

**LADY HARDINGE MEDICAL COLLEGE & ASSOCIATED
HOSPITALS, NEW DELHI**

GOVERNMENT OF INDIA

TENDER

FOR

**Construction of Residential Units and RMO Accommodation
with Associated Services Under Phase-1 for Comprehensive
Redevelopment Plan for Lady Hardinge Medical College &
Associated Hospitals, New Delhi**

VOLUME – IV

TECHNICAL SPECIFICATIONS

**Civil Works & services
Electrical works**

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LADY HARDINGE MEDICAL COLLEGE & ASSOCIATED HOSPITALS

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 1996 Volumes I to VI unless otherwise specified in the nomenclature of individual item or in the specifications. The entire work shall be carried out as per the C.P.W.D. specifications in force with up to date correction slips upto the date of opening of tender.
- 1.02 For the item not covered under CPWD Specifications mentioned above, the work shall be executed as per latest relevant standards/codes published by B.I.S. (formerly ISI) inclusive of all amendments issued thereto or revision thereof, if any, upto the date of opening of tenders.
- 1.03 In case of B.I.S. (formerly I.S.I) codes/specifications are not available, the decision of the Engineer based on acceptable sound engineering practice and local usage shall be final and binding on the contractor.
- 1.04 However, in the event of any discrepancy in the description of any item as given in the schedule of quantities or specifications appended with the tender and the specifications relating to the relevant item as per CPWD specifications mentioned above, or in drawings the former shall prevail.
- 1.05 In general the building floor to floor height is 4.00 m unless specified otherwise in the drawing. The rates for different items of work shall be for up to 4.5 m floor to floor height at all levels, lifts, leads and depths of the building except where otherwise specified explicitly in the item of work or in special conditions appended with the tender. All works above the top most terraces (main) shall be paid under the level existing below (i.e. machine room, mumty etc)
- 1.06 The work shall be carried out in accordance with the architectural, structural, plumbing and electrical drawings etc. The drawings shall have to be properly co-related before executing the work. In case of any difference noticed between the drawings, final decision, in writing of the Engineer shall be obtained by the contractor. For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the Engineer and nothing extra shall be payable on this account.
- 1.07 All materials to be used on works shall bear I.S. certification mark unless specifically permitted otherwise in writing. In case I.S. marked materials are not available (not produced), the materials used shall conform to I.S. Code or CPWD specifications, as applicable in this contract.

In such cases the Engineer shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified as "First Quality" by the manufacturers shall be used unless otherwise specified. All materials shall be tested as per provisions of

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

- 1.08 In respect of the work of the sub-agencies deployed for doing work of electrification, air-conditioning, external services, other building work, horticulture work, etc. for this project and any other agencies simultaneously executing other works, the contractor shall afford necessary coordination and facilities for the same. The contractor shall leave such necessary holes, openings, etc. for laying / burrying in the work pipes, cables, conduits, clamps, boxes and hooks for fan clamps, etc. as may be required for the electric, sanitary air-conditioning, fire fighting, PA system, telephone system, C.C.T.V. system, etc. and nothing extra over the agreement rates shall be paid for the same.
- 1.09 Unless otherwise specified in the bill of quantities, the rates for all items of work shall be considered as inclusive of pumping out or bailing out water if required for which no extra payment will be made. This will include water encountered from any source such as rains, floods, 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 upto a height of 3.0 m above ground level. The contractor shall use painted CGI sheets which are in good condition mounted on steel props.

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

2.0 **ALUMINIUM DOORS AND WINDOWS:**

2.01 **GENERAL:**

2.01.1 **Description:**

This section covers the requirement for furnishing of all materials, labour accessories, tools and equipment for installation of anodized/powder coated aluminium glazing doors and windows including fabrication, fixing and fittings etc.

2.01.2 **Codes and Standards:**

The codes and standards generally applicable to the work of this section are listed herein under:

IS: 733 Wrought aluminium and aluminium alloy bars, rods and sections (for general engineering purpose).

IS: 1285 Wrought aluminium and aluminium alloy, extruded round tube and hollow sections (for general engineering purpose).

IS: 1362 Dimension for screw thread for general purpose.

IS: 1761 Transparent sheet glass for glazing and framing purposes.

IS: 1948 Aluminium doors, window and ventilators.

IS: 1949 Aluminium windows for industrial buildings.

IS:7088 Recommended practice for anodizing aluminium and its alloys.

The following clauses are intended to amplify the requirements of the references/documents listed above and the contractor shall comply with these clauses.

2.02 **MATERIALS :**

2.02.1 **Aluminium alloy :**

Aluminium alloy used in the manufacture of extruded door and window sections shall correspond to IS designation HE9-WP of IS:733. Aluminium alloy hollow section and coupling sections used shall conform to IS designation HV9-WP of IS:1285. They shall conform to dimensions shown in Fig. 5 to IS:1948 unless otherwise specified in the drawings.

2.02.2 Screw threads of machine screws used in the manufacture of aluminium doors, window and ventilators shall conform to IS: 1362. Other threads may be used if permitted by the Engineer.

2.02.3 **Glass :**

Glass used for glazing shall be float quality glass of approved quality manufactured by the firms included in the list of approved makes subject to approval of Engineer, and shall be of thickness specified in the item.

Glass shall be securely and safety crated for delivery, handling and storage. Cushions shall be provided at edges of glass to prevent damage. Glass faces shall be protected from scratches and abrasions. It shall be stored in a dry, well- ventilated location, carefully protected at all times from soiling, atmospheric condensation and other moisture.

2.03 **SAMPLES AND SHOP DRAWINGS :**

All aluminium doors, windows and ventilators shall be furnished by an approved manufacturer and shall be conforming to IS:1948. Before placing their order, the contractor shall submit shop drawings and samples for the approval of the Engineer. If required, the contractor shall also submit the necessary engineering calculations. Shop drawings shall clearly show all work including mechanical systems, the arrangement of components, the sequence and details of fabrications, assembly and erection. These drawings shall also give full size details, all dimensions and thickness anchoring devices and accessories.

2.04 **FABRICATION :**

2.04.1 **Frames :**

Frames of aluminium doors and windows shall be of profile and dimensions as shown in the drawings, Frames shall be square and flat, the corners of the frames being fabricated to a true right angle. Both the fixed and opening frames shall be fabricated out of sections which have been cut of length, mitered and welded at the corners. Where hollow sections are used with welded joints, argon-arc welding or flash-butt welding shall be employed (gas welding or blazing shall not be done). Sub - dividing bars of units shall be tenoted and revetted into the frame.

Fabricate aluminium frames to allow for clearances and shim spacing around perimeter of assemblies to enable installation into prepared openings provided for thermal movement. Provide anchorage devices to securely and solidly attach the frame assembly in place. Accurately and rigidly fit together joints and corners, match components ensuring continuity of line and design. Ensure joints and connections are flush, hair-line and weather- proof. Provide drain routes and outlets to exterior for moisture entering joints and connections occurring within the frame construction.

2.04.2 **Shutters :**

Shutter thickness and dimensions of vertical styles, head and sill shall be as shown in the drawings. Unless otherwise specified, the hinges shall be of anodized aluminium alloy and shall normally be of projecting type. Slot shall be cut in the fixed frame and the hinges inserted inside and may be riveted to the frame. The fins for hinges shall be of stainless steel of non magnetic type of aluminium alloy HR-30 anodized and shall be sealed with oil, wax of lanolin.

2.04.3 **Fittings :**

Handles, peg stays, tower bolts, locking device, hinges and pivots, floor springs, automatic door operators shall be of the design and make approved by the Engineer. Door leaf shall be equipped with adjustable mechanism located in top rail near lock style that will provide for minor clear adjustments after installation. Snap of (Clip on) anodized /powder coated aluminium beadings and glazing clips shall be provided as per design and size approved by the Engineer.

2.05 **Finish:**

- a) After fabrication, any fabrication oil, scratches and tool marks shall be removed leaving the surface free from discoloration, blemishes and defects. Aluminium surfaces shall first be given a medium matt finish by caustic soda etching or by mechanical methods. All aluminium glazing shall be anodized conforming to IS:7088 to the light fast shade approved by the Engineer. A thick layer of clean transparent lacquer based on methacrylates or cellulose butyrate shall be applied to all aluminium glazing to protect the surface during installation. The lacquer coating shall be removed after the installation is completed.
- b) The unit assemblies shall be anodized/powder coated finish. Anodizing shall be minimum 15 microns thick of mat texture, non-directional and non-specular. Anodized surfaces shall be suitably protected during transportation, storage and erection. Powder coating if specified shall not be less than 50 Micron.

2.06 **Receiving and stacking :**

Fabricated aluminium frames and members shall be individually wrapped and delivered at site in crates. The contractors shall receive and unload the same at site with utmost care. The crates shall be opened and the materials carefully examined by the Engineer to detect any damage. Damaged materials shall be immediately removed from the site. Materials found to be acceptable on inspections shall be repacked in crates and stored safely in a vertical position above ground in a dry area. During the unpacking and repacking operations the contractor shall take all precautions to ensure that the protective coating of the fabricated materials is not damaged at all.

2.07 **Installation:**

2.07.1 Just prior to installation, the frames and members shall be unscratched and stacked on edge on level bearers and supported evenly. The contractor shall assemble the various components to form units as called for in the drawings. The assembled units shall be placed in correct final position in the openings and marks made at jambs, sills and heads against holes provided in the frames for anchoring. The frames shall side of appropriate size shall be drilled at the marking with an electric drill to house the expansion bolts.

2.07.2 Expansions bolts shall be inserted in the holes, struck with a light hammer till the nut is forced into the anchor shell. The frames shall be set in the openings by using wooden wedged at supports and shall be plumbed in position. The wedged shall invariably be placed at the meeting points of glazing bars and frames. The frames shall installed straight, level, without distortion and anchored to the supports through cadmium-plated machine screws of required size threaded to expansion bolts.

2.07.3 Where aluminium comes into contact with concrete, brick work, stone masonry, plaster or dissimilar metals, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that electro-chemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion. Adjustments shall be lubricated. Operating parts shall be protected against accumulation of dirt and foreign matters.

2.08 **Glazing :**

2.08.1 The glass panes shall be of the type and thickness specified in the item. Their sizes shall be as shown in the drawings. The glass panes shall be of quality and make approved by the Engineer. They shall have properly squared corners and straight edges. Damaged or defective glass shall be replaced with new glass at no additional cost. Each piece of glass shall be delivered with factory labels intact, indicating glass type, quality and thickness. Labels shall not be removed until installation has been accepted.

2.08.2 Glazing gasket channels and beads of P.V.C. or rubber for all furnished by the door and window manufacturer to fit their frames. Setting block shall be of neoprene or rubber width and high enough to provide minimum edges clearance for glass. Protect glass from breakages immediately upon installation by applying suitable warning markings.

2.09 **Weather proofing :**

Frame at door perimeter shall be fitted with non-porous polymeric weather stripping and door bottom shall have an adjustable electrometric weather-strip. Weather strips shall not

bind or prevent door from closing easily and tightly with weather tight contact between metal.

Alternatively gaps between frames and supports as well as any gap in the various sections shall be raked out as directed and filled with mastic cement of approved make and colour to ensure complete water tightness. The mastic cement shall be of such colour and composition so that it would not stain the supports and shall receive paint without bleeding. Moreover, it shall not sag or run and shall not set hard or dry out under any weather conditions.

2.10 Final cleaning:

Protective coating and warning markings shall remain undisturbed until final acceptance. Immediately prior to final inspection, temporary protective covering or coating shall be removed and surfaces shall be washed with a suitable thinner and left in a finished condition having approved uniform appearance and free from all marks and blemishes. Wash and polish glass on both faces.

2.11 Measurements:

For fixed portion : Weight of Aluminium sections used in the fixed portion including Aluminium snap beadings shall be measured for payment.

For openable portion : Weight of Aluminium sections used in the openable shutters including fixing of fittings shall be measured for payment

For panelling : Area of panelling shall be measured.

For glazing :Area of glass including neoprene gaskets shall be measured.

2.12 GUARANTEE BOND : All aluminium work shall carry two years guarantee after completion of the work against water leakage, unsound material and workmanship and defective anodising as per approved proforma. Two years guarantee in prescribed proforma must be given by the specialised firm, which shall be counter signed by the contractor, in token of his overall responsibility. In addition 10% (Ten Percent) of the cost of these items would be retained as guarantee to which the performance of the work done. The cost guarantee against this item of work shall be in addition to the security deposit mentioned elsewhere in the contract form. If any defect is noticed during the guarantee period, it should be rectified by the contractor within seven days, and if not attended to, the same will be got done from another agency at the risk and cost of the contractor. However, this security deposit can be released in full, if bank guarantee of equivalent amount for two years is produced and deposited with the department.

3.00 CERAMIC TILE DADO

3.01 DESCRIPTION :

This section covers the requirements for furnishing of all materials, labour tools and equipment for completion of ceramic tile dado including preparation of surface under layer.

3.02 Applicable codes and standards:

The codes and standards generally applicable to the work of this section are listed hereinafter:

IS : 8112 Ordinary Portland cement (43 grade)
IS : 383 Coarse and fine aggregates from natural sources.
IS : 777 Glazed Earthenware tiles.
IS : 1489 Portland Pozzolona Cement.
IS : 8042 White Portland Cement.

3.03 SAMPLES:

The contractor shall furnish samples of ceramic tiles to the Engineer well before the commencement of dado work for his approval.

3.04 CERAMIC TILES :

The ceramic tile slabs shall be of the approved make, colour, texture and size conforming to IS:777. Thickness of the tiles shall be as specified in the item. A tolerance of +/- 1mm in facial dimensions and +/- 0.5mm shall be allowed in thickness of tiles. The tiles shall be of uniform colour and shade without crazing. They shall be true to size and shape and free from cracks, twists, uneven and chipped edges and corners and other defects. The underside of the tiles shall be ribbed or some other formation so that the tiles adhere properly to the base. The tiles shall have the following properties:

3.05 SPECIFIC GRAVITY:

The mean specific gravity shall be 2.40 gm/cu.cm with a minimum of 2.3 gm/cu.cm

3.06 ABSORPTION OF WATER:

The mean water absorption shall be as per relevant IS standards.

3.07 WEAR RESISTANCE:

The average wear by abrasion shall not exceed 3.5mm and wear on any individual specimen shall not exceed 4.0 mm.

3.08 CEMENT :

Ordinary cement shall be either ordinary Portland Cement conforming to IS:8112 or Portland Pozzolona Cement conforming to IS:1489. White cement shall be white Portland Cement conforming to IS: 8042. Cement shall be fresh when delivered to the site.

3.09 FINE AGGREGATE :

Fine aggregate shall be clear pit sand or other approved sand conforming to IS:383. It shall be free from injurious amounts of soft and flaky particles and free from vegetable, organic, clayey matter, loom, mice, salts and other deleterious substances.

3.10 WATER :

Water used for both mixing and curing shall be fresh, clean, free from oil, salt, acid, alkali or other chemicals and deleterious matter conforming to IS : 456 :1978

3.11 PREPARATION OF SURFACES :

The joints shall be raked out to a depth of at least 15-mm in masonry wall, preferably when the masonry is being done. In case of concrete walls the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with and keep wet before skirting is commenced.

3.12 LAYING :

Unless specified otherwise in the item, 12-mm thick cement mortar shall be applied and allowed to harden. The plaster/base shall be roughened with wire brushes or by scratching diagonal at closed intervals. The tiles should be soaked in water washed clean, and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in required pattern and jointed. The joints shall be as fine as possible. Top of dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Dado shall not be fixed. These shall be cut/sawn to the required size and their edge rubbed smooth.

3.13 CURING AND FINISHING:

The joints shall be cleared off the cement grout with wire brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush jointed with white cement mixed with pigment required to match the shade of the tiles. The dado shall be kept wet and finished clean. The finished work shall not sound hollow when trapped with wooden mallet.

3.14 MEASUREMENTS :

Length and breadth shall be measured correct to a centimeter. Height shall be measured correct to a centimeter in the case of dado and 5 mm in case of riser and skirting. The area shall be calculated in SqM, correct to two places of decimal. Length and height shall be measured along the finished face of skirting or dado including curves where specials such as coves, internal and external angles and beads are used. Where cornices are used the area of dado shall be measured excluding the cornices.

Nothing extra will be paid for cutting (sawn) the tiles to sizes.

3.15 RATE :

The rate includes the cost of all materials & labour involved in all the operations described above. The specials like covers, internal & external angles, beads & cornices, where required, shall be measured & paid for separately.

4.0 GLASS MOSAIC TILES:-

4.01 The surface to be covered must be perfectly dry, clean and smooth.

4.02 Spread the cement slurry (or jointing compound recommended by the manufacturer) on wall uniformly using toothed trowel of 2mm.

4.03 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.

4.04 Wet thoroughly the backing paper with sponge.

4.05 Wait for water to seep across and then peel the paper off holding it by a corner.

4.06 Fill the joints between the tiles with slurry of rubber latex adhesive.

4.07 Clean the tiles carefully with a wet sponge and subsequent with a dry rag.

4.08 Rate are for all height material, labour, T & P, double scaffolding. Actual surface area shall be measured for payment.

5.0 VITRIFIED PORCELAIN TILES IN FLOORING, SKIRTING AND DADO

5.01 The tiles shall be of approved make, colour, texture and sizes with shine finish grade 'A'. The thickness of the tiles shall be 8.6mm and 9.9mm for sizes 300x300mm and 600x600mm respectively.

The tiles should satisfy the various tests on the parameters given below, when tested according to the codes specified against each. It may be noted that the standards for the parameters and the tests are European.

SL. STANDARD NO.	SPECIFICATIONS	TEST METHOD	EUROPEAN REQD.VALUE
1.0	Deviation in length (a) Polished (b) Unpolished (sized)	EN 98 EN 98	+ or - 0.5% + or - 0.5%
2.0	Deviation in thickness	EN 98	+ or - 5.0%
3.0	Edge Straightness (Wedging)	EN 98	+ or - 0.5%
4.0	Water Absorption (Unpolished)	EN 99	< or = 0.5%
5.0	Scratch hardness (Unpolished) in Moh's Scale	EN 101	> or = 6.0
6.0	Thermal Shock	EN 104	10 cycles
7.0	Chemical Resistance	EN 106	Should not show visible alteration
8.0	Warpage	EN 98	+ or - 0.50%
9.0	Breaking Strength	EN 100	300 kg/sq.cm
10.0	Frost Resistance	EN 202	Frost proof
11.0	Density	DIN 1082	> or = 2.0 gm/cc

5.02 Cement

Ordinary cement shall be either ordinary Portland Cement conforming to IS:8112 or Portland Pozzolona Cement conforming to IS:1489. Cement shall be fresh when delivered to the site.

5.03 Fine Aggregate

Fine aggregate shall be clear pit sand or other approved sand conforming to IS:383. It shall be free injurious amounts of soft and flaky particles and free from vegetable, organic, clayey matter, loom, mice, salts and other deleterious substances.

5.04 Water

Water used for both mixing and curing shall be fresh, clean, free from oil, salt, acid, alkali or other chemicals and deleterious matter.

5.05 Preparation of Surfaces

The joints shall be raked out to a depth of at least 15 mm in masonry wall. In case of concrete walls the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with and kept wet before skirting is commenced.

5.06 Laying

Unless specified otherwise in the item, 12 mm thick plaster of cement mortar in case of skirting or dado and 20 mm thick base of cement mortar in case of flooring shall be applied and allowed to harden. The plaster/base shall be with wire brushes or by scratching diagonal at closed intervals. The tiles should be washed clean, and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in required pattern and jointed. The joints shall be as fine as possible. Top of skirting and dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Skirting and dado shall rest on the top of flooring. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size and there edges rubbed smooth.

5.07 Curing and Finishing

The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be filled with silicon sealant or equivalent jointing material as per manufacturer's specifications. The work shall then be kept wet for 48-72 hours.

5.08 Measurements

Length and breadth shall be measured correct to a centimeter. Height shall be measured correct to a centimeter in the case of dado and 5 mm in case of riser and skirting. The area shall be calculated in SqM, correct to two places of decimal. Length and height shall be measured along the finished face of skirting or dado including curves where specials such as coves, internal and external angles and beads are used. Where cornices are used the area of dado shall be measured excluding the cornices. Nothing extra will be paid for cutting (sawn) the tiles to sizes.

In addition to payment for areas of flooring skirting and dado, specials such as coves, internal and external angles and beads shall be measured separately and paid for running metres. Cornices shall also be similarly measured for payment in running metres.

5.09 **Rates**

The rates shall include the cost of all material and labour involved in all the operations described above. The specials such as coves, internal and external angles and beading shall be measured and paid for separately. The rate shall not include cost of cornices which shall be measured and paid for in running metres separately.

6.0 **EPOXY BASED JOINTLESS ANTISTATIC FLOORING**

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

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

The mechanical parametric properties to be achieved are as follows.

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

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

ANTISTATIC EPOXY FLOOR TOPPINGS

MATERIAL DESCRIPTION

The heavy-duty abrasion, chemical resistant & antistatic epoxy screed flooring shall be an epoxy Self leveling screed, which is laid to a thickness of 3mm. This shall be extremely monolithic, seamless, jointless and is ideally suited for areas requiring Resistance to leakage of Current of 10^4 to 10^8 ohms.

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

ANTISTATIC EPOXY PRIMER - Component A (Resin) (182gm)
ANTISTATIC EPOXY PRIMER - Component B (Hardener) (68gm)
- b. While the primer coat is still tacky, a 3 component, antistatic chemical resistant epoxy SCREED AS BASE COAT is to be applied with following materials @2.0kg/sqm
 - Component A (Resin) (0.84kg)
 - Component B (Hardener) (0.32kg)
 - Component C (Graded Filler) (0.84kg)

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

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

APPLICATION LAYING PROCEDURE

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

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

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

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

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

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

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

Acid & alkali resistant flooring for specialized area as specified in the dwgs or as directed by engineer in charge etc. complete.

7.0 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.

150 mm wide coving at the junction of the walls and flooring by approved colour & make epoxy mortar applied over one coat of epoxy primer and finishing the coving with 2 coats epoxy paint over epoxy putty etc complete as per specification, manufactured by 'Esskay Coatings' or equivalent and as directed by The Engineer in charge

8.0 Calcium Silicate Tiles

General

Composition	: Hydrated calcium silicate, reinforcing fibers and natural fillers. Free from formaldehyde and other harmful materials. Shall not contain any toxic ingredients.
Surface	: All tiles are prime coated on both side. Standard finish in two coats white dispersion type, solvent free paint.
Dimensions of grid, Tile thickness.	: 600mm x 600mm x 15mm thick edges of width all around not less then 24mm and 10mm thick at centre.
Density	: 450 kg/m ³ in all around the edges. 350kg/m ³ at centre.
Relative humidity	: 100% RH resistant.
Fire Resistance	: Incombustible as per BS 476,part IV, Class 1 for spread of flame as per BS 476, part VII Class 0 for fire propagation as per BS 476, part VI
Thermal conductivity	: 0.043 W/mK

Accoustic control	: sound absorption NRC not less then 0.50 depending on the product. Sound attenuation STA-32dB
Light Reflectance	: >85%
Weight	: 5-5.5kg/m ²
Suspensions system	: as per nomenclature of item.

Manufactures certificate shall be submitted for confirmation of test result of product.

Storage and handling precautions

1. ceiling systems shell be supplied in neatly packed cartons.
2. Not to store the cartons in flat and wet location.
3. Handle cartons and individual tile with care.
4. Do not drop or stand cartons or tiles on edges or corners.
5. Open cartons completely and using both hands with protector gloves, remove tiles in pairs with faces together.

Installation Precautions :-

The following to be ensured before installation of the ceiling system:

1. The area is dry prior to ceiling installation work.
2. All wet trades are completed such as plastering, flooring etc.
3. Air conditioning duct work is completed.
4. Electrical chasing or drawing lines etc. are in place.
5. No unauthorized weighting is put on ceiling. Lighting fixtures to be suspended independently.
6. Calcium silicate tile should be installed by experienced contractors in compliance with manufactures and conditions.
7. Installation shell be done in area free from chemical fumes/freezing temperatures and vibrations
8. Calcium silicate tiles shall not be used to support any unauthorized loads
9. Calcium silicate tile shall be mechanically suspended properly and shall not be cemented nor glued to the surface of any other material.

Supporting System :

The supporting of calcium silicate tiles such as hot dipped galvanonised main tee, cross tee, well angle including GI 4mm dia wire support from ceiling, fasteners, level adjustors including soffit cleat shall be provided as per the description of items and as specified by manufacturer and also as directed by engineer in charge.

Measurement:

Plan area of the false ceiling provided shall be measured in sqm. Corrected to two decimals. No extra charges will be paid for cutting and opening of board for diffusers, light fitting, speakers etc.

Rate :

The rate shall include the cost of all operation, labour, fabrication and election at all levels as per the description of the items and as specified above.

9.00 ALUMINIUM COMPOSITE PANEL METAL CLADDING

9.01 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.

9.02 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.

9.03 Aluminium Composite Panel Cladding

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

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

Technical Data

- | | | |
|----|-------------|---|
| A. | Composition | Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene. |
| B. | Dimensions | Panel thickness : 4mm
Panel size: Width 1000/1250/1500mm
Length between 1500 and 5000mm |

Tolerance
Width \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. |

9.03.1 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.

9.03.2 Deflection

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

9.03.3 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.

9.03.4 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.

9.03.5 Water Tightness

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

9.03.6 Acoustic Treatment

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

9.04 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.

9.05 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.

10.00 STRUCTURAL/CURTAIN WALL SYSTEM

10.01 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.

10.02 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.

10.03 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.

10.04 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.

10.05 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.

10.06 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.

10.07 EXECUTION

Performance Testing

a) General Requirements

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

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

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

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

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

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

b) Test of Wind Pressure

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

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

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

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

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

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

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

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

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

c) Test of Lateral Deflection Per Floor Height

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

The deflection of every + 2.5mm shall be increased upto + 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.

10.08 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.

11.0 ACOUSTIC CELING

- 11.1 The acoustic tiles shall be procured from an approved manufacturer as directed by Engineer-In-Charge.
- 11.2 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.
- 11.3 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.
- 11.4 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.
- 11.5 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.
- 11.6 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.
- 11.7 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.
- 11.8 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.

- 11.9 The suspension system shall consist of hangers, main runners, cross tees, perimeter trims, wall connectors etc. The hangers shall be securely fixed to the structural soffit/slab/beams at spacing not more than 1200mm centre to centre by using electroplated Galvanized M.S anchor fasteners of 6 mm (minimum) diameter of approved make and of adequate capacity to carry the design loads. The main runners shall be fixed at spacing not more than 600mm centre to centre. The last hanger at the end of each main runner shall not be placed more than 450 mm from the adjacent walls. Additional hangers shall be placed at a distance not more than 150 mm from the joint in the main runner on either side. The cross tees 600 mm long shall be centrally inter-locked between main runners to form 600 X 600 mm modules. The main runners shall have central notches to accommodate mitered joint of 600 mm long cross tees.

