CHHATTISGARH MEDICAL SERVICES CORPORATION LIMITED

(Government of Chhattisgarh)

Tender

For

Construction of District Drug Warehouse at Janjgir (C.G.), under National Rural Health Mission scheme

TECHNICAL SPECIFICATIONS

VOLUME-IV

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Tender No. HSCC/NRHM/CG./2014 (VI) /07

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.

2.0 CHEMICAL RESISTANT EPOXY RESIN WALL COATING

MATERIAL

The system shall consist of 2 component solvent free, epoxy based, chemical resistant coating. The thickness of the coating shall be between 300 microns depending on the number of coats. The application of primer and coating is to be done as per the manufacturer's specifications.

a. A coat of primer shall be applied over clean, dry surface:

b. While the primer coat is tack-free, two topcoats of epoxy shall be applied:

APPLICATION/LAYING PROCEDURE

The surface should be properly cleaned and should be free from oil, grease, cement laitance and dust. The surface should be free from potholes, honeycombing, potholes & cavities. If defects are found, the surface should be prepared to a smooth finish.

The surface should be primed using epoxy primer Allow the primer to dry overnight so that it is track-free.

Top coat of epoxy should be applied in two coats to a thickness of 300 microns. The first coat should be allowed to become tack free before the second coat is applied.

The system should be air cured for a minimum period of 5 to 7 days to achieve the best results against loading & chemical resistance.

3.00 WATER PROOFING TREATMENT BY CHEMICAL INJECTION SYSTEM (PRECONSTRUCTION)

3.01 HORIZONTAL SURFACE (RAFT SLAB)

A. Before the raft reinforcement is placed in position:

1.1 Laying PCC as per drawings and specifications.(payable under the corresponding item)

1.2 Cement slurry (cement and polymer based water proofing compound) is spread on the PCC for proper bonding with subsequent water proofing treatment.

1.3 Water Proofing Course of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with polymer based water proofing compound is laid over the slurry. Stone aggregates 12mm down is embedded at random.

1.4 After 24 hours, spreading cement slurry (cement and polymer based water proofing compound) on the 1st layer of mortar.

1.5 Providing and laying 2nd layer of 20mm thick cement mortar 1:4 mixed with polymer based water proofing compound. Stone aggregate 12mm down is embedded at random.

1.6 After curing for two days, spread cement slurry mixed with water proofing compound over the 2nd layer of cement mortar. Thereafter, the 3rd and final layer of 20mm thick cement mortar in 1:4 mixed with water proofing compound is laid and finished smooth to receive raft foundation.

1.7 The total thickness of the treatment from operation 1.2 to 1.6 will be about 60mm.

B. After The reinforcement of raft is placed in position:

2.1 Providing and fixing 25mm dia GI threaded grouting nozzles of adequate length at the specified locations @ 1.50 metre c/c or as shown in the drawing all over the slab. The grouting nozzles are tied with reinforcement in such a manner as not to choke its end during concrete operations. The top of these nozzles protrudes above the raft concrete.

2.2 After minimum 7 days of concreting, cement grout of cement and polymer based water proofing compound (non shrinkage grouting compound) in proportion as specified is injected, through these nozzles at the pressure of 2.5 to 3.0 Kg/Sq.cm.

2.3 After grouting, top of the nozzles is cut and the space is filled with cement mortar 1:2 (1 cement: 2 coarse sand) mixed with polymer based water proofing compound.

3.02 Retaining Wall

1.1 The external surface is prepared and polymer based cement slurry is applied.

1.2 Providing and laying 25mm thick cement mortar in 1:4 (1 cement : 4 coarse sand) mixed with polymer based water proofing compound in two layers with chicken wire mesh 26 or 24 gauge 25mm size in between the two layers.

1.3 The G.I. pipes are placed at 1.5m c/c and at location indicated as per drawing and securely fastened to the reinforcement prior to shuttering and concreting or alternately by drilling holes (25mm to 32mm dia) in the concrete upto a depth as shown in the drawing all over the wall surface @ 1.50mt. c/c and as shown in the drawing. Treatment along all construction joints by providing nozzles, as above, shall also be executed.

1.4 Fixing 25mm dia G.I. threaded nozzles in these holes with cement mortar 1:4 mixed with water proofing compound.

1.5 Injecting cement grout of cement and polymer based water proofing compound (non shrinkage grouting compound) in proportion as specified in these nozzles at a pressure of 2.5 to 3.0 Kg/Sq.cm.

1.6 After the grout the nozzles are cut and filled with cement mortar 1:2 mixed with polymer based water proofing compound in proportion as specified and finished smooth.

Note: The proportion of acrylic based polymer compound to be used in respect of ordinary cement shall be 1% by weight.

Acrylic based integral water proof compound shall satisfy the provision IS: 2645.

Guarantee for water proofing:

Work to be get executed through a approved specialized agency & covered by a 10 years guarantee by the main contractor against leakage, seepage and dampness etc. for which necessary performance guarantee for requisite indicated value of work shall be furnished by the contractor before completion.

Measurements:

The length and breath shall be measured correct to cm. The flooring area shall be measured in sq.m. actually executed in raft slab. Inside wall surfaces of the basement upto ground level from top of raft slab shall be measured in sq.m.

Columns cross sections area not to be deducted from the plan area.

Rate:
Rates shall be inclusive of all operations including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.

4.00 ALUMINIUM COMPOSITE PANEL METAL CLADDING

4.01 Scope of Work

The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium composite panel cladding, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description.

The scope of work shall be read in conjunction with those in the specification of curtain walling.

4.02 Design Concept

a) The proposed cladding shall be based on a water-tight system.

b) A 20mm wide joint shall be provided between cladding elements to cater for individual panel installation and shall be sealed off with extruded EPDM gasket or silicon sealant.

4.03 Aluminium Composite Panel Cladding

Providing, designing, cutting, bending and fixing 4mm thick aluminium composite cladding of approved make on external façade of size as shown with Water tight system either curved or straight in plan. Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene, aluminium cladding panel to be of approved colour/shade fixed with extruded aluminium basic frame, angle cleats, weather sealants, rivets, GI brackets all as approved, using suitable chemical/anchor bolts on structural steel work including necessary accessories complete in all respects. Where level difference is shown dummy structural steel backup frame shall be provided. Protective Film: The finished surface shall be protected with 80 microns self adhesive Peel Off film with two layers of white and black tested to withstand at least 6 months exposure to local weather condition, without loosing the original peel off characteristic or causing stains or other damages.

The quoted rate to include for any provision of openable access panels for services wherever required. Weather silicon sealant, non streaking /staining weather sealant shall also be used wherever required.

Technical Data

A.	Composition	Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene.
B.	Dimensions	Panel thickness : 4mm Panel size: Width 1000/1250/1500mm

		Length between 1500 and 5000mm Tolerance Width ± 2.0mm Length ± 4.0mm Thickness + 0.02mm
C.	Principal Properties	Panel weight: 5.5 kg/sq.m Thermal expansion: 1mm/M/60 deg.C.
D.	Acoustic Properties	Average airborne sound transmission loss 26 db.
E.	Mechanical Properties	Tensile Strength RM> 160 MPa. 0.2% Proof stress RP> 130 MPa. Modulus of Elasticity E 70,000 MPa. Elongation A-50 – 5-7%
	Aluminium Extrusions	Extrusions shall be of aluminium alloy 6063 T5, conforming to BS-1470 – 1475 : 1972 in mill finish.

4.03.1 **Design Wind Loading**

850 N/m2 positive and negative to Podium.
1150 N/m2 positive and negative to Tower.
1500 N/m2 positive and negative to Crown to Tower.

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified.

4.03.2 Deflection

Deflection of any aluminium frame shall not exceeding 1/175 of the clear span.

4.03.3 Expansion and Contraction

The cladding shall be so fabricated and erected as to provide for all expansion and contraction of the components. Any temperature change due to climatic conditions shall not cause harmful buckling, opening of joints, undue stress on fastening and anchors, noise of any kind or other defects.

4.03.4 Flatness

The cladding surface taken individually shall not have any irregularities such as oil canning, waves, buckles and other imperfections when viewed at any position but not less than at an angle of 15 degrees to the true plane of the panel with natural lighting of incident of not less than the same angle.

4.03.5 Water Tightness

The panel cladding shall be so constructed to be water tight with provision for rear ventilation.

4.03.6 Acoustic Treatment

The cladding panel system shall be designed so as to dampen noise caused by splashing water.

4.04 Fixings

a) Fastners including concealed screws, nuts, bolts and other items required for connecting aluminium to aluminium shall be of non-magnetic stainless steel.

b) Rivets used for fastening panel to aluminium sub-frame shall be of alloy aluminium large flange head type with stainless steel mandrel.

c) All fixing anchors, brackets and similar attachments used in the erection shall be of aluminium or non-magnetic stainless steel.

4.05 Weather seal

a) All exposed joints between panel which require to be water tight shall be sealed with extruded EPDM gasket of hardness approx. 75 SHORE.

b) All secondary weather seal shall be of self-adhesive tape as approved by Architects.

5. 00 STUCTURAL/CURTAIN WALL SYSTEM

5.01 **SCOPE OF WORK**

A. The contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete curtain wall/structural glazing system to the proposed building, all in conformity with the Drawings as shown. Specification and all relevant construction regulations including providing any measures that may be required to that end, not withstanding any omissions or inadequacies of the Drawings and/or

Without limiting the generalities of the foregoing, the Curtain Wall/structural glazing Systems shall include, without being limited to, the followings:

Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings metal closure, windows etc.

All anchors, attachments, reinforcement and steel reinforcing for the systems required for the complete installations.

All thermal insulation associated with the system.

All fire protection associated with the system.

All copings, end closure and metal cladding to complete the system.

All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.

Isolation of dissimilar metals and moving parts.

Anticorrosive treatment on all metals used in the system.

Polyester powder coating aluminium sections.

B. The contractor shall also be responsible for providing the followings:

1. Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the Curtain Wall/structural glazing System.

2. Scheduling and Monitoring of the Work.

3. Mock-ups, samples and test units.

4. Performance Testing of the Curtain Wall/structural glazing framing and glazing assembly.

5. Co-ordination with work of other trades.

6. Protection.

7. All final exterior and interior cleaning and finishing of the Curtain Wall /structural glazing System

8. As-built record drawings and photographs.

9. Guarantees and Warranties.

10. All hoisting, staging and temporary services.

11. Conceptualising and design of a suitable maintenance system for curtain/structural glazing.

C. The water tightness and structural stability of the whole Curtain Wall /structural glazing System are the prime responsibility of the Contractor. Any defect or leakage found within the Guarantee Period shall be sealed and made good all at the expense of the Contractor.

D. The curtain wall/structural glazing system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects. Specific details should be designed to accommodate thermal and building movements.

5.02 BUILDING REGULATIONS

Curtain Wall/structural glazing shall comply with all Government Codes and Regulations including IS codes, if any.

All curtain walling/structural glazing, individual aluminium and glass components and all completed work shall be designed and erected to comply with the following:

a) Design load and deflection.

i) Curtain Wall/structural glazing construction in its entirety shall be fabricated and erected to withstand without damage or permanent deformation inward (positive) and outwards (negative) pressure, all acting normal to the construction plane with a maximum deflection of not exceeding 1/175 of the clear span between structural support or 20mm maximum whichever is less.

ii) Structural performance of all parts of curtain wall/structural glazing system shall conform to relevant IS codes, wind load as per IS-875 and seismic loads as per IS-1893. Deflection shall cause no permanent set in excess of 1/1000 of span nor evidence of structure failure.

5.03 MEASUREMENTS

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

5.04 RATE

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

5.05 TENDER DRAWINGS AND SPECIFICATIONS

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

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

5.06 POST TENDER REQUIREMENTS

a) Design Proposals

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

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

i) Request details as indicated on the tender drawings.

ii) Metal quality, finishes and thickness.

iii) Glass quality, coating and thickness and proposed manufacturer’s brand names.

iv) Sections of the mullion and transom together with structural calculations.

v) Arrangement and jointing of components.

vi) Field connections especially mullion to mullion and transom to mullion.

