

**TECHNICAL SPECIFICATION FOR
FIRE PROTECTION SYSTEM**

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SECTION – 1 INTENT OF SPECIFICATION

This specification is intended to cover Design, Residual, Engineering, Manufacture, Test and Inspection at works, delivery to site properly packed for transportation, erection, testing, commissioning, performance demonstration at site and handing over to purchaser of Fire Protection System as indicated in the schedule of Requirement and scope of work and as required for reliable and effective fire protection.

- 1.1 This specification also includes complete earthwork, i.e. excavation and back filling for the entire buried piping for hydrant and water spray system.
- 1.2 The specification also includes the supply of erection and commissioning of spares as specified and special tools and tackles.
- 1.3 This specification also makes it obligatory for the contractor for arranging and obtaining necessary clearance / approval from all Local / statutory authorities.
- 1.4 It is not the intent to completely specify all the details of design and construction herein. Never the less the equipment and installation shall confirm to high standard of engineering, design, and workmanship in all respect and shall be capable of performing continuous satisfactory operation and acceptable to the purchaser as well as to the various statutory authorities. In case of any violation of the above contract, the purchaser reserves the right to change / reject / modify the equipment / system during detail engineering.
- 1.5 Wherever material or article is specified or described by the name of particular brand, manufacturer or vendor, the specific item mentioned shall be understood as established type function and quality desired. Other manufacturer's product will be considered provided sufficient information is furnished to allow the purchaser to determine that the product proposed is equivalent to that brand.
- 1.6 The entire system shall be designed and engineered by the Bidder based on the guidelines furnished in the specification, various codes / standards. Bidder's experience and also good engineering practice. Items and quantities, which have been furnished in this specification, are tentative and indicative only. During quoting, the Bidder shall vet the above Bill of Material and may furnish additional items necessary for satisfactory operation of the system.
- 1.7 Supplies and services to be covered under this tender specification and the conditions thereof are detailed in the subsequent sections of the specifications. In case of conflict among various sections, subsections, documents, drawings the same shall be referred to purchaser whose decision shall be final and binding to the Bidder. In all cases, the best advantages will go to the purchaser.
- 1.8 Bidder to note that no technical deviation shall be permitted for the system

SECTION – 2 DESIGN PHILOSOPHY

2.1 CODES AND STANDARDS

The Fire protection system for **M/s. I-AIM HealthCare Center** shall design and installed as per National Building Code (NBC) of India 2016, Part 4, Fire and Life Safety in general, & detailed specifications & Local fire officer.

2.2 HAZARD CLASSIFICATION

As per NBC 2016 part-4, & Local code **M/s. I-AIM HealthCare Center** has been classified, as Institutional buildings, **Group – C Sub- C1** is less than 15 m in height.

2.3 TYPE OF SYSTEMS PROPOSED

Following are the various Fire Protection systems required as per the NBC - 2016 & Local Fire officer.

- Wet riser system & Sprinkler system at all floor, if applicable.
- Addressable Fire detection & alarm system
- Public address system
- Fire extinguishers and Signage (Fire safety plans).

Considering the Scope of Works according to the latest Addendum from KSFES dated January 9,2026:

- One hose reel hose required for every 1000m² of built up area and GI pipe of minimum 60m shall be provided. Hose reel hose of minimum 19mm size of adequate length to reach the farthest point should be provided near the staircase at each floor with a shut off branch having nozzle of 5mm size.
- One down comer is required for every 1000m² of built up area and down comer pipe of minimum 80mm shall be provided and it should be connected to terrace (RCC or FRP)/ underground tank capacity 20000 Ltr. (Exclusive for firefighting) with 900 LPM booster Pump. The down comer if of 80mm internal diameter and of GI 'c' class pipe. From each down comer single hydrant outlets at each landing should be provided. Adequate BIS marked reinforced rubber lined delivery hoses of 63mm size to reach farthest point of the floor/setbacks from the system should be provided with a branch pipe near each hydrant outlet (both internal & external) in a proper box.
- Yard hydrants shall be provided for every 40mtrs around the building and 1No. of 2WAY Fire Service inlet near the entrance should be provided.
- Manually operated Electronic Fire Alarm system shall be provided (Already Executed and working in perfect condition)
- If area of basement exceeds 300m² sprinklers are required in basement (Not applicable)
- Automatic detection system required for entire building (Already Executed and working in perfect condition)
- All the Firefighting pumps shall be connected to alternative power supply (DG of suitable Capacity)

2.4 FIRE WATER STORAGE TANKS

- As per National Building Code (NBC) of India 2016, Part 4, Fire and Life Safety Clause No. 6.0 and Table 7 & Local Fire officer

2.5 FIRE WATER PUMPS

- 1 No. Electrically driven Jockey pump for hydrant system of capacity 180 Lpm @ 70 MWC
All pumps are connected to Fire alarm system control panel for monitoring the status of Fire pumps.