Additional runners and hangers shall be provided where change of direction is required as per the site conditions. All the hangers, runners, tees, cleats, brackets etc. required for fixing the false ceiling suspension system shall be of anti-corrosive hot dipped galvanized M.S sections with zinc coating not less than 170 gms per sq.m and shall be as per BS 2989. The Galvanized M.S runners, cross tees, perimeter trims/ edge profile etc. shall be powder/coil coated (the coating as per the manufacturer's specifications) matt finished, of required colour and shade. The cross tees shall be connected to the main runner by stab and hook type (clip in) installation. The runners and cross tees shall have mechanical stitching for enhanced torsional resistance and shall have mitred inter-section. Further, the grid system with main runners and the cross tees shall have 15 mm wide flanges with a 6 mm central recess with reveal profile, with colour all white with black or white reveal of brand as approved by the Engineer-in-Charge / Consultant. The hangers shall be mechanically pre-straightened and shall not be less than 4 mm diameter and of lengths as required for keeping minimum plenum depth as per the architectural drawings. It shall be suitably cut / tied off. The stainless steel level adjuster clips (spring steel, butterfly 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.

- 11.10 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.

- 11.11 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.
- 11.12 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.
- 11.13 The entire installation shall have minimum half an hour fire rating and integrity as specified as per BS 476.
- 11.14 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.
- 11.15 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.
- 11.16 Metal-aluminium false ceiling of HUNTER DOUGLOUS make or equivalent, Consists of 2 x 2 ft. powder coated plane aluminium panel fixed with aluminium angle framing with all necessary hardware & scaffolding etc. complete.
All the measurements & tests, installation methodology is similar as described above.
- 11.17 Gypsum board false ceiling, the specifications remains the same as mentioned as above.
In case of acoustic ceiling, glass wool shall be placed above the ceiling with the help of adhesive as directed by Engineer in charge.
All the measurements & tests, installation methodology is similar as described above.

12.0 STAINLESS STEEL RAILINGS

- 12.1 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.
- 12.2 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.
- 12.3 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.
- 12.4 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.
- 12.5 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.
- 12.6 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.
- 12.7 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.
- 12.8 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.
- 12.9 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.

12. 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.

12.11 S. S. SIGNAGES – wall mounted

S.S. Signages which is wall Mounted Nonlit directory sign appropriate size as mentioned in arch. Drawings; manufactured by 'Enhance' or equivalent made of 10mm Acrylic with the required text matters stuck on it with plotted self adhesive vinyl & Mounted on 3mm ACP bracketed at suitable locations & as mentioned in Architectural drawings including necessary fittings & fastening etc. complete & as directed by The Engineer in charge.

12.12 S. S. SIGNAGES – Suspended

Providing & Fixing Suspended Nonlit sign 48"x9" manufactured by 'Enhance' or equivalent made of 1" Aluminium framing duly PU painted and 10mm Acrylic element mounted to it from either side with the required text matters stuck on it with plotted Self Adhesive Vinyl bracketed at suitable locations as mentioned in Architectural drawings including necessary fittings & fastening etc. complete & as directed by The Engineer in charge.

12.13 S.S. corner guard

300mm (150 + 150mm) of SS 304 grade, 16 gauge, tapered edged L angle (Having angle 90 & 135 deg.) section for corner guards fitted with SS Screws and necessary buffing etc complete and as per detailed drawing no. WD - 12 and as directed.

13.0 FIRE CHECK DOORS:-

13.1 FIRE AND SMOKE / HOT GASES CHECK DOORS:-

The door shall be procured from approved manufacturer of CPWD / CBRI.

The fire and smoke / hot gases check door shall be conforming to IS-3614 (Part-II)

The fire and smoke / hot gases check door shall not collapse during the rated period of the fire under the specified fire conditions.

The fire and smoke / hot gases check door shall not allow the passage of hot gases or the flames through the rebate of the gap between the door frame and shutter or through the holes, developed in the shutter during fire.

Material: - Door frames and leaves shall be made from ZINTEC ELECTRO GALVANISED STEEL.

Door Leaves shall be constructed from 1.25mm thick electro galvanised steel sheet press formed to provide 46mm thick fully flush, double skin door shell, with lock seam joints at stile edges with internal reinforcement at top, bottom and stiles

edges for fire rating. The internal construction of door shall be specially designed honey combed structure with reinforcement at top, bottom and stile surrounds.

Door Frames shall be manufactured from 1.6mm thick galvanised steel sheet press formed to double rebate profile of size (Nominal)143 x 57mm with a maximum bending radius of 1.4mm.

Sill:- Sill shall be made from 1.6mm (16 G) zinc coated steel sheet shaped to prevent water ingress and entrapment.

Vision Panel shall be rated vision panels with 6mm thick clear glass (2 hours fire rating) made from Spin turned Rings (380mm dia circular vision panel) or press formed (300mm Square vision panel). Glass shall be fixed with glazing gasket of self sticking ceramic glass fibre having a classification temperature of 1260° C.

Finish:- The door frame and door shutter shall be finished with thermo setting acrylic paint for scratch resistance and durability. The paint shall be of approved brand and quality.

Ironmongry Hinges:- Stainless steel ball bearing butt hinges, 3mm thick shall be fixed flushed to the frame and shutter.

Lock:- Mortice sash lock with internal thumb turn and external key operation with lever handles shall be provided.

Flush Bolts:- (Double Door):- 300mm concealed extended lever action flush bolts satin finish, fixed to top and bottom of the inactive blade shall be provided.

Automatic Door Closer:- Dual adjustable speed automatic door closer with rack and pinion method shall be provided.

Smoke Seals :- Heavy duty smoke seals for smoke check doors shall be provided.

Acoustic Seals :- Acoustic seals of appropriate design duly fixed in shutter as well as door frame shall be provided.

Opening Width : - Opening width of door mentioned in the drawings shall be width measured with both door shutters fully open in straight position.

Area of door shutter only shall be measured for payments.

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

13.3 The rates shall be inclusive of all material, T&P, Labour, etc. complete including the cost of fittings, testing etc. as described above.

14.0 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

15.00 Mix Design, Batching Plant/ Ready mix Concrete

15.1 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.

15.2 **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 (within 50 meters distance from the site of work) supplying Concrete at site. The batching plant proposed to be engaged by the contractor shall fulfill the following requirements.

- 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

15.3 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.

15.4 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, Delhi
- ii) Delhi College of Engineering, Delhi.
- iii) Shri Ram Institute of Industrial Research, Delhi
- iv) Any other Govt Laboratory as approved by Engineer.

15.5. 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.

15.6. 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.

- 15.7. 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.

- 15.8. 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 Delhi 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.

- 15.9. 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).

- 15.10. 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

- 15.11. 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.

15.12. 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.

15.13. 43 grade OPC (Conforming to IS-8112) of brand/make/source approved by Engineer shall only be used for production of concrete.

15.14. 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 freezing 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.

15.15. 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.

15.16 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.

15.17. 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

15.18 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.

16.00 APP MODIFIED BITUMEN WATER PROOFING

The item shall be carried out As per CPWD specifications in force. The vital physical and chemical parameters of the membrane shall be as under: - Minimum Joint strength in longitudinal and transverse direction at 23Degree Celsius as 600/375 N/5cm. Minimum Tear strength in longitudinal and transverse direction as 150/150N. Softening point of membrane not less than 110 Degree Celsius. Cold flexibility shall be up to -2 Degree Celsius when tested in accordance with ASTM, D-5147. The laying of membrane shall be got done through the authorized application of the manufacturer of membrane.

Waterproofing treatment of roofs shall be executed through approved specialist agency only, using polymer modified membrane. Vertical / upturn at parapet, skirting includes cost of GI chicken wire netting including necessary extensions and overlaps. Openings for lights, grilles, other fixtures and inspection doors shall be framed to receive the respective fixtures in ceilings – horizontal or vertical faces – as required. The contractor shall submit layout & detail shop drawings for approval.

17.0 HORTICULTURE WORKS:

17.1 GRASSING

17.1.1 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.

17.1.2 SOIL :

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

17.1.3 SOWING THE GRASS ROOTS :

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

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

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

17.1.4 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.

17.1.5 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.

17.1.6 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

17.1.7 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.

17.1.8 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.

17.1.9 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.

17.1.10 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.

18.00 PLUMBING & SANITARY INSTALLATIONS

18.01 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.

18.02 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

18.03 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.

18.04 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 be 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.

18.05 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.

18.06 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.

18.07 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.

18.08 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.

18.09 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.

18.10 COMPOSITE PIPES: Composite pipes shall be used in the internal water supply if specified in the Bill of Quantities. These may required to be connected to the existing/ new GI pipes.

18.11 SAMPLE AND SHOP DRAWINGS;

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

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

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

9.0 TEST KITS

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

Residual Chlorine Indicator

Valve

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

10.0 VALVES

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

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

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

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

11.0 PAINTING AND CLEAN UP

- a) On completion of the installation Contract shall be scrub clean all pumps, piping, filters and equipment and apply one coat of primer.
- b) Apply two or more coats of synthetic enamel paint of approved make and shade.
- c) Provide painted identification legend and direction arrows on all equipment's and piping as directed by Engineer.

- d) All M.S. fabricated items M.S. pipe lines structural, vessels for water treatment plant shall be painted with zinc/chromate primer after through cleaning. On completion of the installation Contractor shall scrub clean all pumps, piping, filters and equipment and again apply one coat of zinc chromate primer.
- e) On final completion of the work, contractor shall clean up the site and the pump room, pump room of all surplus material, rubbish and leave the place in a broom clean condition.

12.0 MOTOR CONTROL CENTERS

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

- a) Incoming MPCB of required capacity
- b) Isolation MPCB/MCCB, one for each motor
- c) Fully automatic DOL/Star Delta starters suitable for motor DOL upto 7.5 H.P.; Star/Delta for 10 H.P. and above H.P. with push buttons one for each motor and On/Off indicating neon lamps.
- d) Single phasing preventor of appropriate rating for each motor
- e) Rotary duty selector switch
- f) Panel type ampere meters one for each motor shall be with rotary selector switch to read line currents.
- g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase
- h) Neon phase indicating lamps and indicating lamp for each motor and on incoming mains.
- i) Rotary switch for manual or auto operation for each pump
- j) Fully taped separate aluminium bus bar of required capacity for normal and emergency supply where specified.
- k) Space for liquid level controllers and other equipment specified separately in the contract/given in the schedule of quantities
- l) The panel shall be pre-wired with colour coded wiring. All interconnecting wiring from incoming main to switchgear, meters and accessories within the switchboard panel. Wiring shall have suitable copper or aluminium ferrules.

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

13.0 WATER SOFTENING PLANT

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

13.1 Hardness Test Kit

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

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

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

- a) PP wound Micron Catridge Filters in food grade material in combination of 5 & 10 micron rating or alternatively spring type cross filter with manual/auto backwashing system and shall be provided with necessary isolation valves, inlet & outlet pressure gauges etc. Micron filters shall be with differential pressure measurement system and cleaning frequency should not be more than once in a month.
- b) Anti-scalent and pH correction system as per feed water quality along with process demanding instrumentation and piping etc.
- c) RO module fitted with thin film composite TFC 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.
- 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)s pumped by Pumps P10 A/B to the Over Head Soft Water Tank. Soft Water pump P10 A/B would be automatically controlled by the Level controller provided in tank (T8) These Level Controllers as in earlier cases would also give audio visual/alarm in case of very high or very low level.

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

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

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

16.0

TREATED WATER QUALITY

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

APPENDIX - I

Tentative Raw Water Characteristics :

S.NO	PARAMETER	VALUE
1.	Hardness	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.

20.0 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.

21.0 PUMPS FOR HYDROPNEUMATIC & DRAINAGE SYSTEM

21.1 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.

21.2 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 hdyro pneumatic pumping units shall have the following features ;

21.2.1 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.

21.2.2 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 least 10 different pre-set pressure points as required.
- When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s). In event of control failure, the pumps shall be able to be start/stopped manually at the local panel by means of pressure switches.
- The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.
- The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps form running dry.

- Automatically starting the pumps when the water level is back to normal.
- In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.
- Functions to limit the no. of start/stop of pumps per hour.
- The system control panel shall incorporate at least the following components :
 - a. LCD Display
 - b. Pumps selections for up to 4 pumps so that system controller can control up to 6 pumps
 - c. Pump status button to display duty pump speed and system capacity
 - d. Zone status button to display operating parameters for different pumping units
 - e. Setting button to input preset pressure, system start/stop time etc.
 - f. ± 1 button to key in numeric data such as pressure set point, etc.
 - g. Enter button for confirmation of input into the system
 - h. Alarm button to show location of fault - self diagnostic function display
 - i. Hour Run measurement for each supplied pumpset
 - j. Buttons for scrolling to select the actual display reading for system configuration, i.e. up and down scroll concept.
 - k. Necessary devices for programming, supervising and monitoring operation data/system, status shall be incorporating into the control panel.

21.2.3 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.

21.2.4 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
- Fuses
- 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.

21.2.5 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.

21.3 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.

22. TECHNICAL SPECIFICATIONS OF SOLAR WATER HEATING SYSTEMS

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

1.	SYSTEMS CAPACITY	As specified
2	NO of SYSTEMS	As specified
2.	SYSTEM TEMP. OUTPUT	60°C year average basis on clear sunny days
3.	SOLAR COLLECTORS Type Make	Selectively coated (Cu-cu type) ISI marked Make BHEL/TATA BP /EMMVEE

	Applicable IS No. Quantity of Solar collectors Absorption area	SOLAR SYTEMS Pvt. Ltd IS:12933 As per requirements 2.0 Sqm(MIN)
4.	COLLECTOR/TANK SUPPORT FRAME	MS Angle 35x35x5mm/40X40X4mm minimum adequate for 150 km/hr wind pressure
5.	HOT WATER STORAGE TANKS (INSULATED) Quantity Capacity Material Insulating material Insulating material Density Insulation thickness Waterproof covering Cladding material	1 No. each As per site requirements 304 Stainless Steel Rockwool/Glass wool 48 kg/cu.m 100mm (Min.) polythene lining Aluminum 22 swg (0.71 mm thick)
7.	Distribution PIPINGS (Extra payable as per actual measurements) CPVC/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 1/2" BSP H Guru
10.	STRAINER Material Type Mesh	Cast Iron Y-type Horizontal Brass
11	ELECTRICAL BACK-UP	As PER REQUIRED Heater ISI Marked
12	HEAT EXCHANGER Material Type Surface area	Stainless Steel 304 Cage As per site requirements
13	OPERATION GUARANTEE	One year
14	ALLIED CIVIL & ELECTRICAL WORKS	Complete for making the system operational/functional in all respects including wiring upto nearby distribution board.

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

Collector specifications: The collectors shall be of Cu-Cu type with Absorber area of 2.0 sq. mtrs. The absorber riser-tubes shall be made of high-grade copper & welded to the copper fins with the State of the Art ULTRASONIC WELDING process to ensure superior conductivity of heat & long life of absorber plate. The absorber plate shall be selectively coated with a very special NALSUN coating for efficient absorption of heat from the Sun-rays. The efficiency of the collectors has been specified as $FR (Ta) = 0.72$, $FROL = 3.62 \text{ W/Sq. mtr/}^{\circ}\text{C}$. 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 arrange on roof in such a way so that the shadow of the collectors/ parapet etc can be avoided. The outer sides shall be having a Powder Coated finish in Yellow colour. The collector should have very high Absorbivity of $> 0.95 \%$ & Emissivity $< 0.2 \%$. Anti-Condensation breather outlet shall be incorporated at rear bottom of collector to drain out condensed moisture if any. This prevents the inner glass surface from Fogging.

Tank specifications: The Insulated Hot Water Tank shall be of the Vertically oriented cylindrical type made out of SS-304. It shall be duly insulated with 100mm thick glass-wool insulation with thermal conductivity of 0.028 to.033 W/mk and density 48 kg/cu.m. This will be covered with Aluminium cladding of thickness #22 SWG along with chicken mesh and thin polythene sheet. There shall be a built in Heat Exchanger of multiple tube type made of SS-304 to transfer the heat to the water in the tank. This closed loop system shall be provided with a make up tank. Also provided shall be a sacrificial anode to prevent Galvanic Corrosion. Electrical backup of as required with SS/Cu Thermostat (range 30-80⁰C, 15A/250 VAC) shall also be provided.

24.00 FIRE FIGHTING SYSTEM

24.01 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, Fire Fighting work shall be carried out by specialized fire fighting agency approved by HSCC.
- 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/data sheet of equipment 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.
- 17.2 The period of training shall be adequate and mutually agreed upon by the Engineer and Contractor.
- 17.3 The Owner's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.
- 17.4 Nothing extra shall be paid to the Contractor for training Owner's personnel.

18.0 PERFORMANCE GUARANTEE

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

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

24.02 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 / S.S
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/Sq m	-----
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 within 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 preventnal-operation.

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

6.9.3 Moulded Case Circuit Breaker (MCCB)

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

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

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

The general-purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

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

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

6.9.4 Motors and Starters for Fire Pumps

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

6.9.5 Name Plates & Lables

- i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switchboards, similar panel and board identification lables shall be provided at the rear also.
- ii) All nameplates shall be of non-rusting metal or 3-ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Owner's approval.
- iii) Suitable stencilled paint marks shall be provided inside the panel/module identification of all equipment in addition to the plastic sticker lables, if provided. These lables shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

6.9.6 Painting of all Steel Work

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

- a) Degreasing: All the steel components, to be painted, should be effectively cleaned by alkaline degreasing.
- b) Pickling: Oxide scale rust formation are to be removed in a hot bath of sulphuric acid. Pitting of the surface is to be prevented by the use of pickling 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 phosphoric solution is to be used in the phosphating plant.

Passivating: This process is to be carried out by using deoxidizing 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 baked in an electrically heated, air circulated area type drying 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.

24.03 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 /GI/DI pipe fire risers within the building.

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

Excavation, anchor blocks and valve chambers.

2.0 GENERAL REQUIREMENTS

2.1 All materials shall be of the best quality conforming to the specifications and subject to the approval of the employer. The wet riser system shall remain pressurized at all times during operation, and as such the piping work shall be carried out to withstand the same.

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

- 2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.
- 2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.
- 2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

3.0 PIPES AND FITTINGS

FOR INTERNAL WORK:

- a. All pipes within the building in exposed locations and shafts including connections buried under floor shall be ERW mild steel tubes conforming to IS: 1239 (Heavy class) up to 150mm AB and IS 3589 above 150 NB's with screwed or welded joints as specified by the engineer in charge at least 10% of welded joints shall be radiographically tested.
- b. Fittings of 50mm or below shall be forged steel with socket weld ends of approved makes. For 65mm and above shall be W.I./M.S. with butt weld ends.

4.0 JOINTING

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

5.0 EXCAVATION

- 5.1 Excavations for pipeline shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipelines shall be buried to a minimum depth of 1 to 1.5 meter or as shown on the drawings.
- 5.2 Wherever required contractor shall support all trenches or adjoining structures with adequate supports to prevent land slides.
- 5.3 On completion of testing and painting, trenches shall be refilled with excavated earth in 15-cm layers and compacted.
- 5.4 Contractor shall dispose off all surplus earth within the site.

6.0 ANCHOR BLOCKS

- 6.1 Contractor shall provide suitable cement concrete anchor blocks as may be necessary for overcoming pressure 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.

- 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 sprindile.

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 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 store 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.

24.04 SPECIFICATIONS FOR SPRINKLER SYSTEM

1.0 SCOPE OF WORK

- 1.1 Work under this section shall consist or furnishing all labour, materials, equipment and appliances necessary and required to completely install the sprinkler system as required by the drawings and specified herein after or given in the schedule of quantities.
 - a) Sprinkler mains, branch and external piping complete with valves, alarm, hangers and appurtenances and painting.
 - b) Sprinkler heads with spare sprinklers
 - c) Connections to risers, pumps and appliances

2.0 GENERAL REQUIREMENTS

- 2.1 All materials shall be of the best quality conforming to specifications and subject to the approval of the engineer.
- 2.2 Pipes and fittings shall be fixed truly vertical horizontal or in slopes as required in neat workman like manner.
- 2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.
- 2.4 Pipes shall be supported from walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.
- 2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

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

3.0 SPRINKLER HEADS

a) Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly yoke and the deflector. The sprinklers shall be of approved make and type.

b) Types:

i) Conventional Pattern:

The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown upwards to the ceiling. The sprinklers shall be suitable for erection in upright position or pendant position.

ii) Spray Pattern:

The spray type sprinkler shall produce a hemispherical discharge below the plane of the deflector.

iii) Ceiling (flush) Pattern:

These shall be designed for use with concealed pipe work. These shall be installed pendant with plate or base flush to the ceiling with below the ceiling.

c) Constructions:

i) Bulb: - Bulb shall be made of corrosion free material strong enough to with stand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.

ii) Valve Assembly:-Water passage of the sprinkler shall be closed by a valve assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.

iii) Yoke: - The yoke shall be made of high quality gun metal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anti-corrosive treatment if the same is to used in corrosive conditions.

iv) Deflector:-The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler.

d) Colour Code :

The following colour code shall be adopted for classification of sprinkler according to nominal temperature ratings:

e) Size of Sprinklers Orifices:

The following sizes of sprinklers shall be selected for various classes or hazards.

Extra light hazard	10/15 mm nominal bore
Ordinary light hazard	15 mm nominal bore
Extra high hazard	15/20 mm nominal bore

f) Stock of replacement sprinkler :

The following spare sprinklers shall be supplied along with the system:

Extra high hazard systems	6 sprinklers
Ordinary hazard systems	24 sprinklers
Extra high hazard systems	36 sprinklers

g) Temperature Rating:

For normal conditions in temperature climates rating of 68/74 deg. C shall be used. However the temperature rating shall be as closed as possible to, but not less than 30 deg. C above the highest anticipated temperature conditions.

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

- a. One man stop valve of full way pattern with gunmetal pointer to indicate where open/shut.
- b. One automatic alarm valve, fitted with handle and cover.
- c. One hydraulic alarm motor and gong for sounding a continuous alarm upon out-break of fire.
- d. One combined waste and testing valve including 5mtr of tubing and fittings.
- e. Alarm stop valve
- f. Strainer
- g. Drain plug
- h. Padlock & strap
- i. Wall box for installation of valve

5.0 Pressure Gauges:-Burden type pressure gauges conforming to IS/BS specifications shall provided at the following locations.

- a. Just above alarm valve.
- b. Just below alarm valve, on the installation stop valve.
- c. One pressure gauge on delivery side of each pump.
- d. Required number of pressure gauges on pressure tank.

6.0 INSTALLATION OF PIPING

A. Below ground piping :- Under ground piping shall be installed in masonry trenches with cover or reinforced concrete. The pipe work shall be supported at regular intervals of 2.5m with masonry or RCC supports. Wherever pipes pass through roads/pavements suitable size hue pipes shall be provided for protection of piping. Underground pipes shall be protected against corrosion with two coats of bituminous painting and wrapped with tarfelt or similar covering. If the piping is to be buried in ground with back filling of earth, a coat of epoxy painting shall be given.

B. Above ground piping:-

a. All above ground piping shall be installed on suitable to pipe hangers/supports as required. The hangers shall be made of MS angles, channels etc. and painted to the required finish (with suitable synthetic enamel Paint). The spacing of piping supports shall be as follows:

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

b) Piping shall be so installed that the system can be thoroughly drained. All the pipes shall be arranged to drain to the installation drain valve. In case of basement and other areas where the pipe work, is below the installation drain valve/auxiliary valves of the following sizes shall be provided.

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

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

d) The piping shall be pressure tested by the hydrostatic method upto a pressure of 1.5 times the working pressure the piping shall be slowly charged with water so that all the air is expelled from the piping by providing a 25mm inlet with a stop cock. The

pipng 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 trickle 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.

24.05 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 with in 8cm from the top of the enclosure.

Necessary facility for draining the rise pipe shall be provided at ground floor level with 40mm size sluice valve.

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

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

All hoses shall be numbered and a record submitted with completion plane. The number and length shall be easily recognizable on each hose pipe.

External hose boxes shall be installed such that the hose is not exposed to sun rays.

3.0 PRECOMMISSIONING

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

3.1 TESTING OF M.C.C

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

- 3.1.1 Insulation resistance test with 500 volt merger, before and after high voltage test, on all power and control wiring.
- 3.1.2 High voltage test at 2000 volts A.C. for one minute on all power and control wiring.
- 3.1.3 Low voltage continuity test (6 volts) on power wiring of each feeder, between bus bars and outgoing terminals with switches and contractors in closed position.

- 3.1.4 Low voltage continuity test (6 volts) on all control wiring.
- 3.1.5 Operation test for all feeders with only control supply made “ON” to ensure correctness of control wiring, operation of the various equipment used, such as push buttons, protective devices, indicating lamps and relays, etc. All contractors shall be checked for the presence of humming and chattering.
- 3.1.6 Earth continuity test with voltage not exceeding 6 volts between various non-current metallic of equipment, steel work, etc. and the earth bus provided in the M.C.C.
- 3.1.7 Operation of all instruments and meters provided on the M.C.C.
- 3.2 FIRE PROTECTION SYSTEM
 - 3.2.1 Check all hydrant valves and close if any valve is open. Check that all suction and delivery connections are properly made.
 - 3.2.2 Test run and check rotations of each motor and correct the same if required.
- 3.3 PIPE WORK
 - 3.1 Check all clamps, supports and hangers provided for the pipes.
 - 3.2 Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications if any leakage is found. Rectify the same and reset the pipes.
- 4.0 COMMISSIONING AND TESTING
 - 4.1 FIRE HYDRANT SYSTEM
 - 4.1.1 Pressurize the fire hydrant system by running the main fire pump and after attaining the required pressure shutoff the pump.
 - 4.1.2 Open by-pass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the pre-set pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.
 - 4.1.3 Open bye-pass valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump should cut-in at the preset pressure and should not cut-out automatically on reaching the normal line pressure. The main fire pump should stop only by manual push button. However, the jockey pump should cut out as soon as the main pump starts.
 - 4.1.4 Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.
 - 4.1.5 When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant simultaneously and allow the hose pipe to discharge water

into the fire tank to avoid wastage. The electrically driven pump should run continuously for eight hours so that its performance can be checked.

- 4.1.6 Diesel engine driven pump should also be checked in the same manner as given in para above by running for 8 hours.
- 4.1.7 After laying and jointing, the entire piping shall be tested to hydrostatic test pressure. The pipes shall be slowly charged with water so that the air is expelled from the pipes. The pipes shall be allowed to stand full of water for a period of not less than 24 hours and then tested under pressure. The test pressure shall be 10kg/cm². The test pressure shall be applied by means of manually operated test pump or by a power driven test pump to be provided by the Contractor. In either case precautions shall be taken to ensure that the required test pressure is not exceeded.
- 4.1.8 The open end of the piping shall be temporarily closed for testing.
- 4.1.9 Test shall be conducted on each pump set after completion of the installation with respect of delivery head, flow and B.H.P. The test shall be carried out by the Contractor at his own cost.
- 4.1.10 All leaks and defects in different joints noticed during the testing and before commissioning shall satisfaction of Engineer.
- 4.1.11 Check each landing valve, male and female couplings and branch pipes for compatibility with each other. Any fitting, which is found to be incompatible and does not fit into the other properly, shall be replaced by the contractor. Landing valves shall also be checked by opening and closing under pressure.
- 4.1.12 Testing of fittings/equipments shall be carried out either at site or at works in the presence of a representative of the Engineer. Test certificates shall also be furnished by the Contractor.
- 4.1.13 The automatic operation of the system for the various functional requirements and alarms as laid down in his specification shall be satisfactory carried out on as described above.