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

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

ix) Provisions for thermal movements.

x) Sealant and sealing method.

xi) Glazing method.

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

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

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

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

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

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

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

b) Samples

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

c) Preliminary Programme

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

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

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

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

5.07 EXECUTION

Performance Testing

a) General Requirements

Mock-up units shall be constructed by the contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the façade.

After approval of structural calculations and shop drawings for the curtain wall/structural glazing, one (1) Test Unit for performance testing of the curtain wall/structural glazing shall be constructed by the contractor at a laboratory approved by the Department.

Erect mock-up under manufacturer's/installer's direct supervision and employ workmen as they would be employed during the actual erection at the job site.

Test procedures test schedules and test locations shall be submitted to Client for approval before testing.

Prior to fabrication of Test Units, the contractor shall submit shop drawings and calculations of the Test Unit for the Architect's approval.

Production for final job site erection shall not start until approval has been obtained as a result of the mock-up test.

b) Test of Wind Pressure

The equivalent load of wind pressure or wind suction shall be given to the Test Unit as increasing or decreasing the inside pressure in the 'Pressure Chamber' at which the Test Unit is fixed.

The static wind pressure shall be applied up to 1.5 Kpa at maximum wind pressure.

The variation of dynamic pressure shall be of any approximate sine-cure-line.

Deflection on each observational points of the Test Unit shall be observed and recorded under the Static pressure as described above.

Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

The deflection on the main structural parts in these conditions shall not exceed:

1/175 of the span between supports or 20mm, whichever is the lesser for vertical elements.

1/250 of the span between supports for horizontal elements.

The extent of recovery of deformation 15 minutes after the removal of the test load is to be least 95%.

c) Test of Lateral Deflection Per Floor Height

Lateral deflection per floor height shall be occurred on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

The deflection of every + 2.5mm shall be increased upto + 13mmm on the Test Unit (Static Deflection Test).

The dynamic deflection shall be applied upto + 13mm.

The variation of dynamic deflection shall be of an approximate sine-curve-line, one period of 3 seconds.

The dimension of the deflection on each observational points of the Test Unit shall be measured under the condition as described above, the damage shall be observed.

Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall/structural glazing except sealant at maximum deflection.

d) Test of Water-tightness

Water shall be sprinkled to the Test Unit under the wind pressure.

Pressure shall not be applied to the Test Unit.

The volume of the sprinkling water in one minute shall be 5 litres/m2 min. (0.1 gal/sq/ft.).

All water leakage and drainage system at the joint and openable sash of the curtain wall/structural glazing system shall be observed from the outside of the chamber.

Hold the test 2 times, in sequence as described below, conforming to the above mentioned conditions.

Install the test unit.
Hold Ist water-tightness test.
Hold test of wind pressure as described above.
Host 2nd water-tightness test.
Lateral deflection test.

Water leakage at all parts of the Test Unit shall not be observed inside during the Ist water-tightness test.

e) Test Report

The Contractor is required to submit five (5) copies of test reports to the Client.

f) Cost of Performance Test

The Contractor shall allow in his tender for the cost of the performance testing and of fabrication, erection, corrections to and demolition of the Test Units including any special provision required in the testing laboratory for the tests mentioned above.

The Contractor shall allow for amendments and adjustments to the mock-up as required by the Employer.

If the Test Unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the Test Unit and shall have to get the Test Unit retested by the Testing Laboratory till it passes the tests.

Cost of corrections to the Test Unit and cost of re-testing shall be borne by the Contractor at no additional cost to the Employer.

g) Shop Drawings and Calculations for the Performance Testing

Prior to fabrication of Test Unit, the Contractor shall submit shop drawings and calculations of the Test Unit for Client/employer`s approval.

h) Record Drawings

The testing laboratory shall keep copy of approved Test Unit shop drawings and calculations at testing laboratory during testing of Test Unit.

The testing laboratory shall accurately and neatly record on the above mentioned shop drawings all changes, revisions, modification etc. made to Test Unit, which shall become the record drawings.

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the Client.

i) Contractor’s Representatives

Full time attendance by Approved Representatives of the Contractor & subcontractor associated with the erection of curtain wall/structural glazing shall be provided for the erection of the Test Unit and for all testing of the Test Unit.

5.08 PERFORMANCE GUARANTEE

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

6.0 ACOUSTIC CELING

6.1 The acoustic tiles shall be procured from an approved manufacturer as directed by Engineer-In-Charge.

6.2 The tiles and the suspension system shall be as specified in the item nomenclature .The Contractor shall prepare the shop drawings for the False Ceiling based on actual measurements at site and based on the architectural drawings, clearly indicating the typical panel as well as edge panel on all sides with details to adjust

the minor variations in orthogonal. Also, junction details with different types of false ceiling materials shall be prepared and submitted for the approval of the Engineer-in-Charge before execution.

6.3 The installation shall be got done through a reputed interior contractor who shall be engaged by the Contractor. The false ceiling shall be perfectly level after installation.

6.4 The Contractor shall then prepare the mock-up at site for approval of material and quality of workmanship by the Engineer-in-Charge. Only after the approval of Mock-up, the Contractor shall start the mass work.

6.5 The acoustic tiles shall be of size 600x600 mm or as required as per the architectural drawings and as per the site requirements and shall be of the texture and physical & other characteristics as per approved brand. The tiles shall have NRC, humidity resistence, light reflectance, thermal conductivity and other properties as described in the BOQ item. The contractor shall obtain and submit to the Department the manufacturer's certificate for compliance of the acoustic tiles & the suspension system as per the manufacturer's specifications and also copy of the manufacturer's test report for the record.

6.6 The tiles shall be made of non -combustible bio-soluble wool and shall have finely granulated surface texture with virtually invisible micro-perforations as specified & as required for its performance. It shall meet the various performance parameters like aesthetics, acoustics (sound absorption), hygiene, humidity resistance, impact resistance, fire resistance, durability etc.

6.7 The tiles shall have precisely machined edges including edge treatment required for the installation depending on the type of suspension system grid of brand and manufacture as approved by the Engineer-in-Charge / Consultant and as per the architectural drawings. The openings of required size for light fittings; fire detection devices, sprinklers, AC diffusers etc. shall be suitably made in the tiles by cutting in an approved and workmanlike manner. For the purpose of measurement, no deduction shall be made in the area of false ceiling on this account. Also, nothing extra shall be payable on this account. The end tiles shall be cut to the required size in a workman like manner as per the site requirement. Nothing extra shall be payable on account of any wastage in the material and /or account of providing grid at closure spacing than 600mm c/c.

6.8 These tiles shall be fixed on to coordinated suspension ceiling system with supporting grids system that fully integrates with the ceiling tiles. It shall be ensured that the suspension system shall be suitable to take the entire incidental and dead loads and other authorized loads efficiently and shall not sag .The permissible sag shall be as per the British Standards BS 8290 - 1991. The Contractor shall provide a guarantee for 10 years against sag on account of defective material and / or workmanship.

6.9 The suspension system shall consist of hangers, main runners, cross tees, perimeter trims, wall connectors etc. The hangers shall be securely fixed to the structural soffit/slab/beams at spacing not more than 1200mm centre to centre by using electroplated Galvanized M.S anchor fasteners of 6 mm (minimum) diameter of approved make and of adequate capacity to carry the design loads. The main runners shall be fixed at spacing not more than 600mm centre to centre. The last hanger at the end of each main runner shall not be placed more than 450 mm from the adjacent walls. Additional hangers shall be placed at a distance not more than

150 mm from the joint in the main runner on either side. The cross tees 600 mm long shall be centrally inter-locked between main runners to form 600 X 600 mm modules. The main runners shall have central notches to accommodate mitered joint of 600 mm long cross tees.

Additional runners and hangers shall be provided where change of direction is required as per the site conditions. All the hangers, runners, tees, cleats, brackets etc. required for fixing the false ceiling suspension system shall be of anti-corrosive hot dipped galvanized M.S sections with zinc coating not less than 170 gms per sq.m and shall be as per BS 2989. The Galvanized M.S runners, cross tees, perimeter trims/ edge profile etc. shall be powder/coil coated (the coating as per the manufacturer's specifications) matt finished, of required colour and shade. The cross tees shall be connected to the main runner by stab and hook type (clip in) installation. The runners and cross tees shall have mechanical stitching for enhanced torsional resistance and shall have mitred inter-section. Further, the grid system with main runners and the cross tees shall have 15 mm wide flanges with a 6 mm central recess with reveal profile, with colour all white with black or white reveal of brand as approved by the Engineer-in-Charge / Consultant. The hangers shall be mechanically pre-straightened and shall not be less than 4 mm diameter and of lengths as required for keeping minimum plenum depth as per the architectural drawings. It shall be suitably cut / tied off. The stainless steel level adjuster clips (spring steel, butter fly clips having suitable number and diameter of machine punched holes and bent to required profile) shall be provided on the hangers to achieve the level ceiling. The suspension hangers shall be vertical or near to vertical as far as possible. The hangers shall be suitably designed not to have distributed load more than 12.5 kg. per sq.m and shall have capacity to take incidental loads of fixtures, suspended signages etc. within the tolerance limit of deflection as specified in BS 8290. Providing additional hangers if any, may accommodate increased load.

6.10 The contractor shall ensure that the grid system is designed and installed to carry all incidental loads and no other unauthorized load shall be transferred to this system. The luminaries, air grills / diffusers, signage etc. shall be as far as possible independently supported to avoid any over loading of the ceiling system which may result in excessive deflection or twisting of grids. Any strengthening of grid system by providing additional hangers, fasteners, runners, cross tees etc. or providing additional bracing may be carried out as required for any specific locations or for specific purpose for which nothing extra shall be payable. Perimeter trims / edge profiles of required size and shape, powder/coil coated to required colour and shade, shall be installed at the suspension grid perimeter to completely enclose the ceiling and shall be properly secured to the walls at not more than 450 mm centre to centre using stainless steel screws and PVC sleeves. It shall be neatly jointed at all external and internal angles and over lap sections in a workman like manner with mitered joints.

6.11 The ceiling should be set out such that the perimeter boards or tiles are in excess of half a module so that the edge panels on both the sides are of equal sizes as far as possible. The tiles shall be cut to required size and shape with rebates as specified using hand tools or mechanically operated tools in a workman like manner but with all precautions as per the manufacturer's specifications regarding generation of dust and ventilation.

6.12 The contractor shall ensure that the material is procured and delivered at installation site without any damage. Adequate care shall be taken before installation as well as afterwards till handing over the building for occupation. It shall be protected from

rains, excessive humidity, chemical fumes, vibrations, dust etc. The contractor shall ensure careful handling and storage and prevent any rough handling, rolling of cartons or dropping cartons to prevent any edge damage or breakage. Any tile with edge damaged or crack etc. shall not be allowed to be used in the work and shall be replaced by the contractor at his own cost. Similarly, adequate care shall be taken by the contractor while placing or removing and handling the tiles so as not to cause any damage. Also, the contractor shall direct his interior contractors to take adequate precautions to prevent the tiles from any dirt, fingerprints, any other marks / splashes etc. The ceiling shall not be wet cleaned. Abrasive cleaners shall not be used to clean the marks.

6.13 The item of false ceiling includes cost of all inputs of labour, materials, wastage if any, T&P, scaffolding, staging or any other temporary enabling structure / services etc. and all other incidental charges including making necessary cut outs for A.C diffusers, Light fittings, grills, Fire detection, alarm, sprinklers devices and fittings etc. No deduction in the area shall be made for openings nor any thing extra shall be payable for making the openings. Also nothing extra shall be payable on account of any wastage in materials. Also nothing extra shall be payable on account of any strengthening of the supporting suspension system for the false ceiling, around the openings in the false ceiling by using additional hangers, fasteners, runners, cross tees, etc.