2.6 FIRE HYDRANT SYSTEM

- Ring main on Terrace level for inter connecting all Wet risers.
- Wet risers for Entire building.
- Landing Hydrants on all floors for every 1000 m²
- Fire Brigade Inlet connection for filling the Firewater tank as well as wet riser system.

2.7 WET RISER SYSTEM

- Wet riser for every 1000 sq.mts floor area for all buildings.
- Landing Hydrants on all floors with **Single-headed hydrant valve**, 2 x 15Mts. of fire hoses, Hose reel with 40 Mts. Rubber hose and nozzle.

2.11 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are provided at locations mentioned below;

- ABC powder type fire extinguisher conforming to IS:15683 near car parking lots, main switch board room, transformer, generator room, pump room and lift machine room (Both ABC & CO₂ shall be provided for LMR)
- 9 Liters capacity Water mist type fire extinguisher conforming to IS: 15683 located near each staircase landing on every floor.
- Co₂ 4.5 kg type fire extinguisher conforming to IS: 15683, located in electrical panel room,
- Mechanical foam type fire extinguishers at HSD storage, D.G. Rooms, and near oil filled Transformers.

SECTION – 3 APPLICABLE CODES AND STANDARDS

Unless specifically mentioned otherwise, all the applicable Codes and Standards published by the Bureau of Indian Standards and their subsequent revision / BS Standards shall govern in respect of design, workmanship, quality and properties of materials and method of testing; standards listed below shall be applicable, in particular:

NBC 2016	:	National Building Code of India Part IV for Fire Protection System
IS-1239 / IS 3589	:	Specification for MS / GI Pipes
API 600 / BS 5163 IS778/780/2906	:	Specifications for Gun Metal gate, globe & check Valves for water supply.
IS-800	:	Specifications for Structural steel
IS-814	:	Specifications for covered electrodes for metal are Welding of structural steel.
BS-5155	:	Specifications for C.I.butterfly valve.
IS-4927	:	Specifications for Canvas Hose Pipes.
IS-903	:	Specifications for Branch pipes Fire hose Couplings and auxiliary equipments
IS-5290	:	Specifications for hydrant landing valves.
IS-1200 fittings)	:	Method of measuring of building & civil Engineering Works (water supply, plumbing drain & sanitary
IS-4853	:	Recommended practice for radiographic inspection of Fusion welded butt joints in steel pipes.
IS-636	:	Synthetic, jacketed hose pipes.
IS-2198	:	Control Panels.
IS-2159	:	Hot dip galvanising of iron and steel
IS-5	:	Specification for painting

IS 9137	:	Specification for horizontal end suction centrifugal pump
BS-1965 Part I	:	Specification for butt-welded Pipe Fittings.
IS 8423	;	Controlled percolating hose for fire fighting.
IS 2871	:	Branch pipe, universal for fire fighting purposes.
IS 884	:	First aid hose reel for fire fighting
IS 2190	:	Code of practice for selection, installation and maintenance of Portable first aid fire extinguishers.
IS 937	:	Specification for washers for water fittings for fire Fighting system.
IS 9972	:	Specification for automatic sprinkler heads.
IS 13849	:	ABC type Fire extinguishers
IS 15683	:	Water mist Fire extinguishers
IS 15683	:	Carbon – di – oxide type Fire extinguishers
IS-2189	:	Installation & Maintenance of Fire Detection and Alarm System
IS-2175	:	Detectors
IS-694	:	Copper wire
IS-9968 (Pt-1)	:	Rubber Insulated Braided Wire
IS-1554 (Pt-1)	:	PVC Insulated Cables
Shade No.536 of IS-5	:	Paint Shade for main Equipments/accessories

SECTION – 4 SCOPE OF WORK

4.1 INTRODUCTION

The scope of work includes design, Engineering with necessary design calculations, fit – up details, supporting details, Manufacture/Fabrication, supply, storing. Installation/Erection, testing, commissioning the fire hydrant system, Hose Reel system and quoted rates should include complete earth works i.e., excavation, back filling for the buried pipes wherever applicable & with all necessary accessories as per Specifications and National Building Code of India -2016 at M/s. I-AIM HealthCare Center, Fire Advisory issued by KSFES and latest Addendum from KSFES dated January 9,2026.

4.2 DRAWINGS AND DESIGN CALCULATIONS

The drawings enclosed herewith are for the general guidance to Bidder. The contractor shall upon the award of the work, furnish detailed working drawings (as mentioned under Clause No. 4.1 above) necessary to carry out the work at site with detail design calculation. These shall be submitted to the Employer/Architect for the approval and the work shall be commenced only after the approval of drawing by the Employer/Architect.

4.3 INSPECTION AND APPROVAL

The contractor shall obtain approval to the installation from the **department**, Successful Bidder shall be responsible for preparation of documents / applications / drawings & hydraulic calculations and flow up action at all stages, (Drawing / completion) arranging inspections, revisions / modifications for obtaining approval from department within the overall completion period stipulated in the Tender. The Contractor shall also make payment of all statutory payments (if any & same will be re-imbered by clients) like payment for department approval etc. The quoted rates shall take care of any contingencies.