4.2 HANDING OVER

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

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

24.06 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.

24.07 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

25.00 LIST OF APPROVED MAKES : CIVIL WORKS

Sl.No.	MATERIALS	MANUFACTURERS
1.	Doors & Windows fixtures/ Fittings:	Everite, Hardima, Earlbehari
2.	Door Closer / Floor spring :	Doorking, Everite, Hardwyn, Amar Darny, 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,BIRILA,Jaypee
12.	Reinforcement Steel :	SAIL,TATA, RINL
13.	Back-up Rod. :	Supreme Industries or equivalent
14.	M.S. Pipe :	Jindal Hisar, Prakash-Surya, BST, Kalinga, Tata
15.	Polysulphide sealant. :	Pidilite, Fosroc, or equivalent as approval by Engineer.
16.	Polycarbonate Sheets :	GE Plastics or approved equivalent
17.	Wooden/Metal Fire Check Doors :	Navair, Shakti-met, Godrej, Pacific Fire Control,
18.	Gypsum Board System :	India Gypsum, Laffarge,
19.	Sunken Portion Treatment :	Roffe, Krytone,Sika,
20.	Admixtures for concrete. :	Cico, Vam Organics, Roffe, Pidilite,FOSROC
21.	Epoxy Paint. :	Nerolac, Shalimar or approved equivalent.

22.	Ceramic Tiles	:	Johnson, Somany, Kajaria, Bell,Navin
23.	Pre-Laminated Particle Board	:	Novopan, Greenlam, Kitlam, Marino
24.	Flush Door Shutters.	:	Century, Kitply, Novapan, Green Ply, Marino
25.	Silicon Treatment	:	GE-Silicon, Pidilite, Fosroc
26.	Glazed Tiles	:	Bell, Somany, Johnson, Kajaria, Cera,Navin
27.	White Cement.	:	Birla White, J.K.
28.	Powder Coating Material Pure Polyester.	:	Jotun , Berger, Goodlass Nerolac
29.	Masking Tapes	:	Suncontrol , Wonder Polymer.
30.	Stainless Steel Screws For Fabrication and fixing of Windows.:	:	Kundan , Puja , Atul.
31.	Dash Fasteners./Anchor bolts	:	Hilti, Fischer, Bosch.
32.	Stainless Steel Bolts, Washers and Nuts.	:	Kundan, Puja, Atul.
33.	Stainless Steel Pressure Plate Screws.	:	Kundan, Puja, Atul.
34.	Stainless Steel Friction Stay.	:	Securistyle, Earl Bihari.
35.	E.P.D.M. Gaskets.	:	Anand Reddiplex, Enviro Seals
36.	Weather Silicon.	:	Dow Corning, Wacker, GE
37.	Structural Silicon at butt joints	:	- Do -
38.	PVC continous fillet for periphery packing of Glazings /Structural glazings.:	:	ISI marked as approval by engineer.
39.	Floor Springs.	:	Doorking, Opel ,Amar
40.	Aluminium Cleat arrangement for Glazings.	:	Deco or approved equivalent
41.	Water proofing / Injection Grouting	:	SIKA or equivalent approval by Engineer
42.	6mm thick Reflective Glass	:	Glaverbel, Glavermas, Saint Gobain.
43.	Door Locks.	:	ACME, Godrej, Harrison, Hardima, Mobil
44.	Door Seal – Woolpile Weather Strip	:	Anand -Reddiplex.
45.	Aluminium Grill	:	Decogrille and approved Equivalent

46.	Vitrified Tiles	:	Naveen, Bell-Ceramics, Kajaria, Somani, Johnson
47.	Aluminium Cladding sheets	:	Alucobond, Alucomat or equivalent as approval by Engineer
48.	Aluminium Die-cast handles & two point locking kit	:	Giesse, Securistyle, Alu-alpha
49.	Stainless steel D-handles	:	D-line, Giesse, Dorma, Hardima
50.	Fabric for Auditorium	:	ESSMA, Raymonds or equivalent
51.	Stainless Steel Pipes/Flats	:	304 Grade (as approved by Engineer)
52.	Structural Steel	:	SAIL, TATA, RINL
53.	Ready Mix Concrete approved equivalent	:	ACC, BIRLA, Ahlcon or
54.	SBS bitumen based Self adhesive membrane Material	:	Grace-Bituthene CP1.5, Texsa-Texself 1.5
55.	Acoustic Mineral Fibre	:	USG-Radar, Armstrong, 21 st Century, Acostyle
56.	Curtain wall/Structure Glazing/Hermatic seal Sliding Doors	:	Specialised Agency to be approved by Engineer
57.	Fire Panic bar	:	Briton, Monarch, Von-Duprin, Dorma, Mobel
58.	Ply board	:	Greenply, Kitply, Century, Archid, Marino
59.	SS Railing	:	Mobel, D Line, Hardima
60.	Interlocking Paver Tiles	:	Ultra, Shree or Approved Equivalent
61.	Acoustic Seals	:	Anand Reddiplex, Enviroseal or equivalent
62.	Smoke Seals	:	Pemko or Equivalent
63.	GRC Jali		Unistone, Mahesh GRC
64.	Turf		Mondoturf, Fieldturf Tarkett
65.	Furniture	:	Delite(Kom), Debono(Flexcom), Godrej
66.	Signage and Display System	:	M/s Pushp (I) Ltd., Evergreen adsign-graphics, Bhartiya Advertising

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

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS
PLUMBING

S.No.	Details of Materials / Equipment	IS CODE	Manufacturer's Name
1	Vitreous China Sanitary ware such as EWS, Wash basin, Urinal, Urinal partitions, toilet paper roll holder	I2556	Hindustan Sanitaryware / Parryware / CERA / KOHLER/
2	White Glazed Fire Clay Sink	771	Sanfire, Cera, Neycer, Hindware.
3	Stainless Steel Kitchen Sink		Neelkanth/ JAYNA, Nirali, Jaquar, Orient,
4	W.C. seat cover	2548	Commander / Bestolite/ Diplomat/ Jaquar/ Sona
5	Electric Water Heater		Venus, Voltas, Racold, Usha Lexus
6	C.P. brass flush valve for WC and Urinals		Jaquar / Marc / KOHLER, , DOCOL(Germany) marketed by GEM, Ideal Orient
7	C.P. brass fittings such as pillar cocks, stop cocks angular stop cocks, C.P. flexible pipes, C.P. brass waste, C.P. brass cast bottle trap, C.P. brass shower rose, long body bib taps, C.P. brass health faucets, single lever mixing fittings etc.	1795 / 4291/ 4827/	Jaquar / Marc / Aquaplus, / KOHLER
8	Centrifugally /Sand cast iron pipes & Fittings. Manhole covers and frames	3989/1729	, NECO, BIC, HEPSCO
9	GI Pipes (IS : 1239 and IS : 3589)		Tata Steel / Jindal (Hissar) / Prakash – Surya, BST, SAIL
10	GI pipes fittings (IS : 1239 and IS : 3589)		Unik / Zoloto / Leader, K.S, Zenith
11	Gunmetal Valves	778	Zoloto, Leader, Kilburn

12	Brass stop & Bib Cock	781	Zoloto, L&K, Jaquar
13	Ball valve with floats	1703	Zoloto, Leader, Sant, Jayco
14	Stoneware Pipes, Gully Traps	651	Perfect Potteries, JABALPUR or Approved equivalent ISI marked
15	RCC Pipe	458	ISI Marked Pipes
16	Water Tank		Sintex, Polycon, Uniplast
17	Mirror		Golden / Atul / Modi Guard Gujrat Guardian
18	Automatic hand drier		Kopal / Automat, Euronics, u tec
19	PVC flushing cistern		Commander, Parryware, Duralite
20	Insulation for Hot Water Pipes		Armacel – Armaflex (UK) / Eurobatex – Union Foam (Italy) / K-Flex / Vidolex insulation / Superlon insulation or equivalent
21	PVC Pipe		Supreme / Finolex / Prince / Oriplast
22	D.I. pipes Class LA and fittings, DI		Keso-spun, Supra, JINDAL, TATA, Electrosteel.
23	Sluice Valves / NRV		Kirloskar / Zoloto / Kilburn / Castle
24	Butterfly Valve		Keystone / Zoloto / Audco / Castle / Intervalve / C&R
25	Check Valve		KSB/Zoloto/ Audco /
26	Air Release Valve		Zoloto / Cim or approved

		equivalent
27	Y Strainer	Emerald / Zoloto or approved equivalent
28	UPVC/HDPE pipes & fittings	Flnolex , Prince, Supreme, Oriplast
29	Infrared Sensor operated Faucets	Jaquar / U-Tec, Euronics
30	Infrared Sensor operated Automatic flushing system for Urinals	Jaquar / U-Tec, Euronics
31	C.P. Grating for Floor Trap	Chilly Cockroach Trap / Jaquar / Vijay
32	Gratings, Strainers, Cleanouts etc	Neer Brand (Sage Metals) or equivalent
33	Drinking Water Cooler	Blue Star / Voltas / Usha
34	CPVC Pipe	Ajay / Flow Guard / Astral
35	Anti Vibration Mounting	Dunlop / Resistoflex or approved equivalent
36	Ultra Violet Water Sterilizer	Eureka Forbes / Pentair / ALRIA
37	Water supply pumps	KIRLOSKAR, GRUNDFOS, Mather & Platt (WILO)
38	Submersible pumps	KIRLOSKAR, GRUNDFOS, KSB, Mather & Platt
39	Chlorinator	ALFA, USA, Ion exchange, Sigr DH Combine Inc.
40	HDPE Solution tank	WATCON, ION EXCHANGE, Water Supply Specialist P (Ltd)
41	Level Controller (Water)	Active Controls / Technika,

		Femac or equivalent
42	Level Indicator (Water)	Active Controls / Technika
43	Drainage Pumps	Grundfos, KSB , Kirloskar
44	Water Treatment Plant / Sewage Treatment Plant	ION-Exchange / Thermax / Aqua Process / Akar Impex, Geo Miler & Co,
45	R.O System	Thermax, Fontus,, Ion-Exchange, Akar Impex, Polycon Technologies, Aqua Process
46	PE-AL-PE	Kitec, Jindal, NEXGEN
47	HDPE pipes and fittings	Oriplast, Polyfab
48	Hydropneumatic Pumps and other pumps	DP Holland/Grundfos, Mather & Platt (WILO)
49	Variable Frequency Drives	Siemens / Danfoss
50	Pressure Gauge	Emerald / Fiebig / HGURU
51	Water Meter (Mechanical Type)	Kaycee / HGURU
52	Dosing Pumps	LMI / Toschon / Pulser Feeder
53	Pypcoat for Burried Piping	IWL / Coaltek or approved equivalent
54	Welding Rods	Advani or approved equivalent
55	Hot Water Generators	Thermax /Olympia
56	Calorifiers / PHE	Thermax/Olympia
57	DI Pipes and fittings	Electrosteel / Kesoram / Jindal

58	Solar Heating System	Tata BP/ Emmvee / BHEL
59	Grab Bars	Marino or equivalent
60	Copper Pipe	Raj Co, Maxflo or approved equivalent
61	Copper fittings	Viega, IBP or approved equivalent

26.00 LIST OF APPROVED MAKES : FIRE FIGHTING WORKS

S.No.	Material	Relevant ISI Code	Brand/ Manufacturers OR EQUIVALENT
1.	G.I./M.S. Heavy class pipe	1239/3589	Jindal-Hissar, Tata, Prakash -Surya, B.S.T., SAIL
2.	Gate Air Valve		Leader, Zoloto, SBI,
3.	Butterfly valves	13095	Audco, Keystone, Intervolve, C & R, Zoloto, Castle
4.	Portable Fire Extinguisher	2171	Minimax, Safex, Firex, Eversafe Ceasefire, Newage
5.	First aid Fire hose reels	884	Minimax, Safex, Firex, Newage, Eversafe
6.	Fire hose pipes	636	Newage, Safex, Jyoti, Jayshree, Eversafe, CRC
7.	Fire Hydrant valves	5290	Minimax, Newage, Safex, Ceasefire, Vijay, Agnice, Eversafe
8.	Sprinkler Heads		
a)	Pendent type		Spray safe, HD, Newage, Reliable
b)	Side wall type		Newage,, Spray safe, Reliable
c)	Sprinkler Side wall extended through		Spray safe, HD, Reliable,
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 , Newage,
11.	Reinforced rubber lined/canvas		Newage, Jayshree, CRC
12.	Standby battery lead acid		Exide, Standard, Amco
13.	PVC Insulated Copper Conductor.		Finolex, Plaza, National
14.	Recessed/concealed type		Spraysafe., Reliable
15.	Fire pumps		Kirloskar, Mather & Platt(WILO), 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 Or approved equivalent
21.	Suction strainer	Leader, ZOLOTO, AUDCO
22.	Vibration eliminator connectors	Dunlop, Resistoflex, or approved equivalent
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
26.	Starters, switches, T.P.N switch	L&T / Siemens / GE Power/ Schneider
27.	Pressure switch.	Indfoss / Switzer or approved equivalent
28.	Pressure Gauges	Indfoss / Switzer or approved equivalent
29.	Fasteners	Hilti / Fischer/ Bosch
30.	Weld Rods	Advani or approved equivalent
31.	Mechanical Seal	Durametallic / Burgmann or approved equivalent
32.	Installation Control Valve	Central/HD/Grinell /Tyco.
33.	Pipe Supports (Band Hanger)	Chilly / Targa or approved equivalent
34.	Electronic Level Indicator	Minilec/Pumptcol or approved equivalent
35.	Fire Sealent	Birla 3M / Hilti 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**

**COMPREHENSIV REDEVELOPMENT PLAN OF LADY HARDING MEDICAL
COLLEGE AND ASSOCIATED HOSPITALS
AT
SHAHEED BHAGAT SINGH MARG
NEW DELHI
TECHNICAL SPECIFICATIONS FOR
INTERNAL & EXTERNAL ELECTRICAL WORKS
PACKAGE -2 RESIDENTIAL AREAS**

Item No.	Description of Items	
1.0	GENERAL	
2.0	11 KV HT PANELS	
3.0	11KV/ 433 V TRANSFORMERS	
4.0	11 KV KV CABLES	
5.0	L.T. CABLES AND CONTROL CABLES	
6.0	BUS DUCTS.	
7.0	LT PANELS	
8.0	DG SETS & ASSOCIATED WORK	
9.0	ROAD LIGHTING	
10.0	DISTRIBUTION BOARDS	
11.0	CONDUIT & WIRING SYTEM	
12.0	LIGHTING FIXTURE AND FANS	
13.0	CABLE TRAY	
14.0	EARTHING	
15.0	FIRE ALARM AND DETECTION SYSTEM	
16.0	PUBLIC ADDRESS SYSTEM	
17.0	LIFTS	
18.0	DRAWING/PROCUREMENT & INSPECTION OF EQUIPMENT	
19.0	LIST OF APPROVED MAKE OF MATERIAL	

TECHNICAL SPECIFICATIONS

1.00 GENERAL

1.01 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 regulation. Electrical work in general shall be carried out as per following specifications with upto date amendment.

General Specifications for Electrical Works:

(Part I - Internal) - 2005.

(Part II - External) - 2007.

(Part IV - Substation) - 2007.

(Part VII – DG Set) - 2006

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.

1.02 SCOPE OF WORK

The scope of work shall cover electrical works for proposed **Lady Harding Medical College and associated Hospitals residential area at New Delhi.**

The items / activities covered under the electrical works shall include the following:

- i. Supplying , Fixing testing and commissioning of Main LT Panel, capacitor Panel, Main Distribution Boards, Meterboards and Sub distribution boards complete in all respect.
- ii. Supplying , fixing, Laying , testing and commissioning of 11 KV and LT Cable complete in all respect.
- iii. Supplying, fixing, testing and commissioning of DG Sets of 415V complete in all respect.
- iv. Supplying , Fixing , testing and commissioning of 11 KV HT Panel and 11 KV / O.433 KV Transformers complete in all respect
- v. Supplying, Fixing, testing and commissioning of External light pole including High mast complete in all respect.
- vi. Earthing with maintenance free earthing system complete in all respect.

- vii. Main Distribution Boards, Meter boards, Sub Distribution Boards and Distributions Boards. Switch fuse unit/MCB/Isolator for lifts, major hospital equipment etc. complete in all respect.
- viii. Cables from Main Distribution Board to Sub Distribution Boards. Submain wiring from Main/Sub Distribution Boards to various final Distribution Boards. Power wiring for hospital equipment, lift etc. complete in all respects.
- ix. Point wiring of all lights points, Ceiling fan points, exhaust fan points, cabin fan points, light plug points, general power points, metal clad plug & socket outlet points etc. including supply and fixing of light & power accessories etc. complete in all respects.
- x. Light fixtures, ceiling fans, exhaust fans and cabin fans.
- xi. Provision for telephone system consisting of conduit and cabling from telephone distribution board upto each outlet including main & sub tag blocks, telephone outlets incoming GI/RCC pipe etc. complete in all respect.
- xi. Provision of computer wiring consisting of conduit, outlet box, junction boxes etc., complete in all respect.
- xii. RCC/GI pipes for cables, manholes, cable tray and other items required to complete with electrical installation work in all respects.
- xiii. Earthing of electrical installation complete in all respects.
- xiv. Scope of work shall include supply installation, testing and commissioning of complete electrical installation as described above.
- xvii. Supplying, Fixing testing and commissioning of Addressable Fire Alarm and detection system including Hooters, Manual call point, wiring / cabling Response indicators and the Main Panels and the central monitoring system.

1.03 STANDARD AND REGULATIONS

All equipments, switchgear, cables and other items of work shall conform to Indian/IEC Standard specifications.

The installation shall conform in all respects to Indian Standards Code of Practice for Electrical wiring installation IS:732- 1989. It shall also be in conformity with the current Indian Electricity Rules and the Regulations and requirements of the Local Electric Supply Authority, Local laws/by laws in so far as these become applicable to the installation. Wherever these specifications call for a higher standard of materials and /or workmanship than those required by any of the above regulations, these specifications shall take precedence over the said regulations and standard. In general, the materials, equipment and workmanship shall conform to the following Indian Standards, unless otherwise called for.

- * XLPE insulated PVC sheathed armoured
Cables of 1.1kv grade as per

IS 7098 Part-I &
II 1988/1985

*	Marking and arrangements for Switchgear: Bus bars, main connection and auxiliary wiring.	IS 375 - 1963
*	Specifications for normal duty air break switches and composite units for air break switches and fuses for voltage not exceeding 1000 volts.	IS 13947-1993 (Part-I to V)
*	Specification for low voltage switchgear and controlgear assemblies	IS 8623 -1993 (Part-I to III)
*	Specifications for enclosed distribution	IS 2675 - 1983
*	Installation and maintenance of Switchgear	IS 10118-1982 (Part-I to IV)
*	HRC Fuses	IS 9224 -1979
*	Specification for Rigid Steel conduits for electrical wiring.	IS 9537 -1981 (Part-II)
*	Specifications for accessories for rigid steel conduits for electrical wiring.	IS 3837 -1976
*	3 pin plugs and socket outlets	IS 1293 -1988
*	General & safety requirements for electric light fittings.	IS 1913 -1978
*	Electric ceiling fans and regulators	IS 374 -1979
*	Code of practice for earthing	IS 3043 -1987
*	Current transformers	IS 2705 -1992 (Part-I)
*	Shut capacitors for power system	IS 2834 -2986

* Exhaust Chimney

IS 6533 -1989
(Part-II)

Inspection and approval of the work by local authority: On completion of this work, the contractor shall obtain and deliver to the Client/HSCC all the certificates of inspection and approval by the electrical inspectorate as required. The Client/HSCC shall have access to the manufacturer's premises for inspection of any item of the tender for which contractor has to make arrangement with different manufacturers.

2.0 11 KV HT PANELS

2.01 System Design Parameters

Nominal system voltage	:	11KV
Frequency	:	50 Hz
System fault level	:	350 MVA
Site Altitude level	:	Less than 1000 m above sea level

The HT Panel shall comply with the following Indian standard as amended up – to date.

IS 3427 – 1991

IS 12729 - 1988

2.02 11 KV, 350 MVA SWITCH BOARD

The panel shall be fully compartmentalised, with separate compartments for CT/ cable termination, busbar chamber, breaker compartment and LT chamber, housing the LT equipment, like meters/relays etc. The panels shall be suitable for fully drawout execution with horizontal isolation. The breaker truck to have three distinct positions, i.e. test, service and isolated. Necessary interlocks to be provided to prevent operation of breaker in any intermediate position.

Busbars shall be fine electrolytic copper, air insulated. The busbars shall be enclosed in separate compartments and shall be air insulated. The busbars supported on bus support insulators shall be able to withstand the dynamic stresses during short circuits.

The partitions between the breaker compartment and the bus and cable connecting compartment respectively shall be made of metal-clad plates. These plates shall carry individual metallic shutters for primary contact arms. The shutters shall operate automatically without any complex operating mechanism but under no circumstances be pushed open inadvertently when the breaker truck is removed. Sealing of the breaker compartment against the bus and cable compartments must be ensured even when the breaker is withdrawn.

The breaker panel is to have both power and control cable entries from bottom.

Current Transformer

For metering and protection, panel shall be provided with two core wound epoxy cast resin current transformers.

Potential Transformer

For metering, panels shall be provided with epoxy cast resin potential transformers in single phase design.

LT Compartment

A separate LT compartment shall be provided, which houses the relays, meters etc.

Earthing

Positive scrapping earth shall be provided by means of a copper busbar, which remains in contact with the breaker trolley in all positions till the breaker is withdrawn fully outside the panel.

All metal parts of the panels shall be earthed. A continuous running earth busbar of copper shall be provided which can be connected to the station earth.

Installation, Operation and Maintenance

The switchgear shall be supplied in fully assembled, transportable sections, ready for installation and connection. The details of this shall be given in the operating instructions supplied with the panel board.

2.03 11 KV VCB CIRCUIT BREAKER

OPERATING CONDITIONS

The 11 KV drawout type VCB circuit breaker shall be suitable to operate on an electric power supply system having 3 phase, 50 HZ, 11KV earthed system and having a fault withstand capacity level of 25 KA for 1 seconds at 11KV.

ENCLOSURE AND PROTECTION

The breaker enclosure shall be metal clad and shall comprise of standard prefabricated cold rolled sheet steel units assembled to form a rigid free standing dead front structure.

The breaker shall be totally enclosed dust and vermin proof housing conforming to protection class IP42. It shall have opening for natural ventilation. The openings shall be louvered with wire mesh.

Doors and openings shall be provided with neoprene gaskets.

Each unit of breaker enclosure shall have internal sheet metal barriers to form separate compartments for fuses, bus bars, instruments, relays cable connections etc.

It shall be possible to extend the enclosure in either direction in future. Ends of bus bars shall be suitably drilled for this purpose.

The draw out carriage on the board shall have three positions viz. service, test and draw out. Automatic Safety shutters shall be provided to ensure inaccessibility of all live

parts after the breaker is drawn out. It shall not be possible to draw out the carriage with circuit breaker closed. Suitable interlocks shall be provided to prevent faulty operation.

ACCESSIBILITY

It shall be possible to remove/check components without disturbing adjacent equipment. All auxiliary equipment shall be easily accessible. All mounted equipment shall have identification tags. Unused current transformer secondary terminals must be short-circuited.

2.04 BUS BARS CONNECTIONS.

The boards shall comprise of one sets of 1250 Amp continuous current carrying capacity 3 phase bus bars extending throughout all the units of the breaker. All phase bus bars shall be of uniform cross section and shall be sized to carry continuously the current specified on the single line diagram. Bus bars shall be made of electrolytic copper and shall be sleeved. Joints shall be shrouded. The bus bars and the supports shall be adequately sized and braced to withstand the specified short circuit level. .

2.05 POWER CONNECTIONS

The incoming and outgoing power connections shall be through 11KV 1 x 3 core, 400 Sqmm aluminium XLPE cable respectively. Ample space shall be provided for connection of this cable at the rear of the breaker. The power cable shall enter the breaker from bottom.

2.06 AUXILIARY WIRING AND TERMINALS

Inside the cubical, the wiring for control, protection and instruments circuits shall be done with 1100 Volt grade PVC insulated control cables. The wiring shall be preferably enclosed in plastic channels. 10% spare terminals shall be provided on each terminal block. Conductors shall be terminated with adequately sized compression type lugs. For connection to equipment terminal and strips, elmex terminals shall be used. All spare contacts of auxiliary relays, timers etc. shall be wired up to the terminals.

Each core shall be identified at both the ends by PVC ferrules and shorting links shall be provided for all the CT terminals.

For CT circuit, 2.5 sqmm copper conductor shall be used. Other control wiring shall be with 1.5 Sqmm copper conductor.

2.07 CONTROL AND INDICATION

Circuit Breaker closing devices shall be fed from the transformer at 110 volts AC supply and 24 volt DC energy stored type power pack shall be provided for tripping and closing operation and panel lighting. The relays used shall be current operated relays.

Breaker positions ON/OFF/Spring charged/Test position/service position shall be indicated mechanically. For electric indication following colour shall be used.

Breaker ON	:	Red lamp
Breaker OFF	:	Green lamp
Auto trip	:	Yellow lamp

Push Buttons for ON and OFF positions shall be mounted on the panel for local operations.

2.08 EARTHING CONNECTIONS

All cubical shall be connected to an earth bus bar running through out the length of the breaker. The earth bus size shall be 50 mm x 12 mm copper. All doors and movable parts shall be connected to the earth bus with flexible copper connection.

All non current carrying metallic parts shall be earthed.

2.09 NAME PLATE

A name plate with the breaker designation and feeder details shall be provided at front and rear of each panel.

2.10 PAINTING

All metal surfaces shall be thoroughly cleared and degreased. The fabricated structure shall be pickled and then cleansed to remove traces of acid. A coat of zinc chromate primer shall then be applied. Thereafter Synthetic enamel paint shall be applied in 2 coats. The steel part of panel shall be cadmium plated to prevent corrosion.

2.11 SPACE HEATERS

The cubical shall be provided with anti-condensation space heaters to prevent moisture condensation and maintain cubical temperature 5 degrees centigrade above ambient. The space heaters shall be located at the bottom of the board and shall be controlled through a thermostat with an adjustable setting and a manually operated switch. The thermostat shall be located in the metering relay chamber.

2.12 BASE FRAME

The panel shall be installed on a base frame. The base frame shall be fabricated from M.S. angle of suitable size and installed on concrete foundation and fixed with bolts and nuts.

Installation of breaker shall be carried out in accordance with manufactures instructions and/or as directed by the purchaser.

2.13 EQUIPMENTS

CIRCUIT BREAKER.

Fully draw out type Vacuum breaker shall in door type and rating shall be as under:

Rated volt	:	11 KV
Rated frequency	:	50 Hz
Rated current	:	400 A
Rated breaking current	:	25 KA for 1 seconds

CIRCUIT BREAKER

The Breaker shall comprise on Vacuum interrupter unit. The Unit shall be Vacuum and sealed for the life required no maintenance. The Lubrication shall be of life-time type.

