall have single horizontal extruded section fixed louvers the grilles may or may not be with an outer frame.

7.2 The grilles shall have opposed blade dampers of GI. black sheets, which shall be key operated from the grille face wherever required.

7.3 The damper blades shall be of 0.80 mm (22 gauge) G.I. black sheets and shaped to form air tight joints the frame work for dampers shall be fabricated from 1.00 mm (18 gauge) M.S. black sheet the grill flange shall be fabricated out of 25 x 25 x1.5 mm aluminium angle grilles longer than 450 mm shall have intermediate supports for the horizontal louvers.

8.0 Diffusers

8.1 The ceiling type round or square diffusers shall be of extruded aluminium sections with flush or step down face, as specified with fixed pattern and round neck.

8.2 The diffusers shall be die formed for proper air diffusion.

8.3 All supply diffusers shall be provided with m.s. sheet dampers, with knurled knobs for adjustment from the bottom.

9.0 Linear Grille

9.1 The linear grille shall be of extruded aluminium sections flush mounted with single or double direction air flow adjustment louvers..

9.2 The diffusers shall be die formed for proper air diffusion.

11.0 Painting

11.1 All grilles, and diffusers shall be anodised or powder coated as per the requirements of the interior decorators to the approved colour to suit the interiors

11.2 All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish.

11.3 All grilles, diffusers and registers shall be provided with rubber gasket between flanges and the wall or ceiling.

12.0 Testing

12.1 After completion, all duct system shall be tested for air leakage.

12.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the engineer-in-charge for approval.

1.0 General

The electric wiring of motors for compressors, pumps, air handling units etc. As well as controls, heaters etc. and earthing of all equipment shall be carried out as per specifications given hereunder.

2.0 Wiring for Motors, Heaters etc.

2.1 The wiring for above equipment shall be carried out in pvc armoured cables conforming to I.S.:1554.

2.2 The PVC armoured power cable for use on 415 volts system shall be 3 or 3.5 core with aluminium conductors and be of 1100 volts grade, as per is 1554 part is-1964. The cross section of the cable shall be to suit the load or rating of the equipment. The cable shall be aluminium conductor PVC insulated single wire/strip armoured with overall PVC sheathing.

2.2.1 The cables shall be laid as per I.S. -1255/1967, Indian standard code of practice.

2.2.2 The cables shall be laid, as per drawings or along a short and convenient route between switch board and the equipment, either in trenches, on wall or on trays. Hangers, supported from the slab. Cable routing shall be checked on the site to avoid interference with structure, equipment etc. Where more than one cables are running close to each other, proper spacing should be provided between them Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls, or laid directly in ground or clamped on structures, as may be required. Cable ducts shall not be provided in plant rooms. Cable trays shall be fabricated from slotted angle/solid angles to make ladder type cable tray, designed with adequate dimensions for proper heat dissipation and also access to the cables. Alternatively, cable trays may be of steel sheet with adequate structural strength and rigidity, with necessary ventilation holes therein. In both the cases, necessary supports and suspenders shall be provided by the Air-conditioning Contractor as required.

2.2.3 The radius of bends of the cable should not be less than 12 times the radius of cable to prevent undue stress and damage at the bends, the cables should be supported and fixed on M.S. supports, when running in trenches, wall or ceiling suspended hangers when laid under ground the cables should be covered with sand and protected with cement concrete covering. Suitable G.I. pipe shall be used wherever cable is laid across road, crossing of other services and when passing through R.C.C.

2.2.4 Wooden bushes shall be provided at the ends of pipes through which cables are taken.

3.0 Control Wiring

3.1 Control cables shall be 1100 volts grade as per is 1554 with copper conductor of 2.5 sq mm PVC insulated single wire/strip armoured with an overall PVC sheathing as per is 1554.

3.2 The cabling shall be carried out as per details given under 2.2 above.

4.0 Earthing

4.1 Pipe Earth Electrode

G.I. pipe shall be of medium class 40 mm dia 4.5 m long in length. Galvanising of the pipe shall conform to relevant is. G.I. pipe electrode shall be cut tappered at the bottom and provided with holes of 12 mm dia drilled not less than 7.5 cm from each other upto 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20 cms below ground level.

4.2 Plate Earth Electrode

4.2.1 For plate electrode minimum dimensions of the electrode shall be as under:

i. G.I. plate electrode : 60cm x 60cm x 6mm thick.

ii. Copper plate electrode : 60cm x 60cm x 3mm thick.

