

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

TENDER

FOR

**Construction of Residential Complex (Part II) for
AIIMS like Institution at Bhubaneswar under
PMSSY**

VOLUME – IV

Technical Specifications

JUNE 2011



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Tender No. HSCC/PMSSY/BHUB/HOUS/2011

Technical Specification

OF

CIVIL WORKS

TECHNICAL SPECIFICATIONS

CIVIL WORKS

1.0 GENERAL:-

- 1.01 The specifications and mode of measurements for Civil and Plumbing works shall be in accordance with C.P.W.D.specifications in force(with upto 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 latest 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 m unless specified otherwise in the drawing. The rates for different items of work shall be for floor to floor height up to 4.5 m 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, subsoil water table being high 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 Hospital authorities to maintain the smooth functioning / operation of existing hospital 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 hospital complex are properly cordoned off by means of barricades and screens up to 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 GLASS MOSAIC TILES:-

- 2.01 The surface to be covered must be perfectly dry, clean and smooth.
- 2.02 Spread the cement slurry (or jointing compound recommended by the manufacturer) on wall uniformly using toothed trowel of 2mm.

- 2.03 Apply the mosaic tile sheets, and set them in line so as to obtain a correct vertical and horizontal meeting of joints. Top the sheets with a wooden or rubber trowel to ensure adequate adhesion.
- 2.04 Wet thoroughly the backing paper with sponge.
- 2.05 Wait for water to seep across and then peel the paper off holding it by a corner.
- 2.06 Fill the joints between the tiles with a slurry of rubber latex adhesive.
- 2.07 Clean the tiles carefully with a wet sponge and subsequent with a dry rag.
- 2.08 Rate are for all height material, labour, T & P, double scaffolding. Actual surface area shall be measured for payment.

3.0 HORTICULTURE WORKS:

3.1 GRASSING

3.1.1 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.

3.1.2 SOIL :

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

3.1.3 SOWING THE GRASS ROOTS :

Grass roots (Cynodon dactylon 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.

3.1.4 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.

12.1.5 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 $\frac{1}{2}$ to $\frac{3}{4}$ 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.

3.1.6 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

3.1.7 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.

3.1.8 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.

3.1.9 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.

3.1.10 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 heeled in as soon as received or otherwise protected from drying 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 labeled. 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.

4.0 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 laying 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.

5.0 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 tack-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.

6.00 ALUMINIUM COMPOSITE PANEL METAL CLADDING

6.01 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.

6.02 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.

6.03 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 losing 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 \pm 2.0mm
Length \pm 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.

6.03.1 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.

6.03.2 Deflection

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

6.03.3 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.

6.03.4 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.

6.03.5 Water Tightness

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

6.03.6 Acoustic Treatment

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

6.04 Fixings

- a) Fasteners 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.

6.05 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.

7.00 STRUCTURAL/CURTAIN WALL SYSTEM

7.01 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, notwithstanding 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.

7.02 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.

7.03 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.

7.04 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.

7.05 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.

7.06 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.

7.07 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-curve-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 + 13mm 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 1st water-tightness test.

Hold test of wind pressure as described above.

Hold 2nd water-tightness test.

Lateral deflection test.

Water leakage at all parts of the Test Unit shall not be observed inside during the 1st 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.

7.08 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.

8.0 ACOUSTIC CELING

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

8.2 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.

8.3 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.

8.4 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.

8.5 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 sound absorption, sound attenuation, and humidity resistance, impact resistance and fire resistance as specified as per the manufacturer's specifications. The thickness of the tiles shall not be less than 15mm.The tiles shall have light reflectance not less than 83%, thermal

conductivity not more than 0.057W/m degree K and humidity resistance for at least 95% Relative Humidity and sound absorption (Noise Reduction Co-efficient) of minimum 0.90 with sound attenuation not less than 32dB. The weight shall not be less than 3.5 kg per sqm without grid. 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.

- 8.6 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.
- 8.7 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 workmanlike 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.
- 8.8 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.
- 8.9 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 interlocked 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.

- 8.10 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.
- 8.11 The main runners and the cross tees shall be 15mm x 8mm x 42 mm roll formed from G.I sheets (0.35 mm thick for main runners and 0.33 mm thick for cross tees), powder/coil coated with 6 mm wide reveal profile. The main runners and the cross tees shall not be fixed to the edge profile/ wall moulding and should only rest on the edge profile/ wall moulding. The edge moulding shall be 19 x 7 x 14mm roll-formed from 0.35 mm thick G.I sheet powder/coil coated on the exposed face to the matching colour and the shade.
- 8.12 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.
- 8.13 The entire installation shall have minimum half an hour fire rating and integrity as specified as per BS 476.

- 8.14 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.
- 8.15 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.

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.

10.0 POLYSULPHIDE SEALANT:

Material Specifications:

All moving joints in buildings, concrete highways, bridges, water retaining structures, basements, subways, culverts, airfields, etc., shall be filled with 2 part elastomeric Polysulphide sealant. It shall comply with BS 4254-1983 and shall have 25% movement accommodation when applied in butt joints.

Material properties

Property	Acceptable Limits
Mixed density	Min 1.55 kg/ltr
Pot life	Atleast 2 hours at 30 ⁰ C
Shore A hardness	16-22 after complete cure
Movement Accommodation	25% for butt joints 50% for lap joints

Tests Required:

Manufacturers QC lab certificate for all the batches of material supplied.
Testing as per BS 4254 for all the above-mentioned properties.

Application Methodology:

Joint Preparation:

1. Prepare the joints maintaining depth to width ratio as 1: 2 or as recommended by the manufacturer. Minimum width to depth ratio shall be maintained and in any case it shall not be less than 2
2. Clean the joint to remove all loose materials, dirt, rust, lacquers, grease, bitumen and its traces, mechanically using wire brush, chisel, etc. It is also recommended to use compressed air / vacuum cleaner to remove dirt or any loose materials from the joints
3. Stick masking tape on the both edges of the joint

Priming

Prime only on two sides of the properly prepared joint surface with with a brush.

Mixing:

1. The accelerator / curing agent should be mixed thoroughly and ensure that the settled solids is completely dispersed
2. Then add the accelerator / curing agent to the base and mix thoroughly with a slow speed electric mixer (300 to 450 RPM) for approximately 5-6 min or until a homogeneous, uniform grey colour material is obtained
3. **Part mixing should be avoided at site. Mix entire material at one time.**

Application:

1. POURING GRADE sealant can be poured directly into the joint. For Gun grade sealant, sealant gun shall be used.
2. Apply sealant in the prepared joint when the primer coat is TACKY carefully maintaining depth to width ratio of the joint as 1:2 (min) for a normal application. For joints subjected to skew movements the same shall be maintained as 1:1
3. Ensure that the joint is filled 1-2mm below the top surface
4. The application should not be taken up in extreme weather conditions. Preferably application shall be done when the temperature is minimum during that day
5. After the initial curing, if the cured sealant is found to have pinholes / blowholes, the same has to be repaired at the locations. In case, large surface is found to have air entrapped and pinholes, the affected section needs to be cut, removed and re-done.

Tooling & Finishing

1. Immediately after filling the joints, the sealant should be tooled either with a stainless steel or wooden spatula. While tooling, the spatula should be wetted with a wetting agent
2. During tooling ensure complete removal of air bubbles and filling of all voids by the compacting action, thus ensuring proper adhesion to the sides
3. Remove the masking tape immediately by pulling it outwardly after tooling is done

11.00 Mix Design, Batching Plant/ Ready mix Concrete

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

1.	Nominal Maximum size of aggregate	20mm angular as Per CPWD specification
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.

11.2 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

11.3 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.

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

11.5. In the event of all the four 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.

11.6. 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.

11.7. 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.

11.8. The contractor shall engage Ready Mix Concrete (RMC) producing plants (Distance of plant from site to be approved by Engineer in Charge) supplying Concrete in Bhubneshwar 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.

11.9. 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).

11.10. 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

11.11. 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.

11.12. 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.

11.13. 43 grade OPC (Conforming to IS-8112) of brand/make/source approved by Engineer shall only be used for production of concrete.

11.14. 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 EQUIPMENT RMC

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

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.

11.15. 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.

11.16 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.

11.17. 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 and the contractor shall arrange sufficient length of pipe at site to place the RMC in the minimum required time. The contractor shall co-ordinate with RMC supplier and pumps hirer to have effective concrete placement.

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

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

11.18 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.

12.00 PLUMBING & SANITARY INSTALLATIONS

12.01 All the plumbing pipe fixture shall be used in conformation with GRIHA-3 rating system of green building

12.02 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.

12.03 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

12.04 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.

12.05 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.

12.06 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.

12.07 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.

12.08 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.

12.09 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.

12.10 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.

12.11 CPVC PIPES: Chlorinated polyvinyl chloride (CPVC) of grade SDR-11 (heavy duty) pipes shall be used in the internal cold & hot water supply if specified in the Bill of Quantities. These may be required to be connected to the existing/ new GI pipes. CPVC Fittings, pipes & joint solvent should be used of same approved make.

12.12 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 along with 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.

13.00 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 (CENTRALIZED)

14.1 On the basis of sample water analysis, the Contractor shall design, supply, erect, test and commission the pre-assembled common 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 polyimide 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 for centralized RO plant .The warranty of the RO plant for individual drinking water shall be as per approved manufacturer technical details, but in no case less than 12 months warranty

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 through 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 through 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) is 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	550 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	1000 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.

14.0 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, fuses, 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 sealant 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.

15.0 PUMPS FOR HYDROPNEUMATIC & DRAINAGE SYSTEM

15.1 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.

15.2 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 hdyopnematic pumping units shall have the following features ;

15.2.1 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.

15.2.2 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 from 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.

15.2.3 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.

15.2.4 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.

15.2.5 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.

15.3 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.

16.00 FIRE FIGHTING SYSTEM

16.01 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.

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 earthing 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.

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

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

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

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.

17.02 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

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
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 fiber 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 arcing 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 prevent 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/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

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 stencilled paint marks shall be provided inside the panel/module identification of all equipment in addition to the plastic sticker labels, if provided. These labels 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 inhibitors.
- 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 deoxidate 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 spliced between terminal points.

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

Not more than 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 bear 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.

17.03 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/GI 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./GI 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 thrusts 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. DI pipe will be used in external, fire ring main as per BOQ. The pipe fittings, joints, excavation shall be measured separately for DI work.

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. rods, 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.

17.04 SPECIFICATIONS FOR SPRINKLER 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 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 be calibrated before the testing is carried out. All the leakages and defects in joints revealed during the testing shall be rectified to the entire satisfaction of the 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 dual 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 earthing 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.

17.05 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 carried 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 not strong enough to support the pipes, thereby likely to cause different settlement.
- ix. Necessary anchor block of ample dimensions in 1:2:4 cement concrete at all bends, tee connections, foot of the wet riser, and other places as required to stand the pressure thrust in pipes.
- x. Necessary masonry work/steel work for supporting hose cabinets near external (yard) hydrants.
- xi. Valve chambers of approved design with external (yard) hydrant.
- xii. Ground level hydrants of approved design, where specified.
- xiii. Cutting and making good the damages for the installation work of the riser system
- xiv. 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 pit 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 within 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 by-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.

17.06 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 Service (Fire Department) for all fire fighting installations.

17.07 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.

17. 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°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	1 No. each As per site requirements 304 Stainless Steel Rockwool/Glass wool 48 kg/cu.m

	Waterproof covering Cladding material	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 $FR (T_a) = 0.72$, $F_{ROL} = 3.62 \text{ W/Sq. mtr/}^{\circ}\text{C}$. The outer dimensions of the collector box shall be 2000 mm x 1000 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 35X35X5mm (min) or as per approved drawing, 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 arranged 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 Absorbitivity 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 0.033 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 30-80⁰C, 15A/250 VAC) shall also be provided.

18.00 LIST OF APPROVED MAKES : CIVIL WORKS

Sl.No.	MATERIALS	MANUFACTURERS
1.	Doors & Windows fixtures/ Fittings:	Everite, Hardima, Global, Crown,Earlbihari
2.	Door Closer / Floor spring	: Doorking, Everite, Hardwyn, Amar D Army, 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,National
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.	Cement	: ACC, Ultratech, Birla, Jaypee
12.	Reinforcement Steel	: SAIL, RINL, TATA
13.	Glass Mosaic Tiles	: Italice, Bizzaza. Pallidio

14. Back-up Rod. : Supreme Industries or equivalent
15. M.S. Pipe : Jindal Hisar, Prakash-Surya, BST, Kalinga, Tata
16. Polysulphide sealant. : Pidilite, Fosroc, or approved equivalent
17. Polycarbonate Sheets : GE Plastics or approved equivalent
18. Wooden/Metal Fire Check Doors : Navair, Shakti-met, Godrej, Pacific Fire Control,
Promat
19. Gypsum Board System : India Gypsum, Laffarge,
20. Sunken Portion Treatment : Roffe, Krytone, Sika,
21. Admixtures for concrete. : Cico, Vam Organics, Roffe, Pidilite, FOSROC
22. Epoxy Paint. : Nerolac, Shalimar or approved equivalent.
23. Ceramic Tiles : Johnson, Somany, Kajaria, Nitco, Bell
24. Pre-Laminated Particle Board : Novopan, Greenlam, Kitlam, Marino
25. Flush Door Shutters. : Century, Kitply, Novapan, Green Ply, Marino
26. Silicon Treatment : GE-Silicon, Pidilite, Fosroc
27. Glazed Tiles : Bell, Somany, Johnson, Kajaria, Cera,
28. PVC Water Stops : Supreme, Fixopan or approved equivalent
29. White Cement. : Birla White, J.K.
30. Powder Coating Material Pure Polyester. : Jotun, Berger, Goodlass, Nerolac
31. Masking Tapes : Suncontrol, Wonder Polymer.
32. Dash Fasteners./Anchor bolts : Hilti, Fischer, Bosch.
33. Stainless Steel Bolts, Washers and Nuts. : Kundan, Puja, Atul.
34. Stainless Steel Pressure Plate Screws. : Kundan, Puja, Atul.
35. Stainless Steel Friction Stay. : Securistyle, Earl Bihari.

36.	E.P.D.M. Gaskets.	:	Anand Reddiplex, Enviro Seals
37.	Weather Silicon.	:	Dow Corning, Wacker, GE
38.	Structural Silicon at butt joints	:	- Do -
39.	PVC continous fillet for periphery packing of Glazings /Structural glazings.:		Roop, Anand, Forex Plastic.
40.	Floor Springs.	:	Doorking, Opel or equivalent
41.	Aluminium Cleat arrangement for Glazings.	:	Deco or approved equivalent
42.	Water proofing / Injection Grouting	:	Overseas Water Proofing Corporation or approved equivalent
43.	6mm thick Reflective Glass	:	Glaverbel, Glavermas, Saint Gobain.
44.	Door Locks.	:	ACME, Godrej, Harrison, Hardima, Mobel
45.	Door Seal – Woolpile Weather Strip	:	Anand -Reddiplex.
46.	Aluminium Grill	:	Decogrille and approved Equivalent
47.	Vitrified Tiles	:	Restile , Naveen, Bell-Ceramics, Kajaria, Somani, Johnson
48.	Carpets	:	Hollitex, Standard, Mohawk
49.	Aluminium Cladding sheets	:	Alstrong , Alpolic, Alucobond, Alucomat Alu Decor
50.	Aluminium Die-cast handles & two point locking kit	:	Giesse, Securistyle, Alu-alpha
51.	Stainless steel D-handles	:	D-line, Giesse, Dorma,Hardima
52.	Fabric for Auditorium	:	ESSMA, Raymonds or equivalent
53.	Stainless Steel Pipes/Flats	:	304 Grade (as approved by Engineer)
54.	Structural Steel	:	SAIL, TATA , RINL
55.	Ready Mix Concrete	:	ACC,BIRLA, Ahlcon or approvedequivalent
56.	Antistatic Epoxy Floor	:	Fosrock, Beck, Famaflor,
57.	SBS bitumen based Self adhesive membrane		

	Material	:	Grace-Bituthene CP1.5, Texsa-Texself 1.5
58.	Acoustic Mineral Fibre	:	USG-Radar, Armstrong, 21 st Century, Acostyle
59.	Curtain wall/Structure Glazing/Hermatic seal Sliding Doors	:	Specialised Agency to be approved by Engineer
60.	Fire Panic bar	:	Briton, Monarch, Von-Duprin, Dorma, Mobel
61	Ply board	:	Greenply, Kitply, Century, Archid, Marino
62	PVC Doors (Solid Profile)	:	Rajshri or approved equivalent
63	PVC Doors (Hollow Profile)	:	Syntex, Plasopan or approved equivalent
64	PVC Flooring	:	LG, Tarkett, Responsive or approved equivalent
65	SS Railing	:	Mobel, D Line, Hardima
66	Interlocking Paver Tiles	:	Ultra, Shree or Approved Equivalent
67	Calcium Silicate False Ceiling	:	Aerolite, Hilux
68	Wall Clading Tiles	:	Ultra, Shree or Approved Equivalent
69	Acoustic Seals	:	Anand Reddiplex , Enviroseal or equivalent
70	Smoke Seals	:	Pemko or Equivalent
71	Fire rated door closer/Mortice Lock/ Door Co-ordinator	:	Dorma, Becker F.S. Australian or approved equivalent