Type test report shall be furnished along with bid for 100 nos operations at 25KA/Eqvt rating.

CB shall have an Operation duty O-0.3 sec. -CO – 15 sec. - CO.

CONSTRUCTION OF VACUUM INTERRUPTER

The interrupter shall consist of the following.

ENCLOSURE

The enclosure shall be made of Air insulated, metal clad construction with high quality of CR steel.

END FLANGES

End flanges shall be provided for accommodating seal.

CONTACTS

The contacts shall be made of large stem with large disc shaped face. The material used for contacts tips shall be Cooper Chromium bismuth alloy.

ENDURANCE

10000 CO operations at normal current.

OPERATING MECHANISM

The Circuit Breaker shall be power operated by a motor charged spring operated mechanism.

The operating mechanism shall have anti-pumping features under every method of closing.

The main poles of the breaker shall operate simultaneously. Also there shall not be any objectionable rebound of the moving contact in the fixed contacts.

The mechanism shall be such that any failure of auxiliary spring shall not prevent tripping. When the breaker is in closed position, failure of any auxiliary spring shall not cause damage to the Circuit Breaker or danger the operation.

A mechanical indicator shall be provided on the breaker operating mechanism to indicate open and closed position of the breaker. This shall be visible to a man standing in front of the switch gear cubical with the door closed.

It shall be possible to operate the breaker mechanically. This shall be possible only after opening the cubical door.

All working parts of the mechanism shall be of corrosion resistance material. All split pins, nuts and other parts shall be properly pinned and locked to prevent loosening with repeated operation of the breakers.

Auxiliary switch containing 6 nos. + 6 nos. potential free contacts rated for 10 Amp. 240 V AC (Inductive breaking) shall also be provided.

SPRING OPERATED MECHANISM

Spring operated mechanism shall be complete with motor, opening spring, Closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.

The breaker operation shall be independent of the motor which shall be used only for tensioning/compressing of the spring. The closing operation shall automatically charge, the tripping spring.

The closing, opening shall get charged immediately after a closing operation performed.

Motor used shall be preferable universal type operate on AC supply. The motor shall operate satisfactory at all values between 85% to 110% of rated voltage.

OPERATING MECHANISM CONTROL

The operating mechanism shall normally be operated by remote electrical control, when the breaker is in service position. Electrical tripping shall be performed by shunt trip coils. Provision shall be made for local electrical control also when the breaker is in the test position by a control switch on the switch gear cubical doors. Red and green indicating lamps to indicate breaker close and open respectively shall be provided on the cubical doors alongwith breakers service and test position.

INSTRUMENT TRANSFORMER

Current and voltage transformers shall be cast resin insulated. Primary and secondary terminals shall be marked indelibly. The secondary winding shall be provided with a removable and accessible link for earthing.

CURRENT TRANSFORMER

The current transformer shall generally conform to IS 2705-1981. They shall be mounted on the stationary part of the switch gear. The CT rating shall be as shown on the single line diagram. The protective CT shall have an accuracy of class 5P and accuracy limit factor greater than 10.0 Low resistance CTs shall be used for protection. CTs for instruments shall have an accuracy of class 1.0 P and accuracy limit factor less than 5.

VOLTAGE TRANSFORMER

The voltage transformer shall be draw out type and provided with primary and secondary fuses. MCBs with auxiliary contacts shall be used on secondary side. It shall have accuracy of class 1 for voltage ranging 10% to 120% of normal voltage.

MEASURING INSTRUMENTS

All measuring instruments shall be of a square pattern flush mounted type. Instruments shall be provided as indicated on a single line diagram.

AUXILIARY EQUIPMENTS

RELAYS AND CONTACTORS.

Auxiliary relays and contactors shall generally be used for interlocking and multiplying contacts. The auxiliary contacts shall be capable of carrying the maximum estimated current.

TRIPPING RELAYS

The tripping relays shall be lockout type with hand reset contacts and shall be suitable to operate off the specified current. They shall be mounted in on draw out case.

PROTECTIVE RELAYS

All protective relays shall be back-connected draw out type suitable for flush mounting and fitted with dust tight covers. All relays shall preferably be mounted on the front of the panel and shall be as specified. All measuring relays shall have built-in flags to indicate relays operation. It shall be possible to reset the flag without opening the relay case.

FUSES

All control fuses shall be of link type. Fuse shall generally be mounted on the upper half of the panel. All fuse links shall have HRC cartridge. Rewirable fuses are not acceptable.

PUSH BUTTONS

Indicating colours of Push Buttons shall be as under:

STOP, OPEN, EMERGENCY	RED
START, CLOSE	GREEN

Red push button shall be on the left side and green push button on the right.

CONTROL SWITCHES

All control switches shall be rotary, back connected type, having a cam operated contact mechanism. Phosphor bronze contacts shall be used on the control switches.

Circuit breaker control switch shall have 3 position ON, NEUTRAL and OFF. Return to Neutral from both ON and OFF position shall be spring actuated. They shall have pistol grip handles.

INDICATING LAMPS

Switch board type low power consumption indicating lamps shall be used. They shall be suitable for 6 volts. The lamps shall be supplied with current limiting resistors, translucent lamp cover to defuse light etc.

2.14 SCOPE OF SUPPLY

The scope of supply covers Metal enclosure, fully draw out type Vacuum circuit breaker, cable box, bus bars operating mechanism, space heater, current transformer, voltage transformer, measuring instruments, contractors, tripping relays, protective

relays for transformer protection, fuses, push buttons, control switches, indicating lamps, local/remote switch, power pole as per single Line diagram / data sheet.

2.15 Technical Specification of Panel Boards 11 KV Panel for Substation -1 in residential area.

a) Incoming Feeder 1

Nos. Required	-	1 Nos (one)
Current Rating	-	400 A
Short Circuit Rating	-	350 MVA
Design	-	Indoor type, metal clad, dead front, drawout type, motor operated spring closed, 3 pole, 11 KV vacuum circuit breaker.
Potential Transformer	-	Three (3) ratio $11000/\sqrt{3}$ to $110/\sqrt{3}$. Cast resin single pole draw out type 100 VA potential Transformers.
Current Transformer	-	Three (3) nos. for metering 15 VA burden, ratio 150/75/5-5A, Double core, Accuracy class 1.0 accuracy.
Instrument & Meters	-	Three (3) ON, OFF, Trip, CB open and spring charge indication lamps. Digital type P.F. Meter, digital type (0-15 KV) Voltmeter with push buttons, frequency meter, digital type KVAH meter, digital type (0-150 A) ammeter with push buttons ON, OFF, Trip and Trip circuit healthy Push Buttons. One no. push button for emergency stop
Relaying & Protection-circuit	-	Protection relays as identified in the single line diagram. (1 set of over current / short & no. earth fault relay, Over voltage relay, Under voltage relay, Master trip relay, Trip circuit supervision relay
Accessories	-	Door interlock, Safety shutters, locking of breaker in isolated position. Trolley lever handle, Breaker Trip, Push Button.
Interlocking	-	Electrical Interlocking of two incomers as

per the schematic diagram and the requirement.

b) Outgoing Feeder no. 2,3

Nos. Required	-	2 No (two)
Current Rating	-	630 A
Short Circuit Rating	-	350 MVA
Design	-	Indoor type, metal clad, dead front, drawout type, motor operated spring closed, 3 poles, 11 KV vacuum circuit breaker.
Current Transformer	-	Three (3) nos. for metering 15 VA burden, ratio 75 / 35 / 5-5 A Double core, Accuracy class 1.0 accuracy (as per the schematic diagram).
Instrument & Meters	-	Three (3) ON, OFF, Trip, CB open and spring charge indication lamps. Digital type P.F. Meter, digital type (0-15 KV) Voltmeter with push buttons, frequency meter, digital type KVAH meter, digital type (0-150 A) ammeter with push buttons ON, OFF, Trip and Trip circuit healthy Push Buttons. One no. push button for emergency stop
Relaying & Protection	-	Protection relays as identified in the single line diagram. (1 set of over current / short circuit & no. earth fault relay, Over voltage relay, Under voltage relay, Master trip relay, Trip circuit supervision relay
Accessories	-	Door interlock, Safety shutters, locking of breaker in isolated position. Trolley lever handle, Breaker Trip, Push Button.
Termination	-	Outgoing suitable for terminating 2 x 3C x 240 Sq mm (Al) XLPE 11 KV cable.

2.16 Technical Specification of Panel Boards 11 KV Panel for Substation -2 in residential area.

a) Incoming Feeder 1

Nos. Required	-	1 Nos (one)
Current Rating	-	400 A
Short Circuit Rating	-	350 MVA
Design	-	Indoor type, metal clad, dead front, drawout type, motor operated spring closed, 3 pole, 11 KV vacuum circuit breaker.
Potential Transformer	-	Three (3) ratio $11000/\sqrt{3}$ to $110/\sqrt{3}$. Cast resin single pole draw out type 100 VA potential Transformers.
Current Transformer	-	Three (3) nos. for metering 15 VA burden, ratio 75/35/5-5A, Double core, Accuracy class 1.0 accuracy.
Instrument & Meters	-	Three (3) ON, OFF, Trip, CB open and spring charge indication lamps. Digital type P.F. Meter, digital type (0-15 KV) Voltmeter with push buttons, frequency meter, digital type KVAH meter, digital type (0-150 A) ammeter with push buttons ON, OFF, Trip and Trip circuit healthy Push Buttons. One no. push button for emergency stop
Relaying & Protection	-	Protection relays as identified in the single line diagram. (1 set of over current / short circuit & no. earth fault relay, Over voltage relay, Under voltage relay, Master trip relay, Trip circuit supervision relay
Accessories	-	Door interlock, Safety shutters, locking of breaker in isolated position. Trolley lever handle, Breaker Trip, Push Button.
Interlocking	-	Electrical Interlocking of two incomers as per the schematic diagram and the requirement.

b) Outgoing Feeder no. 2,3

Nos. Required	-	2 No (two)
Current Rating	-	630 A
Short Circuit Rating	-	350 MVA
Design	-	Indoor type, metal clad, dead front, drawout type, motor operated spring closed, 3 poles, 11 KV vacuum circuit breaker.
Current Transformer	-	Three (3) nos. for metering 15 VA burden, ratio 40 / 20 / 5-5 A Double core, Accuracy class 1.0 accuracy (as per the schematic diagram).
Instrument & Meters	-	Three (3) ON, OFF, Trip, CB open and spring charge indication lamps. Digital type P.F. Meter, digital type (0-15 KV) Voltmeter with push buttons, frequency meter, digital type KVAH meter, digital type (0-150 A) ammeter with push buttons ON, OFF, Trip and Trip circuit healthy Push Buttons. One no. push button for emergency stop
Relaying & Protection-	-	Protection relays as identified in the single line diagram. (1 set of over current / short circuit & no. earth fault relay, Over voltage relay, Under voltage relay, Master trip relay, Trip circuit supervision relay
Accessories	-	Door interlock, Safety shutters, locking of breaker in isolated position. Trolley lever handle, Breaker Trip, Push Button.
Termination	-	Outgoing suitable for terminating 2 x 3C x 240 Sq mm (Al) XLPE 11 KV cable.

2.17.1 DATA SHEET ON 11 KV VACCUM CIRCUIT BREAKER

OPENING CONDITION

Location	:	SUB STATION
Type & Nos.	:	1 Nos.

Power Supply

Normal Voltage	:	12 KV
Rated Voltage	:	11 KV
Frequency	:	50 HZ
Phase	:	3 Phase
Rated current	:	800 A
Fault level at supply point	:	350 MVA
Rated Symmetrical Breaking		
Current (rms) capacity	:	25 KA
Short Time current Withstand		
(RMS) capacity	:	26.2 KA
Rated Making Current		
Peak capacity	:	65.5 KA
Rated Insulation level	:	28/ 75 KV

Transformer

ENCLOSURE

Material	:	Cold rolled sheet steel
Type	:	Compartmentalised, and free floor standing
Protection Class	:	IP 42
Doors & Opening	:	Neoprene gasketed
Power connections	:	From bottom
Painting	:	Powder coating with stoving.
Shade	:	As per approval Engineer-in-charge

BUS BAR

Material	:	Electrolytic copper
Size	:	Adequate to carry. A current continuously at 11 KV supply, at 50 Hz and 3 Phase system.
	:	Resin moulded adequately sized and braced to withstand short circuit level
Joints	:	Taped/shrouded
Earth bus bar	:	Required
Auxiliary wiring	:	Required

Control and indication :	Required
Space heater	: Required
Base frame	: Required

2.17.2 BATTERY & BATTERY CHARGER (Power Pack)

There are four nos of Power Packs for the above 11 KV HT Panels. The Ah of the batteries to be suitably selected.

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

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

3.00 11 KV/0.433 KV TRANSFORMER

3.01 GENERAL

Power transformer shall be dry type for indoor use having capacities indicated in the schedule. The supply is 11KV/433 volts, 50 Hz and 3 phase. All the transformers shall be with OFF LOAD TAP CHANGER type.

The design manufacture and performance of transformer shall comply with all performance of equipment status, regulations and safety codes in the location where the transformers will be installed. Transformers shall conform to the latest applicable standards.

3.02 CODES AND STANDARD

Transformers shall comply with the latest edition of Indian Standards No. IS 2026 Part I to Part V (Power Transformer) and IS11171 for Dry Type Transformer . In case the Provision of Indian Standards are not directly applicable to dry type Transformer , the provision of Latest IEC-726 and any other relevant IEC shall apply. Latest Stadards as applicable shall be followed the Insulating materials, Bushing, Installation and Maintenance of the Transformer.

3.03 **SERVICE CONDITION**

Altitude	Less than 1000 meters.
Maximum Ambient Temperature	50 deg. C
Minimum Ambient Temperature	0 deg C
Relative Humidity	100 %
Installation	Corrosive, dusty, humid and tropical.

3.04 **RATING AND TYPE**

The Transformer shall have core type construction, 3 phase and shall be suitable for Indoor service under the climatic conditions prevailing at site. The Transformer shall be capable of withstanding thermal and mechanical effects of short circuit at terminals of any winding with full voltage maintained on other winding as per IS: 2026.

3.05 **WINDING**

The primary and secondary winding shall be of electrolyte copper conductors. The high and low voltage winding shall be totally encapsulated and should be cast under vacuum in moulds with fiber glass reinforced epoxy resin laminate. Both HV and LV winding of each phase shall be separately cast as rigid tubular coil with no mechanical and electrical connection between their co-axial arrangement. The Transformer shall be free of partial discharges at least up to 1.1 times the rated voltage.

The winding shall absorb no moisture under the worst tropical conditions collection of moisture and dust over the winding shall not in any way affect the insulation strength of the winding.

3.06 **CORE**

The transformer core shall be built up with high non-aging low and high permeability CRGO Silicon steel lamination. CRGO sheet shall be coated with inorganic material or equivalent insulation to reduce eddy current to minimum. After shearing, the laminations shall be treated to remove all burrs and shall be annealed to remove all the residual stresses.

Coreframe work and clamps shall be arranged and tightened to securely hold lamination in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits. All the Iron parts except the core shall be galvanized and treated with high temperature resistance paint. Core Fastening shall be insulated to reduce losses and avoid spots. Transformer shall be designed to withstand 10 % overfluxing corresponding to rated voltage.

Suitable lugs shall be provided for lifting the complete core and coil assembly of the transformer.

3.07 INSULATION

Turn to turn and intercoil insulation shall be designed such that dielectric stress is uniformly distributed throughout the winding under all operating conditions. The winding shall be provided with Class 'F' Insulation.

3.08 TEMPERATURE RISE

The Temperature rise of the winding shall not exceed 90deg by resistance on continuous full load above maximum ambient temperature of 50 Deg C and in no case shall reach a value that may damage the core itself or other adjacent part.

3.09 VECTOR GROUP:

Transformer shall have the vector group of Dy 11.

3.10 IMPEDENCE

The desired impedance shall be as mentioned in the IS:2026.

3.11 FLUX DENSITY

The Maximum flux density at any point in the winding shall not exceed 2.2 Amp. Per sq.mm at the rated full load, voltage and frequency.

3.12 CURRENT DENSITY

The maximum current density at any point in the winding shall not exceed 1.6 Tesla on the normal rated tap voltage and frequency.

3.13 COOLING

The Transformer shall be designed for natural cooling (AN)

3.14 ENCLOSURE

Transformer shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protection of enclosure shall be IP 21 for indoor installation and IP 33 for outdoor installations. The sheet steel thickness of enclosure shall be minimum 2mm.

3.15 CABLE TERMINATION

The low voltage side of the transformer shall be suitable to receive Aluminium Bus Duct of suitable capacities from the top of the Transformer. A suitable size of flange to be provided for connecting the overhead bus trunking in the LT Box.

H.T. sides of the transformers shall have cable end boxes to receive 3 C X 240 sq.mm desired size of 11KV cables.

All cable end boxes shall have bore holes to match the opening for each cable specified and shown in the single line diagram.

3.16 **EARTHING**

Two main earthing terminals shall be connected to the terminals provided for transformer.

3.17 **FITTINGS AND ACCESSORIES**

Rating and Terminal Marking Plate of the Transformer including the details of OFF circuit changing voltage of the links.

Earthing terminal with Lugs.

Transformer Neutral Earthing terminal.

Marshal Box with wiring and terminal and temperature scanner.

PT 100 type temperature scanner and its connection with marshal box.

Neutral CT 2000/1 Amp. And its connection with marshal box for 2000 KVA Transformer only.

Limit switch in all hinged door fix door and wiring till marshal box.

HV cable end box at primary.

LT bus Trunking box at secondary.

4 nos Plan bi- directional rollers.

Inspection windows shall be provided in the cover.

Lifting lugs for both the transformer and core shall be provided.

3.18 **INSTALLATION OF TRANSFORMER**

Installation of transformer shall be carried out in accordance with manufacturer's instructions and/or as directed by purchaser.

All power/control connections and mechanical joints shall be completed, checked and adjusted to ensure safety and satisfactory operation of the transformer.

Transformer shall not be placed on bare ground during unloading but it shall be placed on wooden sleepers. After placing on foundation, alignment, leveling etc. shall be carried out in best workman like manner.

For the power/control cabled projecting above the ground, the termination to cable box shall be run in GI conduits of suitable cross section and the same shall be supported properly and pipe ends shall be sealed with bitumen compound.

The cable box of detachable type of the transformer shall be supported properly so as to facilitate taking out of the transformer for repair without disturbing the cables.

3.19 TEST CERTIFICATES.

Test certificate shall be furnished in required number of copies for approval.

The routine, special and type test certificate of the transformer shall be furnished for approval before the delivery of the equipment from the factory.

The routine and type test certificates of miscellaneous components shall be furnished for approval.

3.20 ROUTINE TESTS

During manufacture and on completion the transformer shall be subjected but not limited to the following Routine Tests as laid down in the latest revision of the IS 11171 IEC - 726

- i) Applied voltage test
- ii) Induced voltage test
- iii) No-load loss and excitation current tests
- iv) Impedance voltage and load loss tests
- v) Resistance measurement
- vi) Ratio tests
- vii) Polarity and phase relation tests
- viii) Insulation resistance tests
- ix) Insulation power factor tests

3.21 TYPE TESTS

The type test certificates for the following type tests carried out on similar capacity rating shall be submitted along with the routine test certificates.

- i) Heat run test
- ii) Impulse test

3.22 FIELD TEST

After installation at a site, the transformer shall be subjected to the following field test:

- i) Construction inspection
- ii) Ratio tests
- iii) Polarity test
- iv) Tap change operation test.

3.23 DATA SHEET FOR 1000 KVA TRANSFORMER

Nos. required	-	2(two) nos
Capacity	-	1000 KVA
Type of Cooling	-	Air cooled Dry typr Transformer
Rated Primary Voltage	-	11000 volts
Rated Secondary Voltage	-	433 V between phases and 250 between neutral.
Rated supply frequency	-	50 Hz or cycles per second
No. of phases	-	Three (3)
No. of windings	-	Two (2)
Winding connection	-	Primary Delta, Secondary-Star with fully insulated neutral brought out to secondary terminals.
Material of Winding	-	Copper
Vector Group	-	DYn 11 to IS: 2026
Voltage taps	-	OFF load taps on primary for + 5% to – 7.5 % steps of 1.25% each
Protection	-	WTI and Limit switches
Primary side connections	-	Suitable for 3 x 240 mm sq. 11 KV XLPE cable.
Secondary side connections	-	Suitable for . Al Bus ducting.
Under Carriage	-	Suitable under carriage with rollers with edges designed so as to permit sliding the transformer when required without damaging the floor.
Marshaling Box	-	To facilities connections of all protection devices like WTI and Limit switches, etc.
Fitting & Accessories	-	As per IS specification and as specified.

3.24 DATA SHEET FOR 400 KVA TRANSFORMER

Nos. required	-	2(two) no
Capacity	-	400 KVA
Type of Cooling	-	Air cooled Dry typr Transformer
Rated Primary Voltage	-	11000 volts
Rated Secondary Voltage	-	433 V between phases and 250 between neutral.
Rated supply frequency	-	50 Hz or cycles per second
No. of phases	-	Three (3)
No. of windings	-	Two (2)
Winding connection	-	Primary Delta, Secondary-Star with fully insulated neutral brought out to secondary terminals.
Material of Winding	-	Copper
Vector Group	-	DYn 11 to IS: 2026
Voltage taps	-	ON LOAD taps on primary for + 5% to - 15% steps of 1.25% each
Protection	-	WTI and Limit switches
Primary side connections	-	Suitable for 3 x 240 mm sq. 11 KV XLPE cable.
Secondary side connections	-	Suitable for . Al Armoures cable of 2 x 3.5 C X 300 sq.mm.
Under Carriage	-	Suitable under carriage with rollers with edges designed so as to permit sliding the transformer when required without damaging the floor.
Marshaling Box	-	To facilities connections of all protection devices like WTI and Limit switches, etc.
Fitting & Accessories	-	As per IS specification and as specified.

3.25 ELECTRICAL & PERFORMANCE REQUIREMENT :

- a) Transformer shall operate without injurious heating at the rated KVA at any voltage within variation of +/- 10% of the rated voltage of that particular tap.

- b) Transformer shall be designed for 110% continuous over fluxing withstand capability.
- c) The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.
- d) Overloads shall be allowed with in the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap changers or other auxiliary equipment shall apply.
- e) Temperature Rise for continuous full load application shall be guided by Maximum temperature rise clause of IS 2026. The temperature rise shall not exceed 45 degree C by thermometer in oil or 50 degree C for winding over an ambient of 45 degree C.
(Please note maximum ambient temperature shall be considered 50 degree C).

3.26.0 DRAWINGS AND O&M MANUALS:

- 3.26.1 Four copies of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers. List of spare parts shall also be indicated.
- 3.26.2 Two copies of the drawings incorporating the following particulars shall be submitted with the offer for preliminary study.
 - a) GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.
 - b) Crane requirements for assembly and dismantling of the transformer.
 - c) Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.
- 3.26.3 The drawings in (four sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.
 - a) GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, crane lift for un tanking, oil quantity, H.T./L.T. clearances etc.
 - b) Drawings of Bus duct termination arrangement.
 - c) HV cable box arrangement & disconnecting chamber GA drawings.
 - d) Name plate and terminal making and connection diagram.
 - e) Assembly of OLTC gear mechanism & details of mechanism parts, limits, contours of wearing parts, timing gear adjustments etc.

3.26.4 Reproducible copy of the above drawings for records

4.00 11 KV KV CABLES

4.01 GENERAL

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

4.02 Rating

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

4.03 Core Identification

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

4.04 Current Rating

The current rating shall be based on the following conditions.

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

4.05 Short Circuit Ratings

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

- | | | | |
|----|---|---|-------|
| a) | Max. conductor temperature under full load conditions | : | 65 C |
| b) | Max. S. C. Conductor Temperature | : | 140 C |

4.06 Selection of Cables

The cables have been selected considering the following:

- Max. connected load.
- Ambient temperature.
- Grouping of cables.
- Short circuit level.

4.07 Storing, Laying and jointing

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

- Storing**

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

b) **Laying: Cable laying in trenches**

HT cables can be laid in outdoor trenches, if specifically called for although provision exists for pulling cable in existing ducts. Wherever, cables are laid in outdoor trenches, the depth of the trenches shall no be less than 900 mm plus radius of cable, from upper surface of the ground. Where more than one multicore cable is laid in the same trench, a horizontal internal spacing of 0.25 metres shall be left in order to reduce mutual heating and also to ensure that fault occurring on one cable will not damage the adjacent cable.

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

4.08 **Cable Jointing**

Cable jointing shall be made as per the instructions of the cable manufacturer. Cable jointing shall be carried out only by qualified and competent cables jointers. A copy of manufacturers recommendations shall be submitted to the consultants for approval of consultant. Cable shall be jointed using standard cable joining boxes with a lead sleeve and MS/CI rectangular box.

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

4.09 **Testing**

- a) Insulation resistance of both sections of the cables to be jointed should be checked by 1000 V megger.
- b) H.T. Cables shall be pressure tested to withstand a voltage after the jointing is completed. However, the test voltage and duration of test shall be in conformity with local standards. Before carrying out the DC high voltage test, the cable shall be laid in its final position with all the end terminations kept unfinished so that substation equipments are not subjected to the test pressure.

5.00 L.T. CABLES AND CONTROL CABLES

5.01 General

MV 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 manufacturers name clearly written on the drum.

The recommendation of the cable manufacturer with regard to joining and sealing shall be strictly followed.

5.02 Material

The MV cable shall be PVC insulated. Aluminium conductor armoured cable conforming to IS : 7098 Part I & II 1988 / 1985 laid in trenches/ducts as shown on drawings.

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

5.04 Joints in Cables

The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoidance of joining cables. This apportioning shall be got approved by the architect before the cables are cut to lengths. straight joints are prohibited.

5.05 Laying cables

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks, the drums shall be unrolled and cables run over wooden rollers in trenches at intervals not exceeding 2 meters. Cables shall be laid at depth of 0.7 meters below ground level. A cushion of sand, not less than 80 mm shall be provided both above and below the cable and joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main. The cable shall first be laid in excavated trench 80 mm layer of sand and shall be spread over the cable. The cable then shall be lifted and placed over the sand bed. the second layer of 80 mm sand shall then be sprayed over the cable. The relative position of the cables, laid in the same trench shall be preserved and the cables shall not cross each other as far as possible. at all changes in directions in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than 8 times the diameter of cable, Minimum 3 meters long loop shall be provided at both sides of every; straight joint and 3 meters at each end of cable. Distinguishing marks shall be made on the cable ends for identification. Insulation tapes of appropriate voltage and in red, yellow and blue colour shall be wrapped just below the sockets for phase identification.

5.06 Protection of Cables

The cables shall be protected by bricks on the top layer of the sand for the full length of underground cable. Where more than one cable is running 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. Cables under road crossings and any other places subject to heavy traffic, shall be protected by running them through Hume Pipes of suitable size. The depth of the Hume Pipe shall be 1 meter below the finished floor level.