4.2.2 The electrode shall be buried in ground with its faces vertical and top not less than 3 m below ground level.

4.2.3 In case of plate earth electrode a watering pipe of 20 mm dia of medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on top of this pipe for watering the earth. In case of pipe electrode a 40mm x 20mm reducer shall be used for fixing the funnel. The watering funnel attachment shall be housed in masonry enclosure of not less than 30cm x 30cm x 30cm. A cast iron/ms frame with cover having locking arrangement shall be suitable embedded in the masonry enclosure.

4.3 Loop Earthing

4.3.1 Loop earthing shall be providing for all mountings of main board and other metal clad switches and db's with G.I. strip of size specified but not less than 14 swg copper or 12 swg gi or 4 sq mm aluminium wite. The earthing lead from electrode owner's shall be suitably protected from mechanical injury by a 15 mm dia GI pipe in case of wire and 40 mm dia medium class G.I. pipe in case of strip. Metallic covers or supports of all medium pressure or ht apparatus or conductor shall in all cases be connected to not less than two separate and distinct earths.

4.3.2 All equipment connected with electric supply shall also be provided with double earthing continuity conductors. The size of G.I. earthing conductors shall be :-

Earthing should be carried out as per IS-3043

Size of phase wire Sq.mm.	Size of G.I. conductor aluminium tape/wire (swg)
185	25 mm x 4 mm (strip)
150	25 mm x 4 mm (strip)
120	20 mm x 3 mm (strip)

Size of phase wire sq.mm	Size of G.I. conductor aluminium tape/wire (swg)
95	20 mm x 3 mm (strip)
70	4 swg
50	4 swg
35	6 swg
25-6	6 swg
4	8 swg

5.0 Miscellaneous

5.1 The final connections to the equipment shall be through flexible connections where the equipment is likely to be moved back and forth, such as on slide rails.

5.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 metres away from the main panel.

5.3 Two separate and distinct earthing conduits shall be connected from the equipment upto the main switch board panel.

5.5 All exposed hangers etc. shall be given 2 coats of suitable paint of approved colour, when all work has been completed.

TESTS AT SITE

1.0 General

The contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the architect, in accordance with the provisions of the applicable ASHRAE standards or approved equal and furnish necessary test certificates from manufacturers.

3.0 Ductable Split Type Air Conditioners

3.1 **Blowers**

3.1.1 Identification of material in accordance with test certificates.

3.1.2 Dynamic/static balancing of impeller.

3.1.3 Performance test as per applicable codes.

3.2 **Coils**

3.2.1 Identification of material in accordance with test certificates.

3.2.2 Pneumatic test.

3.3 **Filters**

3.3.1 Manufacturer's test certificates also to be produced for the assembled A.H.U. final dimensional check will be done. Inspection will be done during assembly of components for quality of workmanship, painting etc.

Piping : materials check for specifications and size.

3.4 **Valves**

Hyd./Pneumatic test certificates.

3.5 **Motors**

Manufacturer's test certificate as per motor data sheet.

3.6 **Instruments and Controls**

Visual examination for operation.

4.0 For Associates Works at Site

4.1 All electrical items will be subjected to inspection at any stage during manufacturing activity. Routine electrical test as per relevant codes. Inspection of manufacturer's test certificates.

4.2 Inspection of raw materials to be used for fabrication and assembly and inspection of manufacturer's certificates.

4.3 Inspection of welding including welders qualification as desired by inspection engineers. Inspection of fabricated items.

4.4 Pressure testing of pipe fit used for the refrigerant and water services.

4.5 Pressure testing, leak testing of complete piping network for chilled water. Condenser water and refrigerant/services.

4.6 Vacuumising and gas/oil charging for refrigeration system.

4.7 Checking of electrical circuits (power & controls) and checking functioning of controls of refrigerant systems and other circuits of air conditioning plant.

4.8 Checking of calibration of controls and instrumentation

4.9 Checking of assemblies for electrical control panel, instruments panels, local panels (dimensional and functional) annunciator panels etc.

4.10 Inspection of complete electrical installation at site.
4.11 Installation of main equipments like compressor, condenser, chiller, evaporator.