The contractor shall guarantee both the material and workmanship of first class quality corresponding to standard engineering practice. Any defective materials/workmanship shall be rejected, the contractor has to rectify/ replace at his own cost. Guarantee certificate of the materials supplied shall be handed over to the clients.

6.4 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

List of data/document/drawings to be submitted along with bid shall as mentioned below,

- 1) Preliminary Overall dimensions of pump sets /motors/engines
- 2) List of Deviations (Technical) if any, as an Annexure.
- 3) Technical parameters of all equipment offered (catalogues, G.A. drawings etc).
Preliminary pump house layout confirming adequacy of space provided for firewater pumps

6.5 DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

List of data/document/drawings to be submitted after the award of contract shall be indicated. The list shall essentially contain the following:

- 1) Design and operation philosophy of the complete fire system
- 2) Piping layout
- 3) Schematic drawings,
- 4) Data sheets of all the equipment envisaged
- 5) Detailed Hydraulic calculation

Bar chart/network schedule covering all milestone activities.

6.6 INSTRUCTION MANUAL/COMPLETION DRAWING/TRAINING

The contractor shall be responsible for training of the Employer's personnel (minimum 6 rounds) in the period of operation and maintenance of the system and conduct Fire drill. The rates quoted shall inclusive of submitting 6 sets of the following documents (HARD COPIES) along with CDs (Soft copy) and the following,

1. Detailed equipment data in the approved Performa
2. Manufacture's maintenance and operating instructions manuals
3. Set of as built drawings, layouts, piping, ducting, cable routing, cable schedules etc
4. Approved test readings of all equipment and installations
5. Inspection certificates
6. Certificates of approval from statutory or Local Authorities for the operation and maintenance of the installations, wherever such approval or certification is required. This shall include Application filed along with enclosures and receipts of fees paid and deposits made.
7. Warranty / guaranty certificate for all equipments
8. List of recommended spares together with list of suppliers and their contact details.
9. Certificate from the main civil contractor that he has cleared the site of all debris and litter caused by him.
10. Undertaking that all the materials supplied by him at site are fully tax paid and shall produce all documentation for satisfaction of the Employer / consultants / Architects / PMC or taxation authorities.

Submission of the above documentation shall form a precondition for final acceptance of the plant and installation and final payments.

SECTION - 5

EQUIPMENT SPECIFICATIONS

A. FIRE HYDRANT SYSTEM

- 1.0** Without restricting to the generality of the foregoing, the fire hydrant system shall include the following:
- 1.1** Pumps, suction / delivery pipes, Valves, control panel and Instrumentation and pump set shall be suitable for auto operation. Pumps shall be manufactured as per BIS standards for fire fighting purpose.
 - 1.2.** **G.I "C" (heavy grade)** ring mains / riser main within the building and as well outside the building.
 - 1.3** Landing valves, external hydrant valves, hose reels, fire duct shutters. Hose cabinets, fire brigade connections and connections to pumps and appliances.
 - 1.4** All materials shall be of the best quality and brand new, conforming to these specifications / standards and subject to the approval of the Client / consultant.
 - 1.5** 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.
 - 1.6** Pipes and fittings shall be fixed to walls and ceilings by suitable clamps at intervals specified. Only approved types of anchor fasteners shall be used for RCC ceilings and walls.
 - 1.7.1** Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat manner. The pipes shall be supported by structural steel fabricated (like, channel / angle / flat / plate etc) supports with suitable anchor fasteners / suspended thread rods not less than M16 in size.
 - 1.8** Valves and other appurtenances shall be as located that they are easily accessible for operation, repairs and maintenance. Valves / other equipments fitted above the false ceiling shall be provided with trap / access doors.
 - 1.9** Pipes for wet risers within the Building shall be G.I pipes conforming to IS 1239 (heavy duty 'C' class) with flanged/welded joints.
 - 1.10** Fittings for steel pipes shall be malleable iron or forged iron fittings with screwed / welded joints.
 - 1.11** Inter connection between sprinkler and hydrant pumps shall be carried out at discharge side With Check valve and isolation valves, if required as per the local fire officer.

- 1.12** Construction of Fire water tanks, Fire water pump house, Puddle flanges at water tanks for suction / delivery / test lines and core cutting / opening if required on floor / wall will be done by Fire protection contractor.

2.0 PIPING

All pipes inside the building and where specified, outside the building shall be **G.I pipes** conforming to IS: 1239 - heavy duty. Fittings for pipes shall be as per IS: 1239, Part II (heavy grade / as per Data sheet) up to 150mm dia., 200 mm dia. and above shall be G.I. pipes as per IS: 3589 with minimum 6 mm wall thick & fittings shall be fabricated from pipes confirming to IS 3589.