5.07 **Excavation & Back fill**

All excavation and back fill including timbering, shoring and pumping 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 exceed 150-mm. Each layer shall be properly rammed and consolidated before laying the next layer. The contractor shall restore all surface, road ways, side walks, curbs, walls of other works cut by excavation to their original condition, satisfactory to the owner's representative.

5.08 **Testing of cables**

Prior of burying of cables, following tests shall be carried out :

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

On completion of cable laying work, the following test shall be conducted in the presence of owner's representative.

- a) Insulation Resistance Test. (Sectional and overall)
- b) Continuity Resistance Test.
- c) Sheathing continuity Test.
- d) 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, equipment and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Architect/Consultant.

6.00 **BUS DUCTS**

The Bus duct shall be Compact and Sandwich in construction for 415 Volts, 3 Phase, 50 Hz, 4 wire AC supply for providing connection between Transformer to L.T. Switchgear, DG Set to Synchronizing panel and from synchronizing panel to LT Panel. The enclosure will be of 1.6 mm Thick (16 SWG) of GI with powder coated. Busbars shall be in Sandwich construction and of aluminum, conforming to IEC-60439/IS 8623 for short circuit withstand of one second as specified.

6.01 The bus bars shall be provided with class 'B' insulation.

6.02 The Individual sections shall be of maximum 3 mtrs length and Busbars of one section shall be connected to adjacent section by Uniblock system of joint assembly operated by

single bolt. The Joint assembly shall be removable as separate sub-assembly without disturbing the connected sections.

- 6.03 The busduct shall conform to standard IE-60439/IS 8623 in all respects and nominal rating shall be for ambient temperature of 40 Deg C.
- 6.04 The adaptor chambers shall be provided at two ends for connecting Busduct to Transformer/ LT Panel, synchronising panel / DG Set terminals at ends by copper flexible connections. The Busduct shall be complete with necessary Bends, (Vertical or Horizontal), as required by layout.
- 6.05 Two Aluminium Earth strips shall be provided outside the enclosure running throughout the length and bolted/riveted to the enclosure at appropriate intervals.
- 6.06. **Busbar:** The busbar shall be of aluminium grade.
- 6.07. **Enclosure protection:** The enclosure shall provide IP-54 Protection.
- 6.08. **Short Circuit withstand:** The short circuit withstand capacity shall as per system requirement
- 6.09. **Temperature Rise:** The Ambient Temperature 50 Deg C. The temperature rise as per IEC 60439/ IS 8623 -II.
- 6.10 **Earthing strips:** The Bus duct shall be provided with 2 Nos earthing strips of aluminium of appropriate size as per short circuit withstand specified and as per IEC 60439. Earthing strips shall be riveted or bolted to the enclosure at regular intervals.
- 6.11 The minimum short circuit ratings of the bus bar trunking shall be of 50 KA.

7.00 **LT PANELS**

7.01 **SCOPE**

Under this section, the bidder's scope covers design, fabrication, transportation to site, assembly, interconnections, erection testing and commissioning of the various switch board panels at site. The medium voltage Power Control centers shall be located in substation. All panels shall conform to the requirement of IS-8623 - 1993 and shall be need as per all other relevant statutory regulations that of the local inspector.

7.02 **STANDARDS**

- 7.02.1 The equipment shall be designed to conform to the requirements of :
 - I IS-8623 - Factory Built Assemblies of switchgear and control gear.

- Ii IS-4237 - General requirements for switchgear and control gear for voltages not exceeding 1000 volts.
- Iii IS-2147 - Degrees of protection provided by enclosures for low voltage switchgear and control gear.
- Iv IS-375 - Marking and arrangement of busbars.

7.02.2 Individual equipment housed in the Main & Sub Distribution Board shall conform to the following IS specifications:

- i Moulded Case Circuit Breakers – IEC60947-2
- ii Fuse Switch and Switch Fuse Units – IEC60947-3
- iii H.R.C. Fuse links - IS 2208-1962 or IS 9224-1979.
- iv Current Transformers - IS 2705
- v Voltage Transformer - IS 3156
- vi Relays - IS 3231
- vii Indicating Instruments - IS 1248
- viii Integrating Instruments - IS 722
- ix Control Switches & Push Buttons - IS 6875
- x Auxiliary Contractors - IEC 60947-4

7.03 CONSTRUCTIONS

Main LT Panel , Main Distribution Board/Sub Distribution and Meter Boards shall be metal enclosed, indoor, floor mounted free standing type made up of the required vertical section, which when coupled together shall form continuous dead front Distribution Board. Main Distribution Board/Sub Distribution Board shall be dust and damp protected the degree of protection being no less than IP-42 for indoor applications and IP – 54 for outdoor applications to IS 2147. All Panels & Main Distribution Board shall be extensible on both sides by the addition of side section after removal of end covers. Main Distribution Board/Sub Distribution Board shall be fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness, doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shroud and partitions shall be of exterior of Main Distribution Board/Sub Distribution Board shall be smoothly finished, leveled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust excluding neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust. All switch gears shall be selected for continuous operation for desired current rating at 45 deg. C over an ambient temperature of 40 deg C.

Following minimum clearances to be maintained after taking into account connecting bolts, clamps etc.

- i Between Phases - 32 mm
- ii Between Phases and neutral - 26 mm
- iii Between Phases and earth - 26 mm
- iv Between neutral and earth - 26 mm

All insulating materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions.

Functional units such as fuse switch / switch fuse unit/ moulded case circuit breakers shall be arranged in multi-tier formation. The design of the Main Distribution Board/Sub Distribution Board shall be such that each fuse switch/switch fuse units/MCCB shall be fully compartmentalised.

Insulated barriers shall be provided with a vertical section and between adjacent section to ensure prevention of accidental contact with main busbars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorised access, The panel shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables. For each cable, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3mm thick.

7.04 METAL TREATMENT AND FINISH

All steel work used in the construction of the switch board should have gone a rigorous metal treatment process as followed after undergoing eight tank process before application of power coating paint. Colour of panel shall be Siemens gray or as ask for specifically.

- i. Primer coating with two coat of a highly corrosion resistance primer, applied wet and dried under strictly controlled conditions of temperature and time.
- ii. A finished coat of stoving synthetic enamel paint to the specified shade of IS:5. The total thickness of paint should not be less than 75 microns as per standard.
- iii. MS Zinc passivated nuts and bolts shall be used.

7.05 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-91E of IS-5082.

The busbars shall be suitable braced with non hygroscopic SMC supports to provide a through fault withstand capacity of 50KA RMS symmetrical for one second and a peak short circuit withstand capacity of 105KA for Main LT Panel & 50KA RMS symmetrical for one second for Main Distribution boards and other Panels

The neutral as well as the earthbar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creep age distances shall be provided on the busbar system to minimize the possibility of fault. The main phase busbars shall have continuous current rating throughout the length of the panel. The cross section of neutral busbars shall be same as that of the phase bus bar for busbars of capacity upto 300 Amp., for higher capacities, the neutral busbar shall not be less than half (50%) the cross section of that of the phase busbars. Connections from the main busbars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars shall be colour coded with PVC sleeves.

The Main Distribution Board/Sub Distribution Board shall be designed that the cables are not directly terminated on the terminals of switch fuse/fuse switch etc. but are terminated on cable termination links. Capacity of aluminium busbars shall be considered as follows.

Current rating (Amp.)	Current carrying capacity of Al. Bus bars (Amp. Per sq.mm)
100 Amp – 500 Amp	1.0 Amp./ sq.mm
600 Amp – 1600 Amp.	0.8 Amp. / sq.mm
2000 Amp – 3200 Amp.	0.7 amp. / sq.mm
3600 . – 5000 Amp.	0.6 Amp. / sq.mm

7.05.1 DRAW OUT TYPE AIR CIRCUIT BREAKERS.

Incomer Air Circuit Breakers

The ACB shall conform to the requirements of IEC 60947-2 / IS 13947-2 and shall be type tested & certified for compliance to standards from CPRI, ERDA, ASTA / any accredited international lab. The circuit breaker shall be suitable for 415 V \pm 10%, 50 Hz supply system. Air Circuit Breakers shall be with moulded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" indications.

The ACB shall be 3/ 4 pole with modular construction, draw out, manually or electrically operated version as specified. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (Ics) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity(Icu) and short circuit withstand values (Icw) for 1 sec.

$I_{cu}=I_{cs}=I_{cw} = 50KA$ for 1Sec.

Circuit breakers shall be designed to 'close' and 'trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel. Inspection of main contacts should be possible without using any tools. The ACB shall be provided with a door interlock. i.e. door should not be open when circuit breaker is closed and breaker should not be closed when door is open.

The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breaker shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status of the ACB.

The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open. Minimum 2 NO and 2 NC auxiliary contacts shall be provided on each breaker.

Rated insulation voltage shall be 1000 volts AC.

Cradle

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

There shall be 4 distinct and separate position of the circuit breaker on the cradle.
Racking Interlock in Connected/Test/Disconnected Position.

Service Position	:	Main Isolating contacts and control contacts of the breaker are engaged.
Test Position	:	Main Isolating contacts are isolated but control contacts are still engaged.
Isolated Position	:	Both main isolating and control contacts are isolated.

There shall be provision for locking the breaker in any or all of the first three positions.

The following safety features shall be incorporated :

Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open condition.

Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position. All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn. All Switchgear module front covers shall have provision for locking. Switchgear operating handles shall be provided with arrangement for locking in 'OFF' position.

Protections

The breaker should be equipped with micro-controller based , communicable type release with RS 485 port for communication to offer accurate and versatile protection with complete flexibility and shall offer complete over current protection to the electrical system in the following four zones :

Long time protection with intentional time delay

Short time protection with intentional delay.

Instantaneous protection option for Off

Ground fault protection with time delay.

The protection release shall have following features and settings:

True RMS Sensing

The release shall sample the current at the rate so that it shall be capable to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current. It shall take into account the effect of harmonics also.

Thermal Memory

When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads.

Trip Indication

Individual fault indication for each type of fault should be provided for faster fault diagnosis.

Release shall have display of power parameters for Main Incomer feeders.

Release shall be able to capture short circuit current on which ACB has tripped. The last five trips shall be stored in memory with the date & time stamping along with type of fault.

Protection

The ACB control unit shall offer the following protection functions as standard:

Long-time (LT) protection with an adjustable current setting and time delay;

Short-time (ST) protection with an adjustable pick-up and time delay;

Instantaneous (INST) protection with an adjustable pick-up and an OFF Position.

Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the appended single-line diagram.

Current and time delay setting shall be indicated in amperes and seconds respectively On a digital display.

The ACB Protection release should be equipped with a making release which should ensure that the ACB should not close on .

Measurements

An ammeter with a digital display shall indicate the true rms values of the currents for each phase.

Safety Features

The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle. It shall not be possible to interchange two circuit breakers of two different thermal ratings. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.

There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.

The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.

It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

Draw out breakers should not close unless in distinct Service/Test/Isolated positions.

All ACBs should have Ready to close contact.

All ACBs should be supplied with adopter terminals.

The ACB shall provide in built electrical and mechanical anti-pumping.

Outgoing Air Circuit breakers

General

The ACBs shall comply to IEC 60947 Part I & II and IS 13947 Part I & II and shall be suitable for operation on 415 Volts, 50 Hz 3 Phase system.

The breaker shall comply with Isolation function requirements of IEC 60947, Part-II, section 7.12 and shall be clearly marked as “Suitable for Isolation / Disconnection” to ensure safety of operating personnel.

The ACB shall provide Class-II insulation between front panel and internal power circuit as per IEC 60947 Part II Section-7.12 to avoid accidental contact with live parts during inspection & maintenance.

The ACB shall additionally certify for operation in Polluting degree III environments as defined by IEC 60947 (Industrial Environment). The ACB shall conform to Tropicalisation Tests as per following IEC standards

IEC 68-2-30 Damp Heat Test

IEC 68-2-2 Dry Heat Test

IEC 68-2-11 Salt Spray Test

IEC 68-2-1 Low Temperature during storage Test

The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity shall be as specified on the single line diagram and shall be equal to the short circuit withstand values for 50KA as specified in BOQ / SLD. The current carrying capacity of neutral pole shall be equal to main poles.

For ALL ACBs $50 \text{ KA} - I_{cs} = I_{cu} = I_{cw} (1 \text{ sec})$

Total tripping time of ACBs shall be not more than 40 msec for faster fault clearance for reduced thermal-dynamic stresses on the system and total closing time shall be less than 60 msec for faster closing.

Construction

The ACB shall be 3/4 pole, fixed / draw out type, manually / electrical operated as indicated in drawings/ BOQ and shall be provided with a trip free manual operating mechanism with mechanical “ON” “OFF” “TRIP” indications. ACB shall have inbuilt Anti pumping feature.

The ACB shall be capable of providing short circuit, overload and earth fault protection with adjustable time delays through an electronic control unit to ensure accurate protection meeting the EMI/EMC requirement as per standard.

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate.

There shall be mechanical indicator on the front panel for “**READY TO CLOSE**” situation for the breaker by checking all inter-locking

The ACB shall be provided with a door interlock and rating error prevention device to avoid mismatch between cradle and breaker rating.

There shall be following distinct and separate position of the circuit breaker on the cradle.

- Service Position - Main Isolating contacts and Control contacts of the breaker are engaged.
- Test Position - Main Isolating contacts are isolated but control contacts are still engaged.
- Isolated Position - Both main isolating and control contacts are isolated.
- Maintenance Position - Circuit breaker fully outside the panels ready for maintenance after the cubicle door is opened.

There shall be provision for locking the breaker in any or all of the first three positions. All above positions should be indicated clearly on the cradle. Safety shutters for Draw out breaker to be provided as standard.

Operating mechanism

The operating mechanism shall be of stored energy spring type with a closing time of less than or equal to 40ms.

There shall be 2 types of spring charging:

- Manual charged spring where the springs are charged manually
- Motor charged spring where the springs are automatically charged by an electric motor.

It should be possible to close manual ACB remotely.

Arc chutes and arcing contacts

Arc chutes shall be removable on site to allow inspection of arc chutes and main contacts. Arc chute removal should require a simple tool like screw driver.

Arcing contacts should be replaceable at site. Spares for the same should be available.

Electrical Auxiliaries

All electrical accessories / auxiliaries like under voltage, shunt, closing coils including the motor spring charging mechanism shall be front fitted type only. It should be possible to fit them at site without any adjustment / calibration etc..

They shall be fitted into a compartment which under normally loaded conditions has no metalwork energized from the main poles exposed with it. Any adaptation carried out thus shall not increase the breaker volume.

Under voltage release should have time delay to avoid nuisance tripping for transient voltage failure. U/V, Shunt and closing coils shall be rated for continuous operation.

Protection Release

The over current relay shall be of thermal type.

It shall be bimetal based and be integrated as part of the circuit breaker the overcurrent relay shall be connected with epoxy coated CT. The overcurrent relay shall have a wide adjustment range (50-100%) to allow flexibility of the setting on site.

The short circuit release should have the following characteristics:

- It should be direct acting type. Instead of sensing through a CT it should sense the current directly.
- It should be possible to have phase wise indication of fault operation for short circuit release.
- There should be a provision of resetting the release after every short circuit fault to have antipumping feature.

Earthfault release should have the following characteristics :

- Current setting should be available from $0.2I_n$ to $0.6I_n$
- Time delay from instantaneous to 1 second should be possible with various steps in between.

Safety Features

- 1.The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
- 2.It shall not be possible to interchange two circuit breakers of two different thermal ratings.
- 3.There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.
4. Arc Chute covers shall be provided.
5. It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibrating and shocks.

SWITCH FUSE/FUSE SWITCH UNIT

GENERAL

Switch fuse/fuse switch shall be incorporated in the Main Distribution Boards/Sub Distribution Boards wherever specified. Switch fuses/fuse switch units shall conform to IS 60947-3. Switch fuse/fuse switch units upto 63 Amp rating shall conform to AC-22 (heavy duty) while rating 100 Amp & above shall conform to AC-23 duty. Switch fuse/fuse switch unit shall be suitable for 415 volts, 3 phase, 4 wire, 50Hz, AC supply. In case of non availability of SPN switch fuse units with HRC fuses, three pole switch with fuse base & HRC fuses may be used at no extra cost to the client.

CONSTRUCTIONS

The unit housing shall be of robust construction designed to withstand arduous conditions encountered in the electrical system. Sheet materials used for switch fuse/fuse switch enclosure shall be given a rigorous rust proofing treatment before it is fabricated and painted. Unit shall preferably be double break per phase in order to isolate fuse links when the switch is in "OFF" position.

FUSES

The units shall contain fuse base and carriers for accommodating HRC units. HRC fuse units of specified rating and conforming to IS:2208 & IS:9224-1979 shall be provided.

OPERATING MECHANISM

The operating mechanism of the unit shall be positive in action with quick-make, quick-break silver plated contacts, the operating handle shall be suitable for rotary operation

unless otherwise specified. Position of the handle such as "ON" "OFF" shall be clearly indicated.

SHROUDING

All the live parts inside the switch fuse/fuse switch units shall be shrouded to prevent any accidental contact.

TERMINALS

All the terminals shall be liberally designed.

INTERLOCKING

All switch fuse/fuse switch unit shall be provided with suitable interlock such that the door of the switch board panels shall not open unless the switch is in "OFF" position.

TESTING

Routine test shall be conducted as per IS:4064 and type test certificates shall be furnished.

MOULDED CASE CIRCUIT BREAKERS

GENERAL

Moulded case circuit breakers shall be incorporated in the Main Distribution Board and Sub Distribution Board wherever specified. MCCB's breaking shall be suitable either for single phase AC 230 volts or three phase 415 volts AC at 50 Hz. MCCB shall have class-II front face with no live parts accessible to the user.

The MCCB shall be suitable for isolation as per IS/IEC with clear ON/OFF indicator. The Circuit breaker shall comply with IEC60 947-2 and IS 13947 part 2. The MCCB shall be suitable for isolation as defined by IEC60947-2.

The breaking capacity performance certificate shall be available for category A to the above mentioned standards along with disconnection function requirements. The test shall be carried out under the breaking performance during operation (I_{cs}) equal to 100 % of the ultimate breaking capacity (I_{cu}), with following minimum services Breaking capacity requirements..

All circuit breakers shall have a rated operational voltage of 415V AC. The rated insulation voltage shall be 500V.

Thermal overload release adjustment can be done from a single point.

MCCB cover need not to be opened for doing such adjustment.

Electrical endurance of MCCBs at full load shall be as per the IEC 60947

All MCCB 's shall have spreaders and phase barriers on each terminal. The Breaker shall be maintenance free and fully tropicalized.

CONSTRUCTIONS

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo setting insulating material. MCCB shall have double break mechanism & Operating handle shall be quick make/ quick break, trip-free type. The operating handle shall have suitable "ON" "OFF" and "TRIPPED" indicators. Three phase MCCBS shall have common operating handle for simultaneous operation and tripping of all the three phases.

Tripping unit shall be of thermal magnetic up to 250 Amp & Microprocessor type above 250 Amp provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic or microprocessor tripping device shall have IDMT characteristics for sustained over loads and short circuits. MCCB shall conform to RoHS regulated substances and compatible values to recycle at the end of product life.

Contacts trips shall be made of suitable are resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

Protections requirements

General

MCCBs shall comprise a device, designed to trip the circuit-breaker in the event of high-value short-circuit currents. This device shall be independent of the thermal-magnetic or electronic trip unit. The breaking will be carried out in less than 10ms for short-circuit currents above 20In.

MCCBs with ratings up to 250A shall be Thermal Magnetic type. Above 250A MCCBs shall be with Microprocessor trip units.

In case of Ground fault protection, the ground fault module shall be external or internal only.

It shall not be possible to switch off the basic protections i.e. overload & short circuit in MCCB.

7.06 MEASURING INSTRUMENTS FOR METERING

7.06.1 GENERAL

Direct reading electrical instruments shall be in confirmed to IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. All meter shall be of **Digital type**. The errors due to variation in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between 10 degree C to +50 degree C. All meters shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and

manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories with in the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications here in after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

7.06.2 **AMMETERS**

Ammeters shall be Digital type. The ammeters shall be manufactured and calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during faults conditions without damage or loss of accuracy.

7.06.3 **VOLTMETERS**

Voltmeter shall be Digital type. The range for 415 volts, 3 phase voltmeter shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the systems. The voltmeter shall be provided with protection MCB of suitable capacity.

7.06.4 **MULTIFUNCTION METER**

All Multifunction meter shall be of Digital type with UL c, C – Tick and CE certification with accuracy class 1.0 to show the True RMS, Accurate on distorted wave forms, simultaneous sampling of Volts and Amp. Low CT and PT Burden with built in RS 485 port to communication, Touch safe terminals.

7.06.5 **CURRENT TRANSFORMERS**

Current transformers shall be in conformity with IS:2075 (part I, II & III) in all respects. All current transformers used for medium voltage applications shall be of Cast resin type rated for 1 kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

Measuring : Class 1
Protection : Class 5P10

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 65KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each CT shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated FRLS wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner. The Panel builder to be produced the original invoice of the manufacturer of the current Transformers.

7.06.6 **MISCELLANEOUS**

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the led type of low watt consumption, provided with series resistor where necessary, and with translucent covers which shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

7.06.7 **CABLE TERMINATIONS**

Cable entries and terminals shall be provided in the distribution board to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

7.06.8 **CONTROL WIRING**

All control wiring shall be carried out with 1100V grade single core FRLS PVC cable conforming to IS:694/ IS 8130 potential standard copper conductors of minimum 1.5sq. mm for potential circuits and 2.5sq.mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at end. All control fuses / MCB shall be mounted in front of the panel and shall be easily accessible.

7.06.9 **TERMINAL BLOCKS**

Terminal blocks shall be 500Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminal blocks shall have a minimum current rating of 10amps and shall be shrouded. Provisions shall be made for label inscriptions.

7.06.10 **LABELS**

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

7.06.11 **TEST AT MANUFACTURES WORK**

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

7.06.12 **TESTING AND COMMISSIONING**

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

- a) Operation checks and lubrication of all moving parts.
- b) Interlocking function check.
- c) Insulation test: When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.
- d) Insulation test of Oil : When tested as per IS: 6792-1972, the oil shall withstand a voltage of 40 KV for a minute with out break down.
- e) Trip tests & protection gear test.

7.7 **POWER FACTOR IMPROVEMENT SYSTEM**

7.7.1 **General**

The power factor improvement system shall comprise of capacitors and associated switchgear and control gear as per the requirements.

7.7.2 SCOPE

This specification covers design, manufacturing, testing, supply with accessories, installation and commissioning of APFC Panels for Power Factor improvement.

7.7.3 Capacitors

a. TYPE: The capacitor unit shall be made of metallized Polypropylene **film with Zn/Al alloy, special resistivity** di-electric impregnated with inert gas. The capacitor unit shall be self-healing type, internally 3-phase delta connected, self-cooled, and suitable for outdoor installation in multi positions (vertical & horizontal). **Should be fitted with pressure sensitive disconnecter in each individual capacitor cell.** The capacitors shall be rust -proof in dry type design having sufficient protection against rain, dust and accidental contact. The temperature category shall be -5/D.

b. PERMISSIBLE OVER LOADS: The capacitor unit shall be suitable for over loads as per the relevant clauses of IS 13340-41 and shall be suitable for prolonged operation RMS voltage, 1.1 times the rated voltage and **1.8** times the RMS lines current that occurs at rated voltages and rated frequency excluding transients but taking in account the capacitance tolerance. High inrush current withstand capability that go along , without degrading useful life. Capacitor should comply **special edge** “wavy cut”, plus heavy edge film design to handle inrush current of upto **250 times** rated current.

c. CONSTRUCTION:

(i) The gas filled capacitors should be compact size, 3 phase delta connected to form three-phase bank. Elements should be encapsulated in Aluminum container.

(ii) The insulated connecting wires should be individual for each phase/line and terminal block should be suitable for outdoor operation under the atmospheric conditions specified and to totally eliminate the possibility of fault occurrence external to the capacitor unit.

(iii) The gas filled in capacitor units must be harmless to environment. The operation and disposal of capacitor units must be environmentally friendly. The constructional features necessary to prevent leakage and to ensure safety during operation must be adopted.

(iv) The capacitor units must be suitable for mounting in any desired position.

d: SAFETY REQUIREMENTS:

- (i) Capacitor units shall be provided with directly connected discharge device as per IS: 13340-41 (with latest amendments upto date of tender receipt)
- (ii) The discharge device shall reduce the residual voltage from crest value of the rated voltage to less than 50 volts within one minute after the unit disconnected from the source of supply.
- (iii) The capacitor units contain shall be provided with a suitable earth terminal, clearly marked it will be connected by the successful bidder to the system earth.
- (iv) The capacitor units shall comply with the general safety regulations for power installations as per the latest Indian electricity rules.
- (v) Terminal with SIGUT terminal technology should ensure reliable and straightforward connection, even in parallel capacitor circuit.
- (vi) Capacitor should have overpressure tear-off fuse, self healing technology, Explosion proof construction, touch proof terminals and non flammable.

e: CAPACITOR LOSS: The Di-electric shall not be more than 0.20W/KVAR. This should be indicated in the bid. The total capacitor loss shall not exceed 0.5W/KVAR.

f. Detuned Reactors. The reactors should be 440 v, 3 phase module of 7% detuning factor.

- The design entails single layer winding in the entire range of reactor, to allow for maximum dissipation of heat to perform capably in natural air cool work environment.
- The **copper** conductor used either have dual coat enamel insulation or are provided with insulation of nomex paper, capable of withstanding temperature exceeding 180 deg. C.
- High linearity ($L > 0.95 \times I_n$: 220 %)
- H- class insulation
- Vacuum impregnated.
- Tolerance of inductance should not be more than 5%
- Filter factor as per BOQ/SLD.
- For the temp, protection a Temp sensor should be there.
- **IEC 61642:1997; Clause No 3.3 guidelines**

g: LIFE EXPECTANCY: The life of capacitor units shall not be less than upto **1,30,000 hours.**

h: MARKINGS: As per IS 13340:1993

7.7.4 Intelligent Power factor controller Relay--- Specifications

- Design Intelligent Microprocessor Based, 32 digit LCD Display
 - Minimum Operating Current 40 m Amp.
 - Measurement current (CT) X/1,X/5 Ampere
 - Supply Voltage 230V AC
 - Setting 0.8 ind --0.8 cap
 - Power consumption 5 VA
 - Dimension W*H*D 144*144*60 mm
 - Protection Class IP 54 For front plate, IP 20 for rear side
 - Switching time range 1-1200 seconds
 - Discharge time range 1-1200 seconds
 - Control Modes 20 series presets +control series editor For free programming LIFO, FIFO and self optimized intelligent
 - HT sensing The relay should be capable of sensing in Hside, Using Existing CT and PT of Burden 15 VA.
- **Display of instantaneous Power line parameters like** Voltage, apparent current, frequency, power factor, active power, apparent power, missing Kvar, temperature, Harmonic (from 3 to 21 harmonics)
 - Relay should have facility to program each stage as Fixed/Auto/Off.
- Data logging facility using RS 232 port.(OPTIONAL)

7.7.5 CONTROL AND SELECTOR SWITCHES

Control selector switches shall be :

- i) Of the rotary type with enclosed contacts.
- ii) Adequately rated for the purpose intended (Minimum acceptable rating is 10A continuous at 240 V AC and 1 A (inductive break) 220 V D.C.
- iii) Provided with name plated clearly marked to show the positions.