4.12 Performance testing of complete A/C plant as per specifications.

5.0 The above inspection procedure is given for general guidance and information of vendors and inspection of purchaser/consultant is strictly not limited to these and inspection engineer of purchaser/consultant will have full right to have detailed inspection at any stage right from placement of order to completion of project as desired by inspection engineer, co-ordination of inspection agency of purchaser/consultant with his factory/sub-vendor's factory/erection site will be the sole responsibility of successful vendor after placement of order for complete air conditioning plant covered under these technical specifications.

6.0 Piping System

6.1 In general pressure tests shall be applied to piping only before connection of equipment and appliance. In no case shall piping, equipment or appliances be subjected to pressure exceeding their test ratings.

6.2 Tests shall be completed and approved before any insulation is applied.

6.3 After tests have been completed, the system shall be drained and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fittings, and debris.

7.0 Duct Work

7.1 All branches and outlets shall be tested for air quantity, and the total of the air

quantities shall be within plus five percent (5%) of fan capacity.

7.2 Fire dampers, volume dampers and splitter dampers shall be tested for proper operation.

8.0 Balancing and Adjustment

All air handling ventilation equipment, duct work and outlets shall be adjusted and balanced to deliver the specified air quantities indicated, at each inlet and outlet, on the drawings. If these air quantities cannot be delivered without exceeding the speed range of the sheaves or the available horse power, the architect shall be notified before proceeding with the balancing of air distribution system.

9.0 Electrical Equipment

9.1 All electrical equipment shall be cleaned and adjusted on site before application of power.

9.2 The following tests shall be carried out :

9.2.1 Wire and cable continuity tests.

9.3 Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using a 500 volt meggar. The meggar reading shall be not less than one megohm.

9.4 Earth resistance between conduit system and earth must not exceed half (1/2) chm.

9.5 Phasing out and phase rotation tests.

9.6 Operating tests on all protective relays to prove their correct operation before energising the main equipment.

9.7 Operating tests on all starters, circuit breakers, etc.

10.0 Performance Tests

10.1 The installation as a whole shall be balanced and tested upon completion, and all relevant information, including the following shall be submitted to the architects.

10.1.1 Air volume passing through each unit, duct, grilles, and apertures.

10.1.2 Differential pressure readings across each filter, fan and coil, and through each pump.

10.1.3 Static pressure in each air duct.

10.1.4 Electrical current readings, in amperes of full and average load running, and starting, together with name plate current of each electrical motor.

10.1.5 Continuous recording over a specified period, of ambient wet and dry bulb

temperatures under varying degrees of internal heat loads and use and occupation, in each zone of each part of the building.

10.2 Daily records should be maintained of hourly readings, taken under varying degrees of internal heat load and use and occupation, of wet and dry bulb temperatures, upstream "on-coil" of each cooling coil. Also suction temperatures and pressures for each refrigerating unit. The current and voltage drawn by each machine.

10.3 Any other readings shall be taken which may subsequently be specified by the architect.

11.0 Miscellaneous

11.1 The above tests are mentioned herein for general guidance and information only but not by way of limitation to the provisions of conditions of contract and specification.

11.2 The date of commencement of all tests listed above shall be subject to the approval of the architect, and in accordance with the requirements of this specification.

11.3 The contractor shall supply the skilled staff and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system if the architect requests such a test for determining specified or guaranteed data as given in the specification or on the drawings.

11.4 Any damage resulting from the tests shall be repaired and/or damaged material replaced, all the satisfaction of the architect.

11.5 In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommended after the adjustment or repairs have been completed.

11.6 The contractor must inform the architect when such tests are to be made, giving sufficient notice, in order that the architect or his nominated representative may be present.

11.7 Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the architect.

11.8 The contractor may be required to repeat the test as required, should the ambient conditions at the time not given, in the opinion of the architect, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.

MODE OF MEASUREMENTS

1.0 Unit Prices in the Schedule of Quantities

1.1 The item description in the schedule of quantities is in the form of a condensed resume. The unit price shall be held to include every thing necessary to complete the work covered by this item in accordance with the specifications and drawings. The sum total of all the individual item prices shall represent the total price of the installation ready to be handed over.

1.2 The unit price of the various items shall include the following:

1.2.1 All equipment, machinery, apparatus and materials required as well as the cost of any tests which the consultant may request in addition to the tests generally required to prove quality and performance of equipment.

1.2.2 All the labour required to supply and install the complete installation in accordance with the specifications.

1.2.3 Use of any tools, equipment, machinery, lifting tackle, scaffolding, ladders etc. Required by the contractor to carry out his work.