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

19.00 LIST OF APPROVED MAKES : PLUMBING WORKS

S.No.	Materials	Relevant IS Code	Manufacturers
1.	Vitreous China Sanitary ware	2556	Hindustan Sanitary ware, Cera, Parryware, Neycer
2.	White Glazed Fire Clay Sink	771	Sanfire, Cera, Neycer, Hindware.
3.	Stainless Steel Sink		Orient, Jayna, Jaguar, Commander, Nirali
4.	Plastic seat cover of W.C	2548	Commander, Bestolite, Diplomat, Jaquar, Sona
5.	Geyser		Racold, Venus, Voltas, Usha Lexus
6.	C.P. Fittings Mixer/Pillar taps Washers, C.P. brass accessories	1795 4291/4827	Aquabaths, Othello, Jaquar, Marc
7.	Centrifugally /Sand cast iron pipes & fittings	3989/1729	NECO, HEPCO
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
10.	Gunmetal Valves	778	Zoloto, Leader,
11.	Brass stop & Bib Cock	781	Zoloto, Sant, L&K, Jaquar
12.	Ball valve with floats	1703	Zoloto, Leader, Sant, Jayco
13.	Stoneware pipes & Gully Traps	651	IS Marked pipes
14.	R.C.C. pipes	458	IS Marked pipes
15.	D.I. Manhole Covers	1726	RIF, 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

21.	PVC Rain Water Pipes.		Supreme, Prince, Finolex. Oriplast
22.	C.I. pipes Class LA and fittings, DI		Keso-spun, supra, Electro steel. Jindal, TATA
23.	Sluice valve / NRV		Kirloskar, Kilburn, Zoloto Castle,
24.	Water supply pumps	:	KIRLOSKAR, WILO, GRUNDFOS,
25.	Submersible pumps	:	KIRLOSKAR, GRUNDFOS, KSB, Mather & Platt
26.	UPVC/HDPE pipes & fittings	;	Finolex , Prince, Supreme, Oriplast
27.	Chlorinator	:	ALFA, USA, Ion exchange, Sigma DH Combine Inc.
28.	HDPE Solution tank	:	WATCON, ION EXCHANGE, Water Supply Specialist P (Ltd)
29.	C.P Flush Valves	:	Jaquar, DOCOL(Germany) marketed by GEM, Ideal Orient
30.	C.P Angle Valves, bib cock	:	Othello, Jaquar, Marc, Jainco, Rybo
31.	Infrared Sensor operated Faucets	:	Jaquar, AOS-Robo , Euronics,U-tec
32.	Gratings, Strainers, Cleanouts etc	:	Neer Brand (Sage Metals) or Equivalent
33.	Level controller	:	Femac or equivalent
34.	Drainage Pumps	:	Grundfos, KSB , Kirloskar
35.	Water / Sewage Treatment Plant	:	Thermax, Geo Miler & Co, Ion-Exchange, Aquaprocess, Akar- Impex, Polycon Technologies, FONTUS
36.	Decorative bath room fittings	:	Jaquar (Florentine range), Marc (equivalent) Aquabaths (equivalent)

37.	R.O System	:	Thermax, Aqua Process, Ion-Exchange, Akar-Impex, Polycon Technologies,Fontous
38.	PE-AL-PE	:	Kitec, Jindal, NEXGEN
39.	HDPE pipes and fittings	:	Oriplast, Polyfab
40.	Infrared Sensor operated Urinals	:	Jaquar, Euronics,U-tec
41.	Grab Bars	:	Marino or equivalent
42.	CPVC pipe	:	Ajay, Flowguard, Astral
43.	Solar Panel	:	Tata BP, BHEL, EMMVEE
44.	Copper Pipe	:	Raj Co., Maxflo
45.	Copper Fittings	:	Viega, IBP

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

20.00 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, Intervolve, C & R, Zoloto, Castle
4.	Portable Fire Extinguisher	2171	Minimax, Safex, Nitin, Firex, Ceasefire, Newage, Eversafe
5.	First aid Fire hose reels	884	Minimax, Safex, Firex, Newage, Eversafe
6.	Fire hose pipes	636	Newage, Safex, Eversafe, Jyoti
7.	Fire Hydrant valves	5290	Minimax, Newage, Eversafe, Ceasefire, Vijay, Agnice
8.	Sprinkler Heads		
a)	Pendent type		Tyco, Viking, Spray safe, HD, Newage
b)	Side wall type		Newage, Reliable, Tyco, Vikink-usa
c)	Sprinkler Side wall extended through		Spray safe, HD, Vikink-usa, Tyco.
9.	Sluice and non return/ check valve foot valve strainer		Kirloskar, I.V.C., Kilburn, Zoloto, Leader
10.	Rubber hose 12/20mm dia		Dunlop, Good year, Jyoti Eversafe
11.	Reinforced rubber lined/canvas		Newage, Jayshree, CRC, Eversafe
12.	Standby battery lead acid		Exide, Standard, Amco
13.	PVC Insulated Copper Conductor.		Finolex, Plaza, National
14.	Recessed/concealed type		Spraysafe., Reliable
15.	Horizontal centrifugal/Fire pumps		Kirloskar, Mather & Platt(WILO), Max-Flow, GRUNDFOS,
16.	Diesel engine		Kirloskar Cummins, Ashok Leyland
17.	Electric motors		Kirloskar, GEC, Siemens, NGEF, ABB

		Crompton
18.	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
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
25.	Yard Hydrant Stand Post,4 way suction	Eversafe, Minimax, Newage

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

21.00 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 from 100% 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 HSCC/CLIENT BEFORE EXECUTION OF WORK.

Technical Specifications

(Electrical works)

A.I.I.M.S HOUSING AT BHUBHNEHWAR

TECHNICAL SPECIFICATIONS

1.0 GENERAL SCOPE OF WORK

The scope of work shall cover internal and external Electrical Works for A.I.I.M.S HOUSING AT BHUBHNEHWAR. The Scope Covers Supply, Installation, Testing and Commissioning of Electrical works of the project including the following main items/systems:

- a. Internal electrification through concealed MS conduit and provide light points, fan points, socket outlets etc. including supplying, installation, testing and commissioning wiring/cablings, installation, testing & commissioning of sockets & switches.
- b. Providing MCB Distribution Boards and Panels (MDB/SDB) including submain wiring/cablings.
- c. 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.
- d. Addressable Fire Detection & Alarm System consisting of Main Fire Control & indicator Panel, Smoke & Heat Detectors, Manual Call points Hooter etc. including conduiting/wiring & cabling complete.
- e. Conduiting and wiring for Cable TV system.
- f. Lightning protection system consisting of lightning arrestor, finial, horizontal and vertical strips, test joints, earth electrodes etc.
- g. Lifts
- h. RCC/GI pipes for cable entry.
- i. External Cabling
- j. Earthing of electrical installation complete in all respect.
- k. Submission of GA drawings of electrical equipments and getting approvals from Client/HSCC before manufacturing /fabrication.
- l. Testing and commissioning of all electrical installations.
- m. Diesel Generator set with AMF/ Synchronization panel, diesel tank, chimney etc as required by PCB.

- n. Obtaining approvals from Chief Electrical Inspector, Local Electricity Supply Authority, Telecom Department, and any other statutory authorities for the complete scope.
- o. Any other works required for complete of electrical works.
- p. Contractor shall submit equipment drawings from manufacturer along with the layout etc, electrical working drawings and will get them approved from HSCC Electrical Engineer before manufacture/commencement of work at site.
- q. All equipments require factory testing, as per CPWD specifications, before dispatch to the site to be attended by the representative of HSCC.
- r. Mode of all measurement will be as per latest CPWD norms/ specifications.
- s. Guarantee period for all installations will be 12 months after handing over of installation.
- t. After all required tests and statutory approvals the handing over of all installation will be as per CPWD norms/ specifications.
- u. List of approved manufacturers is enclosed at the end of the technical specification. In the interest of work HSCC reserves the right to choose any of the approved manufacturers / make.

2.0 REGULATIONS AND STANDARDS

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

- | | | |
|----|--|------------------------------------|
| a) | CPWD General specifications for electrical works | Part-I (Internal)- 2005 |
| b) | CPWD General specifications for electrical works | Part-II (External)-1995 |
| c) | CPWD General specifications for electrical works | Part-III (Lifts & Escalators)-2003 |
| d) | CPWD General specifications for electrical works | Part-IV (Substation)-2007 |
| e) | CPWD General specifications for electrical works | Part VII (DG Sets) 2006 |
| f) | CPWD Specification/norms for measurement | Latest revision |

g)	Guide for marking of insulated conductors	IS 5578
h)	Guide for uniform system of marking and identification of conductor and apparatus terminals.	IS 11353
i)	Low voltage switchgear and control gear assemblies	S 8623 Part-1 to 3
j)	Specification for low voltage switchgear and control gear	IS 13947
k)	Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC	IS 2675
l)	Code of practice for selection, Installation and maintenance of switchgear and control gear.	ISI 10118 Part – 1 - 4
m)	Low-voltage fuses for voltages not exceeding 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 breakers	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) Power transformer

IS 2026(Part I – Part V)

In case of contradiction in specification the priority of the documents shall be as follows: CPWD/ IS specification, BOQ, drawings, Technical specifications.

3.0 INTERNAL ELECTRIFICATION OF BUILDING

3.1 SCOPE

As specified in subhead 1.00

3.2 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 installation. Electrical work in general shall also be carried out as per following CPWD Specifications with upto date amendment.

- CPWD General Specifications for Electrical Works Part-I (internal)-latest edition.
- CPWD General Specifications for Electrical Works Part-II (External)-latest edition.

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.

3.3 DISTRIBUTION BOARDS

As a general practice only pre-wired MCB type double door DB shall be used. Pre-wired DB shall have following features:

- i) Recess/ surface type with integral loose wire box.
- ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.
- iii) DIN channel for mounting MCB's.
- iv) Arrangement for mounting incomer MCB/RCCB/RCBO/MCCB as required.
- v) Copper bus bar.
- vi) Earthing terminals.
- vii) Wiring from MCB's to terminal block.
- viii) Interconnection between terminal block/ incoming switch/ bus bar/ neutral/ terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
- ix) Termination block should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
- x) Terminal block shall be made of flame retardant polyamide material.
- xi) Colored terminal blocks and FRLS wires for easy identification of RYB phases, Neutral and Earth.

- xii) Pre-wired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.
- xiii) The pre-wired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
- xiv) Detachable plate with knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.
- xv) DB shall be of double door construction provided with hinged cover in the front.

Distribution 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 9 KA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker shall be current operated type and of 30mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn't have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. EICB shall be housed within the Distribution Board.

Before procurement of Distribution Boards, MCB's, ELCB's (incomer and outgoing) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the HSCC's Electrical Engineer. The whole pre-wired unit i.e. Distribution Board, MCB's ELCB's etc. shall come from the manufactures premises/ workshop. After inspection and clearance from the HSCC's Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB of 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's Electrical Engineer.

3.4 METALLIC CONDUIT WIRING SYSTEM

3.4.1 TYPE AND SIZE OF CONDUIT

All conduit pipes shall be of approval 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 circumstance pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.

3.4.2 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 jamnuts 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 13mm to 19mm 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.

3.4.3 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.

3.4.4 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.

3.4.5 RECESS/CONCEALED 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. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. 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 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 facilities replacement of wired, 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.

3.4.6 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 metal on all sides except on the front.

3.4.7 ERECTION AND EARTHING OF CONDUITS

The conduit of each circuit of section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the 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.

3.4.8 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 5 pin type and 15 Amp socket shall be 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. Switchboards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by HSCC Electrical Engineer.

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 mean for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

3.4.9 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.

3.4.10 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.

3.5 WIRING

3.5.1 WIRES

- 3.5.2 The low voltage wiring cables shall be PVC insulated single core, colour coded, stranded Copper conductor rated for 1100 V and conforming to IS 694 and IEC 227. Conductor strand diameter and resistance of the conductor shall be in conformity with IS: 8130 – 1984.
- 3.5.3 The stranded conductor shall be made of thin strands of electrolytic copper not less than 0.25mm. The number of strands shall be suitable for the size of the cable. However the minimum number of strands shall be as follows:

Size of the Wire	Thickness of the conductor	No. of Strands.
1.5 Sq.mm	0.25 or 0.3 mm	32 or 22
2.5 Sq.mm	0.25 or 0.3mm	50 or 36
4.0 Sq.mm	0.3 mm	56
6.0 Sq.mm	0.3 mm	84

- 3.5.4 The insulation used in manufacturing the cable/wires shall be of flame retardant and low smoke generating material.
- 3.5.5 All wiring shall be done in loop in and loop out method and joints shall be made only at switches, outlets or in ceiling rose. Draw wires shall be pulled through before wiring and all wires shall be drawn only after completing conduit work. The wires shall be adequately sized for suitable current rating, taking into account the load on the circuit, de-rating factors necessary for bunching several wires and operating temperature and ambient temperature.
- 3.5.6 The wires shall be colour coded as follows:

Phase	Colour of wire
R	Red
Y	Yellow
B	Blue
Neutral	Black
Earth	Yellow Green (or) Green

- 3.5.7 The colour coding shall be maintained throughout the installation as per IEE regulations and Local Code of Practice.
- 3.5.8 Flexible cords for short extensions to the luminaries, equipment shall be with heat resistant PVC insulated copper conductors conforming to relevant Indian Standard Specification.

3.6 WIRING ACCESSORIES

- 3.6.1 Wiring accessories shall be provided as listed out in the drawings, BOQ and as directed. All wiring accessories shall be flush mounted unless otherwise approved.

- 3.6.2 The switches and sockets shall conform to IS 3854 and relevant IEC standards, supplied, complete with overlapping cover plates unless otherwise specified with shockproof rocker bars mounted in sheet boxes. Switch contact shall of silver welded to rocker arm.
- 3.6.3 The switches shall be sunk pattern where used with concealed conduit or other wiring accessories. Switches shall be quick make and break type. The distance between the edge of the switch plate and the edge of the Architrave shall be minimum 150mm as far as possible.
- 3.6.4 In general different phases shall not be allowed in one switch box. Upon an unavoidable circumstance where more than one circuit necessarily to be allowed in one-multi gang switches box, phase barrier shall be used for separating the phases/circuits.
- 3.6.5 Plate switches shall be mounted in sheet steel boxes of minimum 35mm deep with one adjustable lug to allow for variations in the thickness of plaster.
- 3.6.6 The faceplates of switches shall be fixed square and flush with the wall. The door opening positions shall be checked on site prior to locating switch positions. The switch boxes shall be located 200mm away from the door openings.
- 3.6.7 Surface mounted switches in surface conduits system shall be fitted to malleable Cast Iron or pressed sheet steel boxes with cover plates giving protection to Dollies. Watertight switches shall be fitted to malleable Cast Iron boxes with spout nipple entries or in weatherproof ABS boxes specially made for this purposes.
- 3.6.8 Dimmer switches shall be flush mounted with cover plates matching with other switch plates.
- 3.6.9 Timer switches shall be 16 Amp rated, single pole, 30 minute dial type, recess mounted and with 20000 guaranteed cycles.
- 3.6.10 Double pole switches shall be complete with Neon indicating lights mounted on the same switch plate. The Neon light shall be arranged to switch on when the switch is in the 'ON' position.
- 3.6.11 Where the light points are not visible from the switch position, the switch plates shall be engraved with the point position and the engraved letters shall be filled in black.
- 3.6.12 All switches and sockets used in the work shall be of grid type ones.
- 3.6.13 Light switches shall be rated 6A complying with IS 3854 and be suitable for operating on inductive load.
- 3.6.14 Weatherproof switches shall be used in all external or damp areas. The switches shall be made of robust UV stabilized PVC or ABS plastic. Threaded conduit entry shall be provided on the enclosure. The WP switch sockets shall be manufactured to relevant IEC standards. The ingress Protection class of the switch socket shall be IP 55.
- 3.6.15 Weatherproof light switches shall be suitable for semi flush type installation conforming to IP 55 protection. The Neon indicator fitted to the switch plates shall be wired as a locator, illuminating when the relevant switch is on off position.

- 3.6.16 The sockets shall be supplied with plug tops conforming to IS 3854. The socket shall be rated for 250V AC supply unless otherwise stated. Industrial sockets shall conform to IEC 309. All plug top pins shall be shrouded for accidental contact.
- 3.6.17 Surface and flush mounted sockets shall be 6/16A, 6 pin round type and wiring shall be installed on the ring main principle. The flush mounted 6/16A sockets shall be with single pole switches and shall be single or double gang as shown in the drawing with removable front plates.
- 3.6.18 The outlets tot the equipment shall be protected with fuse of rated capacity 6/16 amps. Flex outlet units with fuse shall be used to tapping connection to equipment.
- 3.6.19 The colour of the faceplate of all socket outlets fed from UPS power supply shall be different from normal power supply. The shade of the faceplate shall be decided in consultation with Project Manager/Engineer.
- 3.6.20 Exposed length of flexible cable for final connection to the equipment shall be as short as possible. Cables shall not be installed directly on walls/ceilings without prior approval. Cables shall be fixed on cable tray /trunking as directed by the Project Manager/Engineer.
- 3.6.21 Exposed length of flexible cable for final connection to the equipment shall be as short as possible. Cables shall not be installed directly on walls/ceilings without prior approval. Cables shall be fixed on cable tray/trunking as directed by the Project Manager/Engineer.