7.0 FIRE RATED DOOR SHUTTER, FRAME AND FITTINGS

Door Shutter

Fully insulated wooden fire rated shutter of minimum 120 minutes fire rating shall conform to BS: 476 part 22 and IS:3614 Part II as per the prototype tested and certified by CBRI Roorkee.The fire check door shall not collapse during the rated period of the fire under the specified fire conditions.

Thickness of door shutter 55mm thickness,

Door Leaves shall beconstructed of 75mm x 49mm hardwood internal timber frame work, with infill of 96 kg/m3, ceramic fiber blankets of approved quality, coated with intumuscent coating on both sides for insulation. The coated insulation shall be sandwiched between 12mm thick, Non combustible calcium Silicate boards of approved quality provided on both sides (edge to edge on internal Hardwood frame) and cladded with 3mm thick commercial ply of approved quality & 1mm thick laminate of approved shade, brand and manufacture on both sides. 2nd class teak wood lipping of size 55mm x 14mm shall be provided all round the shutter. The shutter shall be made suitable for mounting on the fire rated wooden door frame.

Door Frame

Door frames of minimum 120 minutes fire rating shall conform to BS: 476 part 22, IS:3614 Part II as per the prototype certified by CBRI Roorkee

Door Frame will be made out of 2nd class Teak Wood (Ivory Coast) frame of section 140x65mm, with heat activated intumescent fire seal strips of size 20 x 4 mm(for smoke sealing) provided in grooves on all three sides of the frame with one coat of fire retardant primer of approved brand including two coats of fire retardant paint un thinned on cleared hard wood surface of door frames (@3.5 sq.m. per litre per coat) including preperation of base surface as per recommendations of manufacturer to make the surface fire retardant.

The frame shall be fixed with 8 nos. 100 mm long, 10 mm dia metal dash fastners of approved brand and manufacture or as per direction of Engineer in charge

Both frame and shutter shall be fitted with fire & smoke intumescent seal of Viper or equivalent make of size 20 x 4mm on all the three sides except bottom. The pasting of the

ply/veneer/laminate must be done using automatic machine and should be free from any nails or perforations. The board shall be Resistant to vermin, mould growth, minor impact, abrasion and short term water attack. The shutter shall be fixed with the frame with the help of SS 304 grade ball bearing hinges of size 100x76x2mm with necessary stainless steel screws and making cut out for vision panel. Provisions/reinforcement for fixing all fixtures shall be built in on the door prior to the supply.

Prototype Test certificate for fire rating of doors from CBRI, Roorkee for earlier tested design shall be attached along with manufacturers test certificate. Provisions/reinforcement for fixing all fixtures shall be built in on the doors prior to the supply.

Testing: The Client holds the right to get the door tested for fire rating at the cost of the contractor/vendor. In case the Engineer-in-charge desires to get the doors tested then one door including shutter, frame and all fittings shall be selected at random out of the entire lot and shall be tested for two hour fire rating. The testing shall be got done from CBRI, Roorkee. The cost of material for testing and transportation / packing & other incidental testing charges shall be borne by the contractor. In case the door fails to meet the requirement, the entire lot shall be rejected.

Measurement:
Final finished area of door shutter shall be measured after fixing it with the frame in the opening correct to one cm. Final finished length of door frame shall be measured after fixing it in the opening correct to one cm.NOTE:- cost of fire seal strips, dash fastners are included in the item. Nothing extra shall be paid if size of any component of material exceeds the limit mentioned in the item. The rates shall be inclusive of all materials, T&P, Labour, etc. complete including the cost of fittings, testing etc. as described above.

Fire rated glass

6 mm thick piroshield fire rated clear glass of approved make, of 120 minutes fire rating having a minimum 13 mm square electrically welded chemically treated steel wire mesh of dia 0.51 mm sandwiched in the centre during the continuous rolling process shall be fixed in vision panel

Area of glass shall be measured correct to 5 mm. Rate for the item includes the cost of glass, fire rated gasket channel and moulding/beading etc. all complete.

Fire rated panic exit device

UL listed fire rated single/double leaf panic exit devices tested in accordance with BS EN 1125: 1997 & BS EN 179: 1997, EN 1670 (Corrosion Resistant), & BS 476 Part 22 (for fire rating) shall be provided at fire staircase locations. The device shall be fixed with necessary hardware as recommended by the manufacturer. A minimum one year warrantee is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

Fire rated door closer

Fire rated door closer tested in accordance with BS:476 Part 22 (for fire rating) and BS EN 1154 shall be provided wherever required. The door closer shall be fixed with necessary hardware as recommended by the manufacturer. A minimum one year warrantee is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

Fire rated mortice lock

2 hrs, fire rated mortice lock with lever handle tested in accordance with BS:476 Part 22. A minimum one year warrantee is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

Pull handle
300 mm long stainless steel grade 304 D type pull handle shall be fixed with necessary screws etc. complete. A minimum one year warrantee is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

8.0 PVC FLOORING

PVC Sheet Flooring

Materials

The PVC Flooring Material shall conform to IS : 3462. It shall consist a thoroughly blended composition of thermoplastic binder, filler and pigments. The thermoplastic binder shall consist substantially of one or both of the following:
Vinyl chloride polymer
Vinyl chloride copolymer
The polymeric material shall be compounded with suitable plasticizers and stabilizers.
Thickness: The thickness of PVC sheet shall be as per BOQ item.

Thickness of PVC sheets shall be measured with micrometer of Ratechet type or a dial gauge graduated to 0.02 mm. The micrometer shall have flat bearing surfaces of at least 6.5mm diameter at both contact points.
The thickness of the specimen shall be measured at twenty scattered points.

Tolerance	
a) Thickness	±0.15 mm
b) Width of Sheets and Rolls	±0.1 percent

Adhesive : Rubber based adhesive are suitable for fixing PVC flooring over concrete, wooden and metal sub-floors. PVA based adhesives shall be used for concrete and wooden subfloors. PVA based adhesives are not suitable for metallic surfaces and also for locations where there is constant spillage of water.

Preparation of Sub-Floors

Before Lying PVC Sheets, it is essential to ensure that the base is thoroughly dry and damp proof as evaporation of moisture can't take place once the PVC flooring is laid. Moisture slowly damages the adhesive resulting in PVC sheet being separated from the base and curled up. In case of new work a period of 4 to 8 weeks shall be allowed for drying the sub-floor under normal conditions.
In new concrete floor, the smooth finish required shall be produced by using cement slurry spread on fresh concrete floor and finished smooth. If the concrete floor is old and surface not even, the surface should be made smooth by first cleaning it free of all foreign material and then a layer of cement mortar 1:2 (1 cement : 2 coarse sand) of average thickness of 6mm shall be applied on the surface finishing the surface smooth. The finished surface shall be cured for 7 days and then allowed to dry thoroughly.

Laying and Fixing

Prior to laying, the flooring sheets shall be brought to the temperature of the area in which it is to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours.

Before commencing the laying operations, the sub-floor shall be examined for evenness and dryness. The sub-floor shall then be cleaned with a dry cloth. The PVC flooring shall not be laid on a sub-floor unless the sub floor is perfectly dry.

The layout of the PVC flooring on the sub-floor to be covered should be marked with guidelines. The PVC flooring shall be first laid for trial, without using the adhesive, according to the required layout.

The adhesive shall be applied by using a notched trowel to the sub-floor and to the backside of the PVC sheet or tile flooring. When set sufficiently for laying, the adhesive will be sticky to touch, but will not mark the fingers. In general, the adhesive will require about half an hour for setting. It should not be left after setting for too long a period as the adhesive properties will be lost owing to dust films and other causes.

Care should be taken while laying the flooring under high humidity conditions so that condensation does not take place of the adhesive. It is preferable to avoid laying under high humidity conditions.

The area of adhesive to be spread at one time on the sub-floor depends entirely upon local circumstances. In case of a small room, adhesive may be spread over the entire area but relatively small area of sheets flooring should be treated in a larger room.

When the adhesive is just tack free the PVC flooring sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface. After laying the sheet in position, it shall be pressed with suitable roller weighing about 5 kg to develop proper contract with the sub-floor. The next sheet with its back side applied with the adhesive shall be laid edge to edge with the sheet already laid and fixed in exactly the same manner as the first sheet was fixed. The sheets shall be laid edge to edge so that there is minimum gap between joints.
The alignment should be checked after laying of each row of sheet is completed. If the alignment is not perfect, the sheets may be trimmed by using a straight edge.

Any adhesive which may squeeze up between tiles should be wiped off immediately with a wet cloth before the adhesive hardens. If, by chance, adhesive dries up and hardens on the surface of the sheet or tile, it should be removed with a suitable solvent. A solution of one part of commercial butyleacetate and three parts of turpentine oil is a suitable solvent for the purpose.

A minimum period of 24 hours shall be given after laying the flooring for developing proper bond of the adhesive. During this period, the following shall not be put to service. It is preferable to lay the PVC flooring after completion of plastering, painting and other decorative finish works so as to avoid any accidental damage to the flooring.

The joints between the sheets shall be hot welded using a suitable weding rod so that the flooring becomes jointless. The welded shall be so done as not to harm the sheet in any way.

When the flooring has been securely, fixed, it shall be cleaned with a wet cloth soaked in warm soap solution (two spoons of soap in 5 litres of warm water).

Where the edges of the PVC sheets or tiles are exposed, as for example, in doorways and on stair treads, it is important to provide protection against damage of flooring materials. Metallic edge strips may be used and should be securely fastened to the sub-floor to protect edges of the flooring.

The work shall also be carried out in skirting/ coving as per drawing/ instructions of the engineer/ architect.

Measurements

Length and breadth of flooring, skirting and/ or coving shall be measured correct to a cm and its area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for void not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for providing PVC flooring in borders, margins, skirting/ coving irrespective of their width.

Rate

The Rate shall include the cost of all materials and labour involved in all the operations described above. The rate does not include the cost of sub-floor or damp proof treatment if any. It also does not include the cost of metallic edge strip to protect edge of flooring, wherever provided, it shall be paid separately.

9.0 STAINLESS STEEL RAILINGS

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

9.2 The stainless steel work shall be got executed through specialized fabricator as per the list of the approved agencies having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in-Charge.

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

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

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

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

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

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

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

9. 10 The railing shall be fixed in position using stainless steel pipes, stainless steel posts of grade S 304 of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

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

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.

11.0 LAMINATED FLOORING

Manufacturing Standards

Laminate flooring panels must be manufactured in conformance with the European Standard of Laminate Flooring EN 13329:1998.The European Standard Specifies characteristics, requirements, and gives test methods for laminate floor coverings. It includes a classification system, based on EN 685, giving practical requirements for areas

of use and levels of use. Laminate flooring panels must be abrasion tested according to the above standard and meet or exceed the requirements for the Abrasion.

Preliminary

Remove wrapping and lay flooring panels out flat at room temperature for 48 hours. Check all panels for defects. and ensure the surface to be covered with panels is clean, smooth, and level. Uneven areas must be levelled. Do not install over carpets. Remove carpet along with any residual adhesive material and install on smooth, firm surface.

Concrete Surfaces

A 'Patch Test' must be performed on concrete sub-floors. If there is any evidence of moisture, the concrete must be treated with an appropriate sealer. **NOTE**: DO NOT install laminates floor if patch test reveals moisture build up, until concrete Is sealed.

It is recommended that a moisture barrier (Poly) be placed all over concrete sub-floors to protect against any possible moisture emissions.

Moisture Barrier

To protect panels against moisture form surfaces where moisture is likely to occur, a moisture barrier must first be placed over the base surface. Use 6-mlH (0.2mm) polyethylene film. Overlap the edges of the polyethylene by a minimum of 8 inches and seal the junction with moisture proof self-adhesive tape. Use on concrete floors and at floors below grade or other areas where condensation or moisture emission may occur.