1.2.4 All the necessary measures to prevent the transmission of vibration.

1.2.5 The necessary material to isolate equipment foundations from the building structure, wherever necessary.

1.2.6 Storage and insurance of all equipment apparatus and materials.

1.3 The contractor's unit price shall include all equipment, apparatus, material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to make in question on its own (and within the system as a whole) complete even though not specifically shown, described or otherwise referred to.

2.0 Measurements of Sheet Metal Ducts, Grilles/Diffusers etc.

2.1 **Sheet Metal Ducts**

2.1.1 All duct measurements shall be taken as per actual outer duct surface area including bends, tees, reducers, collars, vanes & other fittings. Gaskets, nuts, bolts, vibration rotation pads are included in the basic duct items of the BOQ.

2.1.2 The unit of measurements shall be the finished sheet metal surface area in metres squares. No extra shall be allowed for lapse and wastages.

2.1.3 All the guide vanes, deflectors in duct elbows, branches, grille collars quadrant dampers etc. shall be measured for actual sheet metal surface and paid for at the same rate as duct of same thickness.

2.1.4 The unit duct price shall include all the duct hangers and supports, exposing of concrete reinforcement for supports and making good of the same as well as any materials and labour required to complete the duct frame.

2.2 **Grilles/Diffusers**

All grilles/diffusers as per tender requirements shall be treated as a lump sum item. Where extra grilles diffusers are ordered upto award of work, they should be measured as follows:

2.2.1 All measurements of grilles/diffusers shall be the actual neck size excluding the outer flanges.

2.2.2 The square or rectangular grilles/diffusers shall be measured in plain sq.m.

2.2.3 All round diffusers shall be measured by their diameters in cm.

2.2.4 All linear diffusers shall be measured as per actual length in metres.

3.0 Measurements of Piping, Fittings, Valves, Fabricated Items

3.1 Pipe (Including water piping, steam piping, oil piping, lpg gas piping, air piping, vacuum piping) etc.

3.1.1 All pipes shall be measured in linear metre (to the nearest cm) along the axis of the pipes and rates shall be inclusive of all fittings e.g. tees, bends, reducers, elbows etc. deduction shall be made for valves in the line.

3.1.2 Exposing reinforcement in wall and ceiling and floors of possible and making good the same or installing anchor fasteners and inclusive of all items as specified in specifications and schedule of quantities.

3.1.3 Rates quoted shall be inclusive of providing and fixing vibration pads and wooden pieces, wherever specified or required by the project co-ordinator.

3.1.4 Flexible connections, wherever required or specified shall be measured as part of straight length of same diameter, with no additional allowance being made for providing the same.

3.1.5 The length of the pipe for the purpose of payment will be taken through the centreline of the pipe and all fittings (e.g. tees, bends, reducers, elbows, etc.) as through the fittings are also presumed to be pipe lengths. Nothing extra whatsoever will be paid for over and above for the fittings for valves and flanges, section 3.2 below applies.

3.2 **Valves and Flanges**

3.2.1 All the extra ci & cm flanged valves shall be measured according to the nominal size in mm and shall be measured by number. Such valves shall not be counted as part of pipe length hence deduction in pipe length will be made wherever valves occur.

3.2.2 All gun metal (gate & globe) valves shall include two Nos. of flanges and two

numbers 150 mm long ms nipples, with one side threaded matching one of the valves, and other welded to the M.S. slip-on-flange. Rate shall also include the necessary number of bolts, nuts and washers, 3 mm thick insertion gasket of required temp. grade and all items specified in the specifications.

3.2.3 The rates quoted shall be inclusive of making connections to the equipment, tanks, pumps etc. and the connection made with an installed pipe line shall be included in the rates as per the B.O.Q.

3.3 **Structural Supports**

Structural supports including supports fabricated from pipe lengths for pipes shall be measured as part of pipe line and hence no separate payment will be made. Rates shall be inclusive of hoisting, cutting, jointing, welding, cutting of holes and chases in walls, slabs or floors, painting supports and other items as described in specifications, drawings and schedule of quantities or as required at site by project co-ordinator.

3.4 **Copper Connections for Fan Coil Units**

3.4.1 Copper connection assembly for making connections to the fan coil units shall be measured, as part of the fan coil unit price and shall include brass flare nuts, brass straight connector, brass tees, brass reducing fittings, fixing of automatic 3 way valve, making connections and leak testing, complete assembly as per specifications and drawings. Nothing extra shall be payable on account of any variation in the length of copper pipe.