3.7 MOUNTING HEIGHTS FOR WIRING ACCESSORIES

- 3.7.1 The various types of wiring accessories shall be mounted at level as noted below unless specified otherwise. The levels shown shall be measured above finished floor level. All dimensions noted below other than Distribution Board shall be from FFL to the center line of the face plate.

Light switches	1400 mm FFL
Socket /Telephone/TV outlets	450 mm FFL
Bell push near the door (if applicable)	1400 mm FFL
Socket on Bench/work top	200 m above the worktop
Distribution boards	1800 mm to top of boards FFL
Flex out for Water Heater in Toilet	2100 mm FFL
Flex out let for FCU of Split AC	case may be
Flex out let for FCU of Split AC	2300 mm FFL or Ceiling mounted as the case may be
Flex out let for window AC	300 mm FFL (or at Lintel Level)

3.7.2 WIRING OF SUB-CIRCUITS

The final sub-circuits shall be wired with the following minimum wire sizes copper conducted wires unless otherwise specified. However size of the cable shall be based on the permissible voltage drop. Sub main wiring shall be carried out with 2.5 Sq.mm wire.

Lighting Circuit	2.5 Sq. single core PVC + 2.5 Sq.PVC insulated earth continuity conductor
Socket Circuits	2.5 Sq. single core PVC + 2.5 Sq. PVC insulated earth continuity conductor
20A Power outlets	4 Sq. single core PVC + 4Sq. PVC insulated earth continuity conductor
Water Heaters (20A)	4 Sq. single core PVC + 4Sq. PVC insulated earth continuity conductor

3.7.3 All lighting circuits shall be wired on a Loop-in and loop-out system using rock connectors or loop in ceiling roses as approved by the Engineer and in conformity with code of practice for Electrical Wiring Installation IS-732-1989 with latest revisions. Where the above type of terminal is not specified, the line connector shall be used at the light point terminal box or in light fitting itself.

3.7.4 Surface mounted light fittings shall be connected with heat resistant PVC insulated cables.

3.8 WIRING OF MECHANICAL EQUIPMENT

3.8.1 The electrical power requirements of mechanical equipment shall be as shown on the drawings or as specified by the equipment manufacturer / supplier.

3.8.2 The contractor shall be required to connect each of this equipment in two separate operations. First fix to local isolators for the units upon clearance by the Mechanical Installation Contractor. The second fix shall be from isolator to the equipment. Cable size and number of cable runs shall be as recommended by the equipment supplier. The wiring shall be carried-out in accordance with the manufacturer's wiring diagrams.

3.9 TESTING OF WIRING

On completion of the electrical installation work and before energizing the system all wiring shall be tested for continuity of circuits and earthing.

The insulation resistance shall be measured between earth and the whole system of conductors and any section thereof with all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured, as above shall not be less

than 50 divided by the number of points provided on the circuit, the whole installation should have an insulation resistance greater than five meg-ohms. The insulation resistance between the frame work of housing of power appliances and all live parts of each appliances shall not less than that specified in the relevant standard specification or where there is no such specification shall not be less two meg-ohms. All cabling to equipment shall be inspected at works by the Project Manager/Engineer as per relevant IS and testing & commissioning of installation as per Appendix 'E' of IS: 732-1989 shall be done and all record to be maintained.

The earth continuity conductor of power and distribution cables shall be tested for electrical continuity and resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

In a two wire system a test shall be made to verify that all non-linked single pole switches have not connected to the same conductor throught out the such conductor shall be labeled or marked for connection to an outer or phase conductor or to non-earthed conductor of the supply. In a three or four wire installation, a test shall be made to verify that every non-linked single pole is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Project Manager/Engineer as well as the Local Authority, CPWD and Directorate of Electrical Inspector.

4.0 LIGHTING FIXTURE AND FANS

SECTION – I GENERAL LIGHTING

PERFORMANCE OBJECTIVES

4.1 The objective of the lighting design development and installation shall be to provide an energy efficient, cost effective, visually pleasing environment for the occupants and other visitors. To this extent the engineer has outlined the following performance parameters for the luminaire, control gear and lamp.

4.2 LUMINAIRE

4.2.1 The contractor is to note that the design and selection of the fixture is based on the name in the approved make column. The equipment selected from a particular manufacturer's range has been specified with a view to performance, optics, maintenance, quality, aesthetics etc.

4.2.2 Manufacturer shall remain responsible for ensuing compliance with relevant standards, the accuracy of information shown on his drawings and technical details and for ensuring that the equipment offered is fulfilling the requirement of the specification.

4.3 CONTROL GEAR

4.3.1 All necessary control gear and transformers shall be from reputed manufacturer. All fluorescent fixtures shall be with high frequency electronic ballast and all low voltage fixtures shall have electronic transformers. All control gear shall be of good quality construction and shall comply to with the relevant standards and codes, shall be compatible with the lamps specified and shall be mounted and wired in accordance with the manufacturers instruction.

4.3.2 The contractor/manufacturer shall provide all the data concerned with gear losses etc to enable the dimmers and contactors to be sized accordingly.

4.3.3 Transformers used in the project shall have stable output voltage of 11.4/22.8 under varying load conditions where the output voltage is nominally quoted at 12/24V. and this shall be demonstrated, if required during testing and commissioning time.

4.3.4 All high frequency electronic control gear shall comply with relevant Bureau of Indian Standards and required type test certificates provided.

4.3.5 Where gear and transformers are installed remotely, care shall be taken to check for the voltage drop and calculations shall be provided to substantiate the cable sizes. Also care should be taken care of. It shall also be ensured that the control gears are easily accessibly and maintainable.

4.3.6 The control gear mounting must be in a gear tray and shall not be riveted to the body of the fixture.

4.3.7 All power and control wires from the control gear to the lamp shall be heat resistant type.

4.4 LAMPS

- 4.4.1 All lamps provided in the project shall be as specified. No lamps shall be operated. Other than for mock-ups/testing, prior to final inspection. First fix of lamps shall be form part of the supply of light fixtures. Lamps shall be long life high quality types.
- 4.4.2 For all low voltage reflector lamps, requirement of beam angle specified, shield characteristics, lamp cover etc shall be adhered to. The color temperature of each lamp is not specified; however the contractor shall submit details for approval before actual procurement. All similar lamps in the project shall have the same colour temperature and colour rendering properties.

4.5 The lighting in the project consists of the following areas:-

- Internal Lighting - Building

- 4.5.1 The contractor shall coordinate the luminaire selection and locations as shown on the Drawings and Schedule.
- 4.5.2 The main emphasis on the internal lighting in the terminal building is the arrival and departure concourse and departure area on first floor. In view of the building profile general lighting is proposed with down lighters recessed in the building structure. The contractor shall not the particular design intent and the features of the specified fuxtures and adhere to the complete design intent.
- 4.5.3 Pole top light fittings are also proposed in the terminal building to fit up the dark patches, which is forming due to the profile of the roof.
- 4.5.4 The mechanical and electrical plant rooms shall be provided with normal fluorescent, industrial type fixtures as specified.
- 4.5.5 CONTROL REQUIREMENTS
- 4.5.6 All details of the control are mentioned / marked in lighting layout drawings.
- 4.5.7 The contractor shall obtain a writing approval from the Engineer on the control/switching philosophy prior to installation.

4.6 Approval

- 4.6.1 The contractor shall submit the catalogue along with model number of the light fittings proposed, for approval to HSCC against each item of BOQ. The contractor shall procure the item (luminaries etc.) only after approval from HSCC.

4.7 INSTALLATION

- 4.7.1 The contractor shall coordinate with site condition to check/verify the recess depth before procurement of the luminaries. No claim shall be acceptable for non-coordination at a later stage and any replacement of the fixture due to lack of depth or other conditions shall be borne by the contractor and a new fixture to fit in the suitable space shall be provided. Any delay and costs arising out of this shall be the responsibility of the contractor. The contractor

shall intimate the Engineer of any problems related to the installation of the fixture prior to the procurement and a suitable decision for the same shall be provided.

- 4.7.2 All transformers and remote control gear shall be located in such a way that they are accessible for maintenance and shall be as close as to the fixture and in a ventilated space.
- 4.7.3 Compatibility of all transformers and control gear shall be the responsibility of the contractor.
- 4.7.4 Where false ceiling is provided the mounting height shall be the false ceiling bottom and in the case surface mounted light fittings the height shall be to the approval of the Engineer.

4.8 SUPPLEMENTARY STEEL, CHANNEL AND SUPPORTS

- 4.8.1 The contractor shall furnish and install all supplementary steel, channels and supports as required for the proper installation, mounting and support of all lighting fixtures and electrical equipment as required. These supports shall be independent of any other supports. Supports of suspended ceiling shall not be used for fixing light; instead independent supports shall be used.
- 4.8.2 All such steel shall be post galvanised unless otherwise approved by the Engineer for specific locations.
- 4.8.3 Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Engineer's Representative prior to the installation of same.
- 4.8.4 The Electrical Contractor shall coordinate with the civil contractor for the fixing of additional steel supports and submit a shop drawing for the Engineer's review and Approval.

4.9 PROTECTION

- 4.9.1 All equipments shall be suitable protected to ensure preservation during transportation to the site and any subsequent storage within the site or outside. All vulnerable finished parts liable to scratching or other abrasion during handling shall have further protection by removable film. Any reflector seen installed in site without this protective film shall be rejected and any damage with respect to scratches, fingerprints etc to the reflector shall be made good or a new reflector shall be procured by the contractor. This protective film shall come as a standard with the manufacturer and no site adhesiveness of this film is acceptable.

4.10 GUARANTEE

- 4.10.1 All equipments and components supplied shall be guaranteed against failure due to poor workmanship, material, luminaire design for a period of not less than 12 months from the date of handing over.

5.0 LOW VOLTAGE SWITCH GEAR

5.1 DISTRIBUTION BOARDS

- 5.1.1 The distribution boards shall consist of steel unit manufactured in accordance with IS 8623 and IEC 439 capable of accepting full range of plug in type miniature circuit breakers.
- 5.1.2 The Bus-bar rating shall be adequate to cater for required load. Incoming RCCB of distribution boards shall be 100mA/30mA sensitivity for power and lighting as suggested in the drawing/BOQ. Outgoing SP/TP MCBs shall be of adequate rating. All final circuits shall be protected with MCBs.
- 5.1.3 Phase and circuit identification label shall be provided. Neutral and earth bars shall be provided. Neutral and earth bars shall be provided with adequate capacity to enable termination of neutral and earth of sub-circuits in the same order as that of connected to MCBs.
- 5.1.4 It shall be fitted with insulating barrier to prevent accidental contact. Barriers shall also be provided between phases. The degree of protection shall conform to IP 42 for indoor and IP 55 for outdoor applications.
- 5.1.5 The enclosure shall be rigid sheet steel construction, electrostatically painted with epoxy resin and having removable end plates with knock-outs to facilitate conduit terminations.
- 5.1.6 All spare MCB positions shall be fitted with blank plates supplied by the manufacturer.
- 5.1.7 The boards shall have a one-piece front cover with hinged lid of a size to suit the number of MCBs.
- 5.1.8 The distribution boards shall be firmly fixed flush to the structure in an approved manner.
- 5.1.9 The top of the boards shall be 1800mm from finished floor levels unless otherwise shown on the drawing or directed by the Project manager/Engineer.
- 5.1.10 The bunching and dressing of the cable/wires in DBs shall be done in a neat and approved manner. All outgoing wires shall be provided with circuit identification mark with number/letter ferrules.
- 5.1.11 Neat typewriter circuit charts shall be kept inside non-flammable pockets securely mounted on the distribution boards. The charts shall contain details of outgoing circuit numbers, MCB rating, area served and cable sizes.

5.2 MINIATURE CIRCUIT BREAKER (MCB)

- 5.2.1 The miniature circuit breakers shall conform to IS 8828-1996. The miniature circuit breakers shall be single pole/triple pole or 4 poles as specified and shown in the drawing / BOQ. The breaking capacity of MCBs shall have minimum 10 kA. The tripping characteristics shall conform to classification C.

- 5.2.2 The MCB shall be plug in type with individual locking off facility, automatic trip reset facility and a common trip bar on TP MCBs. The MCBs shall be suitable for using as incomer circuit breaker or as an isolator.
- 5.2.3 MCBs shall be with Trip free mechanism and toggle with positive contact indication.
- 5.2.4 The MCB shall have self-wiring contacts with full size silver tungsten alloy contacts.
- 5.2.5 Indications ON/OFF shall be moulded into MCB.
- 5.2.6 Electrical endurance of the MCB shall be not less than 20,000 operations.
- 5.2.7 Power loss per pole shall be in accordance with IS and the same shall be furnished by the manufacturer.
- 5.2.8 MCB used for controlling the lighting and general power circuits shall be with tripping characteristics of 'C' curve where as MCBs used to protect UPS circuits or control transformer circuits shall be with tripping characteristic of 'D' curve.

5.2.9 Residual Current Circuit Breaker (RCCB)

- 5.2.10 RCCB used in the work shall be in conformity with IS12640-1988/IEC1008. The short circuit withstands capacity of the RCCB without the associated short circuit/overload protection shall be not less than 3kA. The sensitivity of the RCCB shall be as specified in the drawing or in DB schedule.
- 5.2.11 There shall be clear identification of earth fault or short circuit fault on the RCCB.
- 5.2.12 The RCCB shall be suitable for SMPS loads (i.e. the unit be unaffected by the d.c pulsated components, harmonics etc, lighting, line disturbances due to other equipment) and should not give nuisance tripping.

5.3 MOULDED CASE CIRCUIT BREAKER (MCCB)

- 5.3.1 Moulded case circuit breakers shall be current limiting type with isolation mode and fully conforming to IS: 13947 part 1 and 2 and IEC 947-part 1&2. The MCCBs shall be suitable for continuous duty at full load current and load reversibility with out duration. The minimum short circuit rating shall be follows:

At LT panel level incoming & out going 50KA at 415 V
At MV Panel incoming 32 KA at 415 V
At MV Panel outgoing 25 KA at 415 V

- 5.3.2 Breakers shall be provided with trip-free operation. On over load and short circuit protection and release shall be provided. The breaker shall be provided with adjustable setting facility for over load and short circuit condition and over load setting shall be with in a range of 60% to 100% of the normal current rating where as short circuit setting shall be with thermal and magnetic tripping mechanism and protection shall be activated and break the contact

instantaneously. All contacts inverse time and instantaneous over current tripping elements. Multi-pole breakers shall have a single action operating mechanism.

- 5.3.3 All breakers must be temperature compensated so that the operating and tripping characteristic are unaffected by the variations in ambient temperature.
- 5.3.4 The breakers shall be provided with overload and short circuit adjustable setting facility. Over current setting shall be from 60% to 100% of the nominal current (in) where as short circuit protection from 2 to 10 times of the set current. The feature shall be available for all breakers above 50 A rating.
- 5.3.5 MCCBs with rating 400A and above shall be provided with microprocessor control releases and a O/c, S/C or E/F tripping shall be indicated by LED. The MCCBs above 400A rating shall be with microprocessor control release and with electromagnetic compatibility and thermal memory.
- 5.3.6 All circuit breakers with a rating of 200 amps and above shall be the interchangeable thermal magnetic trip release Assembly.
- 5.3.7 The MCCBs shall suitable for coordination of over-load & short-circuit tripping with the upstream and downstream and downstream circuit breakers to provide Total Discrimination.
- 5.3.8 All MCCBs shall be provided with rotary handle unless or other stated.

5.4 AIR CIRCUIT BREAKER (ACB)

- 5.4.1 Air Circuit breakers are proposed for electrical isolation and protection of the circuits. In air circuit breaker, protection shall be in the forms of thermal magnetic device or residual current operated tripping device. The breakers shall be provided with isolation and should be clearly indicated on the front facia of the breaker. The circuit breakers shall be manufactured to IS 13947-part 1&2 and IEC 947-part 1&2 for circuit breakers. The Circuit breaker shall be provided with contacts wears indication.
- 5.4.2 The breaking Capacities shall be 50KA at 415 V.
- 5.4.3 Over load protection range should be suitable for 0.5 – 1 times the In. Short – circuit protection shall be 1.5 to 10 times the set current (Ir) with time delay Inst. to 0.4 sec.
- 5.4.4 Earth fault protection shall be suitable for a range of 0.2 in to 0.6 in with adjustable threshold settings and time delay setting ranging from 100ms to 400ms.
- 5.4.5 Over current, short circuit and earth fault tripping shall be indicated on the microprocessor control facia.
- 5.4.6 There shall be built in LCD display ammeter as a feature in the breaker. Zone selective interlocking facility shall also be provided. The feature shall be provided for both short circuit & Earth faults to offer time discrimination between breakers through out the system there by ensuring faster fault clearance and reducing thermal/dynamic stress.

- 5.4.7 The microprocessor release shall be provided with a memorized temperature rises feature to optimize the protection of the equipment or the circuit conductors in the event of repeated overloads or faults.
- 5.4.8 Internal overheating of the microprocessor control unit shall be signaled by self monitoring alarm.
- 5.4.9 The release shall have push to reset button for anti-pumping function.
- 5.4.10 Air circuit Breakers shall be provided with a communication port to connect the system to BMS if required.
- 5.4.11 The operating mechanism of the ACB shall be with spring charged mechanism. Closing spring charging shall be with the help of manual crank mechanism. The trip spring charging shall be automatic by action of closing spring assembly. The breaker shall be provided with mechanical 'ON' 'OFF' indication.
- 5.4.12 All Air circuit breakers used in the work shall be of electrically draw out type unless other wise stated.