Pipes shall be carefully laid to the alignment, levels and gradients shown on the plan and sections and great care shall be taken to prevent any sand, earth or other matter from entering the pipes during laying. Pipes shall be kept thoroughly clean during the course of laying. The ends of pipes shall be blocked with wooden plugs wedged home, at the end of each day's work to prevent dirt and rodents, insects etc., entering the pipe.

Pipes up to 50mm dia, shall be jointed by using fittings like **Socket welded** and weldable type or pipes above 50mm dia shall be join by welding or flanged connections shall be used. Flanged joints shall be made with 3 mm thick insertion rubber washer / Gaskets. All bolt holes in flanges shall be drilled & making hole by using gas cutting is not acceptable. The drilling of each flange shall be in accordance with relevant Bureau of Indian Standards.

Flanged joints shall be used for connections to vessel equipment, flanged valves and also on suitable straight lengths of pipeline at strategic points to facilitate erection and subsequent maintenance work.

The Bolts /Nuts / Washers used in the system shall be Galvanized as per IS 1367 and suitable length & not more than 15mm beyond the Nut.

2.1 PIPE PROTECTION

2.1.1 ABOVE GROUND PIPES

All pipes above ground and in exposed locations shall be painted with two coat of Etching type primer and two or more coats (each of 75 microns) of synthetic enamel paint of approved shade. The pipes should be initially brushed to remove all foreign matter before applying paint / primer.

2.1.2 UNDER GROUND PIPES

The pipes (buried) should be initially brushed to remove all foreign matter and apply the primer over the pipe. Primer is allowed to dry until the solvent evaporates and surface becomes tacky. The tape 4mm thick and 150/250mm wide shall then be wound in a spiral fashion and bonded completely to pipe by thermo fusion process. The overlap is to be maintained at 15mm.

2.2 EXCAVATION OF TRENCHES

2.2.1 Excavation for pipelines shall be in open trenches to line and grade or as required at site including disposal outside of site at approved dumping yard with the prior approval of concerned authorities. Pipelines shall be buried to a minimum depth of 1M (top of the pipe) from the finished ground level.

2.2.2 The contractor shall support all trenches or adjoining structures with adequate timber supports wherever required.

2.2.3 On completion of testing and painting of the pipelines, trenches shall be refilled with excavated fine earth in 20cms. Layers and consolidated by ramming and watering.

2.3 THRUST BLOCKS

Contractor shall provide suitable PCC blocks of suitable dimensions at Change – in – direction and regular intervals of 6 meters to support the pipes. Minimum Size of Blocks shall be 600mmx600mmx450mm.

2.4 PIPE SUPPORTS

Supports for above ground pipes of 65 mm dia and above shall be fabricated by structural steel of suitable sections with suitable fasteners. The spacing of supports shall be 3mts minimum and painted two coats of enamel paint of approved color over a coat of primer.

Suitable type hangers shall support pipes below 50 mm dia with clamps, anchor fasteners and suspended rods etc. In any case fasteners shall not be less than 12 mm in size.

3.0 VALVES

3.1 BUTTERFLY VALVES

Butterfly valves shall be as per BS 5155 & provided for pipes 50mm dia and above on down stream (delivery side) of the pumps. The valves shall be C.I construction; seat shall be black nitrile rubber with insitu moulding. The valves shall be PN 1.6 rating.

3.2 GATE VALVES

Gate valves shall be as per IS: 14846 / 780, with C.I. body and bronze / brass internal parts and shall be used on suction side of the pumps. Valve shall be flanged end type, PN 10 with **rising spindle type** with C.I hand wheel etc.

3.3 NON – RETURN VALVES

Non – return valves shall be reflux swinging disc type with C.I. body and bronze / brass internals as per Technical data sheet enclosed and as per IS: 5312.

3.4 PRESSURE REDUCING VALVE

Pressure relief valves are provided to keep the pressure in the line below a given value within the reasonable limits in the downstream side of the pipeline when the pressure builds up beyond the

design value. Pressure reducing valves shall be of high-pressured type of specified sizes. The valves should be suitable for mounting between flanges and threading connections also. The valve body shall be of bronze / SS as specified. The valve shall be of spring loaded, direct operation, metallic diaphragm type, as required for the particular usage. The pressure reducing valves should be manufactured in conformance with ASA- 150,300,600,800,900 and 1500, or to BS10- table – D, E, F, H or DIN- ND-16 & ND-40.

4.0 EXTERNAL HYDRANTS

External (yard) hydrant valves shall be single headed as per IS: 5290 (Type A). The valves should be complete with hand wheels, quick coupling connections, springs and blank caps. The hydrants shall be fixed to stand posts of 80mm dia for single headed hydrants at 1.0M from ground level. External hydrant valves shall be consisting with 2 nos. fire Hoses of 15m long 63 mm dia, One No. Gun metal Branch pipe with Nozzle housed in the M.S cabinet and cabinet shall be mounted (next to stand post) on free standing support fabricated by suitable structural steel / pipe of not less than 80 mm dia. Please refer the tender drawings for the details.