A moisture barrier should be installed over floors with radiant heat. Before laying the barrier, turn heat down to 16 C (60 F) one week before. Keep the temperature below 27 C (80 F) at all times.

Underlayment

Panels must be installed on top of underlayment .Use a good quality underlayment (Cork or High Density Foam). Underlayment seams should not overlap and should be taped with self-adhesive tape. If installing both a moisture barrier and underlayment, place the underlayment on top of the moisture barrier, or preferably use a reliable combination product. **Underlayment** - is a clear thin plastic sheet that is installed over the substrate before the laminate floor is floated. The plastic sheet helps the laminate floor to float freely above the substrate.

Installation

First Row: Measure the row before the first panel. Cut the first panel according to the length required for the last panel. Measure for straightness and cut the panels to make sure the inner edge of the first row panels is square before starting second row. Measure the last row of the panel width first. Then cut first row panels to the same width as the last row. Position the first row panels along one wall, leaving space for expansion between panels and the wall. Lock the ends of the panels together until the first row is finished.

Second Row: The first panel of the second row should be long enough so the ends of the second row panels reach past the end seams of the first row panels. If the remaining section of the last panel of the first row is long enough, use it for the first panel of the second row; Line up the first panel of the second row so the outside end is even with the outside end of the first panel of the first row. After locking in place, lay the remaining panels of the row by first locking the long side in place and then tapping the end of the panel and slide it into firmly into place at its end; and

Lay each of the panels of the remaining middle rows.

Last Row: Because the width of the last row may be less than that of the previous rows, it may be necessary to cut the panels of the last row to the appropriate width .See instructions for first row

Expansion

Because changes in heat and humidity will cause laminate panels to expand and contract in both length and width, expansion spaces must be allowed on all sides of the installed floor. The use of spacers inserted between the panels and perimeter wall is recommended. The spacers should be removed after the panels are installed and before mouldings are attached to the walls. For rooms up to 25 feet (7.6 meters) in width and 40 feet (12.2 meters) long, allow for expansion between 3/8" and 5/8" (10 mm to16 mm) along each wall.

ExpansionJoints

For floors more than 25 feet (7.6 meters) wide or more than 40 feet (12.2meters) long, an additional expansion joint must be inserted. Expansion joints are also required in doorways, and between adjoining rooms or areas where adjacent flooring is installed. Use a T- moulding to cover the expansion joint.

Pipes And Other Obstacles

When installing a laminate panel around a pipe or other obstacle, leave the same expansion gap as you would next to a wall, Measure and, precut the affected panel If there is condensation from pipe, cut the panel so there is sufficient space to keep the panel dry. Fill the space around a pipe with a caulking in order to protect the exposed (cut) edge of the panel.

Directions of Panels

For appearance, panels should be installed so the length direction of the panels is the same as the length direction of the room or as shown in the drawing.

Preparation

- Measure doors for clearance of Installed panels. Cut away doorframe and jambs at the bottom if necessary. Remove existing baseboards.
- Surface should be clean, smooth, and level surfaces with slopes steeper than 12.5mm over 1.62m (1/2* over 5') must be levelled. Measure the perimeter of the room to determine room's squareness, and the required width of the last row of panels. Allow for expansion gaps along each wall.
- Install tongue-and-groove panels, attach the tongue on one panel to the groove side of the other panel and the panels will lock snugly together.
- Start with the panel flat on the floor, decor surface up, and the groove side away from the wall. Insert the tongue of the second panel partially into the groove on the first, while holding the second panel at about a 20 angle from the floor. Press the second panel down and use a hammering block to lock firmly into place. (Reverse the procedure to release.) Continue in a similar fashion for the remaining panels.

Mouldings

Transition moulding should be used for the following purpose:

Reducer: Use in from laminate floor to linoleum or other type of hard surface.
T4Moulding: Use In doorways, between rooms and with adjacent floors, and expansion joints.
Stair Nosing: Use at the edge of each step in a staircase.

End molding: Use for transition form laminate floor to other types of floor covering,
Baseboard: Use at the base wail.
NOTE: Always fasten baseboard to the wall, never to the floor.

Measurement:

Length and breadth shall be measured correct to a centimeter. Height of dado shall be measured correct to a centimeter, and the height of skirting shall be measured correct to 5 mm. The area shall be calculated in sqm. Correct to two places of decimals. Length and height shall be measured along the finished face of skirting or dado.

Rates:

The rate of above item shall include the cost of all material and labour involved in all the operations described above.

12.00 HOLLOW METAL STEEL DOOR WITH HONEY COMB CORE

GENERAL

The Contractor shall furnish all materials, labour, operations, equipment, tools & plant, scaffolding and incidentals necessary and required for the completion of all metal work in connection with steel doors, as called for in the drawings, specifications and bill of quantities. The supply and installation of additional fastenings, accessory features and other items not specifically mentioned, but which are necessary to make a complete functioning installation shall form a part of this contract.

All metal work shall be free from defects, impairing strength, durability and appearance and shall be of the best quality for purposes specified made with structural proprieties to withstand safety strains, stresses to which they shall normally be subjected to.

All fittings shall be of high quality and as specified and as per approval.

The Contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code or its Equivalent British Standard and the provisions of the safety code and the provision of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials.

Any approval, instructions, permission, checking, review, etc., whatsoever by the PMC/AEC, shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship, etc.

FRAME

a) **Material** – Frame to be manufactured from 1.25 mm (18 gauge) glavanised steel sheets complying with latest IS 277 Code of GPL Grade with Z 120 Coatings or its Equivalent British Standard.

b) **Profile -** Door frame profile to be single rebated of dimensions 100 mm X 57 mm (+ / - 0.3) with bending radius of 1.2 mm.

c) **Manufacture -** Frame to be manufactured from 1.25 mm thick galvanised steel sheet to the specified profiles and dimensions. Frames manufactured at factory shall be mitered & knock down form with butt joints assembly at site.

d) **Door frame preparations** – Frames to be provided with a 3 mm thick soffit back plates on all jambs with provision for anchor bolt fixing to wall openings. All frames to have reinforcement pads for fixing of door closer, at appropriate location as per manufacturer's details.

e) Frames to have factory finish-pre-punched cut outs to receive specific hardware and ironmongery.

f) Frames to be provided with hinge plates 3 mm thick pre-drilled to receive hinges for screw mounted fixing. All cut outs including hinge plates, strike plates to have mortar guard covers from inside to prevent cement, dust ingress into cut outs at the time of grouting.

g) Frames to have rubber shutter silencer on strike jambs for single shutter frames and on the head jambs for double shutter frames.

h) **Finish**

Door frames to be suitably cleaned with solvents for receiving self etching primer and top coats.

Door frames to be primered in zinc phosphate stoving primer (35 microns DFT).

Door frames to be finished in thermo setting Polyurethane paint (35 microns DFT) of approved colour and make as specified.

DOOR SHUTTER

a) **Material**

General purpose door shutter to be manufactured from 0.80 mm (22 gauge) galvanized sheets

conforming to latest IS : 277 Code of GPL Grade with Z 120 Coating or its Equivalent British standard.

b) **Manufacture**

Shutters to be press formed to 46 mm thick double skin hollow door with lock seam joints at stile

edges. Shutters to have no visible screws or fasteners on either face.

c) **Door shutter core**

Shutters to be provided with honeycomb paper cored to be bonded to the inner faces of the Shutter.

d) **Door shutter preparations**

Shutters to be factory prepared with pre-punched cutouts and reinforcements to receive ironmongery as per final finish hardware schedule. The shutter should have an interlocking arrangement at this stile edges for flat surface on either side.

Shutters to have pre-drilled hinge plates with hinge guard covers. Shutters with locks to have concealed lock box with lock fixing brackets with pre-tapped holes.

All ironmongery preparation to have adequate reinforcement for flush fixing at site.

e) For shutter with door closer reinforcement pads to be provided at appropriate location as per manufacturer's design.

f) **Vision panel**

Vision panel to be provided with clear toughened glass of the thickness 6 mm. Glass to be fixed with clip on frames for square and rectangular vision panels and with spin turned rings for circular vision panels and Glazing Tape with one side adhesive. Vision Panels to be fixed with clip-on frames for square and rectangular Vision Panels with no visible screws. Unless otherwise specified standard sizes are 200 mm x 300 mm, 300 x 750 mm, 450 x 750 mm and 360 mm diameter.

g) **Finish**

Shutters to be suitably cleaned with solvents for receiving etching primer and top coats.

Shutters to be primered in zinc phosphate stoving primer (35 microns DFT).

Shutters to be finished in thermo setting Polyurethane paint (35 microns DFT) of approved colour and make as specified.

PACKING

a) **Frame**

Individual frames members to be protected with Co-extruded PE film, with low tack adhesive. PE film to be minimum 56 micron thick, abrasion resistant with 6 months UV resistance Capability. (Manufacturers Test Report to be submitted) and placed in individual card board boxes. Individual boxes to be sealed. Frames to be assembled at site with aid of roofing bolts.

b) **Shutters**

Shutters to be protected with Co-extruded PE film, with low tack adhesive. PE film to be minimum 56 micron thick, abrasion resistant with 6 months UV resistance Capability. (Manufacturers Test Report to be submitted) and packed in card board and strapped. All frames and shutters duly marked as per door schedule for easy identification at site.

STORAGE

All knocked down frames shall be stacked flat and shutters vertically on wooden runners and suitably covered as per the instructions of manufacturer to prevent rust and damage.

INSTALLATION

i. Door frame fixing

The door frames should be assembled adjacent to the place of installation as the frames are not designed for transporting in an assembled condition. After assembly it is to be ensured that all threaded preparations are covered from the back of the frame using self adhesive strip to prevent penetration of mortar back-fill into screw threads. The head member of assembled frame shall be positioned against jambs ensuring correct alignment and secured using M8 x 20 long plated bolts together with nuts spring and flat washers.

The assembled frame shall be kept in position within the opening by means of bracing. In order to correctly position the frame against finished floor level or equalise on adjustable floor anchors where specified, shim shall be used under jambs. The frame shall be checked for squareness, alignment, twist etc. with carpenters bevel and plumb.

A tie rod shall be fixed to the frame during installation to ensure the correct dimensions between the frame rebated and the same may be removed after installation.

Where a 2nd fix application is required a shim detail is suggested to take up gap between frame and existing opening.

Existing masonry wall openings – Metal expansion shields

a) Brace, position, level etc.

b) Mark all positions of fixings on wall.

c) Remove frame and drill wall to appropriate specified size.

d) Fit rod anchor shells metal expansion bolts into the wall.

e) Fit jamb spacer bracket into back of frame profile.

f) Reposition frame back into opening and realign.

g) Lightly screw CSK HD machine screws into shells, shim behind frame.

h) Slowly tighten screws continually checking plumb, square etc. Finally ensure frames are not deformed as tightened.

i) After fixing the frame shall be grouted with cement mortar 1:3 or Plaster of Paris or Gypsum powder as approved. Gap between frame and wall to be closed by cement pointing using cement mortar 1:3.

j) Back full the frame through holes provided and insert nylon plugs.

Door shutter fixing

k) Fix all the hardware to the door shutter like hinges, flush bolts, bolts, mortice locks, door closer, door stoppers, handles etc. with the appropriate screws and bolts supplied. The shutter is to be then fixed to the frame which is already installed. Align the shutter to match the hardware to the cutouts in the frame. Tighten the hinge screws.

Measurements

Area of door shall be measured for payment .Area in Sqm shall be calculated by multiplying width & height as given below.

Width shall be measured correct to 1cm from outer to outer of door frame, measured horizontally

Height shall be measured correct to 1cm from top most of door frame to bottom of door shutter, measured vertically.