Control switches shall be:

- i) of the spring return to normal type.
- ii) provided with pistol grip type handles.

Control switches for circuit breaker control shall be provided with:

- i) contact development as specified.
- ii) Sequencing device.

Wherever specified in data sheets, control switches with built-in flashing type discrepancy lamps shall be provided to control circuit breakers in lieu of the normal control switch, red, green and amber indicating lamps. The discrepancy lamp shall be replaceable from the front of the module door.

Selector switches shall be:

- i) of the maintained contact stayput type. Switches in ammeter circuits shall have make be for break type contact.
- ii) provided with oval handles.

7.7.6 PUSH BUTTONS

Push buttons shall be:

- i) of the momentary contact, push to actuate type rated to carry 10A at 240V AC and IA (inductive breaking) at 220V DC.
- ii) fitted with self reset, 2 No. and 2NC contacts.
- iii) Provided with integral escutcheon plates marked with its function.

'Start', 'Open', 'Close' push buttons shall be green in colour.

'Stop' push buttons shall be red in colour.

All other push buttons shall be black in colour.

'Emergency stop' push buttons shall be of the lockable in the pushed position type and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push button.

The Capacitor bank shall be facilitated with the space.

8.0 DG SETS & ASSOCIATED WORK

8.01 SCOPE OF WORKS

The Scope of work shall include under this specification design, manufacture, supply, loading, unloading, storage, installation, testing and commissioning of the Diesel engine alternator sets including labour, tools, tackles and plants, hardware and consumables, steel fabrication and items as prescribed below:

- ▶ Diesel engine alternator set complete with base frame and accessories.

- ▶ Engine mounted engine control integral panel duly wired upto terminal box for engine safeties with sensors and protection for inter facing with Controller /Microprocessor based relay.
- ▶ Fuel oil system including day service oil tank, piping, valves, filters etc. from engine to service day oil tank.
- ▶ Lube oil system with piping etc. (Pre-lube oil pump with controller if required).
- ▶ Cooling system with radiator, heavy duty suitable for 50⁰C operation complete with make up water tank.
- ▶ Exhaust emission shall meet EURO II norms without catalytic converter or online scrubber and residential silencer, exhaust piping with mineral wool insulation and aluminum cladding as called for.
- ▶ Steel fabricated structure/support/hanger including fixing, grouting and bolting etc.
- ▶ Painting of steel work.
- ▶ L.T. / Control cabling.

The bidder shall also indicate in his offer the time schedule for routine maintenance / overhauling operations necessary for continuous satisfactory operation of D.G Set.

The item rate shall remain valid for variation to any extent of the estimated quantities given in the Schedule of Quantities.

All equipment shall be of the class most suitable for working under the conditions specified and shall withstand the atmospheric conditions without deterioration.

Minor civil work is included in the contractor's scope of work. However, the responsibility of coordination with the civil and other contracting agencies ensuring completion of turnkey contract rests with the contractor and shall be certified.

Contractor shall co-ordinate with all other agencies working at site for interconnection and safety aspects.

Also the D.G. Supplier will furnish a combined guarantee minimum for one year from the date of successful commissioning for the entire equipment, In case there is any defect the free replacement of any part or in whole will be made immediately at not loss to Owner.

8.02 FEES & PERMITS

The contractor shall obtain all sanctions and permits required for the running of DG sets for all the relevant authorities. All actual fee payable in this regard will be reimbursed against receipt/documentary proof (evidence). On completion of the work, the supplier shall obtain N.O.C from concerned authorities including Chief Electrical Inspectorate, of state in original shall be delivered to the employer through Architect.

8.03 CODES & STANDARDS

The design, construction, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standard (BIS), British Standards (BS), International Electro Technical Commission (IEC) publication, NEMA & VDE standards amended upto date.

Some of the applicable standards are listed below :

BS- 5514/ISO 3046/DIN 6271	Reciprocating internal combustion engines
BS - 4613	Electrical performance of rotating electrical machine
BS - 4999/5000	Applicable parts of BS 4999/5000
IEC-34-1/IS-4722/VDE 0530	Specification for rotating electrical machines.
IS - 4889	Method of determination of efficiency of rotating electrical machinery.
IS - 6491	Degrees of protection provided by enclosures for rotating electrical machinery.
IS - 4729	Measurement and evaluation of vibration of rotating electrical machines.
AIEE - 606	Recommended specification for speed governing (1959) of internal combustion engine generator units.
IS - 2705	Current transformers.
IS - 1248	Electrical indicating instruments.
IEEE - 115	Test procedure for synchronous machine.

8.04 DESIGN

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

8.05 PERFORMANCE REQUIREMENT

The equipment shall be capable of delivering power continuously at the generator

Terminal, a net output not less than the specified value at 0.8-0.95 p.f. excluding auxiliary power (shall be included over and above), when operating under the site ambient conditions described in this specification. Gen Set should be capable of taking 100 % step load & it should be able to take full load in less than 25 sec. from start. (The set shall be suitable for prime duty).

The design parameters of the generator and excitation system shall be chosen that the set is stable while running at any load between no – load and full load and also during starting of motors. It should also have isosynchronous speed control with load sensing governing system suitable for parallel running of D.G. sets.

Engine should be heavy duty four strokes, turbo charged after cooler ‘V’ construction/in line electric start. Engine should have minimum lube oil change period 500 Hrs. Bidders are required to offer the Duplex filter system for lube oil and fuel oil in case of non compliance.

The set shall have vibration limit less than 130 microns (as per BS:4999 Part – 142)& noise level shall be (105-110 db (a) at 1 mtr) under all conditions of load. The set shall be dynamically balanced. The set shall be mounted directly on the inertia foundation or with foundation bolts etc. The efficient residential silencer shall be provided with or without catalytic converter on-line scrubber & the set shall meet EURO-II norms for D.G Sets, for the exhaust. Air inlet shall also be provided.

The total harmonics contents should be less than 3% as per IS 4722/1969. The graph & calculation for harmonic distortion shall be submitted.

Contractor to specify and guarantee maintenance contract cost and to give an undertaking to take a comprehensive maintenance contract after expiry of warranty period for which price may be quoted.

The engine shall be stationary, compression ignition, totally enclosed, water cooled, 4 stroke direct injection, cold battery starting, turbo charged and low temperature with after cooled Radiator Cooled 1500 RPM in accordance to BS 5514 and IS: 10002 complete with all accessories.

The D.G. engine shall be suitable for black start & should be able to pick up 100% load within 25 seconds.

The DG engine & the batteries shall be designed to take up at least six starting attempts beyond which the system shall be protected by means of an over crank relay. Calculations for battery sizing and battery charger capacity shall be submitted for review of the consultants. The successful bidder will submit shop drawing of the equipments/accessories selected for this work for the approval of Consultant/Employer.

8.06 SERVICE INTERVAL AND OPERATION

The set shall be capable of running at full load for not less than 500 hrs continuously. The change period both for the lube oil, lube oil filters shall be minimum 500 Hours of operations, in the event the change period for above consumables fall short below the

specified time period as above, bidders are required to quote for duplex type filters with oil make up systems.

The time to Top overhaul, major overhaul & maintenance schedules shall be specified by the bidders.

8.07 DIESEL ENGINE - CONSTRUCCION

Material of construction of major parts shall be as under or as per manufacturer design.

- ☞ M.S. base frame with anti-vibration mountings.
- ☞ Crankcase – Aluminium alloys.
- ☞ Crank shaft, connecting rods –Forged Alloy Steel.
- ☞ Piston – AL alloy casting.
- ☞ Piston rings – Alloy Steel.
- ☞ Engine Block – Cast Iron
- ☞ Cylinder Liner – Cast Iron

All other material of construction shall be as per relevant standard/code and the copies of same shall be supplied free of cost to Consultant.

One common base frame shall be provided for mounting the engine and alternator complete with electric suspension between D.G set and foundation bolts, leveling lines etc. as required.

All externally mounted hardware shall be high tensile steel only.

The normal speed of the engine shall be 1500 RPM and the direction of rotation shall be clearly marked on the set.

The engine shall be fitted with an exhaust gas driven turbo charger of air / water cooled type complete with its own self contained lubricating system. The turbo-charger shall be positioned at the free end of the engine preferably

The engine shall be fitted with a charge air inter cooler of the air/water type. Air from the turbo-charger compressor passes through the inter cooled and then to the engine manifold. The inter cooler shall be of tubular construction or as per manufacturer design with aluminum bronze tubes, mild sheet steel and cast iron water headers.

Fuel injection and valves shall not require frequent adjustment while in service.

All filters like fuel, lubrication oil, by pass etc shall be provided in the engine and shall be dry, paper element type.

Starting system shall be 24V DC comprising of batteries (25 plates, 360 AH capacity), Voltage regulator and arrangement for initial charging of batteries.

Bed Plate

The bed plate shall be fabricated from M.S. channel. The welding shall be radio graphed, and the entire fabrication shall be stress relieved after welding. The bed plate shall have integral well ribbed diaphragms for supporting the main bearing housings.

Crank Case

The crank case shall be steel construction with heavy steel plates to form water compartments around the cylinder. To facilitate access for purpose of inspection, inspection ports shall be provided.

Lube-Oil Priming Pump

An A.C. motor driven intermittent operation lube-oil priming pump shall be provided. This shall also include necessary piping, fitting instruments etc. for lubrication system along with clock timers if required.

Crank Shaft

The crank shaft shall be made of high tensile strength steel forging, and shall have a suitable flange to which the flywheel shall be bolted.

The bearing journals and fillets shall be induction hardened; and fully balanced.

Main And Big End Bearings

The main and big end bearings shall be detachable shells of high grade bearing material, and shall be pre-finished.

Connecting Rods

The connecting rods shall be of high grade drop forged steel I - beam section, centre to centre length. The rods shall be rifle drilled for pressure lubrication of piston pin. The rod shall be tapered at piston pin end provided to reduce unit pressures. The piston pin of suitable diameter shall be full floating and made of tubular steel, and retained by a snap ring.

Cylinder Liners

The cylinder liners shall be replaceable wet liners, cast iron alloy, and provided with specially machined grooves in their bores to give an oil retaining surface. These liners shall be easily replaceable without re-boring the block.

Piston

The piston shall be made of forged aluminum alloy, cam ground and machined on outer surface. The piston shall be fitted with an oil scraper ring, and compression rings of hardened cast iron alloy. The piston shall be oil cooled.

Camshaft

The camshaft shall be of induction hardened steel alloy with gear drive, and one of this shall be provided for each block of cylinders.

Exhaust Manifold

The exhaust manifold shall be multi-branch, of insulated design utilizing Ni-resist casting.

Flywheel

The flywheel, which shall conform to requirements of NEMA/ASA/BS codes, shall be made of mild steel statically balanced after machining and shall have graduated markings around the periphery / markings for checking of the valves can also be located on the vibration damper. Barring slots shall be provided around the flywheel rim for hand-barring/ alternatively a suitable barring arrangement should be provided.

8.08 Radiator

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

8.09 ALARMS/TRIP (AUDIO AND VISUAL)

The following Alarm/Trip indications shall be provided as minimum with first stage as pre alarm & second stage as trip:

- ❖ High water temperature.
- ❖ Low lube oil pressure.
- ❖ Low fuel level.
- ❖ Low coolant level.
- ❖ Over crank
- ❖ Over speed

8.10 OTHER AUXILIARY EQUIPMENT/SERVICES

These shall be complete include the following:-

Silencer

Exhaust Silencer shall be residential type to reduce the noise level. Values for Pressure drop across the silencers to be indicated by the vendor.

Cooling

The engine shall be water cooled heat exchanger type. Adequately designed for ambient conditions, 50 deg C.

8.11 DAY SERVICE FUEL TANK

Day service fuel tank shall be made of 3 mm thick MS sheet of 990 litres capacity for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection, trough to collect spilt oil, air vent pipe with air filter, manhole with cover, low level and full level float valve arrangements with all fittings, interconnections between tanks and engine. The tank shall be provided with suitable calibration scale. The Fuel to be used for trials and acceptance tests shall be high speed diesel. First fill of 990 litres HSD per DG set required coolant and lube oil is included in the scope of this contract at no. extra cost.

8.12 PAINTING

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

8.13 ALTERNATOR

The alternator shall be brushless synchronous and suitable for 62.5 and 82.5 KVA 3 phase rated Genertaed Voltage of 415 Volts, 4 wire, 50 Hz, 0.8 p.f., 1500 RPM. The Voltage regulation shall be of + /- 1 % at load between no load to full load and at power factor 0.8 to unity.

The alternator shall be suitable for coupling directly to the diesel engine It shall be Drip proof, screen protected as per IP 23. The alternator shall be double bearing type & self ventilating. The alternators shall be continuously rated and shall have class 'H' insulation with a temperature rise restricted to that of class H designed and built to withstand tropical conditions. It shall generally conform to BS: 5000 (part - 99) / standards listed above.

The net rated output of the alternators at specified site conditions at 0.8 lagging power factor shall be 62.5 KVA and 82.5 KVA. The alternator shall be suitable for sustaining a 10% overload for 1 hour in any 12 hour period without exceeding temperature rise limits specified in IS: 4722 / IEC 34 or BS 5000 when corrected to ambient temperature rise injury. The terminal arrangement for alternator shall be suitable for Cable connections of adequate size to deliver the full load of the alternator.

The Alternator shall be suitable for the parallel operation . The Damper winding shall be provided to facilitate parallel operation.

EXCITOR

Self excited, self regulated and providing alternator output regulation at plus or minus 0.25%. The alternator shall be provided with a pilot-excited, permanent magnet-excited

generator (PMG) for superior short circuit capabilities. Bidders to specify sustained short circuit current capabilities for up to 10 seconds.

The alternator shall be provided with sealed Barings to give minimum service life of 40,000 Hours. The Bidders to specify the maximum rating of the motor that can be started direct on line without any base load, with 50% base load, restricting the Voltage depth to 20%.

INSTRUMENTATION

Instrumentation shall be provided and mounted on the Generator Set to monitor the following:

- ❖ Engine Speed
- ❖ Oil Pressure
- ❖ Oil Temperature
- ❖ Water Temperature.

A Gauge Board shall be provided with all the indicators grouped together. **The generator shall be provided with a microprocessor-based controller equivalent to Cimminns PCC 2100 with AMF monitoring and protections. The following minimum monitoring & protection is required for the alternators.**

Alternator Monitoring

- ☞ Current. (I1, I2, I3)
- ☞ Frequency
- ☞ Voltage (L-L & L-N)
- ☞ KVA
- ☞ KVAR
- ☞ Power Factor
- ☞ Percentage alternator duty heavily i.e. actual load / KW rating.

The Generator shall be protected against the following electrical faults

- Overload and short circuit
- Ground fault
- Over current
- Over frequency
- Under frequency
- Under Voltage
- Over Voltage
- Locked Rotor
- Reverse power protection.

It should be possible to read the data i.e. Parameters and Shutdown status locally on the D.G Set. All the above Parameters should be displayed on The Local Control Panel through appropriate meters and status on faults should be indicated through a facia annunciator. It should be possible to display all the functions as above on a personal computer.

8.14 EXHAUST SILENCER PIPING

The exhaust silencer piping system shall be of heavy duty MS pipes confirming to Class - B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. Exhaust pipe along with silencer inside the building shall be provided with mineral wool insulation with chicken mesh wrapping and 26 SWG aluminum cladding. All terminal connections and pipes joint shall be of welded construction. The terminals of sizes 2" and above shall be butt welded, and of sizes 1.5" and below shall be socket welded, complete with flanges, jointing and fasteners. This welding shall be done as per relevant ASME/ASA codes. The Contractor will have to indicate beforehand the welding procedure he proposes to use. After confirmation by the Project Manager the procedure which is finalised shall be strictly adhered to.

8.15 SOUND ATTENUATING ACOUSTIC ENCLOSURE

Sound Attenuating Acoustic Enclosure should have pleasant and aesthetical looks and should be able to bring down the noise by 25 decibels when measured at a distance of 1 meter away from the set. The DG set should be supported on a base frame in an MS Sheet enclosure with suitable ducting for air inlet and outlet. The door and enclosure should be given corrosion resistant treatment and painted to be weatherproof and long lasting. Resin bonded Glass / Mineral / Rock wool of high density (greater than 45 Kg / Cu. M) with minimum thickness of 75 mm covered with perforated MS Sheet should be provided and covered with tissue paper. Enclosures should be provided with durable locking system with doors duly gasket with neoprene rubber. Exhaust gases should be taken out from the DG Set by means of MS Pipe and a noise suppressor. Proper care should be taken for engine heat rejection in order to have safe working temperature inside the enclosure by provision of fans etc, as required. The design aspect should ensure free and uninterrupted flow of suction and exhaust air in order that the temperature rise of the enclosure with respect to the ambient is less than 7°C.

8.16 TESTS AT MANUFACTURER'S WORK

The following tests shall be performed at manufacture's works prior to packing and dispatch to site.

On DG Set

- ▶ Maximum power load capacity.
- ▶ Maximum motor starting capacity
- ▶ Endurance test.
- ▶ Fuel consumption at full load, 50% load, 75% load and 25% load.
- ▶ Engine - Alternator cooling air flow
- ▶ Load acceptance Test

On the Alternator

- ▶ High voltage tests on stator and rotor windings.

- ▶ Insulation resistance of stator and rotor windings.
- ▶ Temperature rise test.
- ▶ Measurement of resistance of stator and rotor windings.
- ▶ Measurement of losses.
- ▶ Mechanical balance.
- ▶ Load rejection and over speed tests.
- ▶ Stator voltage and current tests.
- ▶ Stator phase sequence check.

On the Excitor

- ▶ High voltage tests on stator and rotor winding.
- ▶ Insulation resistance of stator and rotor windings.
- ▶ Temperature rise test.
- ▶ Measurement of resistance of stator & rotor winding
- ▶ Measurement of losses.
- ▶ Response ratio test.
- ▶ Over speed test.
- ▶ Mechanical Balance test.
- ▶ On the Automatic Voltage Regulator
- ▶ Sensitivity test.
- ▶ Response time test.

All routine test as per IS/BS codes shall be conducted on alternator, exciter and AVR.DG Panel shall be part of main L.T. Panel, supplied by the Owner. However DG supplier shall do the coordination and provide all the inputs required for successful operation.

8.17 INSPECTION AND TESTING AT SITE

All pre-commissioning and commissioning test and checks shall be carried out at site. The Contractor shall be required to produce manufacturer's test certificate for the particular batch of materials supplied to him by the manufacturers. The test carried out shall be as per the relevant standards. For examination and testing of materials and the works at site, the Contractor shall provide necessary testing and gauging equipment as required. All such testing and gauging equipment shall be tested for calibration at any approved laboratory as required by the Project Manager. The Contractor shall give notice well in advance to the Project Manager before commencement of any site testing. All materials like consumable stores, fuel oil grease, lubricating oil etc. required for the trails shall be arranged by the contractor. The Contractor shall make all

necessary hook-ups to carry out tests at site and shall furnish necessary fuel. The complete installation should be initially started and checked out for operational compliance by manufacturer's representative.

8.18 TRIALS (AT SITE)

Preliminary Trials

After completion of erection of generating sets and before carrying out main trials, preliminary site trials shall be conducted in the presence of the Project Manager. Such trials shall include the checking and adjustments of all instrument relays, timers, interlocks and meters. Insulation resistance of stator, rotor and exciter windings shall be checked and reading recorded. A check shall be made for the satisfactory working of all auxiliary motors and their starting accessories supplied with the set.

Main Trials

The main trials shall include over 8 hours continuous run at full load. D.G. Panel shall be tested for automatic operation by injecting proper current and voltage by a separate source. The satisfactory working of automatic operation shall be tested and necessary adjustments shall be done for relays in the presence of the Project Manager and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 3% shall be allowed on the fuel oil consumption to cover possible errors in measurement. Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in BS: 5514. Alternator insulation resistance and commutation check shall be as per BS: 5000. Starting time of sets shall be tested at least five times after sufficient time intervals to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment checked. Any further reasonable trial as suggested by the Project Manager shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to PROJECT MANAGER.

8.19 TEST WITNESS

Tests shall be performed in the presence of Project Manager. The contractor shall give at least thirty (30) days advance notice of the date when the tests are proposed to be carried out.

8.20 PERFORMANCE REQUIREMENT

The D.G. set shall operate upto 110% of rated speed, without undue vibration and noise. The unit shall be capable of delivering rated output at 0.8 p.f. at the generator terminals (after derating of the engine due to site conditions). As soon as the set attains rated speed the transient voltage drop at the generator terminal shall not exceed 10% of rated value.

9.00 ROAD LIGHTING

9.01 GENERAL

Road lighting shall be done by GI pole with HPSV lamp. The poles shall be provided along the internal roads and pathways and internal courtyards. The light shall be partly on emergency supply as indicated in the respective control wiring layouts.

9.02 LOW HEIGHT LIGHT POLE

Light pole made of 4 metre high Class-B GI pipe with base plate 300mmx300mmx6mm welded to the pole and painted with approved steel primer with final paint as per schedule of quantities.

9.03 Highmasts

The High mast shall be of 16 mtrs high the vendor shall be capable of every aspects of project design from engineering and manufacturing to construction and installation. The vendor capabilities include in-house engineering team of civil & structural designers quickly provide engineering solution tuned to customers need.

9.03.1 Scope of Work:

The Scope of work is design, manufacture, supply & erection of highmast lighting system.

- Highmast with its accessories.
- Raising lowering mechanism with integral power tool.
- Foundation Bolts
- Light fixtures
- Control Panel
- Construction of Civil foundation
- Erection & Commissioning of Highmast Lighting system.
- Earthing
- Erection of control panel.

9.03.2 Specification of high mast:

HIGHMAST STRUCTURE

- | | | |
|--|---|--------------------------------|
| a) Standard Height of Highmast | : | 16 Mtr. |
| b) Highmast Type | : | Polygonal Continuously Tapered |
| c) Material construction | : | BS EN 100025 or equivalent. |
| d) No. of Sections | : | 1/2/3 as per design |
| e) Length of each section | : | Max. 12 Mtr |
| f) No. of longitudinal welds /section | : | One |
| g) No. of circumferential welds/ section | : | None |

- h) Cross section of highmast : 20 sided polygon
- i) Type of joints. : Stress fit at site.
- j) Metal protection treatment for Highmast : Hot Dip Galvanized.
- k) Average thickness of galvanisation (as per BSEN ISO 1461) : 85 Micron.
- l) Earthing arrestor & AOL arrangement: Mounting at the top.

DYNAMIC LOADING AS PREVAILING AT SITE

- a) Max. wind speed : As per IS 875 part 3
- b) Max. gust speed time : 3 seconds.
- c) Factor of safety for wind load : 1.25
- d) Factor of safety for other load : 1.15

FOUNDATION DETAILS

- a) Type of foundation : Open raft shallow footing.
- b) Size of foundation : As per Design.
- c) Design safety factor : As per IS -456
- d) Considered wind pressure (Kg/Mt2) : As per IS-875-1987

9.03.3 DETAIL TECHNICAL SPECIFICATION FOR HIGH MAST LIGHTING.

SCOPE:

The scope of this specification covers the manufacture, installation, testing and commissioning of the complete lighting system, using Raising and Lowering type of High mast Towers, including the Civil Foundation Works. The Purchaser shall only provide the supply point and the feeder cable of the required size, up to the bottom of the high mast.

APPLICABLE STANDARDS :

The following shall be the Reference Standards for the design of the High mast system:

<u>Code No.</u>	<u>Title</u>
a) I.S.875 (Part III) 1987.	Code and practice for design loads for Structures.
b) BS EN- 100 025	Grades of Special Steel Plates or equivalent
c) BS. 5135.	Welding.
d) BS.ISO 1461.	Galvanizing.
e) TR. No.7 1996 of ILE, UK.	Specification for Mast and foundation.

HIGHMAST:

Structure:

The High mast shall be of continuously tapered, polygonal cross section, 8-20 sided, fabricated from special steel plates. The mast shall be delivered at site in sections and joined together by slip-stressed-fit method. No site welding or bolted joint shall be done on the mast. The minimum over lap distance shall be 1.5 times the diameter at penetration. The mast shall be provided with fully penetrated and welded flange.

Dynamic Loading for the Mast:

The mast structure shall be suitable to sustain an assumed maximum reaction arising from a wind speed as per IS 875 (three second gust), and shall be measured at a height of 10 metres above ground level. The design life of the mast shall be a minimum of 25 years.

Door Opening :

An adequate door opening shall be provided at the base of the mast to permit clear access to equipment like winches, cables, plug and socket, etc.

Lantern Carriage:

A fabricated Lantern Carriage shall be provided for fixing and holding the required number of flood light fittings and control gear boxes. The entire Lantern Carriage shall be hot dip galvanized after fabrication.

Junction Box.

Weather proof junction box shall be provided on the Carriage Assembly as required, from which the inter-connections of luminaries shall be made.

Winch:

The winch shall be completely self sustaining type, without the need for brake shoe, springs or clutches. The winch shall be self-lubricating type by means of an oil bath. The winch drums shall be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. It shall be possible to operate the winch manually by a suitable handle and by an integral power tool. The driving spindle is positively locked when not in use by means of automatic gravity activated pawls.

Power Tool for the Winch:

A suitable, high-powered, electrically driven, internally mounted power tool, with manual over ride shall be supplied for the raising and lowering of the lantern carriage for maintenance purposes. Each mast shall have its own power tool motor.

Head Frame:

The head frame is designed, as a capping unit of the mast, shall be of welded steel construction, galvanized both internally and externally. The top pulley shall be of appropriate diameter, large

enough to accommodate the stainless steel wire ropes and the multi-core electric cable. The pulley block shall be made of non-corrodible material, and shall be of die cast Aluminum Alloy (LM-6). Self-lubricating bearings and stainless steel shaft shall be provided to facilitate smooth and maintenance free operation for a long period.

Stainless Steel Wire Ropes :

The two/three wire rope suspension system consist of only non-corrosive 'marine grade' (AISI 316) stainless steel wire ropes (7/19 Construction) of suitable diameter. The end constructions of ropes to the winch drum shall be fitted with talurit.

Electrical System, Cable and Cable Connections :

The electrical connections from the bottom to the top shall be made by special trailing cable of reputed make. The cable shall be EPR insulated and PCP sheathed to get flexibility and endurance. The trailing cables shall be terminated by means of specially designed, metal clad, multi pin plug and socket provided in the base compartment to enable easy disconnection when required.

Earthing Terminals & Lighting Finial:

Suitable earth terminal using 12 mm diameter stainless steel bolts shall be provided at a convenient location on the base of the Mast. One number lighting finial shall be provided for each mast.

CONTROL PANEL

Highmast shall be provided with a control panel fabricated out of 14/16 SWG CRCA sheet comprising incoming MCB Isolator, Copper wiring, suitable timer-contactor to switch on the luminaries at a pre-set time and control arrangement for the operation of the power tool-motor.

LUMINAIRES

Luminaries shall be specially designed with suitable lamp housing and control gears for 250/400 W HPSV/MHT Lamps as per the requirement.