5.0 HOSE REEL

Hose reel shall be swinging type for 180 deg with mounting base plate. Hose reel shall consist with 19mm dia high-pressure rubber braided hose of 40 mts length with gunmetal nozzles. Hose reel water shall be tapped off from the wet riser with Ball valve. The hose reel shall be installed in fire hose duct inside the building.

6.0 LANDING HYDRANT VALVE

The landing valve (internal) shall be gunmetal **Single-headed** type conforming to IS: 5290 complete with hand wheel, quick coupling, spring and blank cap. 2 Nos. of RRL type hose pipe of 63mm dia and 15 mts. length as per IS: 636 with 63mm dia instantaneous type Gun metal heavy duty couplings & Gun metal Branch pipe and nozzle to be provided. Fire hoses and branch pipes shall be mounted inside the fire shaft with suitable supports.

7.0 FIRE HOSE

Fire hoses shall be Reinforced Rubber Lined (RRL) type as per IS: 636 & 63 mm dia and 15 mts long. Hoses shall be bounded by G.I wire to heavy-duty instantaneous gunmetal couplings as per IS 903.

8.0 BRANCH PIPE WITH NOZZLE

Branch pipe shall be gunmetal, 63 mm dia with Nozzle of 19 mm dia made as per IS: 903 and suitable fitted with hoses as specified elsewhere in this specifications.

9.0 HOSE CABINET

Hose cabinet shall be fabricated by M.S. sheet of 16 SWG and size shall be 750mm x 600mm x 250mm. Hose cabinet shall have glass fronted door fitted with 4mm thick clear glass & powder coated finish of red out side & white inside. Cabinet shall be suitable for stand mounting and shall have built in breakable glass type feature to keep key.

10.0 SHUTTER FOR FIRE SHAFT

Fire shaft shall have shutter fabricated by M.S. sheet of 16 swg with glass-fronted door (glass shall be 4mm thick) and size of the shutter shall be **900mm x 1500mm minimum**. The door shall be in two leaves with necessary stiffeners. Shutter shall be powder coated finish of red outside and white inside and on the glass label of "FIRE" shall be stick, the letter size shall be min. 75 mm height. Also there shall be built in breakable glass type feature to keep key.

11.0 FIRE BRIGADE INLET CONNECTIONS (FBIC)

FBIC shall be as per IS 5131 & gunmetal four way connecting head with 4 x 63 mm dia instantaneous type inlets with built in check valve and 150mm dia outlet connection to the fire main grid with 150mm dia Butterfly valve and non – return valve. The fire brigade inlet shall be feed water in to the system as well as to the fire water tank

12.0 AIR RELEASE VALVES

Air release valve is 25mm screwed inlet GM single acting type and shall be fixed on all high points in the system (wet riser) with Ball valves or as shown on drawings.

13.0 DRAIN VALVES

Gun metal Gate / Ball valve of 15 / 25 / 40 / 50mm dia as per IS; 778 with fittings as required for instruments / draining any water in the system / Risers in low points.

14.0 VALVE CHAMBERS

Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 Coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 20mm nominal size) 15mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box (OR top cover fabricated by M.S. chequered plate of 6 mm thick with frame / stiffeners etc) approved by local fire brigade including excavation, back filling and additional Iron rungs for entering in to valve chamber etc, complete.

Valve chambers shall be 1200mm x 1200mm x 1500mm depth.

15.0 PUMPS AND ACCESSORIES

The pumps shall be exclusively used for fire fighting purposes and shall be manufactured as per BIS. One set for each system with electrical motor driven direct couple centrifugal pump of adequate discharge and additional common standby Diesel engine driven direct coupled centrifugal pump of adequate discharge and head shall be provided. The pumping capacity of main and stand by hydrant / Sprinkler system pumps shall be as per BOQ.

15.1 GENERAL REQUIREMENT

The pumps shall be horizontal centrifugal back pull out type, pump designed for continuous operation and shall have a continuously dropping head characteristic without any zone of instability. The power capacity characteristic shall be non-over loading type. The head vs. capacity, input power

vs. capacity characteristics, etc., shall match to ensure load sharing and trouble free operation throughout the range. In case of accidental reverse flow through the pump the driver shall be capable of bringing the pump to its rated speed in the normal direction from the point of maximum possible reverse speed. The contractor under this specification shall assume full responsibility in the operation of the pump and the drive as one unit. The pump shall be capable to discharge 150 percent of rated capacity at a total head of not less than 65 percent of the total rated head. The total shut off head shall not exceed 120 percent of total rated head on the pump. An automatic air release valve shall be provided to vent air from the pump discharge and also to admit to the pump to dissipate the vacuum there, upon stopping of the pump.

This valve shall be located at the highest point in the discharge line between the pump and the discharge check valve. Pump coupled with motor or engine on a common base plate shall perform smoothly without any excessive noise or vibration. Also pump shall be provided with re-circulation piping with valves.

15.2 PUMP CASING

The casing shall be cast iron to IS 210 and capable of withstanding to the maximum pressure developed by the pump at the pumping temperature.