Rate of items includes the cost of all materials, labour and T&P involved as given in the BOQ item and specifications.

13.0 EPOXY BASED JOINTLESS ANTISTATIC FLOORING

The joint less flooring consists of 3 mm thick epoxy resin based antistatic flooring, self levelling with smooth finish, in required shade and of required conductor loading. Epoxy based flooring should be applied in several layers in order to insure permanent connection for the elimination of static electricity between the supporting base and the surface and should conform to IS: 9197. The entire job is to be undertaken by manufacturer's trained and skilled technicians to lay the epoxy-based floor as per IS: 4631.

The top layer of epoxy resin in 3 or more coats in the desired colour and shade is applied so as to achieve the required thickness, shade and finish.

The mechanical parametric properties to be achieved are as follows.

Resistance to compression	800 Kgf/Cm2
Resistance to deflection	400 Kgf/Cm2
Resistance to abrasion	0.35 g/h
Fire behavior	Class IV/1
Resistance to current leakage	1.10 Ohms

Measurements will be done for the finished and completed area to the nearest centimeter.

ANTISTATIC EPOXY FLOOR TOPPINGS

MATERIAL DESCRIPTION

The heavy-duty abrasion, chemical resistant & antistatic epoxy screed flooring shall be an epoxy Self leveling screed, which is laid to a thickness of 3mm. This shall be

extremely monolithic, seamless, jointless and is ideally suited for areas requiring Resistance to leakage of Current of 10^{4} to 10^{8} ohms.

a. A coat of primer as mentioned below shall be applied over clean, dry concrete surface:

ANTISTATIC EPOXY PRIMER - Component A (Resin) (182gm)
ANTISTATIC EPOXY PRIMER - Component B (Hardener) (68gm)

b. While the primer coat is still tacky, a 3 component, antistatic chemical resistant epoxy SCREED AS BASE COAT is to be applied with following materials @2.0kg/sqm
   - Component A (Resin) (0.84kg)
   - Component B (Hardener) (0.32kg)
   - Component C (Graded Filler) (0.84kg)

c. Over this a 2 component final top coat of antistatic SCREED AS is to be applied @3.5kg per sqm in two layers
Component A (Resin) (2.87kg)
Component B (Hardener) (0.63kg)

a. The system so devised should follow the antistatic specifications of ASTM D257 (Surface Resistivity) or BS 2050 (electrical Resistance) The static decay Test should be around 0.02sec. the manufacturer should have Test Reports from some prestigious institutions like Central Power Research Institute or ERTL.

APPLICATION LAYING PROCEDURE

The concrete should be properly cleaned and must be free from oil, grease, cement laitance, dust and other surface contaminants. The moisture content of the concrete must be checked and if found higher than 4% the concrete should be subjected to blow lamps, etc. to reduce the moisture contents.

Grooves of size 2mmX2mm at the edges of room along the perimeter and across the room are to be cut .

A copper wire of approx 3/20 gauges is to be laid in the groove in a slight tension manner with help of U nails. After lying of Copper wire the entire groove is to be filled with antistatic Epoxy putty comprising of Part A, Part B and Part C.

After fixing the wire and putty apply antistatic Primer @250gms per sqm with component A and B in ratio as mentioned above.

Allow the primer to dry and when it is tack free Mix component A & B & C of screed AS Basecoat and apply on the surface @2.0kg per sqm for approximately a thickness of 1mm.

After this application allow the Basecoat to dry for 24 hrs and then apply the top coat of self leveling SCREED AS on top of the Basecoat after mixing component A & B. The Application of Top coat has to be either in single layer or double layer @ 3.5kg per sqm to give overall thickness of the self leveling Antistatic screed as 3mm. After spreading of screed spread the material with notch trowel and spike the entire surface with specially designed Spike rollers to remove any air bubbles entrapped within the screed .

After the entire Self Leveling screed has been trowel and spiked allows it dry and cure. For soft Foot traffic movement curing of a minimum of 48hrs is recommended and for other regular use of the area a minimum of 7 days of curing is advisable.

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.

MDF

1. The board to be of best make / approved make as per discretion of Engineer.
2. The thickness of board to be 12mm.
3. Hanging arrangement to be of 12mm or more aluminum rods. The length of rods to be as per available heights at site.
4. Rates to be quoted per square meter.
   All-around lipping of aluminium section of desired colour of band in approved shape to be done.

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

Neon Glow signages

1. The diameter of tube to be got approved.
2. Make to be got approved.
3. Matter to be got approved.
4. To be made from100% handcraft glass.
5. Rate to include electric wiring to illuminate complete in all respect as directed.

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 Make	 1 No. each for each system Dial gauge 0-120C 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.

24.00 LIST OF APPROVED MAKES : CIVIL WORKS

Sl.No.	MATERIALS		MANUFACTURERS
1.	Doors & Windows fixtures/ Fittings	:	Everite, Hardima, Global, Crown
2.	Door Closer / Floor spring	:	Doorking, Everite, Hardwyn, Amar Darmy, Hardima
3.	Aluminium Sections.	:	Hindalco, Jindal, Indal , Bhoruka,
4.	Clear Glass/ Clear Float Glass / Toughened Glass	:	Saint Gobain(SG),Modi,Gujrat Guardian, Tata , AIG
5.	Laminates	:	Formica, Decolam, Century, Marino, Green Ply
6.	Synthetic Enamel Paints	:	Berger (Luxol gold), Asian(Apcolite), ICI Dulux (Gloss), Nerolac (Full gloss hard drying)
7.	Oil Bound Distemper	:	Asian (Tractor), Berger (Bison), Nerolac (Super Acrylic).
8.	Cement Paint	:	Snowcem Plus, Berger (Durocem Extra), Nerolac (Nerocem with titanium),.
9.	Plastic Emulsion Paint	:	ICI, Asian, Nerolac
10.	Other Paints/Primers	:	ICI Dulux, Asian, Berger, Nerolac
11.	OPC 43 Grade Cement (Conforming to IS 8112)	:	ACC, Ultratech, L&T, Birla Gold, JK, Ambuja, Laffarge, Century.
12.	Reinforcement Steel	:	ISI marked TMT steel conforming to BIS-1786 & approval of source by Engineer
13.	Glass Mosaic Tiles	:	Italica, Bizzaza. Pallidio
14.	Back-up Rod.	:	Supreme Industries or equivalent
15.	M.S. Pipe	:	Jindal Hisar, Prakash-Surya, BST, Kalinga, Tata
16.	Polycarbonate Sheets	:	GE Plastics or approved equivalent
17.	Wooden Fire Check Doors	:	Navair, Pacific Fire Control, Kutty Agni, Sukri
18.	Metal Fire Check Doors	:	Navair, Shakti- Met, Godrej, Sukri, agni, Pacific

Sl.No.	MATERIALS		MANUFACTURERS
19.	Sunken Portion Treatment	:	Choksey, Roffe, Krytone,Sika, CICO, Chryso,
20.	Admixtures for concrete.	:	Cico, Chryso, Roffe, Pidilite,FOSROC
21.	Ceramic Tiles	:	Johnson, Somany, Kajaria, Nitco
22	Pre-Laminated Particle Board	:	Novopan, Greenlam, Kitlam, Marino
23.	Flush Door Shutters.	:	Century, Kitply, Novapan, Green Ply, Marino
24.	Glazed Tiles	:	Bell, Somany, Johnson, Kajaria, Cera,
25.	PVC Water Stops	:	Supreme, Fixopan or approved equivalent
26.	White Cement.	:	Birla White, J.K.
27.	Powder Coating Material Pure Polyester.	:	Jotun , Berger, Goodlass Nerolac
28.	Masking Tapes	:	Suncontrol , Wonder Polymer.
29.	Stainless Steel Screws For Fabrication and fixing of Windows.	:	Kundan , Puja , Atul.
30.	Dash Fasteners./Anchor bolts	:	Hilti, Fischer, Bosch.
31.	Stainless Steel Bolts, Washers and Nuts.	:	Kundan, Puja, Atul.
32.	Stainless Steel Pressure Plate Screws.	:	Kundan, Puja, Atul.
33.	Stainless Steel Friction Stay.	:	Securistyle, Earl Bihari.
34.	E.P.D.M. Gaskets.	:	Anand Reddiplex, Enviro Seals
35.	Weather Silicon.	:	Dow Corning, Wacker, GE, Chryso
36.	Structural Silicon at butt joints	:	- Do -
37.	PVC continous fillet for periphery packing of Glazings /Structural glazings.	:	Roop, Anand, Forex Plastic.
38.	Floor Springs.	:	Doorking, Opel or equivalent
39.	Water proofing / Injection Grouting	:	Specilized agency as approved by engineer
40.	6mm thick Reflective Glass	:	Glaverbel, Glavermas, Saint Gobain.

Sl.No.	MATERIALS		MANUFACTURERS
41.	Door Locks.	:	ACME, Godrej, Harrison, Hardima, Mobel
42.	Door Seal – Woolpile Weather Strip	:	Anand -Reddiplex.
43.	Aluminium Grill	:	Hindalco, Decogrille or approved Equivalent
44.	Vitrified Tiles	:	Restile , Naveen, Bell-Ceramics, Kajaria, Somani,
45	Carpets	:	Hollitex, Standard, Mohawk,Birla Transasia
46.	Aluminium Cladding sheets	:	Alstrong , Alpolic, Alucobond, Alucomat Alu Decor
47.	Aluminium Die-cast handles & two point locking kit	:	Giesse, Securistyle, Alu-alpha
48.	Stainless steel D-handles	:	D-line, Giesse, Dorma,Hardima
49.	Fabric for Auditorium	:	ESSMA, Raymonds or equivalent
50.	Stainless Steel Pipes/Flats	:	304 Grade (as approved by Engineer)
51.	Structural Steel	:	Conforming to BIS 2062 and approval of source by Engineer
52.	Ready Mix Concrete	:	ACC,BIRLA, Ahlcon or approved Equivalent
53.	Epoxy Flooring/ wall coating	:	Fosrock, Beck, Famaflor,
54.	SBS bitumen based Self adhesive membrane Material	:	Grace-Bituthene CP1.5, Texsa-Texself 1.5
55.	Acoustic Mineral Fibre	:	USG-Radar, Armstrong, 21st Century, Acostyle
56.	Curtain wall/Structure Glazing/Hermatic seal Sliding Doors	:	Specialised Agency to be approved by Engineer
57.	Fire Panic bar	:	Briton, Monarch, Von-Duprin, Dorma, Mobel
58	Ply board	:	Greenply, Kitply, Century, Archid, Marino

Sl.No.	MATERIALS		MANUFACTURERS
59	PVC Doors (Solid Profile)	:	Rajshri or approved equivalent
60	PVC Doors (Hollow Profile)	:	Syntex, Plasopan or approved equivalent
61	PVC Flooring	:	LG, Tarkett, Responsive or approved equivalent
62	SS Railing	:	Specialised Agency to be approved by Engineer
63	Interlocking Paver Tiles	:	Ultra, Shree or Approved Equival
64	Wall Clading Tiles	:	Ultra, Shree or Approved Equivalent
65	Acoustic Seals	:	Anand Reddiplex , Enviroseal or equivalent
66	Smoke Seals	:	Pemko or Equivalent
67	Fire rated door closer/Mortice Lock/ Door Co-ordinator		Dorma, Becker F.S. Australian or approved equivalent
68.	Gyspum Board System	:	India Gypsum, Laffarge, Boral