Suitable Aviation Obstruction Lights of reputed make shall be provided.

FOUNDATION BOLTS

Manufactured from special steels along with nuts, washers, anchor plate and template.

9.04 OCTAGONAL GI POLES

9.04.1 SCOPE

The scope of this specification covers the manufacture, installation, testing and commissioning of the 8 mtr high ,4mm thick Octagonal pole complete lighting system, including the Civil Foundation Works. The Purchaser shall only provide the supply point and

the feeder cable of the required size, up to the bottom of the pole. The octagonal Poles shall be designed to mount street light luminaries

with weight approx. 15 Kg. Each. The octagonal poles shall be **Hot Dip Galvanized** to give average 65 micron thickness. The octagonal poles are designed for max. wind speed of **50 m/s** (180 km/hr). The octagonal Poles of length up to 8 meters are manufactured in single section The Octagonal poles diameter shall be of 150mm indicates the dimension across face (above floor level). The junction box shall be used only for octagonal poles having base dia 150mm (A/F) or as specified. Position of the door shall be of **500 mm** above the base plate.

9.04.2 TECHNICAL SPECIFICATIONS OF STANDARD OCTAGONAL POLES

Design The octagonal poles shall be designed to withstand the maximum wind pressure as per IS 875 Part III. The top loading i.e. area and the weight of fixture are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN: 40-3-3:2003/BS: 5649.

Pole Shaft The pole shaft shall have **octagonal** cross section and shall be continuously tapered with **single longitudinal welding**. There shall not be any circumferential welding. The welding of pole shaft shall be done by submerged arc welding (SAW) process.

All **octagonal** pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified process.

Door opening The octagonal poles shall have door of approximate 400 mm length and suitable width at the elevation of 500 mm above the base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Material	Octagonal poles	Conforming to grade S355JO/ BSEN 100 25 Or equivalent (IS 2062).
	Base Plate	Fe 410 conforming to IS 2062
	Foundation bolts	6.8 Gr. As per IS 1367

Welding The welding shall be carried out confirming to approved procedures. The welders shall also be qualified for welding the octagonal shafts in accordance with ANSI/AWS.D1.1(96) Section 4

Pole sections	The octagonal poles up to the length of 8 meters shall be in single piece with single longitudinal welding joint. There shall not be any circumferential weld joint.
Galvanization	The poles shall be hot dip galvanized as per IS 4759/BSEN 1461 standards with average coating thickness of 65 micron.
Fixing Type	The octagonal poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.
Top Mountings	The galvanized arm shall be supplied along with the octagonal poles for installation of the luminaries.

10.00 DISTRIBUTION BOARDS.

10.01 Distribution Board shall be double door type suitable for flush installation. All distribution boards shall be of three phases (415 Volts) or single phase (240 volts) type with incoming isolator or MCB and/or ELCB as in Schedule of quantities. Distribution boards shall contain plug in or bolted type miniature circuit breaker mounted on busbars. Miniature circuit breakers shall be quick made & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with is 8828-1978. 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. Phase barrier shall be fitted and 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. All distribution board enclosures shall have an etched zinc base stove painted followed by synthetic stoved enamel, colour light gray. A circuit identification card in clear plastic cover shall be provided for each distribution board.

10.02 Miniature Circuit Breakers for lighting circuits shall be of "B" curve where as 'C' Curve MCB's shall be invariable used for motor loads, halogen lamps fitting, sodium/mercury discharge lamps and for all power circuits. All miniature circuit breakers shall be of 10KA rated rupturing capacity.

10.03 EARTH LEAKAGE CIRCUIT BREAKER/RESIDUAL CURRENT CIRCUIT BREAKERS

Earth leakage circuit breaker shall be current operated type and of 30mA sensitivity unless otherwise stated. For single phase distribution, ELCB shall be housed within the

DB box. For three phase distribution board, either the ELCB shall be housed in the same box or in a separate box of shall be width & depth of D.B box. ELCB box shall be of same finish.. Height of ELCB box shall be sufficient to accommodate ELCB & termination of incoming & outgoing wires.

11.00 **METALLIC CONDUIT WIRING SYSTEM**

11.01 **TYPE AND SIZE OF CONDUIT**

All conduit pipes shall be of approved gauge (not less than 16SWG for conduits of sizes up to 32mm diameter) solid drawn or reamed by welding finished with stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS code. No steel conduit less than 20mm in diameter shall be used.

11.02 **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 no sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

11.03 **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.

11.04 **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 anti-corrosive preservative or covered with approved plastic compound.

11.05 PAINTING OF CONDUIT AND ACCESSORIES

After installation, all accessible surface of conduit pipes, fittings, switch and regulator boxes etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

11.06 FIXING OF CONDUITS

11.06.1 SURFACE CONDUIT

Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than one metre but on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30cm from the centre of such fittings. The saddles should not be less than 24 gauge for conduits upto 25mm dia and not less than 20 gauge for larger diameter conduits. The corresponding widths shall be 19mm & 25mm. Where conduit pipes are to be laid along the trusses, steel joint etc. the same shall be secured by means of special clamps made of MS. Where as it is not possible to drill holes in the trusses members suitable clamps with bolts and nuts shall be used.

For 25mm diameter conduit width of clip shall be 19mm and of 20SWG. For conduit of 32mm and above, width of clip shall be 25mm and of 18SWG.

Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling frame work or suspended with suitable supports from the soffit of slab. For conduit pipe run along with wall, the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer at site.

11.06.2 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 taken to fix the conduit and accessories in the position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burying 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 treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 metres, then circular junction box shall be provided.

11.07 OUTLET BOXES & COVERS

The switch box shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanised mild steel. Upto 20 x 30cm size M.S. box shall have wall thickness of 18SWG and MS boxes above 20 X 30cm size shall be of 16SWG. The metallic boxes shall be painted with anti-corrosive paint before erection. Clear depth of the box shall not be less than 60mm. All fitting shall be fitted in flush pattern. Phenolic laminated sheet of approved shade shall be used for switch box covers. These shall be of 3mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-1 OF IS 2036-1994.

11.08 **ERECTION AND EARTHING OF CONDUITS**

The conduit of each circuit or section shall be completed before conductors are drawn in . The entire system of conduit after erection shall be tested 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. Gas, Water pipe shall not be used as dearth medium.

11.09 **SWITCHES**

All 5 and 15Amp switches shall be piano type of 240 volts A.C. grade. All switches shall be fixed on 3mm thick laminated sheet cover. All 5 Amp socket shall be 3 pin type. All 15Amp socket shall be 6 pin type suitable for 15/5Amp. All switches, sockets, telephone outlets, TV controlling the lights or fans shall be connected to the phase wire of the circuit. Switches shall be located at 1200mm above finished floor level unless otherwise indicated on drawings.

11.10 **FLUSH COVER PLATE**

All switches, sockets, telephone and TV outlets etc. shall be fixed on 3mm thick phenolic laminated sheet cover unless otherwise called for in drawing or BOQ. Flush cover plate shall be secured to the box with counter sunk brass screws & cup washers.

11.11 **WALL SOCKET PLATE**

All 5 and 15Amp socket outlet shall be 3 and 6 pin respectively. Each outlet shall have a switch located beside the socket preferable on the same flush cover plate. The earth terminal of the socket shall be connected to the earth wire.

11.12 **WIRING**

All internal wiring shall be carried out with PVC insulated wires of 650/1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switch board may have more than on circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit

shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switch boards. A separate earthwire shall be point wiring red colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated wire for the neutral wires. Bare copper wire shall be used as dearth continuity conductor and shall be drawn alongwith other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing & jointing of copper conductor wires & cables shall be as per CPWD specifications.

11.13 **JOINTS**

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits & junction boxes. Conductors shall be continuous from outlet to outlet.

11.14 **MAINS AND SUBMAINS**

Mains and submain cable where called for shall be of the rated capacity and approved make. Every main and submain shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawings of the submain & main cables. Cost of junction box/drawn box is deemed to be included in the rates of submain wiring. As independent earth wire of proper rating shall be provided for every submain. Single phase submain shall be provided with two earth wire. The earth wire of proper rating shall be fixed to conduits by means of suitable M.S. clips at not more than 1000mm distance.

Where mains and submains cables are connected to the switchgear, sufficient extra lengths of submain and mains cable shall be provided to facilitate easy connections and maintenance. for termination of cables crimping type cable socket/lugs shall be provided. Same colour code as for circuit wiring shall be followed.

11.15 **LOAD BALANCING**

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

11.16 **COLOUR CODE FOR CIRCUIT & SUBMAIN WIRING**

Colour code for circuit & submain wiring installation shall be Red, Yellow, Blue for three phases. Black for neutral and yellow/green or green only for earth in case of insulated earth wire.

11.17 **CLASSIFICATION OF POINTS.**

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

11.18 **CONDUCTOR SIZE.**

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

i.	light point	- 1.5Sq.mm
ii.	Ceiling /Cabin/Exhaust Fan point	- 1.5Sq.mm
iii.	Call bell Point	- 1.5Sq.mm
iv.	Plug Point (5 A S.S. outlet)	- 1.5Sq.mm
v.	Circuit Wiring	- 1.5Sq.mm
vi.	General power point	- 4.0Sq.mm
vii.	Power Point for A.C. Unit	- 6.0Sq.mm
vii	Power point for Geyser, Drinking Water coolers & hand dryers.	-4.0sq.mm

11.19 **TELEPHONE WIRE/CABLES**

Separate conduits shall be provided for internal telephone wiring of telephone system commencing from tag block. Each telephone outlet shall be wired with 2 pair telephone cable from the tag block. All telephone wires shall be of .61mm dia annealed tinned high conductivity copper conductor PVC insulated & PVC sheathed grey conforming to ITD specification SWS 113 B & C. Multipair PVC insulated cables laid in conduit shall be provided for connecting various tag blocks. Telephone cables used for external connections shall be armoured. These cable shall be laid directly in ground or in pipe etc. as call for else where.

Following number of 2 pair wires/cables shall be drawn in various sizes of conduits as listed below.

20mm conduit	-	Upto 3 cables.
25mm conduit	-	more than 3 upto 6 cables.

11.20 Maximum number of

**PVC INSULATED 650/1100 v GRADE ALUMINIUM/COPPER CONDUCTOR
CABLE CONFORMING TO IS : 694 – 1990**

Nominal Cross Sectional area of conductor in sq.mm	20m		25m		32m		38m		51m		64m	
	S	B	S	B	S	B	S	B	S	B	S	B
1	2	3	4	5	6	7	8	9	10	11	12	13
1.5	5	4	10	8	18	12	-	-	-	-	-	-
2.5	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

NOTE :

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

12.00 LIGHTING FIXTURE AND FANS

12.01 GENERAL

- a. The Contractor shall supply and install lighting fixtures including but not limited to lamps, ballasts, accessories fixing hardware necessary for installations, as shown on the Drawings, as required, and as herein specified.
- b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hickey casing, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.
- c. Full -size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule shall be submitted to the Engineer for approval.
- d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening
- e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the drawings.
- f. Manufacturer's name and catalogue number of lighting fixtures are given for general reference only. It shall be understood that the actual fixtures supplied shall meet all the requirements of the specification, and if necessary, the standard fixture indicated for reference, shall be modified accordingly.
- g. Fixtures shall bear manufacturer's name and the factory inspection label.
- h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.
- i. Relamping the fixture shall be possible without having to remove the fixture from its place.
- j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.

12.02 CONSTRUCTION

- a. Fixtures shall be constructed of 0.5mm thick steel minimum. If other metals are used they shall be of the required thickness to have at least the same mechanical strength. Cast portions of fixtures shall be not less than 1.5mm thick.
- b. Metal parts of the fixture, shall be completely free from burrs and tool marks. Solder shall not be used as a mechanical fastening device on any part of the fixture. Fixture joints shall be welded and ground smooth.
- c. Fixtures with visible frame shall have concealed hinges and catches.
- d. Recessed fixtures shall be constructed so as to fit into ceiling without distorting either the fixture or the ceiling. Plaster rings shall be provided for plaster ceilings. The Contractor shall coordinate the dimensions with the false ceiling tile dimensions.
- e. Outdoor fixtures (under canopy or directly exposed to the weather) shall be constructed of an appropriate weather resistant material including gasketing preventing entrance of water into wiring, and shall be marked by the manufacturer "Suitable for Outdoor Use."

- f. Fixtures with hinged diffuser doors shall be provided with spring clips or other retaining devices to prevent the diffuser from moving.
- g. All plastic diffusers shall be of acrylic, unless otherwise noted.
- h. Pendant fixtures and lampholders shall be provided with ball type aligners.
- i. Fluorescent fixtures shall be provided with white lampholders.
- j. Industrial type fluorescent fixtures shall have turret type lampholders.

12.03 **FINISH**

- a. All hardware shall be bonderised, cadmium plated, given a corrosion-resistant phosphate treatment or other approved rust inhibiting prime coat, to provide a rust proof base before application of finish. Finish shall be baked enamel.
- b. Non- reflecting surfaces such as fixture frames and trims, shall be finished with baked enamel paint, unless other-wise specified. The colour of the paint shall be as indicated on the Drawings or as directed later by the Engineer.
- c. Light reflecting surfaces shall be finished with baked white enamel paint having a reflection factor of not less than 85%.
- d. All parts of the reflector shall be completely covered by the finish and free from irregularities.
- e. Unpainted surfaces shall be finished with a clear lacquer except for anodised or "Azac" surfaces.
- f. After finish has been applied and cured, it shall be capable of withstanding a 1cm radius bend without showing sings of cracking, peeling or loosening from the base metal.
- g. Finish shall be capable of withstanding 72 hours exposure to an ultra-violet RS sun lamp placed 10cm from the surface without discoloration, hardening, or warping and shall retain the same reflection characteristics after exposure

12.04 **WIRING**

- a. Fluorescent fixtures shall be wired with not smaller than 1.5 sq mm asbestos-covered wire. No splice or tap shall be located within an arm, stem or chain. Wire shall be continuous from splice in outlet box of the building wiring system to lamp socket or to ballast terminals.
- b. Wiring within incandescent fixtures and for connection to the branch circuit wiring up to the outlet box of lighting point shall not be less than 1.5 sq mm silicone rubber insulated wire. (150 degree centigrade temperature).

12.05 **INSTALLATION**

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer.

Pendant fixtures within the same room or area, shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation.

Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.

Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

12.06 **LAMPS - GENERAL**

Lamp shall be supplied and installed in all lighting fixtures listed in the Schedules of lighting Fixtures on the drawings.

Lamps used for temporary lighting service shall not be used in the final lamping of fixture units,

Lamps shall be of wattage and type as shown in the Schedule of lighting Fixtures.

Lamps for permanent installation shall not be placed in the fixtures, until so directed by the Engineer and this shall be accomplished directly before the building areas are ready for occupancy by the Client.

12.07 **LAMPS - FLUORESCENT**

Lamps shall be of hot electrodes, preheated, normal start type.

Lamps shall have bi-pin bases and a minimum approximate rated life of 8,000 hours.

Unless otherwise indicated on the Drawings, Lamps shall have the colour rendering features and lumens/watt output of lamps with WHITE colour designation as manufactured by Philips (India) or approved equal.

12.08 **LAMPS- INCANDESCENT**

Incandescent lamps shall be inside frosted type. Lamps shall have minimum approximate rated life of 750 hours.

Lamps shall be manufactured by Philips (India) or approved equal.

12.09 **BALLASTS - FLUORESCENT**

Ballasts shall be of electronic type with high power factor.

Ballasts shall have manufacturer's lowest sound level and case temperature rise rating.

Ballasts shall be special cool operated type.

Ballasts for indoor fixtures shall be protected by an integral thermal automatic resetting protective unit which shall disconnect the ballast in the event of overheating.

Ballasts shall be of the same manufacture as the lamps.

12.10 **FIXTURE SAMPLES**

Detailed catalogue for all fixtures or if so required by the Engineer sample fixtures shall be submitted for prior approval of Engineer before orders for the fixtures are placed.

12.11 LAMPS MERCURY

Mercury lamps shall be high pressure mercury -vapour fluorescent lamps, with a quartz discharge tube enclosed in an internally coated avoid outer bulb.

The quartz discharge tube shall contain a small quantity of mercury and a starting gas.

The number of minutes after which the lamp has reached 80% of its final luminous flux shall not exceed 5 minutes for 50 W lamps, above shall be fitted with hard glass.

Lamps shall be similar to Philips HPL -N type or approved equal.

12.12 BALLASTS-MERCURY VAPOUR

Ballasts shall be suitable for outdoor use. Ballast shall conform to IS 6616-1982.

The housing and the cover are made of polyamide, which is heat, impact and stress resistant, with very good insulating properties. The ballast box shall be protected to IP 54.

All ballast boxes shall include the integral ballast, the ignitor, the capacitors, a terminal block, and two properly rated fuses.

12.13 TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the Engineer. All un-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer.

12.14 CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof member. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook (to be provided under civil works) shall be as per CPWD specification. Ceiling fan shall be double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS standards ceiling fan shall be white in colour. Ceiling fan shall be provided with electronic stepped regulator. Regulator shall be suitable for 240 volts A.C. supply 50 Hz and shall be of continuous duty type.

12.15 EXHAUST FANS

Exhaust fans shall be heavy duty type with double ball bearing & conforming to IS 2312-1967. Exhaust fan shall be complete with copper wound motor, capacitor, louvers/shutter, frame & mounting bracket. Exhaust fan shall be suitable fan operation on 240 volts single phase A.C supply.

13.00 CABLE TRAY

13.01 The cable tray shall be fabricated out of slotted/perforated MS sheets as channel sections, single or double bended. The channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at side to the desired lengths. These may be galvanised or painted to the desired lengths. These may

be galvanised or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with cross bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1m spacing. 2mm thick MS perforated sheet shall be suitable welded/bolted to the base as well as on the two sides.

- 13.02 Typically, the dimensions, fabrication details etc. are shown in CPWD General specification for Electrical Works - part II-External, 2006.
- 13.03 The Jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.
- 13.04 The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.
- 13.05 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.
- 13.06 Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice (Details are typically shown in CPWD General Specification of Electrical Work Part II – 2006). The radius of bends, 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.
- 13.07 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 of CPWD General Specification of Electrical work Part II -2006. 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 Engineer, to take the weight of the cable tray with the cables.
- 13.08 The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.
- 13.09 The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.
- 13.10 The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc., and paid for accordingly.

14.00 **EARTHING**

14.01 **GENERAL**

All the noncurrent metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General Specifications for Earthing work shall conform to Internal) -1994 and Indian Electricity Rules 1956 amended upto date and in the regulations of the local Electricity Supply Authority.

14.02 **EARTHING CONDUCTOR**

Earth continuity conductor alongwith 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 galvanised MS strip.

14.03 **SIZING OF EARTHING CONDUCTOR**

All fan regulator, 5 and 15Amp outlet points, switch boxes shall be earthed with 2mm dia. (14SWG) bare copper wire. Separate earth wire shall be drawn alongwith each circuit. From Main/Sub Distribution board to distribution boards, earth continuity conductor shall be of 4mm dia (8SWG) bare copper. Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switch board and sub switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury & corrosion by providing GI pipe.

14.04 GI pipe shall be of medium class 40mm dia and 4.5 metre in length. Galvanising of the pipe shall conform to relevant Indian Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2 metre of length from bottom. The electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2metres from the building. The location of the earth electrode will be such that the soil has reasonable chance of remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS frame & cover having locking arrangement at the top.

14.05 **PLATE EARTH ELECTRODE**

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimensions.

- i. GI Plate Electrode : 600m x 600mm x 6mm thick
- ii. Copper Plate Electrode : 600m 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.

14.06 **ARTIFICIAL TREATMENT OF SOIL**

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

14.07 **RESISTANCE TO EARTH**

The resistance of earthing system shall not exceed 2 ohm.

15.0 ADDRESSABLE ANALOGUE FIRE ALARM AND DETECTION SYSTEM

15.01 General

The fire detection system shall comprise of a central unit, connected by two wires to field devices, including fire detection devices, alarm devices and control devices, located throughout the protected building area.

The control unit shall continuously monitor the analogue status of all sensing devices, and initiate action when a fire or smoke condition is present.

The system shall be designed to provide an early warning utilising the most effective detection methods appropriate to the protected areas. In addition, the system should support following type of sensors.

- Multisensors, with optical smoke and thermal sensing
- Optical smoke sensors
- Thermal sensors

The alarm management shall be field configurable from the control panel via a key pad to enable the system to be tailored to suit the protected building, and to permit future changes. This configuration shall be maintained under power failure conditions.

The system design shall conform to the Indian Standard Code of practice for Automatic Fire Alarm and Detection system IS: 2189:1999 (updated).

The control unit shall have a front panel comprising of indicating LED's, control keyboard, and LCD display, as described in detail later.

Different levels of access into the system menu via the keypad are to be provided. These are to be as follows

level 1 : Operator (no access code required)

Level 2 : Commissioning and Maintenance Technician (access code required)

The control unit and sensors shall conform to the following standards

National Building Code

Delhi Fire Code

EN54

NFPA

EU

IS:2189

15.02. System Operation

15.02.1 Communication System

The system is to incorporate a polling system which polls each sensor individually and reads information at regular intervals to the control unit. The panel shall make decisions based upon the information obtained from each detector.

15.02.2 Communication circuit

A 2-wire circuit is to be used for power and communication between the panel and the sensors.

15.02.3 System control

All communication shall be under the control of the control unit, which shall sequentially poll each device in turn and authorise communication.

No device shall communicate with the control panel without authority.

The control unit must be able to read information from a device or send instructions to a device.

15.02.4 Device address

Each device on loop must be uniquely identifiable by the control unit. This must be achieved by pre-setting the address of each device.

Removal of a detector head from its base must transmit a fault condition to the control unit.

15.02.5 Device identification

The identification of each type of address unit and each type of sensor (i.e. multisensor, ionisation detector, heat detector, sprinkler switch, sounder etc.) must be transmitted to the panel on each polling scan.

15.02.6 Device status

The condition of each loop device, including circuit, calibration and contamination, must be transmitted to the panel on each polling scan.

15.02.7 Display and indicators

All display and indicators shall be LCD for text, and LED for lamp indication.

The type, calibration, sensitivity and status of each device must be able to be displayed at the control panel.

15.02.8 Number of devices in alarm

There shall be no limit to the number of devices which may be in alarm simultaneously.

When a detector is in alarm an LED in its head or base shall be switched on.

15.02.9 Line protection and monitoring

The addressable line must be monitored for short circuit or open circuit.

The occurrence of an open circuit shall cause a fault signal on the panel, but all sensors or devices shall function correctly.

The occurrence of a short circuit shall cause no more than 20 sensors or callpoints to cease operating, and all remaining devices shall function correctly.

15.02.10 Software Algorithms

The data from each sensor must be evaluated by intelligent software algorithms to identify the presence of fire or smoke, and any possible faults present.

The system must support a number of different software algorithms, each tailored to suit the profile of a different hazard or protected area. These algorithms must be specifically matched to provide the optimum protection for each type of area.

It must be possible to customise algorithms to take into account special conditions that may exist in certain specific hazards. This customisation should incorporate the features below.

Alarm sensitivity relative to each analogue detector is to be individually adjustable, device by device, by the control panel.

15.02.11 Remote Terminals

It shall be possible to provide remote access to monitor (Remote Display Terminal) or monitor / control (Remote Control Terminal) operation of the installation. The Remote Control Terminal shall provide the same display, indication and buttons as the Main Fire Panel (Control Unit).

Remote Control shall provide the capability to silence alarms, resound alarms, evacuate and reset the system. In addition, it shall be possible to remotely enable or disable zones and points and remotely configure a zone walk test.

15.02.12 Graphical Interface Software

The system shall provide an optional Graphical Software to be used to monitor the system and operate the fire alarm system

15.02.13 Networking

The system shall be expandable from 1-96 Loops with distributed intelligence. RS485, Fibre Optic or TCP/IP interface shall be available for networking.

For more complex systems, Windows based Graphical Software should allow networking with multiple individual networked systems.

15.03 Loop Operation

15.03.1 Addresses

The loop devices shall each have a unique address. Each device may be addressed as often as is required.

There shall be no preset order for addressing the devices. The devices shall be addressed appropriate to site conditions. This order will be determined during system design or commissioning. In order to maintain system integrity, the panel must not bypass any sensors during a scan.

The control panel will have the facility of determining if more than one device has the same address on the loop. A "double address" alarm shall be given if this occurs.

15.03.2 Loop devices

It shall be possible to fit a range of sensors and devices to the loop, as indicated in detail later in this specification.

Sensors shall transmit data to the control panel, which shall be interpreted by the algorithm allocated to the particular sensor. Response shall be determined by the characteristics of the algorithm.

Manual call points shall each have their own unique address and the panel shall be capable of identifying and responding to the operation of a call point.

Loop sounders shall be powered directly from the addressable loop, without requiring any additional wiring. It shall be possible to fit up to 20 sounders onto each loop, depending on the size and length of the loop cabling.

It shall be possible to fit loop isolators at a maximum spacing of one per 20 devices. The isolators shall protect against short circuits, and partial short circuits, on the loop by isolating that section of the loop where the short circuit occurred, thus maintaining the integrity of the remainder of the system.

Fire condition LED indicators fitted to the devices and any remote indicators shall be remotely and separately operated from the control panel.

Interfacing to other systems

The loop shall be capable of receiving information from third-party systems, e.g. operation of sprinkler system, by means of standard interface units. The source of this information shall be identified by its own unique address. In addition, the interface unit shall indicate to the panel the type of alarm, eg “sprinkler”, “security”, etc.

The loop shall be capable of giving a trigger to third-party systems, e.g. AHU’s, by means of standard interface units.

15.03.3 Device identification and location

The control panel shall be able to identify what type of device is located at each address in order to protect against accidental fitting of an inappropriate sensor.

The control panel shall be able to identify the absence of a field device.

15.03.4 Device monitoring

The panel shall monitor each device on every scan, and give a fault signal for any of the following conditions, within 30 seconds.

Detector removed

Address unit removed

Incorrect device type

Faulty calibration or sensitivity

15.03.5 Line capacity

The capacity of the address line shall be at least 125 addressable devices.

These must be input devices, such as smoke sensors, or output devices, such as sounders or relays.

15.04 Fire Alarm Panel

15.04.1 General Description

The fire alarm panel shall be a 24 volt analogue addressable unit, designed to communicate with the sensors and field devices. It shall be a microprocessor based unit, and shall incorporate all hardware and software to enable it to make decisions based upon information received from sensors, and operate appropriate outputs to initiate required alarms and signals.

The panel shall comply fully with the code and standard mentioned under para 15.01.

15.04.2 Signalling and Annunciation

Signalling and annunciation shall be as specified in standard under para 3.01

Fire indication shall be by zone, displayed on LED indicators, and on the LCD text display.

Fault, maintenance, pre-alarm, and device/zone disabled signals shall be indicated visually by LCD text display, and audibly, in the control unit.

The LCD text display shall show the first alarm received. It must be possible to manually scroll through all alarms on the lower portion of the screen, using “up” and “down” scroll buttons.

The display must show the total number of alarm events currently in the system.