15.3 IMPELLER

The impeller shall be of standard bronze. The impeller shall be secured to the shaft with hydraulically balanced and shall be retained against circumferential movement by keying, pinning or lock rings. All screwed fasteners shall tighten in the direction of normal rotation.

15.4 SHAFT

Shaft size shall be selected on the basis of maximum combined shear stress. The shaft shall be of stainless steel AISI-410 ground and polished to final dimensions and shall be adequately sized to withstand all stresses from motor weight, hydraulic loads, vibrations and torque's coming in during operation. Pump Shaft-Motor Shaft Coupling shall be connected with adequately sized flexible couplings with spacer of suitable approved design. Necessary guards shall be provided for couplings. Pump shall be consisting with Gland plate for gland packing.

15.5 BASE PLATE

A common base plate for mounting both the pump and drive shall be provided. The base plate shall be of rigid construction, shall be fabricated by M.S. channels. Base plate and pump supports shall be so constructed, the pumping unit shall be mounted so as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc.,

15.6 VIBRATION AND BALANCING

The rotating elements shall be so designed to ensure least vibration during start and throughout the operation of the equipment. All rotating components shall be statically and dynamically balanced at

workshop. All the components of pumps of identical parameters supplied under these specifications shall be interchangeable.

15.7 INSTRUCTION MANUAL AND TOOLS/SPARES

A comprehensive instruction manual shall be provided by the contractor indicating detailed requirements for operation, dismantling and periodic operation and maintenance procedures. Recommended tools/spares shall be provided along with the Pump set.

16.0 DIESEL ENGINE

16.1 GENERAL

The diesel engine shall be capable to drive the fire pump and multicylinder type four-stroke cycle with mechanical (airless) injection, cold starting type. The engine shall be manufactured as per IS 10000 and shall be ease of maintenance, repair, cleaning and inspection. This will also provide interchangeability of parts. All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts, if design is applicable.

16.2 STARTING

The engine shall be capable of both automatic and manual start. Generally, the engine shall start automatically but in case of the auto-start system failure the engine shall be capable of manual start. Engine shall be able to start without any preliminary heating of combustion chamber; cranking mechanism shall also be provided. All controls/ mechanism, which has to be operated in the starting process, shall be within easy reach of the operator. A DC motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from two sets of storage batteries. One set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch will be provided at automatic starting control panel to select any of the two sets of battery for manual / auto starting of the engine. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. The battery banks shall be used for no other purpose other than starting of the engine and shall be fully charged at all times with provision for trickle and boost charges. After start of the engine the charger shall be disconnected, the battery being fed from the engine dynamo. The two-battery charger of air-cooled type shall be able to charge on battery bank at a time. The D/E starting panel along with the battery chargers should be of reputed approved makes.

16.3 GOVERNING SYSTEM

The engine shall have a speed control device which will control the speed under all conditions of load., the governor shall be suitable for operation without external power supply. The Governor shall offer following features: An adjustable governor to regulate engine speed within a range of 10%

between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.

16.4 FUEL SYSTEM

The diesel engine is to run on high-speed diesel, the tank provided being enough to hold the volume required for 6 hours (minimum) continuous operation. Fuel tank shall be double wall type, so that over flow of the fuel shall be collected in the secondary tank. Fuel supply and return piping shall be metal with necessary valves. Fuel tank shall be mounted on the fabricated consisting with air vent, over flow, drain, filling and manhole etc.

16.5 COOLING WATER SYSTEM

Direct cooling system shall be employed for the diesel engine. Water shall be tapped from the fire pump discharge. This water shall be led through duplex strainer, pressure breakdown orifice and then after passing through the engine, the outlet water shall be taken directly to the sump through an elevated funnel. Re-circulating thermo siphon system of cooling using a fan cooled radiator or indirect cooling system using heat exchanger shall not be accepted.

16.6 ACCESSORIES

The engine shall be mounted on a base plate of fabricated steel construction. Adequate access shall be provided for the big end and main bearings, camshaft and governor drives, water jackets etc., The engine shall have a base plate made from MS sections. There shall be reasonable space at the big end, camshaft, water jackets, governor drives and main bearings. The engine shall be provided with intake and discharge ductwork, inlet filter and silencer, outlet muffler, expansion joints, dampers etc., as necessary for efficient operation. Intake air should be taken from inside the building in which the engine is located, but the exhaust should be discharged outside the building and exhaust duct shall be adequately sized for minimum pressure drop as per relevant code/standard, and shall be housed clearing man height. The flywheel shall have graduated marking around the periphery to facilitate checking of valve and fuel pump timings. Full set of diesel engine spares as per Standard requirement to be provided along with tool kit.

16.7 INSTRUMENTATION

The diesel engine shall be provided with adequate instrumentation. The gauges etc., as required are provided for in the Engine Panel. Also Bidder shall supply one set of Spare parts recommended by the manufacturer for maintenance purposes.