4.0 Insulation

4.1 The measurement for vessels, piping, and ducts shall be made over the bare uninsulated surface area of the metal.

4.2 **Pipes, Ducts & Vessels**

4.2.1 **Pipes**

The measurements for installation of piping shall be made in linear metres through all valves, flanges, and fittings. Pipes/bends shall be measured along the centre line radius between tangent points. If the outer radius is r1 and the inner radius is r2 the centre line radius shall be measured as (r1+r2)/2. Measurement of all valves, flanges and fittings shall be measured with the running metre of pipe line as if they are also pipe lengths. Nothing extra over the above shall be payable for insulation over valves, flanges and fittings in pipe line/ routings. Fittings that connect two or more different sizes of pipe shall be measured.

4.2.2 **Ducts**

The measurements for insulation of ducts shall be made in actual square metres of bare uninsulated duct surface through all dampers, flanges and fittings. In case of bends the area shall be worked out by taking an average of inner and outer lengths of the bends. Measurements for the dampers, flanges, fittings shall be for the surface

dimension for the connecting duct, nothing extra over the above shall be payable for insulation over dampers, flanges and fittings in duct routing.

4.2.3 **Vessels**

The area of standard dished and flat ends of vessels shall be the square of the diameter of the uninsulated body of the shell. Areas for other shapes shall be the actual calculated area. There shall be no deduction or additions for nozzles, handles ribs, dampers, expansion joints etc. All projections on vessels or tanks shall be measured separately as pipe/duct.

4.3 Accessories Insulation

4.3.1 The unit of measurement for accessories such as expansion tank, pumps, chiller heads etc. shall be uninsulated are in square metres.

4.3.2 In case of curved or irregular surfaces, measurements shall be taken along the curves.

4.3.3 The unit insulation price shall include all necessary adhesives, vapour proofing and finishing materials as well as additional labour and material required for fixing the insulation.

4.4 Acoustic Duct Lining

4.4.1 In case of acoustic lining of air ducts, measurements of the bare inside duct surface in square metres shall be final for billing purposes.

4.4.2 The insulation/acoustic panels shall include cost of battens, supports, adhesives, vapour proofing, finished tiles/boards/sheets as well as additional labour and materials required for completing the work.

LIST OF APPROVED MAKES AND MANUFACTURERS

The subcontractors/makes/brands of equipment listed below are approved for installation.

All items to be used in the works samples, catalogues and specifications are to be submitted by the contractor for approval of the Engineer. Only approved makes shall be used in the works. The approved samples shall be kept in the custody of the Engineer for comparison.

S.No	Material/Item	Approved Makes
	HVAC Subcontractors	**Voltas/ETA/Blue Star/Sterling & Wilson/Unique Engineers/Suvidha**
	High Side Equipment	
1	Centrifugal Chilling Units with VFD (ARI Certified)	Carrier/Trane/York/Daikin-Macquay
2	Screw chiller (ARI Certified)	Carrier/Trane/York/Danhum bush / Mcquay
3	Scroll Chiller	Carrier/Trane/York/Danhum bush / Mcquay/Voltas/Bluestar
4	Primary CHW/Cond Pumps(End suction back pullout)	ITT/Grundfoss/Armstrong/wilo/Mather & Platt
5	Pumps Monoblock	Kirloskar/Beacon/Siemens/KSB/Greaves
6	Pumps Coupled with VFD	ITT / Bell & Goset / Grundfos/ Wilo
7	VFD with controls	ITT/Danfoss
8	Cooling Towers(CTI Approved)	Paharpur/Bell/Mihir/Marley/Advance
9	Electric hot water generator	Rapid cool/ Emerald/ Khokar
	Air Handling Units	
10	Air Handling Units (High Static) with cooling coils	Carrier/Caryaire/Blue-star/ZECO/Saiver/Voltas/VTS/Flaktwood
11	Centrifugal Fan for AHU's	Nicotra/Comefri/Flakt/Kruger
12	VFD for AHU	Danfoss/Siemens/Allen Bradley/ABB
13	Ultra Violet Germicidal Irradiation/PHI	Ruks/Trimed/RGF
14	Fan Coil Units	Blue Star/Carrier/Zeco/Voltas/Daikin
15	Air washer	Ambassador/Humidin/ Roots Cooling
16	Scrubber(Wet/Dry)	Same as AHU/Espair/Peema/Trion/Thermax
17	Humidifier	Rapid cool/Emerald/Khokar
18	Fan section	Same as AHU
19	2 Stage Air washer	Ambassador/Humidin/ Roots Cooling