5.5 USED DISCONNECT SWITCHES / SWITCH DISCONNECTOR FUSES

- 5.5.1 Disconnect switches shall be of heavy duty, single throw, fusible type as shown on the drawings, and shall be manufactured in accordance with IS 13947 Part – 3.
- 5.5.2 Switches shall be suitable for continuous operation at rated current on 415 volts 3 phase 50 Hz. power supply. Sizes and number of poles shall be as shown on the drawings or as required for the load served. The incoming terminals shall be fully shrouded with adequate cable spacing. Enclosures shall be of the suitable IP classification with respect to specific locations.
- 5.5.3 The opening mechanism shall be quick make quick break with external operating handle mechanically interlocked with the enclosure cover. The interlock shall in such a way that it is necessary for the disconnect handle to be in the "OFF" position for normal access in conformity with ISI 3947-Part 3.
- 5.5.4 Enclosures shall have provisions for locking the operating handle in the OFF position. Position of disconnect shall be clearly indicated on the enclosure.
- 5.5.5 The neutral link shall be of detachable type allowing case of testing.
- 5.5.6 The gland plates on top and bottom sides shall be removable types for cable access and termination.
- 5.5.7 The short circuit withstand current (Icw) for 1 second shall be as follows:

Switch rating (A)	40/63	100/160	250	400	630	1000
Icw (kA eff)	3	5.5	8.5	12	25	35

- 5.5.8 The switches shall be tested to with stand an impulse voltage of 8 kV.

5.6 PANEL BOARDS

- 5.6.1 The panel shall be suitable for operation on a 415-volt, 3 phase, 4 wire, 50 Hz. Earthed neutral supply, and capable of withstanding a symmetrical fault condition of 50kA for 1 second.
- 5.6.2 The L.V. Panel Boards shall be totally enclosed, dust and damp protecting construction, free standing, consisting of vertical sections, housing MCCBs, ACBs or Switch Fuse Units/Switch Disconnecter Fuses, as specified, assembled onto common Busbards. The equipment shall be designed, constructed and tested in accordance with the latest relevant Indian Standard Specifications and shall be constructed to IP 43 rating.
- 5.6.3 The modular cubicle type boards shall be constructed from minimum 14 SWG sheet steel folded and braced as necessary to form right enclosures and be complete with removable bus bars gland plates. Front panels shall also be removable for ease of wiring and lockable-hinged doors are fitted to each panel.
- 5.6.4 Where the panel is located in hazardous areas, its design shall be upgraded to meet Division I requirements. These requirements shall apply to the following sections.
- 5.6.5 The panel shall be front access freestanding or wall mounting type to suit the site and application conditions. There shall be at least minimum 50-mm clearance between the base of the cabinet and the connection lugs of the incomer switchgear. There shall be adequate space in front of the panel for working and for any withdrawal sections. Ingress protection of the panel boards shall be IP 40.
- 5.6.6 The boards shall be free standing or wall mounting, as required and suitable provision shall be made for the method of fixing.
- 5.6.7 The main panel board shall be compartmentalized from IV construction and shall be dust and vermin proof. The board complete with bus-bar and bus-bar supports shall be in conformity with IS 13947 Part-3 and shall be suitable for an interrupting capacity of 50kA. The bus-bars shall be shrouded with PVC heat shrinkable sleeves and colour coded for phase identification. Vertical and horizontal bus-bar sections shall be provided as needed. All inter connection between main and sub bus-bars and out going switchgears shall be done with solid Aluminum conductors of appropriate current rating. Main panel board shall be extensible type.
- 5.6.8 The sub-main boards shall be free standing or wall mounting as the case may be and the interrupting capacity of the board shall be 40kA. Bus-bars shall consist of four high conductivity aluminium conductors of equal cross section, mounted on insulated pillars and rated in accordance with the details given on the drawings.
- 5.6.9 The earth bar shall be minimum 50x6mm size running the full length of the switch board and bolted to the supporting frame so as to make good electrical contacts. Solid copper bonding as per code practice for earthing shall be connected between earth bar and each incoming and outgoing cable armour clamp, gland plate or earth tag washer.
- 5.6.10 Each section shall be provided with a cable alley for termination of out going cables.

5.6.11 Cable manager system shall be provided in the compartment/cubical for facilitating control cabling between and within the compartments.

5.6.12 The spare ways if any, shall be provided blanking sheets supplied by the manufacturer.

Operating handle of the highest should not be less than 0.7 mtrs & more than 1.8 mtrs.

5.6.13 Panel boards shall be finished with powder coat of approved shade. The cleaning and protection of the MS sheet work be done in 7-tank process before the final powder coat of application.

5.7 INSTRUMENTATION

5.8

5.8.1 Ammeters and voltmeters shall have moving iron spring controlled dead-beat elements, in square bezel, flush type cases, 96 mm in size, and suitable for panel board mounting. Meters shall conform to IS 6769 Part 1 and shall have grade 'A' accuracy. Scale range shall meet with the requirements and shall be as indicated on the drawing or in the schedule of quantities. In the case of CT operated ammeters class of accuracy of CTs shall be 0.5 to 1 and protective class shall be 5P10.

5.8.2 CTs used in the work shall be resin cast bar primary or wound primary as the case may be and shall be in conformity with IS: 2705-1992 or IEC 185-1987. The short time rating of the CT shall be 50 KA for one second. The burden of the CT shall be suitable for the application.

5.8.3 Energy meters shall be two element switch board mounting type suitable for unbalanced loads. Meters shall incorporate as KW/KVA maximum demand meter with an integration time of 30 minutes. Meters shall conform to IS 11426.

5.8.4 The indication lamps used in the panels shall be of LED type. The lamp holder shall be made of fire retardant ABS plastic and with polycarbonate coloured lens. The size of the unit shall be not less than 18mm. The lamp unit shall be in conformity with IS: 9000 and IS 13947 parts 1 and part 5.

5.8 THERMAL OVER LOAD RELAY

5.8.1 Thermal overload relay used in the circuit with contactor shall be in conformity with IS: 3842 part -2 – 1966 and it shall withstand insulation test to IS: 12083 part 2. The relay shall be provided with adjustable current settings and with a provision of sealing the same to make it tamper proof.

5.8.2 The relay shall have built in single phasing protection and phase unbalance protection as per IEC 947 – Part 4.

5.8.3 The relay shall have in built NO & NC contact.

5.8.4 The thermal over load relay shall be suitable Copper/Aluminium termination, with a maximum permissible temperature rise of 65°C, at the terminals, with maximum ambient temperature of 45°C.

5.9 INDICATION LAMPS

The indication lamps used in the work shall LED Type with protection against electromagnetic interference and over voltage. The lamps shall be suitable for operation on 240 volts. Ingress protection class of the lamp unit shall be IP: 65. The indication lamp unit shall be in conformity with IEC: 947 part 5 Section 1. The dia of the lamp shall be not more than 22 mm.

5.10 PUSH BUTTONS

5.10.1 The push buttons shall be in conformity with IEC: 947 Part – 5 Section 1 suitable for manual operation. The ingress protection class of the unit shall be IP 65. The push button units shall be suitable for operation on 240 Volts and the contacts shall be rated for 3-5 amps on 240 volts. The colour of push buttons shall be as follows:

- Start PB - Green
- Stop PB - Red
- Test PB - Black
- Reset PB - Yellow

5.10.2 The Diameter of the push button shall not be more than 22mm.

5.11. TESTING AND COMMISSIONING

5.11.1 All switch panels and panel boards shall be tested with 1000V insulation tester and the insulation value between the live conductors and frame (ground) should not less than 20 megohms. High voltage impulse test shall be conducted on the main and sub-main panel board. High voltage impulse test shall be conducted at the factory where the panel boards are manufactured.

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 joining and sealing shall be strictly followed.

6.2 MATERIAL

The L.T. power cable shall be PVC insulated PVC sheathed type aluminium conductor armoured cable shall be PVC insulated PVC sheathed type copper conductor unarmoured cable conforming to IS: 1554 : 1988 (Part-I) with upto date amendments.

6.3 INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, and masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and / or as per the direction of Engineer – in – charge. Cable laying 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 utilization 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 jocks 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. Cables 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 preserve. 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. Insulations, 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 cables 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 crossing 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 1000mm.

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 surface, 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 2500 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 centers. These shall be designed to keep provision of some spare capacity for future development.

CABLE 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 cables.

- a. Before laying
- b. After laying
- c. After jointing

Along with the test as prescribed in IS Code, cross sectional areas shall also be checked.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charges.

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.

8.0 CABLE TRAY

8.1 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 250mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted to the desired lengths.

8.2 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 galvanized 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-bracing between them by 50mm x 5mm flats welded/bolted to the angles at 1m spacing. 2 mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

- 8.3 Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works – Part – II – External, 1995.
- 8.4 The jointing between the sections shall be made with coupler plates of the same material and thickness at 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.
- 8.5 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 -1995. The sizes shall be specified considering the same.
- 8.6 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.
- 8.7 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 – 1995). 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.
- 8.8 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 – 1995. 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.

- 8.9 The entire tray (except in the case of galvanized 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.
- 8.10 The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.
- 8.11 The cable trays shall be measured on unit length basis, along the centerline of the cable tray, including bends, reducers, tees, cross-joints, etc, and paid for accordingly.

9.0 ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM

9.1 SECTION – FIRE ALARM SYSTEM

1. SYSTEM OBJECTIVE

9.1.1 PERFORMANCE OBJECTIVES

The Contractor shall supply, install, test and commission an intelligent analogue addressable Fire Detection and alarm system. The fire alarm system shall be based on the fire evacuation procedures. The system shall comprise of but is not limited to : fire detection and alarm; an voice evacuation alarm and fire fighter's telephone system, smoke control & elevator recall slave alarm panels: including all loop cabling, network cabling, outputs to and inputs from other systems and any other components and accessories required for a safe reliable system. The system and all the components shall conform to the recommendations of the following standards:

- NBC
- Bureau of Indian Standards Specification
- NFPA Guide lines
- Local Fire Regulations

9.1.2 In case of fire, the following actions shall occur:

- Identification of the Zone, location and type the device originating the alarm
- Evacuation signal in zone of incident and adjacent zones.
- Alert signal in remaining parts of building.
- Evacuation signal throughout the building
- Activation of visual strobes
- Unlocking of electric door locks in designated escape routes.
- Release of fire and smoke doors held open by magnetic door holders.
- Recall of all lifts to the ground floor and in case of fire in the ground floor it shall return to first or another predetermined floor.
- Closing of smoke dampers in air ducts of system serving zone where alarm was initiated.
- Recording of the event in the system memory.
- Initiate operation of smoke management system.
- Operations of smoke curtains.
- Activation of any other interface deemed necessary by CDA or the Engineer.

9.1.3 The Contractor shall ensure all system components offered should be manufactured by one of the manufacturer who is approved by the Local Fire Officer and Airport Authority of India.

9.1.4 The main fire alarm control panels and all initiation, detection and alarm devices and shall be located in the security room as shown on the schematics and layout drawings.

9.1.5 Coordinate and interfaces with other systems including but not limited to the following:

- Fire Suppression System
- BMS
- Telecom
- Access Control
- Lifts

9.1.6 Fire alarm zoning shall be coordinated with fire compartments, Public Address system, HVAC, smoke management and fire extinguishing systems.

The contractor shall submit a “cause and effects” schedule for Engineer’s approval:

9.2 PARAMETERS

9.2.1 The installation shall be designed, installed, tested and commissioned by an experienced installer having a minimum 5 years of experience, who is an authorized and certified representative of the fire alarm system manufacturer for both installation and maintenance of units required for this project.

9.2.2 Demonstrate that installer has satisfactorily completed at least 2 system installations similar in design and extent to that indicated for this Project shall be certified to ISO 9000 and with a record of successful in-service performance.

9.2.3 The manufacturer shall be experience in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance and shall be certified to ISO 9000.

9.2.4 Obtain fire alarm system components through a single manufacturer.

9.2.5 Compliance with Local Requirements: All fire alarm equipment, material devices and assemblies used on this Project shall be acceptable to Local Fire Office and AAI, listed and/or labeled by an accepted testing laboratory for the specific purpose for which they are used. This equipment must not be altered, installed or modified, in any way, to alter or void the label or listing.

9.2.6 Codes and Standards: Comply with the following:

NBC

Bureau of Indian Standard Nos. 2189 and 11360

NFPA 72, “National Fire Alarm Code”.

NFPA 101, “Code for Safety to Life from Fire in Building and Structures”

- 9.2.7 All components of the fire alarm system including system hardware and software shall be ISI certified or UL listed.
- 9.2.8 The cabling for the fire alarm system shall be carried out in Steel/GI conduit by using FRLS cable.
- 9.2.9 The Contractor shall obtain and submit a written undertaking from the manufacturer that the spare parts of the system to be installed shall be made available for emergency replacement upon request for a least 10 years from the date of substantial completion.
- 9.2.10 System shall be capable for withstanding the project environmental conditions as specified without mechanical or electrical damage or degradation of operating capability.
- 9.2.11 The system shall be designed for operation on 24v D.C. Supply.
- 9.2.12 Facilities shall be provided to constantly monitor and check the following circuits and fault conditions:
- Loop short circuit
 - Loop open circuit
 - Addressable device failure
 - Device not responding
 - PSU (Power Supply Unit) fault
 - Battery fault
 - Auxiliary wiring open circuit
 - Sounder wiring short circuit
- 9.02.13 Provision to increase number of devices in the future by 25 percent above those indicated without adding any internal or external components or cable conductors.
- 9.02.14 System software shall be suitable for standard and open protocols. Carry out Software integration with other specified systems including Fire Alarm itself through a standard protocol such as Lanworks and Bacnet. The system shall be suitable for BMS integration.

9.3 SYSTEM DESCRIPTION

- 9.3.1 The fire detection and alarm system shall be designed to facilitate accurate identification of the source of heat / smoke/ fire in their early stages to minimize occurrences of false alarms due to faulty equipment, electrical transients, system faults etc.
- 9.3.2 Automatically detect and report open circuit, short circuit, and ground fault of wiring for initiating device, signaling line, and notification-appliance circuits. System shall detect ground fault by panel, loop circuit, and group of devices.

- 9.3.3 Automatic alarm response functions resulting from an alarm signal from 1 zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal has the highest priority. Supervisory and trouble signals have second and third level priority. Higher priority signals take precedence over signals of lower priority, even when the lower priority condition occurs first. Annunciate and display all alarm, supervisory and trouble signals regardless of priority or order received.
- 9.3.4 A signal on zone shall not prevent the receipt of signals from other zones.
- 9.3.5 All system components and devices shall be connected to a two wire loop circuits with short circuit isolation provided or in compliance with the recommendation of the system manufacturer.
- 9.3.6 All devices i.e. Sensors, break glass points, repeater panels if any, interface units etc. shall be installed on the same loop.
- 9.3.7 All devices shall be assigned a maximum of 32-character alphanumeric address. In case of fire, fault or warning, the address of the device-sensing threshold shall appear on visual display unit of the panel.
- 9.3.8 Any event i.e. Fire, fault or warning shall be recorded with time, date and place of occurrence in the memory of FACP. These events can either be displayed on CPU/Monitor or printed, as required.

9.3.9 Fire Alarm Control Panel

- 9.3.10 Provision shall be made at the fire alarm control panel to silence the alarm sounders but the visual indication shall remain until the system is reset on the main control panel.
- 9.3.11 Provision shall also be provided at the main fire alarm panels to operate any particular sounder or a group of sounders in alert or evacuate mode.
- 9.3.12 The sensors/detectors shall be capable of full digital communications using both broadcast and polling protocol. Each sensors shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patters and combines different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.
- 9.3.13 Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter stored in the detector head. Distributed intelligence shall improve response by decreasing the data flow between detector and Analogue loop controller.
- 9.3.14 Sensitivity shall be automatically variable of each detector as required, by time zoning whereby sensors can be programmed to respond at different sensitivities relative to any time of day, and any day of week.

- 9.3.15 Facility to operate individual sounder and group sounders.
- 9.3.16 In the analogue addressable mode, adjustable per and full alarm thresholds shall be settable.
- 9.3.17 Once a pre-alarm threshold has been reached, a signal shall be sent to designated locations, alerting those responsible for system monitoring that potential for a fire incident may exist.
- 9.3.18 When the full alarm threshold is reached the system shall automatically provide warning signals to pre-determined areas of the system, facilitating an orderly evacuation of those areas affected.
- 9.3.19 A day/night operation shall be included which can provide a de-sensitized level of detection during the day and full sensitivity during night operation.
- 9.3.20 Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long-term and 4 hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value.
- 9.3.21 Continuous monitoring of detector condition shall be provided to maintain the level of building safety, simplify routine testing and maintenance procedures and minimize the potential for false alarms.
- 9.3.22 A Fire Alarm panel shall be provided with a Flush Mounting mimic panel indicating the fire zones, located in the security room on ground floor, which will indicate zone areas for quick identification of affected area by the Fire officer of AAI. Mimic diagram provided shall clearly indicate the whole building in plan and identify each floor independently. The Mimic panel shall be of polished stainless steel. The Contractor shall submit to the Engineer full details of such Mimic Diagram for approval prior to their installation.
- 9.3.23 The Fire Alarm Panel shall be installed with all the necessary component parts including warning sounders and lights, manual release stations etc. to form a complete stand alone system which shall continue to operate fully from a standby sealed lead acid battery in the event of a mains power failure.
- 9.3.24 Main concourse, check-in hall, immigration hall, toilets, utility rooms, plant rooms, common corridors, lift lobby and the passage within the building shall be provided with alarm sounders.
- 9.3.25 Sequence of activation of sounder and speakers shall be to the requirement of Local Fire Regulations and also to the approval of the Engineer.