17.0 TESTS AT SITE

17.1 PIPING

All piping in the system shall be tested to hydrostatic pressure of 1.5 times of the working pressure without drop in pressure for at least 120 minutes. The test should be made in the presence of and to the satisfaction of the Employers / consultants representatives. Any defects / leakage should be repaired or if necessary defective works / equipment should be replaced with new work / equipment. Tests should be repeated until work is done to the satisfaction of concern representatives. **After testing all pipes shall be flushed with portable water to remove foreign materials.**

Under ground Pipes after lowered in to trenches shall be Holiday tested for damages of the anticorrosion treatment and damages should be rectified, bring it to the notice of the engineer – in – charge of site before closing the trenches.

Also the under ground pipes joints shall be tested for Radiographic for 10 % of the total under ground joints. The test results and films shall be submitted for approval and any defects found in the welding process shall be rectified by the contractor with out any extra cost to the clients.

17.2 PUMPS

On completion of installation works at site the complete system shall be tested for satisfactory performance in line with specifications as per Tender / requirements of Employer / Consultants. Pumps should test for Sequential Auto start in case of using the Hydrants / sprinklers system. Also pump shall deliver minimum required flow & pressure at top most hydrant point. All instruments for testing should be arranged by the Contractor. The performance test includes commissioning spares like, diesel oil, engine oil, coolant, grease, gland packs and spare refills for Fire extinguishers etc complete.

C. ELECTRICAL WORKS

1.0 ELECTRICAL WORKS

1.1 General

The CONTRACTOR shall supply and install the electrical equipment and services necessary for the efficient and safe operation of the fire protection systems detailed elsewhere in the specification, including :-

(a) Motors for Fire water pumps.

(b) MCC cum control panel housing the starters for all motors and complete with the switches, relays, push

Buttons, indicating lamps, etc. necessary for the control of the fire protection system

(c) Power and control cabling between the MCC, motors, pressure switches, etc. including accessories like

Conduits, cable trays, etc.,

(d) To carry out the electrical installation works in accordance with specifications and as required by the local

Statutory departments.

(e) To include the preparation of shop drawings and construction drawings for submission to the Consulting

Engineers to review prior to construction. Final as-built drawings after commissioning of the Fire Protection System.

1.2 ELECTRIC MOTORS

The motor shall be as per IS: 325 and with class "F" insulation, totally enclosed fan cooled, horizontal induction foot mounted type and rated not to draw starting current more than 6 times normal running current. Motor shall be capable of driving the pumps at rated discharge and head & at 150% of its rated discharge at 65 % of the rated head (in any case 15 % safety load should add) and shall be designed for continuous full load duty. The motor shall be capable of handling the required starting torque of the pumps. Speed of motor shall be compatible with the speed of the pump. The cooling fans shall be directly driven from motor shaft. Motor situated outdoors or exposed to the weather shall be weather protected. Motors shall be enclosed type and shall have dust tight construction with suitable means of breathing and of drainage to prevent accumulation of water from condensation. Drain holes shall exclude bodies greater than 6mm diameter.

All components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved. All motors shall be dynamically balanced.

The enclosure shall be designed to provide an effective sealing between the primary and secondary air circuits. Motor winding shall be vacuum impregnated with heat and moisture resistant varnish glass fiber insulated. Two independent earthing points shall be provided in accordance with IS:3043 on opposite sides of the motor for bolted connection. The cable boxes and termination shall be designed to enable easy disconnection and replacement of cables.

2.0 LT SWITCH BOARDS / SWITCH GEAR/ SUB MAIN SWITCH BOARDS

2.1 GENERAL SPECIFICATION OF EQUIPMENT

The switch board shall be metal clad, totally enclosed, rigid, compartmentalized design, floor mounting, air insulated, extensible cubicle type for use on medium voltage power, 3 phase 4 wire 50 cycles system. The degree of protection shall be of IP55 incase of outdoor application as detailed in BOQ. The equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, cleaning and repairs for use in installations where continuity of operation is of prime importance.

The entire logic of the fire protection system shall be built in this panel. It shall have necessary relays/contactors for accepting contacts from Pressure/limit switches and for switching ON/OFF motors accordingly. It shall have ammeter, voltmeter, start / stop push buttons, manual and automatic selector switches, pumps on, off, trip indicating lamps, relays and other control equipment necessary for the efficient indication and operation of the system. A visual and audio alarm shall also be provided to raise an alarm when any of the pumps is tripped. It shall have provision for annunciating the water tank water level high / low / overflow conditions.

Provision shall be made for interfacing with the Building Automation system. Potential free contacts for motors ON / OFF / TRIP, MCC trouble and fire water tanks level LOW/HIGH/OVERFLOW conditions be provided in the control panel for BAS. Also provision shall be made for receiving signals from BAS.