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 : PLUMBING WORKS

S.No.	Materials	Relevant IS Code	Manufacturers
1.	Vitreous China Sanitary ware	2556	Hindustan Sanitary ware, Cera, Kohler, American standard
2.	White Glazed Fire Clay Sink	771	Sanfire, Cera, Neycer, Hindware.
3.	Stainless Steel Sink		Jayna, Jaguar, Commander, Nirali
4.	Plastic seat cover of W.C	2548	Commander, Cera, Kohler Jaquar, American standard
5.	Geyser		Racold, Venus, Voltas, Usha Lexus
6.	C.P. Fittings Mixer/Pillar taps Washers, Bib Cock, Angel Valves, C.P. brass accessories	1795 4291/4827	Aquabaths, Jaquar,Kingston,Marc, Player
7.	Centrifugally /Sand cast iron pipes & fittings	3989/1729	Neco, Hepco, SKF
8.	G.I. Pipes	1239 Part I	Jindal-Hissar, Tata, Prakash-Surya B.S.T., SAIL,
9.	G.I. Fittings	1239 Part I	Unik, K.S., Zoloto Zenith, JSL
10.	Gunmetal Valves	778	Zoloto, Leader, Castle, ATAM
11.	Brass stop & Bib Cock/Pressure Release valve	781	Zoloto, Sant, L&K, Jaquar, Atam
12.	Ball valve with floats	1703	Zoloto, Leader, Sant, Jayco, ATAM
13.	Stoneware pipes & Gully Traps	651	IS Marked pipes
14.	R.C.C. pipes	458	IS Marked pipes
15.	D.I. Manhole Covers	1726	SKF, NECO,
16.	Water Tank		Sintex, Polycon, Uniplast
17.	Mirror		Golden, Atul, Modi guard Gujrat Guardian
18.	Hand drier		Kopal, Automat, Euronics
19.	PVC flusing cistern		Commander, Parryware, Duralite
20.	Insulation of Hot water pipes		Vidoflex insulation, Superlon insulation or equivalent

S.No.	Materials	Relevant ISI Code	Manufacturers OR EQUIVALENT
21.	PVC Rain Water Pipes.		Supreme, Prince, Finolex. Oriplast
22.	D.I pipes		Jindal, Tata, Electrosteel.
23.	Sluice valve / NRV		Kirloskar, Kilburn, Zoloto Castle,
24.	Water supply pumps	:	KIRLOSKAR, WILO, GRUNDFOS
25.	Submersible pumps	:	GRUNDFOS, KSB, Mather & Platt
26	UPVC pipes & fittings	;	FInolex , Prince(aquafit), Supreme, Oriplast
27.	Chlrorinator	:	ALFA, USA, Ion exchange, Sigma DH Combine Inc.
28.	HDPE Solution tank	:	WATCON, ION EXCHANGE, Water Supply Specilist P (Ltd)
29.	C.P Flush Valves	:	Jaquar, DOCOL(Germany) marketed by GEM, Ideal
30	C.P Angle Valves,	:	, Jaquar, Marc, Player, Kholer,Aquabaths
31.	Infrared Sensor operated Faucets	:	Jaquar, AOS-Robo , Euronics,U-tec Kholer
32.	Gratings, Strainers, Cleanouts etc	:	Neer Brand (Sage Metals) or Equivalent
33.	Level controller	:	Femac or equivalent
34.	Drainage Pumps	:	Grundfos, KSB, Mather & Platt
35.	Water / Effluent Treatment Plant	:	Thermax, Geo Miler & Co, Ion-Exchange, Aquaprocess, Akar-Impex, Polycon Technologies, LN Tech
36	Oxilyte (Mixed oxident)	:	Oxybee Solutions, I2M Technologies, Faith Innovations

37	Decorative bath room fittings	:	Not applicable.
38.	R.O System	:	Thermax, Aqua Process, Ion-Exchange, Paintir, Polycon Technologies, Indwa
39	HDPE pipes and fittings	:	Oriplast, So-Soon, Finolex
40.	Infrared Sensor operated Urinals	:	Jaquar, Euronics,U-tec
41.	Grab Bars	:	Marino or equivalent
42.	CPVC pipe,fittings and Solvent	:	Ajay, Flowguard, Astral, Prince(smartfit)
43.	Solar Panel	:	Tata BP, BHEL, EMMVEE
44.	Copper Pipe	:	Raj Co., Maxflo
45.	Copper Fittings	:	Viega, IBP
46.	Lab drainage	:	Viega or Equivalent as approved.
47.	Lab Fittings	:	Vijay, Viega, or equivalent approved
48.	SS pipe(EN-10312) & press type fitting:		Viega, Jindal
49.	PE-AL-PE	:	Kitec, Jindal, PRINCE

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

26.00 LIST OF APPROVED MAKES : FIRE FIGHTING WORKS

S.No.	Material	Relevant ISI Code	Brand/ Manufacturers OR EQUIVALENT
1.	G.I./M.S. Heavy class pipe	1239/3589	Jindal-Hissar, Tata, Prakash -Surya, B.S.T., SAIL
2.	Gate Air Valve		Leader, Zoloto, SBI,
3.	Butterfly valves	13095	Audco, Keystone, Intervalve, C & R, Zoloto, Castle, ATAM
4.	Portable Fire Extinguisher	2171	Minimax, Superex, Nitin, Firex, Ceasefire, Newage, Eversafe
5.	First aid Fire hose reels	884	Minimax, Superex Getech, Newage,
6.	Fire hose pipes	636	Newage, Superex, Eversafe, Getech, Jyoti
7.	Fire Hydrant valves	5290	Minimax, Newage, Eversafe, Ceasefire, Vijay, Getech
8.	Sprinkler Heads		
a)	Pendent type		Tyco, Viking-usa, HD, Newage, Getech
b)	Side wall type		Newage, HD, Tyco, Viking-usa
c)	Sprinkler Side wall extended through		Spray safe, HD, Viking-usa, Tyco.
9.	Sluice and non return/ check valve foot valve strainer		Kirloskar, I.V.C., Kilburn, Zoloto, castle
10.	Thermoplastic fire hose pipe 1258		Mitras,Superex,Eversafe, Getech
11.	Rubber hose 12/20mm dia		Dunlop, Good year, Jyoti Eversafe
12.	Reinforced rubber lined/canvas		Newage, Jayshree, CRC, Eversafe, Getech
13.	Standby battery lead acid		Exide, Standard, Amco
14.	PVC Insulated Copper Conductor.		Finolex, Plaza, National
15.	Recessed/concealed type		Spraysafe., Reliable
16.	Horizontal centrifugal/Fire pumps		Kirloskar, Mather & Platt(WILO), GRUNDFOS,
17.	Diesel engine		Kirloskar Cummins, Ashok Leyland
18.	Electric motors		Kirloskar, GEC, Siemens, NGEF, ABB Crompton
19.	Electrical switch gear & starters		As per Electrical Works

19.	Cables		As per Electrical Works
20.	Flow meter		Scientific Equipment (P) Ltd. Hyderabad , System Sensor
21.	Suction strainer		Leader, ZOLOTO, AUDCO,Castle
22.	Vibration eliminator connectors		Resistoflex, or equivqlent
23.	Single phase preventor		L & T, GEC, SIEMENS
24.	G.I. Fittings	1239 Part I	Unik, K.S., Zoloto Zenith, JSL
25.	Yard Hydrant Stand Post,4 way suction		Eversafe, Minimax, Newage, Getech, Superex

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

END OF CIVIL, PHE & FIRE TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

1.00 GENERAL SCOPE OF WORK

The scope of work shall cover internal and external electrical works for **CONSTRUCTION OF DISTRICT DRUG WAHEHOUSE, UNDER NATIONAL RURAL HEALTH MISSION SCHEME .**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. Main LT , Capacitor panels (APFC), Rising mains, MV Panels.

ii. DG sets including AMF panels etc.

iii. MCB Distribution Boards.

iv. 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.

v. 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.

vi Conduiting and wiring for cable TV

vii Conduiting for computer networking

ix LT Cabling.

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

xi Out door lighting

xii Testing and commissioning of all electrical installations

xiii Enhancement/Sanctioning Electrical Load from State Electricity Board.

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

xv Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Telecom Department, and any other statutory authorities for the complete scope.

xvi 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.

xvii Contractor has to submit the working drawing of internal & external electrification based on our tender drawings for the approval of HSCC Electrical Engineer before commencement of work.

xviii Contractor has to take the approval of DB schedule/drawing of each DB from HSCC.

xix 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)- 2013
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)-2013
e)	CPWD General specifications for electrical works	Part VII (DG Sets) 2013
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 1000V AC or 1500V DC	ISI13703 Part-1&2
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

3.0 MAIN MV & FLOOR PANELS

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 SWITCHGEARS

Refer subhead 5.00 – LT switchgears

3.6 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.

3.7 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.

3.8 TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

3.9 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.

4.0 L.T. SWITCHGEARS

4.1 AIR CIRCUIT BREAKERS

4.1.1 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.

4.1.2 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.

4.1.3 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.

4.1.4 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.

4.1.5 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.

4.1.6 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.

4.1.7 MOUNTING

Circuit Breakers shall be mounted as per manufacturers' standard practice.

4.1.8 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.

4.2 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.

4.2.1 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.

4.2.2 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.

4.2.3 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.

4.2.4 BREAKING CAPACITY

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be minimum 25kA.

4.2.5 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.

4.3 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.

4.4 MEASURING INSTRUMENTS, METERING & PROTECTION

4.4.1 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.

4.4.2 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.

4.4.3 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.

4.4.4 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 & 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.

4.5 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.

5.0 INTERNAL ELECTRIFICATION OF BUILDING

5.1 SCOPE

As specified in subhead 1.00

5.2 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 – 2013 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.

5.3 DISTRIBUTION BOARDS.

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 for residential and 100mA for Hospital and other 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.

5.4 METALLIC CONDUIT WIRING SYSTEM.

5.4.1 TYPE AND SIZE OF CONDUIT.

All conduit pipes shall be of ISI marked (IS:9537 Part-II/1989 amended upto date) 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 25 mm in diameter shall be used.

5.4.2 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.

5.4.3 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.

5.4.4 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.

5.4.5 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.

5.4.6 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.

In case of **PVC Conduit** it will be ISI marked HMS duty type, the PVC Conduit and Accessories will as per IS: 9537 Part III-1983 and IS:3419-1988 Amended up to date

5.4.7 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.

5.4.8 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.

5.4.9 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.

5.4.10 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.

5.4.11 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.

5.5 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.

5.5.1 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.

5.5.2 LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

5.5.3 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.

5.5.4 CLASSIFICATION OF POINTS.

5.5.4.1 General

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I-Internal) 1994.

5.5.4.2 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,

ii) 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.

5.5.5. 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.

5.5.6 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.

5.5.7 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

5.5.8 LIGHTING FIXTURE AND FANS

5.5.8.1 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.

5.5.9 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.

5.5.10 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.

5.5.11 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.

5.5.12 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.

5.5.13 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.

5.5.14 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

5.5.15 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.

6.0 LT CABLES

6.1 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.

6.2 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: 7098 (Part-I) with up to date amendments and ISI marked.

6.3 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.

6.4 INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

6.5 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.

6.6 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.

6.7 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.

7.0 CABLE TRAY

7.1 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.

7.2 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.

7.3 Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

7.4 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.

7.5 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.

7.6 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.

7.7 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.

7.8 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.

7.9 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.

7.10 The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

7.11 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.

8.0 EARTHING

8.1 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.

8.2 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.

8.3 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.

8.4 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.

8.5 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.

8.6 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.

87 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 5 ohm.

8.8 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.

9.0 SAFETY EQUIPMENTS

9.1 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.

9.2 FIRST AID BOX

Standard first aid box with all standard contents shall be supplied.

9.3 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.

9.4 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.

9.5 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.

9.6 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.

10.0 DIESEL GENERATOR SETS

10.1 INTENT OF SPECIFICATION

10.1.1 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.

10.2 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, 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 up to 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 as required 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.

10.03 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.

10.04 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.

10.05 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.

10.06 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 300 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 250 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/AVM pads etc. as required. 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.

10.07 SERVICE INTERVAL AND OPERATION

The set shall be capable of running at full load for not less than 300 hrs continuously. The change period both for the lube oil, lube oil filters shall be minimum 300 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.