- 9.3.26 Contractor shall incorporate all necessary interface units, fire resistant cabling between interface units and the equipments to be interfaced, required containment etc to comply with the above.
- 9.3.27 The system shall also be interfaced with the sprinkler flow switch which when operated shall initiate a fire condition. Sprinkler valves when closed shall report a fault condition at the fire alarm panel and graphics command center.
- 9.3.28 For both the wet riser and sprinkler pump system separate alarm shall be indicated for electric pump, diesel pumps and jockey pumps. For the jockey pumps adjustable time delays shall be incorporated to allow the pump to maintain the system pressure without alarm.
- 9.3.29 On receipt of the signal, the system should be able print the event life fire condition, fault condition etc. and also identification of the zone, device, and function. The date and time of the event should be able to record and print.
- 9.3.30 The Alarm Panel Alphanumeric Display shall be in Plain-English-language and the Descriptions shall denote alarm, supervisory, and trouble events, and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information and data from the system's historical memory.
- 9.3.31 System shall be able to report a map of all initiating devices connected to the system in conformation with "As-Built drawings".

9.4 ACCESSORIES

All accessories used in the work shall be suitable for connecting to an analogue addressable type fire alarm control panel except fire alarm bell or an electronic hooter.

9.4.1 Break Glass Units

Break glass units shall be press glass types of flush mounted pattern with hinged protective cover. The unit shall be finished in red colour. The enclosure shall be suitable for conduit entry from above, below or rear. Terminals shall be provided for normally open or normally closed operation and shall be suitable for accepting cables upto 4mm² cross sectional area and shall be suitable for continuous load of 10 amps at 240V AC or 8 Amps at 12/24 volts DC. Break glass units for wet applications shall be rated to IP-66. In all break glass units instruction shall be inscribed in English.

9.4.2 Smoke Detectors

- 9.4.2.1 Smoke Detectors shall be of surface mounting type suitable for latching on to a pre-wired base that in turn is mounted on conduit box of 51mm diameter. Local LED indication of the operation shall be provided and the facility for connection of a similar remote indication shall

be included. Where smoke detectors are specified for ducted air sampling system, the sampling equipment shall form a standard accessory.

9.4.2.2 Smoke detector shall meet the requirements of BS 5445 and shall be of Ionization Chamber of Optical Type as shown Ionization Chamber smoke detector shall incorporate a dual ionization chamber which the air is ionized by a single radioactive source. The pressure of smoke in the chamber shall cause a change in balance voltage that is sensed by the encapsulated electronic circuit. When preset threshold has been exceeded, an alarm signal is give.

9.4.2.3 The design shall ensure good compensation for atmospheric pressure and temperature and shall be insensitive to the effect to of dirt deposited on the radioactive sources.

9.4.2.4 Optical type smoke detectors shall incorporate asymmetrical sampling chamber to allow easy entry for slow moving smoke whilst greatly reducing the possibility of unwanted alarms caused by dust contamination. The design and signal processing techniques employed shall stop unwanted alarms caused by very small insects. The unit shall be designed to operate on the basis of light scatter due to presence of smoke.

9.4.5 Heat Detectors

The heat detector shall be designed in conformity with the requirements of BS 5445, It shall consist of two electronic temperature responsive elements mounted on a ceramic substrate to that one element is in immediate contact surrounding air whilst the second is in contact through a slower heat path. In rate of rise detectors large and sudden temperature rise shall cause the detector to switch to the Alarm State. A fixed temperature limit shall also be included so that when the temperature reaches a preset limit, the detector shall switch to the Alarm State irrespective of the rate of rise heat detectors or fixed temperature heat detectors shall be based on the requirements of design and as approved by the Project Manager/Engineer.

9.4.6 Alarm Bell

Alarm bells shall be of 152mm diameter and have approved manufacture and model. It shall be surface mounted at 2400mm height. The sound intensity shall be 90 dB at 3 metre distance.

9.4.7 Approvals

9.4.7.1 Submit the following documents for Engineer's approval. These drawings/details shall be coordinated with all other services and shall be in full compliance with the relevant details given in mechanical and electrical specification.

9.4.7.2 The Contractor shall submit the fire alarm scheme in a fully dimensioned working drawing showing all details like location of the Fire Alarm Control panel, detection devices etc. to the Local Fire Officer for his review and approval.

9.4.7.3 The Contractor shall prepare shop drawing in 1:100 scales showing all peripherals with label reference and exact routing of cabling, wire-ways, and detection and evacuation zoning for Engineer's Review and Approval.

9.4.7.4 Operating Instructions shall printed and mounting at the Fire Alarm panel locations.

9.4.8 Testing, Commissioning and Handling Over

9.4.8.1 The Complete installation shall be tested and commissioned by the equipment manufacturer or his representative and the Contractor shall demonstrate the operation of the system to the Engineer and the Client's personal and shall be to their approval. The Contractor shall obtain certificates from the Local Fire Officer to the effect that the installation as a whole complies with the requirements of the Regulation and NOC issued prior to the commencement of the work. The system shall be deemed handed over until this certificate has been issued.

9.4.8.2 The Contractor shall provide one smoke detector and heat detector tester for handing over to the Client.

9.4.8.3 The Contractor shall prepare fully detailed Operation and Maintenance Manuals for every individual item related to the fire installation along with priced recommended spare parts list for the continuous operation of the system for a minimum period of two years and submit to the Engineer for approval.

9.5 O & M Manual and Maintenance

9.5.1 O & M Manual

9.5.1 The O & M Manual shall be complete with the following information:

- Brief description of the system installed.
- The copy of the Final Certificate issued by the Local Chief Fire Officer.
- As Built Drawings including fire alarm schematic.
- Field Test Reports certificate interpreting the test results for compliance with performance requirements.
- Product Certificates signed by manufacturer of system components certifying that products furnished comply with Bureau of Indian Standards, NBC and Local Regulations.
- System Operation.
- System Maintenance Schedule
- Power supply schedule
- Integration and interfaces with other systems documents.

- At Project closeout, submit Record (As-Built) drawings of all system components and peripherals in accordance with the requirements of the Specification.

9.5.2 MAINTENANCE

9.5.2.1 The Contractor shall include for and be responsible for the free-of-charge regular inspection and maintenance as recommend by the manufacturer of the complete F.A. systems for one year after the official handing over of the system. This shall include call outs on a 24-hour basis the Contractor shall be able to attend a fault within 1 hour of notification.

9.6 LIAISON WITH THE LOCAL AUTHORITIES

9.6.1 It is the responsibility of the Contractor to liaise fully with the requirements and regulations of the Local Fire Authority. All relevant drawings and equipment shall be approved by the Local Fire Authority / AAI prior to commencement of work and all time and expenses incurred in gaining approvals and to comply with the requirements of Chief Fire Officer of the area shall be included in the tender.

10.0 LIFTS

10.1 The scope of work shall cover design, supply delivery, installation, testing and commissioning of civil works.

- a) Necessary scaffolding temporary barricade in the hoistway required during the erection of elevators.
- b) Minor building work comprising of cutting holes and making good the car and counterweight rail brackets, hall buttons and indicators including laying of sills in position.
- c) Steel item such as machine beams, bearing plates buffer support channels, sill angles and fascia plates etc.
- d) Suitable trap doors with steel chequered plate covers.
- e) Providing and install a suitable vertical iron ladder for access to the pit.
- f) Any other item required for successful completion and commissioning of lifts. (Including the hoisting beam in the machine room).

10.2 The work shall be done in accordance with regulations of any local code and following ISI codes which govern the requirements of installations.

CPWD General Specifications for electrical works Part-III (Lifts and escalators) – 2003.

IS: 1860-1980 code of practice for installation, operation and maintenance of Electric Passenger and Goods Lifts.

IS: 3534-1976 Outline dimensions of Electric Lifts.

IS 4666-1980 Specifications for Electric passenger and Good Elevators.

Indian Electricity Act 1910

Indian Electricity Rules 1956

Delhi Lifts Rules 1942

10.3 SHOP DRAWINGS AND APPROVAL OF ELECTRICAL INSTALLATIONS

The selected tenderer shall prepare a furnish shop drawings for approval by the Client, such shop drawings shall be based on the Architect drawings and requirements laid down in specifications, local laws and regulations etc.

The detailed drawings shall be submitted within one month of placement of order. The successful tenderer shall obtain the approval of electrical Inspector and other local authorities as per requirements before submitting the drawings to Engineer. The contractor shall not proceed with in installation work till the drawings are approved by the Engineer-in-Charge. Expenses incurred such as license fee etc. towards obtaining the approval of Electrical Inspector, local authority shall be reimbursed to the contractor as per actual on production of documentary proof.

Approval of contractor's drawings shall not absolve the contractor of any of his obligations to meet the requirements of specification under this contract.

Five sets of completion drawings operation manual, maintenance manual, spare parts details shall be submitted to the Engineer after completion of work.

10.4 GUARANTEE

The tenderer shall guarantee the equipment against all defects of material and workmanship for a period of one year from the date of commissioning of the equipment as certified by the owner. Any defects arising during the guarantee period shall be rectified and replaced by the tenderer, at his own expense, to the satisfaction of the owner.

10.5 PERMITS, INSPECTION & LICENSE FEE

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby. Expenses to be borne by purchaser.

10.6 MAINTENANCE

After the completion of the installation and before handing over of each elevator by the elevator contractor, maintenance service for the equipment furnished shall be provided for a period of twelve (12) months. This service shall include regular examination of the installation by trained employees, and shall include all necessary adjustment in proper operation, except any parts made necessary by misuse, accident or neglect caused by other, Contractor shall provide 24 hours Emergency local call back service facility and shall furnished full details of such facilities available.

10.7 POWER SUPPLY

The apparatus shall be designed to operate on 415+5% volts, 3 phase, 4 wires, 50 Hz A.C. Supply for illumination signal equipment shall be 240 volts + 5% single phase 50Hz A.C.

10.8 ELECTRICAL WIRING

The necessary A.C. supply of 3 phase, 415 volts 50 Hz shall be made available in the main control switch unit to be provided by the contractor in the machine room. All the electrical works beyond the main supply switch shall be carried out by the contractor i.e. supply and installations of panels for drive motors, switches and control complete with wiring as per system requirement and approval of the Engineer.

The wiring shall be carried out strictly in accordance with Indian Electricity Rules and Indian code of Practice for Electrical Wiring Installation IS-732-1963 System Voltage not exceeding 650V. For works not covered under any of the above wiring rules, the 13th edition of Electrical Engineers (condense) shall apply. The cable and conduits to be used shall be of suitable size and grade conforming to relevant IS specification. Wiring for LT switchboard to the motor terminal shall be with heavy duty 1.1 KV grade PVC insulated PVC sheathed, FRLS aluminium cable. All the trailing cables used for control and safety device shall conform to IS: 4289-1967, Specifications for lifts cables. The trailing cable circuits for controls, safety devices, lighting and signaling shall be separate and distinct.

Power wiring between controller and main board to various landings shall be drawn in suitable size heavy gauge conduit stove enameled/painted conforming to I.S. specifications.

The Voltage and frequency of the supply shall be subjected to variations permissible under Indian Electricity Acts and Rules.

10.9 PARTICULAR SPECIFICATIONS

11.9.1	TYPE	:	As per Bill of Quantities
11.9.2	NO. OF Lifts	:	As Per Bill of Quantities
11.9.3	CAPACITY	:	As Per Bill of Quantities
11.9.4	SPEED	:	As Per Bill of Quantities
11.9.5	FLOORS SERVED/RISE	:	As Per Bill of Quantities
11.9.6	STOP	:	As Per Bill of Quantities
11.9.7	OPENINGS	:	As Per Bill of Quantities
11.9.8	OPERATION	:	As Per Bill of Quantities

10.10 CAR FRAME

The car frame, which supports the car platform and enclosures, shall be made of structural steel, and equipment with suitable guides and a car safety device mounted underneath the car platform. The hoist ropes shall include adjustable self/aligning hinges.

The car shall be so mounted on the frame that vibration and noise transmitted to the passenger is minimized.

10.11 CAR SAFETY AND GOVERNER

Suitable car safety to stop the car whenever excessive descending speed is attained shall be operated by a centrifugal speed governor connected to the governor through a continuous steel rope.

The governor shall be provided with self tensioning device to keep governor rope in proper tension even after rope stretch. Suitable means shall be supplied to cut off power from the motor and apply the brake on application of the safety.

10.12 COUNTER BALANCE

A suitable guided structural steel frame with appropriate filler weights shall be furnished to promote smooth and economic operation.

10.13 TERMINAL AND FINAL LIMITS

Terminal limit switches shall be provided to slow down and stop the care automatically at the terminal landing within permissible over travel and final limit switches shall be provided to automatically cut off the power and apply the brake, should the care travel beyond the permissible over travel. They shall act independently of the operating devices and buffers.

10.14 TERMINAL BUFFERS

Heavy duty spring buffers shall be installed as a means of stopping the car and counterweight at the extreme limits of travel. Buffers in the pit shall be mounted on steel channels, which shall extend between both the car and counterweight rails.

10.15 CONTROLLER

A Controller shall be provided to control starting stopping and speed of the elevator motor and also be automatically able to apply the brake if any of the safety devices operate or if power fails from any cause. In case of power failure and again restore of power the lift shall land to next floor and shall not go to basement /lowest level. Suitable software/hardware or rescue device shall be provided.

10.16 REVERSE PHASE RELAY

A reverse phase relay shall be provided on the controller, which is designed to protect the lift equipment against phase reversal and phase failure.

10.17 GUIDES

Machined steel tee guides shall be furnished for the car and counterweight. The guide rails shall have tongued and grooved joints. Sliding clips shall be used for fastening the guides to allow building settlement without distorting the guide rails. To keep down the noise level and to reduce wear and tear of the sections, only Nylon Ribs shall be used in the guide shoes, after smoothening of the rails. The flanges shall be machined for the fishplate mounting such that rail alignment at joints almost remains constant.

10.18 FOUNDATIONS

The machine shall be placed directly above the hoistway upon the machine room slab provided by the Owner.

10.19 ROPES

The elevator shall be provided with traction steel ropes. Steel wire rope having a tensile strength of not less than 12.5 Ton/cm² of good flexibility shall be used for lift. The lift rope shall conform to IS: 2365-1963.

10.20 MACHINE

The machine shall be of the single wrap traction type and shall include a motor, electromechanical brake, steel worm, bronze gear, steel sheave shaft and Farrow – Molybdenum sheave all compactly mounted on a single base or bed plate. The worm shaft shall be provided with all bearings to take the end thrust and roller bearings shall be furnished for the sheaves shaft to ensure alignment and line bearing lift. The driving

sheaves shall be grooves to ensure sufficient traction and minimize rope wear. Shall be provided for all bearings and the worm gear.

10.21 BRAKE

The direct current brake shall be spring applied and electrically released and designed to provide smooth stop under variable loads. The brake should be capable of operation automatically by various safety devices, current failure, and by normal stopping of car. It should be possible release the brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short sties. For this purpose one set of brake release equipment shall be supplied.

10.22 MOTOR

The motor shall be suited to the service proposed and arranged for adequate lubrication. The motor shall be class F insulation and one (1) hour rated squirrel cage induction type having high starting torque. It shall also be provided with Thermisters embedded in the stator winding for the highest degree of thermal motor protection.

OPERATION WITH AN ATTENDANT

The regular car operating panel shall include buttons, switches etc for the collective-automatic control and shall also include.

A two-position key-operated switch marked to indicate ATT (attendant operation)
A buzzer : UP and DOWN direction light jewels and A non-stop button.

A car operating panel shall also include an UP and DOWN button.

When the key-switch is in the position of WITH ATTENDANT, the direction light and bizzer shall become operative and the UP and DOWN direction button in the regular care operating panel shall be made effective for the attendant operation.

When an attendant operation, the car and hoist way doors shall open automatically at each stop but the closing of the doors shall be subject to the UP or DOWN direction shall illuminate upon registration of either car or landing calls to indicate the direction of the travel of the car. The attendant shall operate the elevator normally in the direction indicated by the direction jewel but, if desired, opposite direction travel may be realized pressure of a car button for a landing in that direction from the car.

The pressure of a direction button shall cause the doors to close and the car to start in the direction desired, provided a call is registered for the direction. If pressure of the direction button is released before the car starts, the doors will re-open and car shall not travel. It shall so arrange the pressure on direction button can be released, once the car has started.

Continuous pressure of the nonstop button shall cause the car to by-pass all landing calls and respond only to registered car calls.