20	Centrifugal /Axial Flow Fans/Tube Axial	GEC/ Swent / Flakt/Nadi / Divine/Nicotra/Comefri/ Kruger
21	Propeller Fans	GEC(Alsthom)/Crompton Greaves/ Khaitan/Usha/Polar
22	Precision AC units	Emerson/Blue box/Stulz/Hiross
23	Window/split AC	Carrier /Hitachi/Voltas/Bluestar/Daikin/Ogeneral
24	VRV/VRF	Carrier /Hitachi/Daikin/Ogeneral
25	Cassette Units-Chilled water based	Daikin/ETA/Media/Bluestar
26	Inline Fans	Flakt/Nicotra/Comefri/ Kruger/System Air/Ostberg
27	Heat recovery unit complete with Heat recovery wheel	Flaktwoods/Novelaire/DRI/Greenheck
28	Heat recovery heat pipes	SPC
29	Heat Exchanger	Heatx X,Mark,Alfa lavel
30	Thermal storage tank	Crystopia,Dynambush,Calmac
31	Deep Freezer	Voltas/Bluestar
	Electrical Equipment	
32	Electric Panel	As per Electricals
33	AHU/ventilation electrical panels	As per Electricals
34	Electric Motors	Siemens/Kirloskar/ABB/ Bharat Bijlee/Crompton Greaves.
35	MCB	Merlin Gerin, Legrand,Hager,Seimens,ABB/MDS Lexic
36	Earthing	JMV or as per CPWD specs.
37	MCCB/ACB	L&T/ GE Power/ Siemens/ ABB
38	Push button starter	L&T/ GE Power/ Siemens/ ABB
39	Auxiliary Relays/Contactors	L&T/GE/ Siemens/ Schneider
40	Line Type Fuse	L&T/GE/ Siemens/ Schneider
41	Timer	Siemens/Cutler Hammer/ GEC Alsthom
42	Terminal Block	Elmex/ Comex/ HMI
43	Voltmeter/Ammeter	L&T/GE/ Siemens/ Schneider
44	Indicating lamps	L&T/GE/ Siemens/ Schneider
45	Selector Switches	Siemens/L&T/Kaycee/GE
46	Change Over Switch	Siemens/L&T/HH Elcon/ Socomech/ HPL
47	CT/PT	L&T/GE/ Siemens/ Schneider
	Cables	
48	Control Cables	CCI/Universal/ICC/NICCO/INCAB/ National/Rallison Cables/Tyco/Finolex
49	Power Cables	CCI/Universal/ICC/Finolex/INCAB/Rallison Cables/Polycab/RPG/Havels

50	Cable tray	Steelways,Bharti,MM.Engg,Asian ancillaries,Dolphin,MEM
51	Cable lugs	Dowells/Lotus/PEECO
52	Ducting & Grilles	
53	Factory fabricated duct	Zeco/ Ductofab/Rolastar/Technofab
54	Motorised smoke & Fire Dampers motors	
55	G.I. Sheet Metal Duct	Jindal /National/ Tata/Sail
56	Spiral duct	Atco/Seven Star
57	Grilles/Diffusers/Volume Controller	Ravistar/Caryaire/ Mapro/Dynacraft/Airmaster
58	Fire Dampers UL listed	Caryaire/Dynacraft / Ravistar/Ruskin
59	Sound Attenuator	Caryaire/Dynacraft/Ravistar/Trox
60	G.I. Sheets	TATA/SAIL/Jindal/Bhushan Steel
61	Aluminium Sheets	Balco/Nalco/Hindalco
62	Stick Pins	Prima Seal/Air flow
	Pipes	
63	G.I.	ITC/ Jindal Hissar/Tata/SAIL/HSL/Mukut(above 500mm)
64	M.S. upto 150 mm	ITC/ Jindal Hissar/Tata/SAIL/HSL/Mukut(above 500mm)
65	M.S. 200 mm and above dia factory rolled	ITC/ Jindal Hissar/Tata/SAIL/HSL/Mukut(above 500mm)
	Valves	
66	Butterfly Valves	Advance/Audco
67	Motorised butterfly valve(actuator)	Belimo/Honeywell/Invensys/siemens
68	Non Return Valve	Advance/Kirloskar/Audco
69	Balancing Valves	Advance/Audco/Danfoss/Honeywell
70	Gate/Globe Valves	Leader/Divine/Sant/Bankim Sarkar /Zoloto
71	GM valve upto 40mm	Leader/Divine/Sant/Bankim Sarkar /Zoloto
72	Ball Valve with Y strainer	Rapid Control/Sant/Leader/Zoloto
73	Pressure independent Balancing valve	Danfoss/Flowcon/TA
	Accessories	
74	Pot & Y-strainer	Emerald/Sant/Rapid cool
75	Pressure Gauge	Fiebig/Emerald/H Guru/Japsin
76	Thermometer	Fiebig/Emerald/H Guru/Japsin
77	Dial Thermometer(capillary Type)	
78	Flow Switch	Rapid Control/Anergy
79	Automatic Air Vent	Rapid Control/Anergy
80	Suction Guide	Anergy/ Rapid Control/Flowcon
81	Air Filters	