10.08 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/AVM pads, 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, 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.

10.09 HEAT EXCHANGER

The DG Set should be equipped with a Heat Exchanger for suitable operation.

10.10 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

10.11 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 Radiator/heat exchanger type. Adequately designed for ambient conditions, 50 deg C.

10.12 DAY SERVICE FUEL TANK

Day service fuel tank shall be made of 2 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.

10.13 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.

10.14 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 23. 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
- ❖ 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 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
- ▪ 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.

10.15 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.

10.16 TESTS AT MANUFACTURER'S WORK

The following tests shall be performed at manufacture’s works prior to packing and dispatch to site and test reports for the same shall be furnished.

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.

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.

10.17 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.

10.18 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 5% 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.

10.19 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.

10.20 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 15% of rated value.

GURANTEED TECHNICAL PARTICULARS OF DG

1.1	ENGINE	
	Rating	
	i) Minimum Engine Rating	Matching
	ii) Altitude (m)	Less than 1000m above mean sea level
	iii) Air humidity	30% Min. 95% Max.
	iv) Air temperature (°C)	Minimum 42
		Maximum 50
		Average 40
	v) Duty	Prime Continuous rating duty at specif ambient air Temperature of 45°C

	vi) Standard	BS 5514 and IS 3046
1.2	Overload capacity for one hour	10% over the continuous rating. In 12 hours 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/Radiator	 Yes
1.6	Exhaust System i) Silencer ii) Flexible connection iii)Scrubber	 1 No or more as required Residential type. 1 No for each exhaust pipe near the engine. 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 vi) Water temperature gauge vii) Hour counter	 Audible & visible alarm Trip engine with trip indication Audible visible alarm Trip engine Audible & visible alarm Yes, required 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 1400 KVA, (1200 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 diode assemb
2.7	Over speed %	120

2.8	Transient response & Response voltage dip	Bidders to specify largest motor to be star on DOL with no base load & with 5(base load, TVD to be restricted to 20%.
2.9	Sustained short circuit	Bidders to specify maximum SC capability 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/Radiator type
5.0	ACOUSTIC ENCLOSURE DETAILS	
	Structure	MS Press bent 2 mm
5.1	PANELS	
	Type	Steel Fabricated double wall insulated 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/Cummins 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)	Insertion loss of 25 db(A) 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 l extension and the box for different protection .	
	3 nos spare CT's to be supply by the vendor of the same specification 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 .

10.21 COOLING TOWERS AND WATER CIRCULATING EQUIPMENT

10.21.1GENERAL

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.

10.21.2 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.

10.21.3GENERAL 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 / architect choice.

10.21.4 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.

10.21.5 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.

10.21.6 LADDER

All towers, whose height exceeds 2.5 mtrs, shall be provided with a ladder, made out of hot dipped galvanized M.S. Tubes.

10.21.7 PUMP SETS

The pump sets shall be mono block type with end suction and top discharge flanged conections directly mounted on the drippro of squirrel cage induction motors and suitable starter as specified.

The implller shall be of Bronze, single entry 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’.

10.21.8 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).

10.21.9 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.

10.21.10 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 piping 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.

10.21.11 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.

10.21.12COOLING 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	100 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.

10.22 Synchronisation System

10.22.01 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.

10.22.02 The parallel operation of D.G. set in Synchronization mode shall be completely through Cummins Engine Controller PCC 3.3/GCU/PLC. If synchronization & load sharing facility is inbuilt in engine controller require PLC for only load management facility.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 Synchronizing 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.

10.22.03 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,

10.22.04 Depending upon the load requirements, the the system shall start / stop the D.G. sets.

10.22.05 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.

10.22.06 Alarms and necessary remedial commands for D.G. and electrical system fault.

10.23.1 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. 8 window annunciator with alarm Accept/Test/Reset push buttons, Hooter.

o. Temperature Scanners for RTD and BTD

p. Becon light

q. Hour meter

t 5 Nos Under voltage relay for mains feeder “

r. 5 Nos Over Voltage relay for mains feeder “

s. Stand by Earth fault relay ‘’

t. Reverse power relay (reactive) “

u. Trip circuit supervision relay “

v. Master trip relay “

w. 5 H.P, DOL starter for oil priming pumps for D G Set

x. Power factor meter (Analog)

y. Frequency meter (Digital)

z. Ammeter (Digital)

aa. Voltmeter (Digital)

bb. KW and KVA meter (Digital)

cc. Kwh meter (Digital)

dd. D.C. Ammeter (digital)

ee. D.C.Voltmeter (digital)

ff. Breaker Control Switch for bus coupler

gg. Battery Charger on / off switch with boost and trickle charger facility

hh. Trickle / booster charger selector, switch

ii. Push buttons (lot)

jj. P. T

kk. Aux. Contactor (lot)

ll. transducers

10.23.2Automatic 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.

11.0 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.

12.00 CAPACITOR PANEL

12.01 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. The panel shall include all the specified capacitor banks, switchgears, controller, filter reactors, control gears, busbars, meters, earthing, interconnections etc

12.02 RATING

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors.

12.03ENCLOSURE

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 (14%). 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.

12.04 APFC 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.

12.05 CAPACITORS

The capacitor shall generally confirm to IS: 13585:1994 and IEC 60931:2002
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. It should be rated for 525V for 14% detuned reactor. The KVAR of Capacitor banks should be increased proportionately for combination of Capacitor + reactor.

ii. Capacitor type: The capacitor unit shall be Ultra Heavy Duty APP type The dielectric should be made of polypropylene. Capacitor Impregnation shall be Oil Type. Capacitor should be fitted with safety device for each capacitor units. 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 IEC 60931

v. Over current: 2.5x In

vi. Peak inrush current withstand: 400 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. Separate earthing terminal shall be provided for earth connection of each bank.

De-tuned Filter

- Detuned filter reactor shall be used along with power capacitors to mitigate harmonics, improve power factor and to avoid electrical resonance in LV electrical networks.
- The low voltage filter Copper reactor shall be series type having a three phase, iron core construction suitable for indoor use. The reactor shall be air cooled and the layout shall be in accordance with IEC 60076.
- The permitted tolerance of inductance shall be + 3% of rated inductance value.
- The limit of linearity of inductance of the filter reactor shall be as follows $1.8*I_n$ with $L=0.95*L_N$.
- The reactor shall be fitted with a temperature sensitive micro-switch in the centre coil (normally open) for connection to trip circuits in case of high operating temperatures.

12.05 SWITCHGEAR & PROTECTION:

Incomer switchgear will be as specified in BOQ. Suitable rated Power Contactors or Special Capacitor duty 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 thru 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.

12.06 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.

12.07 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:

12.08 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

13.00 TELEPHONE SYSTEM

13.01 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.

13.02 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.

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**	**MAKE**
1.	Main LT Panel/ Synchronizing Panels/APFC panels /AC panels	**CPRI Approved panel manufacturer (Test certificate of CPRI valid from January 2012 onwards (Contractor must submit the documents for approval of manufacturer to HSCC/ Clients)**
2.	11 KV VCB Panel Board	Siemens/L&T/ABB/Schneider/Kirlosker/Crompton Greaves/Control & Switchgear
3.	Transformer	Areva/ABB/ Crompton /GE/Voltamp
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:	Cummins/ Perkins/ Caterpiller/ MTU/ Kiroskar/Ashok Leyland/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	**CPRI Approved panel manufacturer (Test certificate of CPRI valid from January 2012 onwards (Contractor must submit the documents for approval of manufacturer to HSCC/ Clients)**
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-Record plus/ Siemens-VL/ ABB-TMA/ Schneider NSX-NS/Legrand-DPX
16.	Power/auxiliary Contactors, timers, Relay, starters	ABB/ Schneider/ L&T/ Siemens/GE/Legrand
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/ CromptonGreaves/HPL(SOCOMECH)
19.	Change over switches/Isolators	Merlin Gerlin/ Crompton/ Siemens/ABB/HPL/GE
20.	Instruments (analogue)	L&T(Rishab)/ AE/ MECO
21.	Digital Meter	Enercon/ AE/ Secure/ Allan Bradely/L&T Motwane/Dukati (Imported) Meco/HPL/Trinity/Minilec /C &S
22.	Timers in Distribution board	Legrand/ Hagar/ Siemens/ ABB/ GE/C&S
23.	Battery (Maintenance Free VRLA Battery)	HBL Nife/ Exide/ Standard/Amar Raja/ Furakawa/ Panasonic

24.	MCB distribution Boards	L &T/Hager/Legrand/ Siemens/ ABB/GE/ Schenieder (MG)/Havells/C&S
25.	RCCB	L & T /Hager/ Legrand/ Siemens / GE/Schenider (Merlin –Gerin)/C&S
26.	HT/ LT XLPE cables	/Polycab/ NICCO/ UNIVERSAL/Skytone/ Havells
27.	Copper Control cable	Finolex/ Polycab/ NICCO/ Universal/ National/ Rallision/RR Cable
28.	Compression Glands & Lugs 11KV grade cables(Double compression gland)	Peeco/ Comet/ Dowells/ Siemens
29.	Copper/ Aluminum(Crimping Type cable lugs for 11KV cables	Asian/Dowells /Crystal/Jointwell or equivalent make
30.	Cable Joints (Heat Shrinkable) HT cable termination	Raychem/3M/Cabseal
31.	Cable Trays	Steelways/ Bharti/ Unitech /Maheshwari/or approved by HSCC
32.	Galvanized/PVC Raceways and raceways accessories	Steelways/ Bharti/ Schneider(MG)/Legrand
33.	Light fitting	Philips/ Wipro/ Bajaj/ GE/ Crompton Greaves/Control & Switchgear/ Kesalec Schreder/Anchor(Panasonic)/ Twinkle/ Ankur/ Decon.
34.	Lamps	Philips/ Osram/ GE/Anchor (Panasonic)/
35.	GI / MS conduit ISI marked	BEC/ AKG/ Steel Kraft

36.	PVC conduit	BEC/ AKG
37.	Steel conduit accessories (ISI as approved sample)	Sharma sales corporation, super sales corporation or equivalent.
38.	Modular Metal box for switch /socket	Havells/ MK/MDS/Anchor Roma/Northwest
39.	Copper conductor FRLS PVC insulated wires ISI marked	National/ Skyline/ Finolex/ Havells/ L&T / R R cable/Rallison/Skytone/polycab
40.	Modular Switches & sockets Outlets	Havell's (Crabtree- Atena)/ MK-Wraparound/ Hagger/ Anchor- Roma(Tersa,woods,viola)/ Northwest
41.	Metal clad Socket outlets With boxes	L & T Hager/ Siemens/ Merlin Gerin/ ABB MDS / BCH /Havells
42.	Lighting protection	Erico/Galaxy electrode /Earth plus or equivalent
43.	UPS system	Hitachi/ Siemens/ Amarraja / Etone powerware/Emerson/APC (Schneider) /PCI LTD
44.	Street Light poles	Jindal/ Bombay poles/ Bajaj /Twinkle/ Pierlite or equivalent
45.	Electronic Ballast	Philips/ Wipro/Osram/Bajaj/Crompton
46.	Ceiling fans	Crompton Greaves/ Bajaj/ Orient/ Alastom/ Usha
47.	Main PC with CPU monitor	HP/ Compaq/Del
48.	Auto manual changeover switches (3Way)	Kaycee/L&T/ Schnieder
49.	Public address system	Bosch/ Bose/ Haristasa/Honey well /Harman/JBL/Shure
50.	CCTV camera	Honeywell/ Schnider electric (Pelco)/DVTEL/Bosch/Siemens/Johson control
51.	Fire Detection System	Honeywell- Notifier/GENT/ Thorn/Bosch/Siemens/Cease fire (Hochiki)

52.	Portable fire extinguisher	Minimax/Agnidevices/Superex/Ceasefire/Eversafe
53.	EPABX system	Avaya/ Siemens/Alcatel/Erricsion/Panasonic
54.	Telephone cables /communication cables	AT & T/ Fusion /Polymers/Finolex/Delton Skyline/Skytone
55.	Nurse Call bell system	Omnitech automations/Process care system or equivalent as per spect

END OF TECHNICAL SPECIFICATION

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 'Drug Ware House' located at various districts of Chhattisgarh.