10.23 CAR ENCLOSURES

The car enclosures shall be of sheet steel and shall be of an elegant design comprising of the following:

- a) Suspended ceiling with light diffuser Perspex ceiling and fluorescent light.
- b) Concealed pressure fan with grille in suspended ceiling.
- c) Ceiling steel painted white.
- d) Complete MS powder coated car enclosure in plain finish for passenger Lifts.
- e) PVC flooring (with 3mm thick tiles of approved shade) for Lifts.
- f) Mirror on one face (front face when we enter car).

10.24 CAR DOOR

The car entrance shall be provided with a swinging type single panel door which is opened manually and closed by means of a spring closer when released with proper locking arrangement.

10.25 HOISTWAY DOORS

At each landing, the door shall be of collapsible type with a single panel which slides horizontally.

10.26 SIGNAL AND OPERATIVE FIXTURES

The following signal and operative fixtures shall be provided for each life in stainless steel faceplates except in fireman's switch which shall have a glass face plate.

a) CAR OPERATING PANEL

There shall be one (1) No. panel in car, with hinged stainless steel face plate and shall comprise illuminated floor buttons, door open and emergency stop controls emergency call buttons, door open and emergency stop controls emergency call button, tow position key operated switch, a Buzzer, UP and DOWN direction light panels, a non stop button, and an integral interphone, The jewels and accentuator shall be of modular construction, face plate mounted, rewired using snap on lugs.

b) HALL BUTTONS AND HALL POSITION INDICATOR

There shall be provided combined signal fixture (one riser) of compact design and of attractive hairline stainless steel face plate at the elevator entrance on each floor which for terminal landings shall have a single luminous push button and for intermediate landings shall have an UP luminous push button and a DOWN luminous push button. The jewels shall be of modular construction mounted on a stainless steel faceplate. Whenever a button is pressed, the jewel shall light up to indicate registration of the call and shall remain enlightened till the car arrives.

c) CAR POSITION INDICATOR IN CAR

This shall be of compact design and of attractive hairline finish stainless steel face plate with easy to read digital display of the floors, indicating through which floor the elevator is passing or on which floor the elevator is stopped. This shall also incorporate illuminated arrows showing the direction of travel.

d) BATTERY OPERATED ALARM BELL AND EMERGENCY LIGHT

A solid state siren type alarm unit operated by 2 Nos. 98 volt rechargeable Nickel Cadmium batteries shall be provided which shall give a waxing and waning siren when alarm bell in the car is pressed momentarily.

An emergency light unit using a 9 volt dry battery power pack and incandescent lamp with stainless steel face plate shall be provided inside the car which shall operate automatically in the case of power failure.

e) OVERLOAD WARNING

Overload warning radars with audio-visual indication (visual indication shall show OVERLOADED) with stainless steel face plate shall be installed in the elevator car, so that when there is overload in the car the sign shall light up a flash indicating OVERLOADED and a buzzer shall operate during this period and the doors shall remain open until the overload is removed.

f) FIREMAN'S SWITCH

A toggle switch covered by a glass cover shall be provided on the ground floor for each elevator, which shall permit a fireman to call the elevator to the ground floor by canceling all cars and landing calls. The elevator shall then stop at the ground floor with the door open to permit the fireman to have exclusive use of the elevator without any interference from the landing calls.

g) INTERPHONE

Interphone shall have one master unit in each machine room one master unit on the ground floor for each 1 (outside hoist way) and one slave unit in each elevator car.

10.27 DOOR HANGER AND TRACKS

For the car and each landing door, sheave type two point suspension hangers complete with tracks shall be provided to prevent the door from jumping off the track and for vertical and lateral adjustment of doors.

Sheaves and rollers shall be of steel and shall include shielded ball bearing to retain grease lubrication. Adjustable ball bearing rollers shall be provided to take the upward thrust of the doors. Tracks shall be of suitable steel section with smooth surface. The locking of the two leaf parting type doors should be positive.

10.28 SAFETY SHOE

A safety shoe (one on each door panel) shall extend to the full height of and project beyond and front edge of the car door.

Should this shoe touch a person or an object while the car door is closing, the car and hoistway doors shall return to the open position. The doors shall remain open until the expiration of a pre-determined interval and then close automatically.

10.29 LANDING ENTRANCE MATERIAL'S

These shall consist of headers, extruded aluminium sills and strut angles.

10.30 WIRING

Complete wiring in the equipment.

10.31 AUTOMATIC RESCUE DEVICE

Automatic Rescue Device to be provided for all the lifts with battery backup so that it can land to the nearest level in case of power failure. Automatic Rescue Device shall have suitable SMF battery backup so that it can operate minimum 20 times in 8 hours duration.

11.00 EARTHING

11.01 GENERAL

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General

Specifications for Earthing work - latest revision/ IS 3043 – latest revision and Indian Electricity Rules 1956 amended upto date and in the regulations of the local Electricity Supply Authority.

11.02 EARTHING CONDUCTOR

Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward upto outlet point shall also be of bare copper. Earth continuity conductor connecting Main & Sub Distribution boards to earth electrode shall be with galvanized MS strip.

11.03 SIZING OF EARTHING CONDUCTOR

Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switchboard 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.

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 out 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 2 metres from the building. The location of the earth electrode will be such that the soil has reasonable chance remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS frame & cover having locking arrangement at the top.

11.04 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 cast iron or MS frame with cover having locking arrangement shall be provided at top of metres from the building. Care shall

be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

11.05 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

11.06 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 5 ohm.

12.0 SAFETY EQUIPMENTS

12.01 DANGER NOTICES

Danger notice shall be affixed permanently in a conspicuous position in Hindi or English and the local language of the district with sign of skull and bones at every overhead lines, transformer, electrical equipments motors, etc.

12.02 FIRST AID BOX

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

12.03 FIRE BUCKETS

The fire bucket unit shall consist of our galvanised iron baskets, which shall be with round bottom, and of 13 liters capacity. They shall be filled with dry sand. Arrangement shall be made to hang them on GI pipe stand comprising of at least 2 vertical and one horizontal member of 50mm GI pipe. The stands shall have hooks and locking chain arrangement. The buckets and stand shall be painted with epoxy red paint.

12.04 FIRE EXTINGUISHER

Foam type Fire extinguishers of 9 kg capacity and Dry Chemical type Fire Extinguishers of 10 Kg capacity shall be of approved make. It shall be filled with carbon tetrachloride. It shall have horns. Extinguishers shall be fixed on walls/columns with necessary clamps made out of 50mm x 6mm MS flat and coated bolts and nuts grouted in wall/column.

12.05 RUBBER MAT

Corrugated rubber insulating matting shall be provided in front of all power & motor control centers, push button station and distribution board in the electrical rooms. The width of matting shall be one meter. It shall be as ISI mark.

12.06 INSTRUCTION CHART

Printed instruction chart both in English and Hindi and duly framed with front glass, prescribing treatment to be given to persons having Electric shock, shall be supplied.

13.0 DIESEL GENERATOR SET

SECTION – ELECTRICITY GENERATION EQUIPMENT (DG Sets)

1.0 GENERAL REQUIREMENTS

1.1 SCOPE

17..1 The Contractor shall include for the supply of all new materials & accessories in accordance with the particular specification.

17..2 These shall also include any material / appliance / equipment not specifically mentioned but are necessary and customary to complete the installation in all respect.

2.0 DRAWINGS & DOCUMENTS

18.1 The Drawings provided are schematic. Contractor shall develop & detail the same and obtain approval from the Project Manager / Engineers and competent authorities. Any change/s found essential, in co-ordination with installation of other services, the same shall be made without any cost to the owner. The drawings are for the guidance of the contractor; exact locations, distances and levels shall be governed by the site conditions and further instructions.

3.0 Shop Drawings

18.1 The Contractor shall prepare and submit shop drawings, in scale not less than 1:100 to the PROJECT MANAGER/ ENGINEER for his approval. The detailed shop drawing shall include all Schematics, fixing details of D G Sets, Control Panels & ACB Panels.

4.0 Completion Drawings

- 18.1 On the completion of the work and before issuance of certificate of virtual completion, the contractor shall submit to the Project manager / Engineer, 6 sets of DG Room layout, control circuit diagram and power diagram for approval & inclusion in the O & M manual.

5.0 MANUFACTURER'S INSTRUCTIONS

- 18.1 Where manufacturers have furnished specific instructions relating to the material used in this job and points that are not specifically mentioned in this document, manufacturer's instruction shall be followed.

6.0 MATERIALS AND EQUIPMENT

- 18.1 All materials and equipment shall be of the approved make and design. Unless otherwise called for, only the best quality materials and equipment shall be used. The materials and equipment shall conform to relevant Indian Standard specification as listed under the sub-head 'Regulations and Standards'. The contractor shall be responsible for the safe custody of all materials and shall insure them against theft or damage in handling or storage etc. A list of items of materials and equipment, together with a sample, where applicable, of each item of materials and all relevant certificates, shall be submitted to the Project manager / Engineer within 15 days of the award of the contract.

7.0 TOOLS AND TACKLES

- 18.1 The contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, plants, transport for labour and materials and plant necessary for the proper execution and completion of the work to the satisfaction of the Project manager/Engineer.

8.0 COMPLETION

- 18.1 On completion of the installation the Contractor shall furnish a certificate signed by the licensed supervisor and Contractor's Engineer, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local Authorities concerned.

9.0 TESTING

- 18.1 On completion of the work, the entire installation shall be subject to the following tests in the presence of the Insulation resistance test:
- Earth continuity test
 - Earth resistively test
 - Load test on DG set

18.1 Besides the above and any other test specified by the local authority shall also be carried out Approved testing laboratories shall calibrate all testing instruments and the Contractor shall produce the test certificates thus obtained on demand.

10.0 DEMONSTRATION TO OWNER

18.1 On completion of the Installation, devices subject to manual operation shall be operated at least five times in presence of Project Manager/ Engineer to demonstrate the satisfactory operation of the system.

11.0 CLEANING

18.1 The Contractor shall clear the site of all debris every day to avoid accidents. In case this is not done, the owners shall engage necessary labour to maintain the cleanliness of the premises and removal of debris and debit all the expenditure so incurred from the contractor's bill.

12.0 GUARANTEE

18.1 On completion of the work and before issue of final certificate of virtual completion, the contractor shall furnish written guarantee indemnifying the Owners against defective materials and workmanship for a period of one year after completion. The contractor shall hold himself fully responsible for reinstallation or replacement free of cost the following:

- a) Any defective work or material supplied by the Contractor
- b) Any material or equipment damaged or destroyed as a result of defective workmanship by the Contractor.

13.0 FEES, PERMITS AND TESTS

18.1 The Contractor shall obtain and pay for any and all fees and permits required for the installation. On completion of the work, the contractor shall obtain and deliver to the owner certificates of final inspection and approval by the Local Electricity Authority. Any fee / Deposit paid for obtaining power supply / final certificate will be reimbursed to the contractor by the client on production of cash receipt in original.

14.0 SAFETY PROCEDURES

18.1 The policy is to clearly, define, responsibilities and then to obtain the commitment of all contractors to maintain a high safety standard compatible with the policy. Safe methods of working shall be the main consideration in all operations. Contractors shall provide the Project Manager/ Engineer with details of their methods of work, highlighting the safety aspects and they shall update this information as necessary. It is the responsibility of all persons employed on this project to act responsibly to prevent accidents to themselves and others. The contractor shall be governed by the latest national safety rules and regulations as stipulated from time to time and as mentioned herein.

- Providing safe plant, equipment and working conditions
- Ensuring the establishment of safe working procedures.
- Providing suitable protective equipment, clothing, gloves, ear muffs, goggles, safety belts, harness, Aluminium ladders, Steel scaffolding etc.
- Providing adequate job training
- Providing fire extinguishers and First aid box with adequate medical supplies.
- Reporting all accidents and dangerous occurrences with copies to the Project Manager/ Engineer.
- Ensuring that hazardous materials, if necessary on site, will be stored and used in the safe manner.
- To co-operate with management in creating and maintaining a high standard of safety, health and welfare.

15.0 QUALITY OF WORK

- 18.1 The work shall be carried out to the satisfaction of the Project manager / Engineer. The supply, Installation, testing and commissioning shall comply with the latest requirements of Indian Standard specifications and code of practice as amended. All equipment and material being supplied shall meet the requirements of IS, TAC's regulations, Chief Inspector of Explosives, Local Electrical Inspectorate, Pollution Control Board, Local Fire department, Insurance Company insuring the building, Indian Electricity Rules and other latest Codes and Publications.

16.0 ENGINEER / SUPERVISOR

- 18.1 The contractor shall employ a competent fully licensed, qualified full time Electrical Engineer and Supervisor to direct the work of Electrical Sub-Station installation in accordance with the drawings and specifications. The supervisor shall be available at all times on the site to receive instructions from the Project manager/Engineer or his nominee in the day-to-day activities throughout the duration of the contract. The supervisor shall co relate the progress of the work in conjunction with all relevant requirements of the power supply authorities.

17.0 ELECTRICAL POWER GENERATION EQUIPMENT (DG Sets)

PARAMETERS

- 17..1 Generator set shall be assembled with all equipment mounted on a skid type rigid steel bed frame. It should permit easy operation, maintenance and repair.
- 17..2 Vibration reduction is to be achieved by appropriate design and careful balancing at factory. Provide approved anti-vibration mountings of steel spring or resilient

neoprene between rotating equipment and bed-frame, limiting transmission of vibration to building to a maximum of 0.04 mm amplitude throughout the operating vibration frequency range.

- 17..3 Noise reduction is to be achieved by exhaust silencing as specified, sound attenuators for air inlet and outlets and sound absorbing wall lining shall be used as necessary.
- 17..4 Coordinate with the structural design to ensure the noise level inside the building does not exceed the specified internal sound levels.
- 17..5 Engine is to be fully equipped to start and pick up initial load specified at specific minimum ambient temperature. Provide coolant heater if necessary.
- 17..6 Cold starting aids, such as engine jacket water heater, lubricating oil heater, intake-air heater, battery and all devices, accessories, connections, thermostatic switches and off-duty disconnects with pilot lights and necessary protection, are to be supplemented as recommended by the manufacturer and approved.
- 17..7 Generator voltage, current, frequency, active power (kW), reactive power (kVAR), and battery voltage are all to be monitored via the BMS.
- 17..8 Equipment ratings are to be as shown on the Drawings or the next higher standard ratings provided by the manufacturer, which shall be obtained under local climatic conditions with a maximum ambient of 33.3⁰C and 80% relative humidity. The nearest standard module size for this duty shall be selected after taking into account all relevant de-rating factors and auxiliary power consumption. Full account shall be taken of the nature of the loads particularly motor loads such as air conditioning, fans, pumps, and non-linear loads such as UPS, etc. that are likely to be connected to the generator.
- 17..9 Any proposed deviations from the specifications should be stated in the tender along with technical justifications for consideration at tender stage only.

18.0 SYSTEM DESCRIPTION

The generator system shall be a complete functional system comprising of but not necessarily limited to, the following components and/or sub-systems:

- Diesel generating set, with associated auxiliaries, exhaust system, start-up system, cooling system, fuel system, batteries and charger etc.
- Fuel storage and transfer system.
- Instrumentation, protection and control equipment.
- Manually operated overhead hoist.
- Inter-plant cabling and wiring.
- Earthing.
- Connection to BMS system, including all necessary interface elements as detailed in section BMS schedules and/or shown on the Drawings.

Components: The generator set shall consist of diesel engine, brushless synchronous generator with direct flexible coupling to engine and single control cubicle as required and shown on the Drawings.

- 18.2 Governing is to be to ISO 3046, electronic type governor with limits of speed control as specified.
- 18.2 **Starting and Stopping:** When in the automatic mode the set is to start and stop automatically by a signal sensed through an auxiliary contact in the load transfer switchgear. The set is to stop, after an adjustable cool-down period (2 – 30 minutes).
- 18.2 **Duty :** Plant is to reach full speed within 10 seconds from start impulse, synchronise the sets and accept immediately 60 percent of net rated output (load being mixed, steady and inductive, within motor starting loads as shown on the Drawings). Transient voltage variation is not to exceed 10 percent under any step-load application for which the system is intended, up to full rated load, recovering to within +/-2 percent within a few cycles.
- 18.2 **Failure To Start:** Should engine fail to start following a start impulse, the system is to come to rest for a few seconds. Two further starting attempts are to be automatically made with intermediate 20-second maximum periods of rest. Should the set fail to start after 3 attempts, an alarm is to sound and a 'start failure' signal illuminate.
- 18.2 **Hand operation:** shall be possible for testing or normal operation through a test/manual/off/auto selector switch.
- 18.2 **Routine Operation:** While on 'auto', the set is to be started on a routine basis and automatically every week and is to operate for a minimum of 30 minutes on load before stopping.
- 18.2 Lifetime eyes are required on all items of equipment over 25 kg is weight which may need removal.
- 18.2 Flexible connections shall be provided to all exhaust air, fuel, and water piping to audio facture due t vibration and to minimize conduction of noise.

19.0 ELECTION SCHEDULES FOR REFERENCE SPECIFICATIONS

- 19.1 Engine shall be 4 stroke, direct injection, radiator cooled and with forced lubrication from wet sump with automatic oil make-up system. Full flow oil filters shall be supplied with differential pressure alarm and gauge.
- 19.2 All moving live parts are to be adequately guarded to prevent injury to personnel.
- 19.3 Governing shall be in accordance with manufacturer's recommendations; except that manual adjustment shall be provided for $\pm 5\%$ rated speed and the steady load speed band shall not exceed 1% of rated speed.
- 19.4 Sufficient reserve shall be allowed in the lubrication system to allow 36 hours running without replenishment. Oil cooling shall be by Heat exchanger principle. Suitable oil drainage facilities to the engineers approval shall be provided.