82	Filters(pre,fine Hepa)	Thermadyne/Spectrum/Kirloskar /Anfilco/Johnflower/Dynafilter
	Insulation	
83	Expanded Polystyrene	Beardsell Ltd./ BASF/Styrene Packing/ Indian Packaging Industries/ Lloyd
84	Glass Wool	FGP Ltd./UP Twiga/Kimmco / Owens Corning
85	Polyurethene Foam	Malanpur /Superurethane
86	Crossed linked Polyethylene Foam	Trocellene / Aeroflex/Armacell/
87	Closed Cell Elastomeric Insulation	K-flex /Vedoflex/Armacell
88	Non woven fibre material	Mikron/ Du pont
89	Mineral wool	Rockwool India Pvt Ltd,
90	Premoulded PUF section for pipe & pipe supports	Malanpur/ Lloyd
91	Fibreglass rigid Board/Pipe section	FGP Ltd./UP Twiga/Kimmco / Owens Corning
92	Aluminium Tape	Johnson/Birla 3M/Garware
93	Expansion tank(pressurized) and Air Separator	Anergy/Grundfoss/ITT
94	Bellows	Dunlop/Kanwal/Resistoflex
95	2/3-Way motorized valve for AHU	Stafea/Johnson control/Honeywell/Danfoss/Siemens/Belimo/Oventrop/Invensys
96	2/3-Way motorized valve for FCU	Stafea/Johnson control/Honeywell/Danfoss/Siemens/Belimo/Oventrop/Invensys
97	Thermostats	Honeywell/Johnson controls/Belimo/Danfoss/Siemens/Oventrop
98	Humidistat	Honeywell/Johnson control/ Belimo/Danfoss
99	Electric Strip Heaters	Escorts/Daspass
100	Safety Thermostat for Heaters	Honeywell/siemens/Danfoss/Belimo
101	Cooling/heating Mode Changer	Honeywell/siemens/Danfoss/Belimo
	Paints	
102	Enamel	ICI/ Asian/ Nerolac/ Berger
103	Bituminus	Shalimar
104	Tarfelt (for underground chilled water pipe insulation)	Shalimar
105	IBMS Approved vendor	Siemens/Honeywell/Johnson controls/ABB/Schneider
106	DDC Controllers	Siemens/Honeywell/Johnson controls/ABB/Schneider

107	Sensors(Pressure/Temperature)	Siemens/Honeywell/Johnson controls/ABB/Schneider
108	VAV	Trane/Trox/johnson Control/carryaire/Belimo
109	Airflow Switch (Air & water)	Johnson control/Honeywell/Siemens
	Miscellaneous	
110	V Belt	Dunlop/Fenner
111	Anchor fastners	Fischer/Hilti
112	Dash fastner	Fischer/Hilti
113	Welding rods	Advani/L&T
114	Wire Rope duct supporting arrangement	Gripple
115	Flexible pipe connection	Dunlop/Kanwal/resistoflex
116	Hessian Cloth (fire rated)	Navair/Pyrogaurd
117	Vibration isolator	Resistoflex, Dunlup, Kanwal
118	Air Ozone	Ruks/Trimed/RGF
119	Fire Sealant	Birla 3M/Hilti/Promat
120	On-line non-chemical water treatment system	Scale Guard of Aqua Treat Pvt. Ltd./ Crystallo of D- Borne Engineers/ Scaloid of TBI System
121	Copper Refrigerant Piping	Diamond/Star/Rajco

END OF VOLUME - IV