Fire alarms shall take priority when displaying. However, it must be possible to view all events currently in the system, including, fire alarms, fault alarms, pre-alarms, maintenance alarms, disabled devices, and other events.

It shall be possible to view the devices, by address that initiated the alarm on the LCD text display, on manual request. When viewing the device, a 40 character location message specific to each device shall be displayed.

The visual indications must be arranged so that the different warnings are clearly distinguished. (i.e. amber for fault, red for alarm).

The internal audible signal device may be the same for all alarms, but either tone variation or time switching shall be used to differentiate the signals.

Outputs shall be provided for audible alarms, control functions, remote mimics and connection for computers and printers.

15.04.3 Zoning

The panel shall have minimum fifty zones. The zones must be fully field programmable to permit sensors to be allocated to any zone.

Each zone shall be identified by a 40-character text label displaying on the LCD display. This shall be field programmable.

It must be possible for any number of addressable devices from 0 - 125 to be connected to any zone.

The panel must provide facilities for the operator to inspect the zoning configuration, and inhibit, or activate devices. Facilities must be provided for identifying all active and inhibited addresses, and all connected device types.

15.04.4 Panel indicators

All visual indicators shall be LED's.

3.04.5 Panel displays

The LCD text display must be able to simultaneously display a minimum of the following information in each display mode.

- 1) Zone Display Mode:
 - Type of alarm
 - Alarm count
 - Total number of alarms
 - 40 Character zone location message for each zone
 - Time and date

- 2) Device Display Mode:
 - Loop number, zone number, detector address
 - Alarm count
 - Zone in alarm
 - Detector in alarm
 - Alarm type
 - Active or accepted
 - Time and date

The LCD must be at least a 40 X 4 character display.

15.04.6 Panel controls

The panel is to incorporate a keyboard and push-button with the following functions:

- Numeric keyboard
- System reset button
- Alarm accept button / silence alarm button
- Alarm sound button
- Panel buzzer "mute" button
- Lamp test function
- Control buttons as required for system operation
- Menu functions for maintenance and commissioning

15.04.7 Alarm outputs (Fire)

The panel must incorporate two monitored audible alarm outputs for the switching-on of bells or electronic sounders.

These outputs must be continuously monitored for open and short circuit.

15.04.8 Alarm contacts (Fire)

Two voltage free change-over contact must be provided. This must operate on a "fire" condition, and is to remain "on" until the system is reset.

15.04.9 Alarm contacts (Fault)

One voltage-free change-over contact must be provided. This must release on a "fault" condition, and is to remain "off" until the system is reset.

15.04.10 Remote panel outputs

An optional interface shall be provided for connecting to remote panels and computers.

15.04.11 Optional printer

A 40 column printer shall be available as an option, able to be installed into the panel, visible and accessible from the front.

The printer shall provide a hard copy of the following of events with date and time stamp.

Operation of the printer shall not inhibit, delay or affect the functioning of the detection polling system in any way.

When supplied as an option, the printer must include all connecting cables, hardware, software and instructions.

15.04.12 Remote Panel

The Repeater Panel shall be Addressable & Microprocessor Based. The addressable repeater panel shall fully replicate the control panel information and control facilities allowing multiple operating points within the system.

The addressable repeater panel shall communicate with the master control panel via an RS422/RS-485, Fiber Optic or TCP/IP network.

Depending on control panel loading, it shall be possible to supply power for repeater from the control panel's auxiliary power output or from an external 24Volt power supply or optionally shall be supplied complete with a built in 24V, 2,4A or 5A power supply unit.

15.05. Loop Devices

15.05.1 Device types

It shall be possible to connect the following detectors/devices to the control unit addressable loop.

- Multisensors - optical/thermal type
- Optical smoke sensors - analogue type
- Heat sensors - analogue type
- Manual callpoint "break-glass" units
- Addressable relays i.e. Output devices
- Interface Units i.e. Input devices
- Addressable Sounders (Loop powered)
- Sounder Circuit Controllers
- Addressable Remote LED Indicators
- Loop isolators

15.05.2 Intelligent Point Sensors: General Requirements

Sensors shall have complete electromagnetic and electrostatic protection against externally generated noise and the effects of devices such as fluorescent light fixtures, variable frequency motor controllers, cellular telephones, and electrical surges from other sources.

The system shall operate satisfactorily within the supply voltage range of 17V-28Vdc.

An indicator LED shall be provided on the detector which illuminates when the detector is in an alarm condition.

Provision shall be made for an output from the detector suitable for operation of a remote indicator LED. The output shall be operated independently of the smoke detector from the central control panel.

Sensors must plug into separate mounting bases with a twist-lock action. The bases shall be fitted with corrosion resistant connector springs and terminal screws with captive clamping plates.

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Smoke entry points must be protected against insect ingress by corrosion resistant mesh.

The detector shall be supplied complete and fully tested and calibrated.

The unique address of the detector shall be set by the installer using dipswitches.

15.05.3 Multisensor sensors (analogue/addressable)

The multisensors must comply fully with the general requirements for intelligent point sensors as specified in paragraph 5.2.

Multisensors shall comply with EN54 standard.

The multisensor sensors shall incorporate photoelectronic optical smoke sensors, and high sensitivity thermal sensors, software interlocked to provide early warning from all types of smouldering and thermal fires.

Multisensors shall be able to be operated as smoke sensors only (EN54-7), or as thermal sensors only (EN54-5).

The smoke element shall be of the light scattering type using a pulsed internal LED light source and a photocell sensor.

The thermal element shall utilise high sensitivity, high speed thermistors optimised to measure small changes in temperature, and rate of change.

The elements shall measure both absolute smoke and thermal levels, but also rate of smoke and thermal change.

The smoke and thermal elements must report independently to the control panel, and must be software interlinked to enable intelligent high-level decision making.

The detector shall be capable of operating within the following environmental limits.

- a. Temperature operating range 0°C to +50°C
- b. Humidity operating range 0% to 95% RH (without condensation)
- c. Wind - not affected

15.05.4 Photoelectric (optical) smoke sensors (analogue/addressable)

The photoelectric optical smoke sensors must comply fully with the general requirements for intelligent point sensors as specified in paragraph 3.02.

Photoelectric optical smoke sensors shall comply with standard under para 15.01.

The photo electronic optical smoke sensors shall be suitable for detecting visible smoke such as is produced by slow smouldering fires.

They shall be of the light scattering type using a pulsed internal LED light source and a photocell sensor.

The detector shall be capable of operating within the following environmental limits.

- a. Temperature operating range 0°C to +50°C
- b. Humidity operating range 0% to 95% RH (without condensation)
- c. Wind - not affected

15.05.5 Heat sensors (analogue/addressable)

The heat sensors must comply fully with the general requirements for intelligent point sensors as specified in paragraph 5.2.

Heat sensors shall comply with standard specified under Para 19.01.

The heat detector shall be electronic in operation, and shall monitor ambient temperature by means of a NTC thermistor.

The detector shall be capable of operating within the following environmental limits.

- a. Temperature operating range 0°C to +50°C
- b. Humidity operating range 0% to 95% RH (excluding condensation)
- c. Wind - not affected

15.05.6 Manual call point

Heat sensors shall comply with standard specified under Para 19.01.

The call point shall be manufactured from red injection moulded plastic.

The overall size of the call point shall not exceed 100 mm x 100 mm x 60 mm.

It shall consist of an enclosure, with a captive glass pane, and it shall incorporate an addressable communications module.

Breaking the pane shall initiate an alarm, no secondary action shall be required by the operator.

The callpoint shall incorporate a plastic-laminated safety glass which will not produce sharp edges when broken, thereby protecting the operator from injury.

An externally visible LED must be incorporated to indicate when the device is in alarm. The LED shall illuminate when the call point is activated.

15.05.7 Addressable Sounders

Addressable sounders shall be a combination of sounder and beacon.

Sounders shall be loop powered.

The system shall support minimum 32 sounders per loop.

15.06. Alarm Management

The annunciation and signalling outputs must be field programmable as described below.

15.06.1 Control outputs

Optional control outputs or relays shall be available.

Each relay must be software programmable and must be able to be allocated to a loop device, a zone, fire alarm, fault or coincidence operation.

The optional relays must be able to be allocated in a different grouping or the same grouping as the zones.

Each optional relay shall have a change-over voltage-free contact rated at 2A at 24V DC.

15.06.2 Activation delay

It shall be possible to programme any of the control outputs or addressable relays to activate after a delay period from receipt of the control signal.

This delay shall be 0 - 10 minutes.

15.06.3 Software control

All the above functions, shall be under software control, and programmed through the panels keyboard or by means of a computer.

It must be possible, as an option, to programme the panel off-line on a computer, and download the programme into the panel.

It must be possible to save the programme to disk for future reference.

15.07. System Maintenance

15.07.1 General

The system shall be, as far as possible, self-testing and maintenance free.

15.07.2 Control unit test

The control unit shall have facilities for carrying out various diagnostic functions without interruption of the remainder of the system.

15.07.3 Detector tests

The control unit shall allow for detector test and inspection by a single person.

The test alarm triggered on each detector by the inspection person shall be indicated on the detector by a red LED and shall be automatically reset by the control unit. Alerting shall not take place.

Upon completion of the test, the panel shall print out a report indicating which sensors operated and any sensors which failed to operate.

15.07.4 Alarm test

The control unit shall allow for the testing of all audible and visual alarm devices and control relays, to check correct functioning of these devices.

15.08. System wiring

15.08.1 Loop Wiring Configuration

The system device address loops shall each operate on a single two-wire circuit, which shall be normally screened to provide absolute reliability at all times, and in all environments.

15.08.2 Wiring is to be of Class A type.

15.08.3 The system shall operate satisfactorily with a loop length of up to 1500 metres, of a cable type and size as specified by the equipment manufacturer.

15.09 Graphical Interface Software

The Graphics Display and Alarm Management System shall allow the connection of up to 64 fire alarm panels to a PC. Each panel shall be displayed on the screen as if the operator is standing in front of it, and shall be fully controlled from the computer.

The Graphics Display and Alarm Management software shall be simple to set up & operate. Detectors and Call Points etc. shall be added graphically via the built-in interface. Device Descriptions shall be received directly from the control panel. There shall be no complicated tables to set up.

A printer shall be connected to the computer to record all alarm, fault and programming activity on the system. Whether or not a printer is connected, a log shall be kept of all events. This log can be periodically downloaded and printed if required.

In the event of an alarm or fault, the location of the incident shall be displayed on the computer screen, with three levels of zoom available to the operator. The individual device shall be viewed and interrogated, and if necessary disabled.

Programming shall be password protected. Once in programming mode, each panel in the system shall be enabled, and drawings shall easily be imported from a graphics program such as AutoCAD

Other utilities shall be provided, such as a list of emergency phone numbers, and an operator notepad.

If a second computer is required at another location, this shall be connected as a slave via an Ethernet network to the main computer. For longer distances, Fiber Optic cabling shall be used. TCP/IP communications shall also be used to allow remote access.

16.0 Public Address System

16.01 General

The Public Address System shall comprise of a central paging station with microphone connected to speakers located throughout the protected building area. The Main Amplifier of the building shall be located in the control room on ground floor of each block and the mike or the paging station shall be located in the control room as well as on the every floor of each block.

The system shall be designed to make announcements in normal condition or in case of an emergency from the control room and from the each floor . The system shall have following components.

- Speakers
- Paging Station
- Voice Controller and Amplifiers

16.02. Speakers

The speakers shall be of wall mounted type and the electrical and the mechanical specification of the Speaker shall be as bellows:.

16.02.3 Electrical specifications:

Maximum Power	18 W
Rated Power	12 W (12-6-3 W)

Sound Pressure Level at Rated Power/1 W (at 1 kHz, 1 m)	104 / 93 dB (SPL)
Effective Frequency Range (-10 dB)	160 Hz to 20 kHz
Opening Angle (at 1 kHz / 4 kHz, - 6 dB)	195° / 95°
Rated Input Voltage	100 V
Rated Impedance	833 Ohm

16.02.3

Mechanical specifications

Connection	4-pole push-in terminal block
Color	Black (Dark)
Environmental Ambient Temperature	- 15° to + 55° C

16.03

Paging Station

It shall have 6 zone call station expandable upto 12 zones

It shall have unidirectional condenser microphone on flexible stem

It shall have six zone selection keys, all-call key and momentary PTT-key for calls

It shall have Selectable gain, speech filter and limiter for improved intelligibility.

It shall have Selectable priority levels and different pre- and post call chimes

It shall have LED indications for zone selection, system occupation and call station

16.04

Controller

The controller shall be of 6 zone controller.

The controller shall be used as a stand-alone system with up to 6 zones, or expanded to up to 60 zones using additional 6-zone controllers.

The system shall have all the essential functionality for compliance with the IEC 60849 standard, including full system supervision, loudspeaker line impedance supervision, a supervised emergency microphone on the front panel and a supervised message manager.

The controller shall allow up to 8 call stations can be connected. Interconnections shall be made using standard RJ45 connectors and shielded CAT-5 cable.

16.05

Amplifiers

The amplifier shall be available in configuration of 120W, 240W and 480W.

The amplifier shall provide the 70 V / 100 V and 8 ohm outputs

The amplifier provide dual inputs with priority switching

The amplifier shall provide 100 V input for slave operation on 100 V speaker line

The amplifier shall have Mains, battery back-up and pilot tone supervision.

17.00 LIFTS

17.01 The scope of work shall cover design, supply, delivery, installation, testing and commissioning of passenger lifts/bed lifts. The scope of work shall also include the following item of civil works.

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

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

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

IS: 3534-1976 Outline dimensions of Electric Lifts.

IS: 4666-1980 Specifications for Electric Passenger and Goods Elevators.

Indian Electricity Act 1910.

Indian Electricity Rules, 1956.

Delhi Lifts Rules, 1942.

CPWD Specifications of Lift

17.03 SHOP DRAWING AND APPROVAL OF ELECTRICAL INSTALLATIONS:

The selected tenderer shall prepare a furnish shop drawings for approval by HSCC, 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 drawing to Engineer. The contractor shall not proceed with in installation work until the drawings are approved by Engineer. 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 t meet the requirements of specification under this contract.

Four sets of completion drawings operations manual, maintenance manual, Spare parts details shall be submitted to the Engineer after completion of work.

17.04 GUARANTEE :

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

17.05 PERMITS, INSPECTION & LICENSE FEE:-

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby.

17.06 MAINTENANCE:-

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

17.07 POWER SUPPLY:-

The apparatus shall be designed to operate on $415 \pm 5\%$ Volts, 3 Phase, 4 wires, 50 HZ alternative current. Supply for illumination signal equipment shall be 240 Volts $\pm 5\%$ single phase 50 HZ Alternative current.

17.08 ELECTRICAL WIRING:-

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

The wiring shall be carried out strictly in accordance with Indian Electricity rules and Indian Code of Practice for Electrical Wiring Installation IS-732-1963 System Voltage not exceeding 650 V). For works not covered under any of the above wiring rules, the 13th edition of Electrical Engineers (Condense) shall apply. The cables and conduits to be used shall be of suitable size and grade conforming to relevant IS specification. Wiring for LT switch board to the motor terminal shall be with heavy duty 1.1KV grade PVC insulated PVC sheathed 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 store 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.

17.09 PARTICULAR SPECIFICATIONS

TYPE	Lifts
NO. OF ELEVATORS	As per Bill of Quantities
CAPACITY	-DO-
SPEED	1.0 MPS .
FLOORS SERVED/RISE	As Per Bill of Quantities.
STOP	As Per Bill of Quantities.
OPENINGS	As Per Bill of Quantities
OPERATION	As Per Bill of Quantities

- CAR FRAME. The car frame which supports the car platform and enclosures shall be made of structural steel and equipped with suitable guides and a car safety device mounted underneath the car platform. The hoist ropes shall include adjustable self aligning hitches.
- CAR SAFETY AND GOVERNOR. : 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 ropes 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.
- COUNTER BALANCE. :
TERMINAL AND FINAL LIMITS. : Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings within permissible over travel and final limit switches shall be provided to automatically cut off the power and apply the brake, should the car travel beyond the permissible over travel. They shall act independently of the operating devices and buffers.
- 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.
- 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.

- 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.
- 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 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 ins the guide shoes, after smoothening of the rails. The flanges shall be machined for the fish plate mounting such that rail alignment at joints almost remain constant.
- FOUNDATION. : The machine shall be placed directly above the hoistway upon the machine room slab provide by the Owner.
- ROPES : The elevator shall be provided with traction steel ropes. Steel wire rope having a tensile strength of not less that 12.5 ton/cm² of good flexibility shall be used for lift. The lift rope shall conform to IS: 2365-1963.
- MACHINE.. : The machine shall be of the single wrap traction type and shall include a motor, electromechanical brake, steel worm, bronze gear, steel sheave shaft and Farrow - Molybdenum sheave all compactly mounted on a single base or bed plate. The worm shaft shall be provided with ball bearings to take the end trust and roller bearings shall be furnished for the sheave shaft to ensure alignment and long bearing life. The driving sheave shall be grooves to ensure sufficient traction and minimize rope wear. adequate means of Lubrication shall be provided for all bearings and the worm gear.

BRAKE

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

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 Thermostats embedded in the stator windings for the highest degree of thermal motor protection.

CONTROL

: The control shall be A.C. variable voltage, closed loop control system using solid state devices and electronic speed pattern generator to command the motor speed with digital speed feedback from a velocity transducer and load compensation circuits for a comfortable ride.

In Normal operation, the electromagnetic brake shall only be applied when the lift has come to a complete standstill. The brake shall only be meant for holding the lift in position at every landing, providing stopping without any jerking effect.

each controller cabinet containing memory equipment shall be properly shielded from the pollution.

MICROPROCESSOR:-

The control shall employ a microprocessor working on a program such that precision leveling and highly efficient handling of passengers for least possible waiting and reduced travel time is ensured. The microprocessor system should be designed to accept programming with minimum downtime. It should be able to monitor the state of input calls (such as car calls from COP and hall calls from hall fixtures and output commands such as starting, decelerating and stopping the elevator. It should be able to generate floor location data, thereby, providing a reference position to establish the safety zones for door opening and closing, and also to initiate leveling slowdown.

DUPLEX COLLECTIVE : The operation shall be simplex full collective
OPERATION. with/ without attendant for each elevator and
or shall consist of the following:-
TRIPLEX COLLECTIVE
OPERATION.
(DEPENDING UPON
LOCATION & POSITION
OF ELEVATOR SHAFTS)

IN THE CAR:-

There shall be furnished a flush type attractively finished stainless steel panel which contains a series of luminous buttons numbered to correspond to the landings served, an emergency stop switch and an emergency stop switch and an emergency call button connected to a bell which serves as an emergency signal.

AT HOISTWAY LANDINGS:-

There shall be provided an UP luminous push button and a DOWN luminous push button at each intermediate landing and a single button at a the terminal landings.

The car shall not start unless the door is in the closed position and all hoistway doors are closed in the locked position.

If the car is idle and one or more car or landing buttons above the landing at which the car is standing are pressed, the car shall start in the up direction and proceed to the highest landing for which any button is pressed and stops at intermediate landing for which a car button or up landing button is pressed. Sufficiently in advance of the car's arrival at such landings to permit these stops to be made. After each stop, the car shall proceed in the Up direction until it reaches the highest landing for which a call is registered. The car shall not stop on the UP trip at any landing in response to a DOWN call.

Similarly, if the car is idle and one or more car is standing are pressed, the car shall start in the DOWN direction, proceed to the lowest landing for which any button is pressed and stop at each intermediate landing for which a car button or DOWN landing button is pressed.

When the car is idle and a button for a landing above the car are pressed, lanavo

above the car and a landing below the car are pressed, the car shall start towards the landing corresponding to the button pressed first. The call registered for the landing in the opposite direction from the car shall be answered after the car has responded to the farthest call in the direction established by the button pressed first.

A time relay shall hold the car for an adjustable interval of few seconds at the landings at which stops are made to enable passengers to enter or leave the car.

OPERATION WITH AN ATTENDANT:-

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

A two-position key-operated switch marked to indicate ATT (attendant operation).

A buzzer: UP and DOWN direction light jewels and A non-stop button.

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

As a visual signal to the attendant, the UP and DOWN direction jewel shall illuminate upon registration of either car or landing calls to

Indicate the direction of the travel of the car. The attendant shall operate the elevator normally in the direction indicated by the direction jewel put, if desired, opposite direction travel may be realized by pressure of a car button for a landing in that direction from the car.

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

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

- 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 stainless steel car enclosure in plain finish for passenger and Bed Lifts .
 - e) PVC flooring (with 3mm thick tiles of approved shade) for both Passenger and Bed Lifts.
- CAR DOOR. : The car entrance shall be provided with stainless steel sliding doors in plain finish giving a clear opening of 1000 mm wide by 2000 mm high.
- HOISTWAY DOORS. : At each landing, a center opening stainless steel sliding door in plain finish giving a clear opening of 1000 mm wide by 2000 mm high, shall be provided.

SIGNAL AND : The following signal and operative fixtures shall be provided for each lift in stainless steel OPERATIVE FIXTURES. face plates except in fireman's switch which shall have a glass face plate.

a) **CAR OPERATING PANEL:-**

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

b) **HALL BUTTONS AND HALL POSITION INDICATOR:-**

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

c) **CAR POSITION INDICATOR IN CAR:-**

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

d) **BATTERY OPERATED ALARM BELL AND EMERGENCY LIGHT:-**

A solid state siren type alarm unit operated by 2 Nos. 9 volt rechargable Nickle Cadmium batteries shall be provided whci

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 shall be provided inside the car which shall operate automatically in the case of power failure.

e) **OVERLOAD WARNING:-**

Overload warning features 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 the ground floor by canceling all car and landing call. The elevator shall then stop at the ground floor with the door open to permit the fireman to have exclusive use of the elevator without any interference from the landing calls.

g) **INTERPHONE:-**

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

ELECTRIC DOOR : An electric door operator for opening and closing the car door shall be such that the door shall start opening meant for so that by the time the elevator stops completely, the elevator and hoistway doors shall be fully open.

OPERATOR FOR CAR DOOR AND HOISTWAY DOOR.

The equipment shall consist of a machine on the elevator car operating the car door when the car is stopping at a landing.

The car door and hoistway door shall be mechanically connected and shall move simultaneously in opening and closing.

The car and hoistway door shall be power opened and closed and shall be checked in opening and closing with an oil cushioning mechanism built into the gear unit.

Each hoistway doors shall be provided with an interlock which will prevent movement of the car away from the landing unit.

The doors are closed in the closed position as defined in the ISI codes.

An electric contact for the car door shall be provided which shall prevent car movement from the landing unless the door is in the closed position as defined in the ISI codes.

The locking arrangement shall be so designed that the electrical circuit cannot be completed unless the doors are in the closed position and mechanical latching is effected.

Necessary switches shall be provided in the elevator machine room to control the operation of the doors.

The car and hoistway, doors shall open automatically as the car is stopping at a landing. The closing of the car and hoistway door must occur before the car can be started. Doors can be stopped and reversed during their closing motion.

DOOR HANGER AND TRACKS : For the car and each landing door, sheave type two point suspension hangers completed with tracks shall be provided. Means shall be provided to prevent the door from jumping off the track and for vertical and literal adjustment of doors.

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

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

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

LANDING ENTRANCE MATERIAL'S : These shall consist of headers, extruded aluminium sills and strut angles.

WIRING. : Complete wiring in the equipment shall be done in copper.

18.00 DRAWING/PROCUREMENT & INSPECTION OF EQUIPMENT

18.01 Based on the tender drawings and the equipment/scheme finally selected, the contractor shall supply layouts, GA drawings to be submitted for approval are given below :-

- a) General Arrangement drawings of LT Panels, synchronising panel, Main distribution boards, Meter Boards, Rising mains and Bus duct,.
- b) The Original documents and the specifications in details of all switchgears and material to be used in the manufacturing and commissioning.
- c) Wiring diagram, schematic diagrams and control diagrams for equipment, Switchgear, PCC and the whole system. Schedule and termination details shall also be provided.
- d) Technical catalogue for all equipment, switchgear, cables and materials including a complete write up/details of operation, interlocks and controls etc.

- e) Operation and maintenance manuals along with list of spare parts for all equipment, Switchgear, Cables and materials etc.

18.02 **PROCUREMENT & INSPECTION OF EQUIPMENT**

Approved list of makes and vendors are given at Para No. 19.0. The makes of equipment/materials supplied shall be strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. all equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorized agents.

Client/HSCC shall have access to the manufacturer's premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer's works.

Based on the inspection certificate, Client/HSCC reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection.

19.0 **THE LIST OF APPROVED MANUFACTURES/MAKES**

19.01	Moulded Case Circuit Breakers	-	Siemens L&T G.E.
19.02	Air Circuit Breaker	-	L&T Siemens GE
19.03	Switch fuse unit, Fuse switch unit	-	L & T Siemens GE
19.04	Main LT Panel (Manufacture at the Vedor's works)	-	L &T SIEMENS GE
19.05	Floor Panels (Main Distribution boards, Sub distribution boards, Meter Boards		Krypton

& Feeder Pillers)	Neptune Advance ASG Switch gear Pvt. Ltd. Anand Power SPC Electrotech Pvt. Ltd. Adlec
19.06 Distribution Board with Miniature Circuit Breakers and RCBO	- Schneider L&T MDS (Legrand) SIEMENS GE
19.07 XLPE insulated PVC sheathed armoured cables of 1.1kv grade as per IS 7098 Part-I & II 1988/1985	- Poly cab Universal cable Skytone cable NICCO Rallision Cable National cables
19.08 PVC insulated copper conductor Stranded wire 1100 Volt	- Poly cab Finolex National Batra Hanlay Rallisons
19.09 Modular type Switches, Socket etc. (ISI marked)	- Leg rand Mylinnk Anchor Roma Honeywell MK Aspect
19.10 MS Conduit (ISI marked)	- BEC AKG NIC
19.11 Industrial type sockets	- SIEMENS Schneider Crompton

		MDS
		BCH
19.12 Exhaust Fan/ Ceiling fans	-	Crompton Greaves GEC USHA Bajaj
19.13 Batteries	-	Exide Amar raja Standard Furkwa
19.14 Light Fixtures	-	Philips GE Crompton
19.15 Diesel Engine	-	Cummins Cater Pillar MTU Greaves Kirlosker
19.16 Alternator	-	Stamford Kirlosker Leory Somer Cater Pillar Crompton & Greaves
19.17 11 K V Switch gear	-	SIEMENS AREVA Crompton Greaves L&T VOLTAS ABB
19.18 11 K V /0.433 KV Transformers	-	AREVA Universal Crompton Greaves Volt amp Kirlosker

19.19 Light Poles / High Mast	-	GE Bajaj ASTER Philips
19.20 Sandwich Bus Duct	-	EAE MDS GE SIEMENS ABB
19.21 Capacitor & Accessories	-	Epcos ABB L&T
19.22 Addressable Fire Control Panel, Address monitor modules, control relay modules etc, Addressable Detectors, Hooters, Response indicators, Manual call point etc.	-	Siemens Honeywell Notifier EDWARD Ansul Games well Farewell
19.23 PA System	-	Bosch Bose Aties Harmon
19.24 LIFTS	-	OTIS KONE