- 19.5 Thermostatically controlled jacket water heaters shall be provided. The nominal temperature setting shall be 45°C. Vee type engines shall be provided with a heater in each bank to ensure uniform heating.
- 19.6 Valve seats shall be replaceable.
- 19.7 Five micron dual fuel filters shall be supplied in the fuel line complete with on line changeover facilities. Induction shall be via heavy-duty oil bath air filters or suitably rated disposable paper element type.
- 19.8 A fail-safe mechanical over speed trip facility shall be provided, set at 115% rated speed.
- 19.9 Suitable means shall be provided for turning the crankshaft and the associated generator by hand.
- 19.10 The flywheel shall be dynamically balanced and shall be capable of being roated at 125% and 95% of rated speed during normal running.
- 19.11 The engine shall incorporate an adjustable isochronous electronic governor.

20.0 PRODUCTS/ MATERIALS

20.1 GENERAL

20.1.1 All materials and parts comprising the units herein specified shall be new and unused, and of the highest grade.

20.1.1 The unit shall be the product of a firm regularly engaged in the manufacture of engines, and shall meet the requirements of the specifications set forth herein. The unit shall be of a standard model in regular production at the manufacturer's place of business.

20.1.1 General requirements for the equipment are:

- | | |
|----------------------------|------------------------|
| ○ Number of Units Required | As per BOQ |
| ○ Prime power rating | As per BOQ |
| ○ Generator voltage | 415V, 3 phase, 4 wire |
| ○ Frequency | 50 Hz |
| ○ Speed of rotation | Not to exceed 1500 rpm |
| ○ Power factor | 0.8 lagging |
| ○ Load factor | 0.85 |

20.1.4 **Testing of D.G. set will be as per CPWD specifications.**

20.2 DIESEL ENGINE AND AUXILIARIES

20.2.1 ine shall be water cooled V12/V16 cylinder V-type four-stroke cycle compression ignition diesel. Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, gear driven water pump, fuel pressure gauge and an engine mounted

instrument panel including a water temperature gauge, and a lubricating oil pressure gauge.

- 20.2.2 The engine shall be equipped with an electronic speed sensing governor capable of isochronous.
- 20.2.3 The unit shall be mounted on a structural steel sub-base and shall be provided with suitable vibration isolators and installed inside an acoustic treated room/enclosure as per the local statutory rules.
- 20.2.4 Safety shut-offs for high water temperature, low oil pressure, over speed, and engine over crank shall be provided.
- 20.2.5 Diesel engine is to be designed for type of load and application required. Engine and governor are to be selected to meet operating requirements and response specified.
- 20.2.6 Cylinders are to have removable liners. Wet type liners are to have witness hole between liner sealing rings of each cylinder for early detection of coolant or oil leakage. Each cylinder is to have drilled and tapped hole and valve for connections of pressure indicator.
- 20.2.7 Electronic Governor is to provide isochronous frequency regulation from no load to full rated load, paralleling and load sharing of generator sets where specified. Governor is to have zero percent (isochronous) setting and adjustable droop from zero percent to 10 percent droop. System is to include power supply unit, magnetic speed pick up, control module and actuator using fast response D.C. motor drive or equally approved alternative. Governor is to be designed for fast-response and high precision of speed (frequency) control, automatic paralleling and load sharing and is to include speed adjustment to ± 5 percent of normal, while running, and with remote control interface. frequency deviation under 25 percent sudden load change is not to exceed 0.5 Hz, recovering to stable condition of ± 0.1 Hz in 0.5 seconds.
- 20.2.8 Governor over speed trip is to automatically close fuel pump racks in event of engine over speed. Device is to be separate and independent from governing mechanism.
- 20.2.9 Protective system is to comprise automatic engine shut-down and generator trip with visual and audible alarm in event of over speed, low lubricating oil pressure, high cooling water temperature and over cranking.
- 20.2.10 For water cooled engines separate cooling tower of required capacity to be installed for each DG set.

20.3 GENERATOR (ALTERNATOR)

- 20.3.1 Synchronous, low reactance, high efficiency, revolving field type, with brushless exciter and flexible coupling, sized to pick up effective load without exceeding transient and steady-state voltage deviation limits specified up to its full nominal rating and designed for the performances stipulated in the Specification. It is to be of 2 bearing construction with bearing of the sleeved ball type.

20.3.2 Phase leads are to be brought out fully insulated to a terminal cable box of heavy gauge sheet steel, protection IP 44, Control and protection cables are to be brought out to a separate terminal box.

20.3.3 Maximum voltage difference between the 3 phases at 100 percent balanced load is not to exceed 1 percent. With unbalanced load up to 8 percent on one phase at unity power factor and zero load on other phases, the line-to-neutral voltages are not to differ by more than 2 percent.

20.3.4 The following shall be Characteristics of the Generator (Alternator):

- Number of phase: 3.
- Rated voltage, frequency, and net rated output: As shown on the drawings.
- Rated power factor: 0.8.
- Winding connection: Re-connectable with ends brought out and fully insulated.
- Maximum unbalanced load current, (negative sequence component of current with none of the phase currents exceeding rated current: 8 percent of the rated current.
- Rotor: Salient pole type, incorporating damping grid.
- Excitation: Brushless, with rotating armature rectifiers and discharge resistors.
- Voltage regulator: Automatic, with readily accessible controls for voltage level,
- Insulation: Class H for stator and rotor & Class F for exciter, with class F temperature rise, unless other indicated on the drawings.
- Quadrature Droop CT.
- Enclosure: Drip proof and screen protected (IP 21 to IEC 60947-I).
- Cooling: Built-in centrifugal fans.
- Maintained short circuit: 250 percent for 2 seconds.
- Over-speed: 120 percent (minimum) for 2 minutes.
- Total harmonic factor (THF) at no load: 3 percent max.
- Waveform distortion factor at no load: 5 percent max.

20.3.5 Overall voltage deviation within normal speed variations is to be within limits specified from no-load to full-load, from hot to cold and with load power factor from 0.8 lagging to unity. Regulator is to automatically reduce voltage if load exceeds capacity of generator. Voltage build-up is to be positive and rapid even when full load is suddenly applied. Line-to-line voltage waveform deviation factor is not to exceed +/-5 percent. Total harmonic content is not to exceed 5 percent and that of one harmonic not to exceed 2 percent. Radio interference suppression is to be within the limits set by the Standards, grade (N).

20.3.6 Armature is to be 3 phase, directly mounted to generator shaft and connected to generator field windings through 6 solid state, hermetically sealed, silicon rectifiers accessible for maintenance or repair. Exciter is to have field suppression system to eliminate any source of diode failure resulting from high inductive loads and surges, maintain output voltage within limits specified for any load up to 110 percent generator rating and under any sudden load changes specified.

20.3.7 Solid stage, volts/Hz type, utilizing silicon semi-conductor devices in control and power stages, with built-in electro-magnetic interference suppression and designed for single or

parallel operation. Manual adjustment to +/-5 percent of regulated voltage level is to be possible by a potentiometer at control panel. All components are to be sealed, moisture and heat resistant, with a suitable environmentally protected enclosure. Voltage regulator is to automatically reduce voltage if load exceeds capacity of generator and is to sustain a 3 phase short circuit current at the generator terminals for the period for which the short circuit protection operates and at least for 3 seconds. Voltage regular power is to be supported by generator voltage and current to maintain excitation field power.

20.3.8 Two position switch is to be provided for selection of manual or automatic mode of regulated voltage control.

20.3.9 Where sets operate in parallel provide cross-current compensation and necessary paralleling modules are to be provided to effect sharing of active and reactive loads equally between generators.

20.4 INSTRUMENTATION, PROTECTION AND CONTROL EQUIPMENT

20.4.1 Measuring Instruments: Engine mounted instruments are to include, at least, water temperature gauge, lubricating oil temperature gauge and pressure gauge, speedometer and running time meter. It is to be possible to measure, with extra instrumentation, coolant temperature at lower end of radiator, air depression after air filter, air boost and temperature using methods recommended by manufacturer. Instrument access are to be normally sealed by threaded blanking caps. Speed is to be sensed via a magnetic pickup.

20.4.2 Generating set instruments, Protection and Controls: Control relays, sensing equipment, switchgear protective relays and devices and start, stop and shutdown controls are to be provided as necessary for operation specified. Generating set, instruments, protection and controls are to be mounted preferably in one control cubicle.

20.4.3 Instruments and controls for a non-paralleled set are to include at least the following:

- Voltmeter with selector switch.
- Ammeter with selector switch
- KVA meter
- KVAR meter
- Frequency meter.
- Off/test/manual/auto duty switch.
- Manual-start and stop push buttons.
- Kilowatt hour meter
- Power factor meter
- Service hour running counter
- Plant exerciser.
- Potentiometer for voltage level control
- Speed raise/lower device
- Cool-down time setting controls

- Illuminated indicator panel with LED's at least for low oil pressure, high water temperature, over-speed, fail-to-start, generator overload, reserve-power, generator on load, battery low charge state.
 - Lamp test push-button
 - Indicating gauge and low level fuel alarm
 - Battery charger, on/off switch, pilot lights
 - D.C. ammeter
 - Alarm sounder and reset control
 - Anti-condensation heater.
- 20.4.4 Protection gear is to ensure orderly engine stop or shutdown with reset relays, as required for safety and operational reliability, and is to include the following:
- 20.4.5 Air Circuit Breaker (ACB) with solid state trip unit, in accordance with Section LV Switch gear, (electrically operated and electrically tripped by shunt release) for over current and external earth fault protection.
1. *Over-voltage protection with voltage and time lag adjustment.*
 2. *Loss-of-field / under excitation protection*
 3. *Phase unbalance via negative phase sequence protection.*
 4. *Restricted earth fault protection, with current adjustable settings between 1 and 20 percent of rated current, and time adjustable settings 0 to 3 seconds.*
 5. *Reverse power relay (for sets operating in parallel).*
- 20.4.6 Interface the control system with the BMS so that the BMS if provided in a later date provides an automatic step loading system for sequential application of standby loads with an adjustable (0-30 sec) time delay between each two steps based on priorities. The system is to comprise all necessary control equipment including under/over voltage sensing relays, time delay relays, interface devices and wiring with respective circuit breakers.
- 20.4.7 Relays shall be plug-in type, front adjustable, sealed type, with dust-tight enclosures, removable covers, test terminal blocks and plugs for testing relay without removal from case. Removal from casing is to automatically short-circuit respective current transformer secondary windings.
- 20.4.8 Instruments are to be housed in enameled metal cases for switchboard flush installation, with scales and markings protected and sealed. Indicating meters are to be minimum 90mm square. Accuracy is to be within 2 percent unless otherwise specified. Voltmeters and ammeters are to be electronic digital type.
- 20.4.9 Current Transformers: Class 1 for measuring and protection.
- 20.4.10 **KWH Meter:** 3 element type for unbalanced 3-phase, 4-wire loads, fitted with 6-digit cyclometer.

20.5 FUEL STORAGE AND TRANSFER

20.5.1 The entire fuel system for each engine-generator set shall conform to the requirements of relevant IS and contain the following elements:

- Install inside the container a separate self-supporting day tank with 8 hours capacity complying with relevant Bureau of Indian Standards and Petroleum act 1976.
- Rupture basin
- Fuel strainer
- 25mm solenoid valve
- Fill pipe and Vent pipe/cap to the outside of the container.
- Drain pit cock.
- Rupture basin leak detector switch with remote signal
- 25mm overflow to rupture basin
- 150mm square removable gasketed inspection plate.
- Float switch, solenoid valve and dial-type level indicator to give alarm on over fill and low level.
- "Press to test" switch.
- "Pump running" indicator light
- Tank drain
- Removable top cover

20.5.2 Each engine shall be provided with an integral engine drive pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary re-circulation.

20.5.3 A minimum of one full-flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

20.5.4 A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system.

20.5.5 Fuel lines: Heavy gage, black seamless steel pipe (schedule 40) or equal, treated internally with corrosion resistant paint and with joints sealed with PTFE tape. Plumber's twine or gasket sealing compound is not to be used. Changes in direction and branching and jointing are to be with regular pipefitting. Field fabricated and bent fittings are not to be used.

20.5.6 Valves Generally: 125 psi steam working pressure rating and 200 psi cold water non-shock pressure rating and type that can be repacked under pressure.

20.5.7 Pipe Hangers and Supports: Galvanised steel.

20.5.8 A hand pump suitable for 44 gallons oil tank shall be provided along with flexible suction hose for manual fuel transfer.

20.6 VENTILATION AND COOLING SYSTEM

20.6.1 The generator room shall be equipped with air intake and outlet louver panels, of sufficient free area to allow passage of combustion/cooling air within the parameters required for the selected generator set without significant pressure drop.

20.6.2 Both intake and outlet louver panels shall be of the inclined blade type with integral mechanical shutoff dampers, which close automatically when not energized. The dampers will open automatically when the generator is signaled to start. In addition the intake louver panel will be fitted with filters on the inside in accordance with the specification.

20.6.3 Engine cooling shall be by a water jacket, with water circulating pump and heavy duty tropical radiator and an engine driven pusher fan. The radiator and fan shall be sized to maintain safe operation at 50°C. maximum ambient temperature. The radiator shall be equipped for a duct adapter flange.

20.6.3 The fan shall be rated for the specified site conditions and provide sufficient pressure to maintain the required airflow through the radiator, ducting and louvers. Provide ductwork with flexible connecting section between radiator duct flange and demountable to enable access to generator where applicable. Ventilation louvers shall be provided as detailed in the drawings.

20.6.4 The cooling fluid shall incorporate sufficient corrosion inhibitor to protect the cooling system from internal corrosion. Thermostatic control shall be incorporated.

20.6.5 Obstructions in path of cooling air flow (opening, louvers, grilles, mesh, ducts, bends etc.) are not to reduce airflow below that needed at full rated output. Fan and radiator characteristic are to be selected accordingly. Advise if additional booster fans are required and provide necessary control gear for automatic operation.

20.7 EXHAUST SYSTEM

20.7.2 Exhaust system is to be completed with flanged, bolted, galvanised, seamless steel pipe sections, long sweep elbows, flexible expansion sections, clean-outs, residential 80dBA attenuation silencer, wall thimbles and supporting steelwork, silence is to be independently supported. The exhaust silencer and pipe shall be insulated with mineral wool/rock wool material, not less than 50mm thick, retained by wire ties and cladded with sheet metal aluminium (22 SWG) as a protection to the insulation. Exhaust piping system shall be designed to restrict the back-pressure to below maximum specified by the manufacturer. The exhaust system shall be manufactured in heavy quality steel tubing fitting with suitable robust gas-tight flexible section close to the engine to allow engine movement and to reduce the transmission of engine vibrations to the remainder of the exhaust system and the surroundings. Bends shall have a minimum radius of three times the diameter of the tube.

- 20.7.3 Silencers shall be of the heavy duty baffle and absorption, residential type, so designed and installed as to reduce noise to the specified minimum level. The whole exhaust system including pipe-work and silencer shall be designed so that the generator set can deliver its design output at site conditions.
- 20.7.4 The silencers and exhaust pipe work shall be properly and adequately supported clear of fuel and feed pipes and shall be provided with suitable insulation to protect personnel, plant and building from excessive heat, Design of exhaust system shall be suitable for site conditions and routing, where shown on layout.
- 20.7.5 The pipe work shall drain away from the exhaust manifold and drain pipes shall be fitted in the low points of the system to avoid accumulation of condensate.
- 20.7.6 The system shall be so constructed as to enable it to be readily dismantled for maintenance. Provision shall be made to prevent rainwater entering the exhaust pipe at its outlet to the atmosphere.
- 20.7.7 Including all necessary brackets, supports, insulation and protection, together with all fixing bolts. Bolts washers and nuts shall be greased with graphite grease or other suitable heat resisting lubricant during assembly.
- 20.7.8 The finish of all exhaust silencers exposed to the open air shall be sprayed metallic aluminum by special process complying with the recognized industry practices.
- 20.7.9 The exhaust pipe of DG sets shall be extended to the roof top of the building.
- 20.7.10 System should have catalytic converter.

20.8 LUBRICATION SYSTEM

- 20.8.1 The engine lubricating system shall be such that operate under a predetermined and constant pressure. The primary lubricating oil pump shall be an engine driven, positive displacement pump.
- 20.8.2 Provide a sump, relief valves and by-pass valves as required for proper operation.
- 20.8.3 One full flow strainer and duplex filter shall be provided in the lube oil line on the discharge side of the lube oil pumps. The strainer shall be of the metal edge or screen type with a maximum spacing of 0.007 inch (80 mesh). The filter shall be of the multiple cleaning and replaceable element type and the filter case shall be compatible with the filter element. A pressure relief valve shall be provided to relieve if it becomes clogged. An alarm condition shall be annunciated when the relief valve is in the open position. The strainer and filter shall be mounted in accessible locations without disconnecting the piping or other engine equipment when changing the strainer and filter element. Indicating pressure gauges shall be provided to measure the pressure drop across the strainer and filter.