3.0 Scope of work

The work proposed under this tender includes Supply, Installation, testing & commissioning of Air Cooled Ductable Split AC units, High Wall Split, Windows type Air-conditioning system and ventilation fans for the Drug Ware House.

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	Occupancy	:	App.60- 100 Sq.ft per person or as per actuals.
vi	Equipment Load	:	As per standards
vii	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	110	75
Monsoon	95	83
Winter	45	41

4.3 Inside Conditions

office areas and Drug ware: 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 Window, Split and Ductable Split Type Air Conditioner.

5.2.1 Conditioned air shall be taken from the ductable split type air conditioner through GI/Aluminium ducting and supplied to conditioned areas through ceiling / wall mounted grilles / diffusers. Return / exhaust air shall be collected through similar grilles and diffusers and returned to ductable split AC through false ceiling /return air duct/ through open space.

6.0 Items to be provided by other Agencies free of cost to AC contractor

6.1 Civil works such as trenches for piping, cables and making foundations of equipment etc.

6.2 Main 3 ph, 415 v, 50 hz, A.C. supply power supply up to each panel of Ductable Split AC.

6.3 Main 1 ph, 220 v, 50 hz, A.C. supply power supply within 1 metre for Window & Split AC.

6.4 Any kind of false ceiling, boxing.

6.5 Making frames for fixing grilles & diffusers in false ceiling, boxing or in walls.

7.0 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.

8.0 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:

9.0 Technical Data

The contractor shall furnish complete technical data, on the equipment offered as required under the heading `Technical data'

10.0 Performance Guarantee

10.1 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.

10.2 The contractor shall guarantee that the capacity of various components as well as the whole system shall not be less than specified.

10.3 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.

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

CONTROLS

1.0 General

1.1 The various controls listed below shall be electrically operated and generally comply with the specifications listed below.

1.2 In case of low voltage controls, necessary step down transformers shall be provided with each control as required.

2.0 Modulating Humidistat

The humidistat for humidification shall be snap acting type as per clause 2.5.

2.1 Snap Acting Humidistat

The humidistat for humidification shall be snap acting type with an adjustable differential. The sensing element shall be horse of hair or other accurate device.

2.2 Reheat Thermostat

The reheat thermostat shall be 2 stage snap acting type for room mounting, with 1 deg. C differential.

2.3 Winter Heating Thermostats

The winter heating thermostat shall be to stage snap acting type for room mounting with 1 deg. c differential.

3 Refrigerant Control

3.1 Expansion Valve

The thermostatic expansion valve shall be with external equaliser lines and capillary with "Bulb" for producing super heat.

3.1 Solenoid Valves

The solenoid valve shall be pilot operated with packless seat to ensure leak proof shut off. The pressure drop across the valve shall not exceed 5 psig.

3.2 Temperature Control

3.2.1 The water temperature controller shall be snap acting capillary type with a range of 0^{o} F. to 100^{o} F. and a temperature differential of 2deg f adjustable in the field.

3.3 **Safety Controls**

3.3.1 **Antifreeze Thermostat**

The antifreeze thermostat shall be snap action type with a range of -12^{o} c. to +10^{o} c. It should be complete with a reset button to prevent restarting of the compressor.

3.3.2 **High and Low Pressure Cutout**

The high and low pressure cutout shall be of snap acting type with adjustable set point and differential and range suitable for R-22/R-134a pressure. The high pressure cutout should also have a reset button to prevent restarting of the compressor.

3.3.3 **Oil Failure Switch**

The oil failure switch if required shall be snap acting type with suitable adjustable range and differential and complete with reset button. It should also have a time delay relay for start up of the compressor.

4.0 Gauges

The water pressure gauges shall be of robust construction with minimum 100 mm dial, of suitable range and occupancy calibrated.

5.0 Thermometers

The thermometers shall be mercury filled industrial stem type, with metal casing and threaded fixing arrangement.

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 positions.

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.

DUCT WORK AND OUTLETS

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	40x40x3 mm at the rate of 1.2

				braced diagonally with 10 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.

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	upto 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.

9.0 Walls and Ceiling Acoustic Treatments of Plant Rooms and A.H.U. Room

9.1 **Material**

Resin bonded glass wool of density 32 kg/cub m of 50mm thickness.

10.0 Installation

10.1 Fix 40 mm x 50 mm g.i. sheet channel at 0.5 mtr interval longitudinally then fix cross battens at1.0 mtr centre using suitable gutties, and brass screws. The battens & gutties shall be treated with fire retardant chemical before fixing.

10.2 Fill each rectangle with 50 mm glass wool wrapped in glass cloth.

10.3 Tie with 24 gauge G.I. wires at 300 mm intervals.

10.4 Then cover with 26 gauges (0.50 mm) perforated G.I. sheet having 3mm perforations at 6 mm centres. Overlap all joints and provide beading of 25 mm by 2 mm flats.

ELECTRIC WIRING

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.

2.0 Compressors Condensers/Chillers/Evaporators/Pumps etc.

2.1 Identification of materials in accordance with test certificates.

2.2 Inspection of various laboratory test certificates for physical properties and technical composition conducted on test samples of materials to be used for fabrication, forgings etc. for all important components of various equipment.

2.3 Hydraulic test for various components and assembled equipments at 1.5 times design pressure or double the operating pressure whichever is higher.

2.4 Pneumatic leak test after assemblies at design pressure

2.5 Static and dynamic balancing on electronic precision machine for rotating parts, links, impellor/crank shaft assemblies etc.

2.6 Inspection of assemblies and dis-assemblies of various parts of equipments and complete equipments themselves as desired by inspection engineer.

2.7 Noise level test for various rotating/reciprocating equipments.

2.8 Pressure drop test for condenser, chiller and evaporator.

2.9 Inspection of manufacturer's test certificates shall be supplied for all electrical motors.

2.10 Inspection of welding including welders qualifications as desired by inspection engineers.

2.11 For compressor assembly, electronic leak, air running test, pneumatic test with dry nitrogen and leak test in water.

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.

SCHEDULE OF EQUIPMENT

1.	**Air cooled Package type DX Units(indoor and outdoor unit)**	
a)	Capacity (TR)	8.5
b)	Qty (cfm)	3400
c)	No of rows of coil (Minimum)	6
d)	No. of fins/cm of coil	5

2.	**HIGH WALL SPLIT AIR CONDITIONER**	
a)	Capacity (tons)	**2TR**
b)	Air Qty (cfm)	800
c)	No of rows of coil (Minimum)	3
d)	No. of fins/cm of coil	5

3.	**WINDOW AIRCONDITIONER**		
a)	Capacity (tons)	**1.5TR**	**2TR**
b)	Air Qty (cfm)	600	800
c)	No of rows of coil (Minimum)	4	4
d)	No. of fins/cm of coil	5	5

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
1	Propeller Fans	GEC(Alsthom)/Crompton Greaves/ Khaitan/Usha/Polar
2	Window/split/ ductable AC	Carrier /Hitachi/Voltas/Bluestar/Daikin/Ogeneral
3	VRV/VRF	Carrier /Hitachi/Daikin/Ogeneral
4	Cassette Units-Chilled water based	Daikin/ETA/Media/Bluestar
5	Inline Fans	Flakt/Nicotra/Comefri/ Kruger/System Air/Ostberg
6	Electric Panel (Main)	As per electrical LT panel
7	MCB	Merlin Gerin, Legrand,Hager,Seimens,ABB/MDS Lexic
8	Earthing	JMV or as per CPWD specs.
9	MCCB/ACB	L&T(U-Power)/ GE Power (record plus)/ Siemens(3WL)/ ABB(E-Max)/ Schneider(Masterpact NW)
10	Push button starter	L&T/ GE Power/ Siemens/ ABB
11	Auxiliary Relays/Contactors	L&T/GE/ Siemens/ Schneider
12	Line Type Fuse	L&T/GE/ Siemens/ Schneider
13	Timer	Siemens/Cutler Hammer/ GEC Alsthom
14	Terminal Block	Elmex/ Comex/ HMI
15	Voltmeter/Ammeter	L&T/GE/ Siemens/ Schneider
16	Indicating lamps	L&T/GE/ Siemens/ Schneider
17	Selector Switches	Siemens/L&T/Kaycee/GE
18	Control Cables	CCI/Universal/ICC/NICCO/INCAB/ National/Rallison Cables/Tyco/Finolex
19	Power Cables	CCI/Universal/ICC/Finolex/INCAB/Rallison Cables/Polycab/RPG/Havels
20	Cable tray	Steelways,Bharti,MM.Engg,Asian ancillaries,Dolphin,MEM
21	Cable lugs	Dowells/Lotus/PEECO
22	Ducting & Grilles	
23	Factory fabricated duct	Zeco/ Ductofab/Rolastar/Technofab

24	G.I. Sheet Metal Duct	Jindal /National/ Tata/Sail
25	Spiral duct	Atco/Seven Star
26	Grilles/Diffusers/Volume Controller	Ravistar/Caryaire/Dynacraft
27	Fire Dampers UL listed	Caryaire/Dynacraft / Ravistar/Ruskin
28	Sound Attenuator	Caryaire/Dynacraft/Ravistar/Trox
29	G.I. Sheets	TATA/SAIL/Jindal/Bhushan Steel
30	Aluminium Sheets	Balco/Nalco/Hindalco
31	Stick Pins	Prima Seal/Air flow
	Insulation	
32	Expanded Polystyrene	Beardsell Ltd./ BASF/Styrene Packing/ Indian Packaging Industries/ Lloyd
33	Glass Wool	FGP Ltd./UP Twiga/Kimmco / Owens Corning
34	Polyurethene Foam	Malanpur /Superurethane
35	Crossed linked Polyethylene Foam	Trocellene / Aeroflex/Armacell/
36	Closed Cell Elastomeric Insulation	K-flex /Vedoflex/Armacell
37	Non woven fibre material	Mikron/ Du pont
38	Mineral wool	Rockwool India Pvt Ltd/ Lloyed Insulation
39	Pre-moulded PUF section for pipe & pipe supports	Malanpur/ Lloyd Inssulation
40	Fibreglass rigid Board/Pipe section	FGP Ltd./UP Twiga/Kimmco / Owens Corning
41	Aluminium Tape	Johnson/Birla 3M/Garware
42	Thermostats	Honeywell/Johnson controls/Belimo/Danfoss/Siemens/Oventrop
43	Humidistat	Honeywell/Johnson control/ Belimo/Danfoss
44	Electric Strip Heaters	Escorts/Daspass
45	Safety Thermostat for Heaters	Honeywell/siemens/Danfoss/Belimo
	Paints	
46	Enamel	ICI/ Asian/ Nerolac/ Berger
47	Bituminus	Shalimar
48	Tarfelt (for underground chilled water pipe insulation)	Shalimar
49	Sensors(Pressure/Temperature)	Siemens/Honeywell/Johnson controls/ABB/Schneider
	Miscellaneous	
50	V Belt	Dunlop/Fenner

51	Anchor fastners	Fischer/Hilti
52	Dash fastner	Fischer/Hilti
53	Welding rods	Advani/L&T
54	Wire Rope duct supporting arrangement	Gripple
55	Flexible pipe connection	Dunlop/Kanwal/resistoflex
56	Vibration isolator	Resistoflex, Dunlup, Kanwal
57	Air Ozone	Ruks/Trimed/RGF
58	Fire Sealant	Birla 3M/Hilti/Promat
59	Copper Refrigerant Piping	Diamond/Star/Rajco