20.9 SAFETY SYSTEM

- 20.9.1 The generator set shall be equipped with automatic safety devices which shut down the generator set and open the generator circuit breaker in the event of low lubricating oil pressure, high coolant temperature, engine over speed, high lubricating oil temperature, over load and as specified elsewhere. The stop switch on the engine instrument board may be connected in the circuit if so recommended by the manufacturer.
- 20.9.1 The safety system shall be equipped with visual and audible devices that become operational before engine shutdown.
- 20.9.2 Lube oil pressure and cooling water temperature and pre-alarm to be interconnected to the Building Management System.
- 20.9.3 Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator field and main circuit breakers shall be accomplished.
- 20.9.4 For startup of the engine-generator set, time-delay devices shall be installed by passing the low lubricating oil pressure alarm during cranking, and the coolant fluid outlet temperature alarm. The lube oil time delay device shall return its alarm to normal status after the engine starts. The coolant time delay devices shall return its alarm to normal status 5 minutes after the engine starts.
- 20.9.5 Provide remote monitoring / controls via a suitable LAN network compatible BMS interface.

20.10 STARTING SYSTEM

- 20.10.1 Engine starting is to be manual by push-button or automatic through control system at control panel. Electric starting shall comprise of 24 V equipment including starter motor, alternator and rectifier, lead acid batteries of ample capacity and mains powered constant voltage charging equipment and all connecting wiring.
- 20.10.2 Cranking motor and battery are to be rated for cranking the engine when cold and at lowest temperate recorded. Starting pinion is to automatically disengage when engine fires.
- 20.10.3 Batteries are to be laead-acid, sealed-in-plastic type, complete with battery rack and inter-cell connectors, Battery is to have sufficient capacity to provide and capable of withstanding five 20 second starts in succession in any four hour period, without any de-rating.
- 20.10.4 The Battery Charger shall be 25 percent over-rated, solid state, full-wave rectifier type, adequate to fully recharge depleted battery in not more than 8 hours and to automatically control rate of charge (providing a high-charge rate to a depleted battery and reducing to a trickle – charge rate when battery is fully charged). Ammeter is to be provided to indicate charging rate, which is to be adjustable.

20.10.5 The batteries shall be used to supply auxiliary relays as required whose operation must not be affected whilst supplying starting current. Auxiliary circuits are to be protected by fuses.

20.11 CONTROL & OPERATION

The manufacturer shall provide the following switch selectable operational modes on the diesel generator control system.

- Manual Control (Manual start and stop).
- Semi-Automatic Control (Auto-start manual return).
- Full-Auto control (Auto-start with auto stop when commercial supply returns).

20.12 SYNCHRONISING PANEL

20.12.1 The technical specification and details of the microprocessor based PLC controller for the DG set synchronizing and load sharing shall be as follows:

20.12.2 The microprocessor based PLC panel shall be suitable for use with AVR and electronic speed governor to protect and monitor DG sets.

20.12.3 Double Frequency Meter and Double Voltmeter shall be provided in synchronizing panel.

20.12.4 Synchro check relay also shall be provided.

20.12.5 The PLC shall be provided with following features and audible alarm:

- Engine pre glow control
- Fuel solenoid control
- Engine starter control
- KVA controlled cool-down timer
- Speed monitoring
- Over speed protection
- Oil pressure monitoring, alarm and shutdown of the engine.
- Water temperature monitoring, alarm and shutdown of the engine
- Battery voltage monitoring
- Over speed monitoring and alarm.
- 3 attempt start failure alarm
- Under/Over Frequency
- Reserve Power (Inverse time delay)
- Loss of excitation
- Over current (inverse time delay)
- Loss of utility power detection
- Load surge
- Current unbalance

- Voltage unbalance
 - Mains Protection (vector shift, df/dt ROCOI)
 - True RMS power calculations accurate control
 - Configurable loading/unloading ramp rates
 - Isochronous load sharing of up to 4 units using percentage based load sharing
 - Base load control for optimum fuel efficiency
 - Import export control using a watt transducer
 - Soft utility transfer function
 - Digital signal processing to eliminate harmonic issues
 - Adjustable phase window, Voltage and dwell time
 - Safe dead bus closing logic internal to the control
 - Synchronization across generator and mains breakers
 - Multiple short re-closing with adjustable time delay
 - Manual voltage and speed adjusts for manual synchronizing
 - VAR sharing on isolated busses using percentage based reactive load sharing
 - Power factor or VAR control when base loaded
 - Externally adjustable VAR or PF set point levels.
 - The DG set shall start and stop automatically based on plant bus demand.
- 20.12.6 The PLC system shall be provided with built in relays for protection of the following:
- Reverse Power
 - Reverse KVAR
 - Over current
 - Under and over voltage
 - Under and over frequency
 - Synchronization check and earth fault relay.
- 20.12.7 The PLC system shall be suitable for load sharing by sensing active and reactive power.
- 20.12.8 The PLC system shall comprises of the following:
- Main processor unit
 - Power module for power supply to the processor and the system
 - Power monitor to monitor voltage, KVA, KVAR, KW, KWH, KVAH, KVARH.
 - 16/32 channel Digital input module
 - 16/32 channel Digital output module
 - EEPROM for main processor unit
 - Computer to PLC communication card with necessary cables.
 - Window based operator interface Software Package
 - Mounting chassis for the equipment
- 20.12.9 The microprocessor based main processor of the system shall be suitable for 128 digital I/P and 128 O/P and comprises of the following:

20.12.10 The main processor unit shall be suitable for operation on 24 Volts DC with integrated memory. The integrated Ram memory shall be 20 K Words for program, data and constants plus data memory and flash EP ROM of 16 K works for backup application program, communication card and real time clock.

20.12.11 4 Nos. discrete combination module (Input/output Module) shall be provided and the same shall be suitable for operation on 24 volts DC system. Combination module shall be with 16/32 inputs and 16/32 output channels as per the actual requirement.

- 1 No. 2 slot extension rack
- 1 No. Ram back up battery unit
- 8/4 Nos. digital input module
- 8/4 Nos. digital output module

20.12.12 The CPU display unit shall be suitable for 4 lines of 40 characters. The display shall be with back lit LCD. Clarity shall be not less than 5 x 7 pixels. The height of the characters shall be not less than 5 mm. The data entry shall be with the help of 24 function keys. In addition to this there shall be 10 service keys and 12 alphanumeric keys.

20.12.13 The system shall be provided with RS 232 communication port.

20.13 OPERATION AND COMMUNICATION

20.13.1 The PLC shall monitor the bus bar load continuously. In event of mains failure the PLC shall give signal to select and start the generator, which is closer to the load sensed during the last 60 seconds. In case the load at the time of main failure is more than the highest rating DG set, the PLC shall give command to start 2 Nos. DG sets to suit the load, synchronize the sets and give command to close the breaker on the main LV panel.

20.13.2 If load starts reducing the PLC shall give command to turn off the DG sets through cool down timer. On restoration of main power supply, the PLC shall check the voltage and frequency and if they are stabilized and within the permissible tolerances, the PLC shall give command to shut down the DG sets through cool down timer.

20.13.3 The control and monitoring of the cooling tower and fan and feed pump shall be done through PLC control system. Necessary control wiring between cooling tower, pumps and PLC panel shall be carried out within the scope of work.

20.14 SYNCHRONIZING MODULE

- 20.14.1 The synchronizing module shall be a microprocessor based intelligent unit, which shall monitor the electrical parameters and shall be able to communicate with the PLC control unit in the process of synchronizing and load management. The system shall be suitable for dynamic synchronization. The synchronizing module shall be suitable for programming and set the preferred difference between DG set and bus bar.
- 20.14.2 The synchronization module shall monitor and fulfill the following conditions before the system synchronizes the DG set to mains.
- 20.14.3 Feed back signal from the DG breaker on main LV panel that the breaker is in open condition.
- Bus bar voltage is present
 - Generator voltage is present
- 20.14.4 The frequency regulator in the system shall start when the generator voltage and the bus bar voltage is over 50% of normal voltage. The voltage regulator in the system shall start when the frequency is within 90% of the normal system frequency.
- 20.14.5 The system shall close the breaker on the power panel without carrying out synchronization when all the below mentioned conditions are fulfilled.
- 20.14.6 Feed back signal from the DG breaker on main LV panel that the breaker is in closed condition.
- Bus bar voltage is present
 - Generator voltage is present
- 20.14.7 The synchronizing module shall transmit all monitored electrical parameters to the PLC unit and the PLC unit shall start controlling the synchronization of the DG sets and its load management. The data logging, monitoring and controlling shall be through a PC based SCADA station.

20.15 LABELING AND SAFETY

- 20.15.1 Each major component of the unit shall have the manufacturer's name, address, style, type or catalog number on a plate securely attached to the component of the units.]
- 20.15.2 The function or duty of each meter, instrument, indicator, switch, or push buttons or other devices for external control shall be clearly defined with labels in accordance with the specifications.
- 20.15.3 An instruction notice and first aid chart for the proper and safe working of the plant shall be fixed in a position close to where the operation is carried out.

20.15.4 The engine/generator set shall have a notice fixed in a conspicuous position, with titles at least 25mm high and remainder 12mm high, both in Hindi and English and in red color, starting:-

DANGER – KEEP CLEAR

THIS SET IS REMOTELY/AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME. WRITTEN AUTHORITY MUST BE OBTAINED AND APPROPRIATE SAFETY PRECAUTIONS TAKEN BEFORE ANY WORK IS UNDERTAKEN ON THE SET OR ASSOCIATED CONTROL EQUIPMENT.

20.15.5 Exposed parts that are subject to high operating temperatures or are energized electrically and moving parts which are to such nature or so located as to be a hazard to operating personnel, shall be insulated, fully enclosed, or guarded, Guarding shall be arranged in a manner that will not impair the proper function of these parts.

20.15.6 Painting shall be in accordance with the appropriate specification requirements.

21.0 INSPECTION & TESTING

21.1 Provide the manufacturer's test in accordance with relevant IS on the completely assembled unit in the manufacturer's plant. Submit the results with Shop Drawings prior to installation.

21.2 Provide a factory-trained representative to supervise erection and testing of the emergency engine driven generator system. Submit the results of the following tests in report form.

22.0 Sequence of testing

22.1 Check all engine and driven unit mounting bolts. Check alignment of engine and generator by dial indication. Check generator rotor air-gap.

22.2 Test generator and exciter insulation resistance with a megger. Take generator readings at circuit breaker, to include generator leads to switchboard.

22.3 Perform engine manufacturer's recommended prestarting checks.

22.4 Start engine and make engine manufacturer's "after-starting" check during a reasonable run-in-warm-up period.

22.5 Operate generator set for three hours at 75 percent of rated load using a load bank supplied by the generator manufacturer specifically for the purpose.

22.6 Follow above run immediately with three hours at 100 percent of rated load, Provide a load bank for utilization during the testing phase.

23.0 Checks to be made during Testing

- 23.1 During the tests, all operations of which the controls are capable shall be performed to assure that all controls are functioning in a satisfactory manner.
- 23.2 At several points during the tests, each instrument shall be observed to ensure that all instruments and gauges are functioning properly.
- 23.3 During the tests, all auxiliary accessory equipment, all valves, including pilot valves, and the injection pumps shall be checked to ensure proper operation.
- 23.4 Temperature readings of the manifold shall be taken and compared with those obtained during the manufacturer's tests.
- 23.5 Verify the equipment has been installed and field dimensions are in accordance with the approved installation drawings.
- 23.6 Verify that all required service connections have been made to utilities in accordance with the approved installation drawings and are ready for use.
- 23.7 During test, record the following at 30 minute intervals and after each load stop change:
 - KVA/kW
 - Amperes/PF
 - 3 phase/single phase voltages
 - Coolant/lubricant temperature
 - Frequency / speed
 - Oil pressure
- 23.8 Test alarm and shut down circuits by simulating conditions.
- 23.9 Test system in case of automatic mode as described in this specification.
- 23.10 Demonstrate adequacy of engine-generator unit to operate as specified in all aspects. Any failure to demonstrate adequacy in any respect shall be corrected to the satisfaction of the Engineer.

24.0 TRAINING

- 24.1 Provide instruction and training to the Owner's staff for the operation and maintenance of the equipment. Provide a minimum of 18 hours training to be divided between classroom and hands-on training as required by the Owner.

25.0 OPERATION AND MAINTENANCE PROGRAMME

- 25.1 Submit shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- 25.2 Submit product data showing dimensions, weights, rating interconnection points,

14.00 LIST OF TENDER DRAWINGS :

The lists of tender drawings are mentioned below:

Housing :

<u>S.No.</u>	<u>Drawing Number</u>	<u>Description</u>
1.	HSCC/D&E/AIIMS-H(B)/T-I/EL-01	Type -I Flats
2.	HSCC/D&E/AIIMS-H(B)/T-II/EL-01	Type -II Flats
3.	HSCC/D&E/AIIMS-H(B)/T-III/EL-01	Type -III Flats
4.	HSCC/D&E/AIIMS-H(B)/T-IV/EL-01	Type -IV Flats
5.	HSCC/D&E/AIIMS-H(B)/T-V/EL-01	Type -V Flats

Guests House:

<u>S.No.</u>	<u>Drawing Number</u>	<u>Description</u>
1.	HSCC/D&E/AIIMS-H(B)/GH/EL-01	Ground Floor
2.	HSCC/D&E/AIIMS-H(B)/GH/EL-02	First Floor
3.	HSCC/D&E/AIIMS-H(B)/GH/EL-03	Second Floor

Director's Bungalow:

<u>S.No.</u>	<u>Drawing Number</u>	<u>Description</u>
1.	HSCC/D&E/AIIMS-H(B)/DB/EL-01	Ground Floor
2.	HSCC/D&E/AIIMS-H(B)/DB/EL-02	First Floor
3.	Electrical Symbol & Notes.	

Dinning Hall:

<u>S.No.</u>	<u>Drawing Number</u>	<u>Description</u>
1.	HSCC/D&E/AIIMS-H(B)/DH/EL-01	Ground Floor
2.	HSCC/D&E/AIIMS-H(B)/DH/EL-02	First Floor
3.	HSCC/D&E/AIIMS-H(B)/DH/EL-03	Second Floor

Hostels :

<u>S.No.</u>	<u>Drawing Number</u>	<u>Description</u>
1.	HSCC/D&E/AIIMS-H(B)/PG-II/EL-01	PG Hostel- II G.F. plan
2.	HSCC/D&E/AIIMS-H(B)/UGH/EL-02	UG Hostel Floor plan

Single Line Diagram (SLD) :

<u>S.No.</u>	<u>Drawing Number</u>	<u>Description</u>
1.	HSCC/D&E/AIIMS-H(B)/EL-S01	Single Line Diagram (SLD)

15.00 LIST OF APPROVED MANUFACTURERS

1. Main LT Panel & MV Panels - L&T, Siemens, GEC or manufacturer having CPRI certificate.
Make to be approved by HSCC Engineer.

2. Lifts - OTIS
- Kone/ Bharat Bijlee
- Schindler
- Mitsubishi
- Jhonsons

3. LT Cables - Universal
- NICCO
- INCAB
- Rallison Cables
- KEI
- CabCom India

4. PVC insulated Wires - Kalinga Premium
- Plaza
- Batra Henlay
- KEI
- Padam
- Rallison
- CabCom India.

5. Telephone Tag Blocks - Krone Type

6. Modular Switches, sockets etc. - Anchor Roma
- North West
- Toyama
- MK
- Standard
- LK
- MDS (Mosaic)
- Crab tree
- Fino Switch

7. Industrial Sockets & Plugs. - Siemens
- Schneider
- Crompton
- Standard

- MDS
- BCH
- Keselec
- Havell's
- C&S

- 8. M.S. Conduit
 - BEC
 - AKG
 - M Kay
 - Harsh
 - Siddharth
 - NIC

- 9. Light Fixture
 - Decon
 - Havells
 - Ankur
 - Wipro

- 10. Ceiling Fans
 - CromptonGreaves/Alstom/Usha/Khaitan/
Polar.

- 11. Air Circuit Breakers
 - L&T
 - GE Power Controls
 - Siemens
 - Schneider
 - ABB

- 12. MCCB
 - L&T
 - GE Power Controls
 - Siemens
 - ABB
 - Schneider (Merlin Gerin)
 - Havell's
 - MDS

- 13. MCB-DB's, MCB, ELCB
MCB-Isolator etc.
 - L&T
 - GE Power Controls
 - Siemens
 - MDS
 - Schneider
 - HPL

- 14. Smoke detector
 - Apollo or approved equivalent

- 15. FDA Panel
 - Tata Honeywell/EDWARDS/Minimex/Mather Platt
Palam medicals or approved equivalent

- | | | |
|-----|----------------------|--|
| 16. | Diesel Engine | <ul style="list-style-type: none"> - Caterpillar - Kirloskar - Greave Cotton - Cummins |
| 17. | Alternator | <ul style="list-style-type: none"> - Kirloskar - Cater Pillar - Crompton Greaves - Leroy Somer & Controls (I) Ltd. - Stamford |
| 18. | 11KV VCB Panel Board | <ul style="list-style-type: none"> - Siemens - Easum - Alstom - BHEL - Crompton. |
| 19. | Transformer | <ul style="list-style-type: none"> - Crompton Greaves - GE Alstom - Volt – Amp - Siemens - Kirloskar |
| 20. | HT Cable | <ul style="list-style-type: none"> - CCI - Universal - Nicco - ICC |