2.2 STANDARDS

Following equipment shall conform to the requirements of:

Air Circuit Breaker (ACB)	- IS 13947 - 1,2 / IEC 947 - 1,2
Moulded Case Circuit Breaker (MCCB)	- IS 13947 - 1,2/ IEC 947 - 1&2
Contactors	- IS 13947 - 1,4
Miniature Circuit Breaker (MCB)	- IS 8828 - 1996/ IEC 898 - 1995
Residual Current Circuit Breaker (RCCB)	- IS 12640 - 1988 / IEC 1008
HRC fuse link	- IS 9224 and BS 8 :8
Current Transformer	- IS 2705 and IEC 185
Potential Transformer	- IS 3156
Relay	- IS 3231 & IS 8686 (For Static Relays)
Indicating Instrument	- IS 1248

2.3 CONSTRUCTION

The switch board shall be:

Sheet steel enclosed, indoor floor mounted free standing cubicle type. Made up of the requisite vertical sections modular type which when coupled together shall form continuous dead front switchboards. Dust, vermin and damp proof and enclosure protection not less than IP 52. Each feeder/instrument compartment shall be provided with a hinged door interlocked with MCCB/SFU inside the compartment such that door can only be opened when MCCB/SFU in off position. Readily extendable as required by the addition of vertical sections after removal of the end covers. Switch boards shall have access to the feeders, bus bars, cable termination, cable alley, etc. as required.

2.4 EACH VERTICAL SECTION SHALL COMPRISE

A front framed structure of rolled/folded CRCA sheet steel angle section of minimum 3 mm thickness rigidly bolted together. This structure shall house the component

Its contributing to the major weight of the equipment such as circuit breaker cassettes, fuse switch units, main horizontal bus bars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded CRCA sheet steel of minimum 6 mm thickness and 75 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation. A cable chamber housing the cable end connections and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling and adequate safety for working in one vertical/horizontal section without coming into accidental contact with live parts of the adjacent section. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated

sheet having less than 1mm diameter perforations to prevent entry of vermin. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust. The height of the panel shall not be more than 2200 mm unless otherwise specified and maximum height of operating handle shall not be more than 1800mm from FFL. The total depth of the panel shall be adequate to cater to proper cabling space. Doors shall be of minimum 14-gauge sheet steel and covers/partitions of 16G sheet steel. All sheet steel work forming the exterior of switchboards shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The Components in the switch boards shall be so arranged as to facilitate ease of operation and maintenance and at the same time to ensure necessary degree of safety.

Components forming part of the switchboards shall have the following minimum clearances:

Between phases	-	25mm
Between phases and neutral	-	25mm
Between phases and earth	-	25mm
Between neutral and earth	-	19mm

When, for any reason, the above clearances are not available, suitable insulation barrier/shielding shall be provided. Clearances shall be maintained during normal service conditions. Creep age distances shall comply with those specified in relevant standards. All insulating material used in the construction of the equipment shall be of non-hygroscopic material treated to withstand the effects of high humidity, high temperature and tropical ambient service conditions. Functional units such as circuit breakers, fuse switches, MCCBs, etc. shall be arranged in multi-tier formation except that not more than two air circuit breakers shall be housed in a single vertical section. Metallic/insulated shrouding shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with: Main bus-bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories. Cable terminations of one functional unit, when working on those of adjacent unit/units. All covers providing access to live parts/circuits shall be provided with tool operated fasteners to prevent unauthorized access. Provision shall be made for permanently earthing the frames and other metal parts of the switchgear by two independent distinct connections. Only CRCA steel sheets shall be used for fabricating the cubicle. Thickness tolerance for sheets shall be as applicable in relevant IS.

2.5 METAL TREATMENT AND FINISH

Generally, the treatment and finish of the metal surface shall be as per detailed specifications enumerated elsewhere in this document.

DEGREASING

Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

PHOSPHATING

A recognized phosphate process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again shall be followed by hot water rinsing to remove traces of phosphate solution. Drying in dust free atmosphere.

Primer: Primer coating with a coat of corrosion resistant primer applied on wet surface.

Finish coat: Two finishing coats of stoving synthetic enamel paint to the specified shade of IS:5. Both the finish shall be only spray painted or powder coating. For outdoor units the finishing coat shall be of weather resistant stoving epoxy paint of specified shade of IS5.

2.6 BUS BARS

The bus bars shall be made of high conductivity high strength E91E aluminum alloy suitable for 415 volts, 3 phase 4 wires 50 Hz 20KA unless otherwise specified. The bus bars shall be suitably supported with non-hygroscopic supports to provide a fault withstand capacity as specified. High tensile bolts and spring washers shall be provided at all bus bar joints. Fish plates of equal type and size shall be used at all joints. The bus bars shall have uniform cross section throughout and shall be capable of carrying the rated current at 415V continuously. The bus bars shall be designed to withstand a temperature rise of 45 Deg. C above the ambient. A current density of 1.00 Amp/Sq. mm shall not be exceeded for Aluminum bus bars.

The neutral bus bars shall have a continuous rating of at least 50% of the phase bus bars, unless mentioned otherwise. Bus bars shall be fully sleeved using heat shrunk PVC sleeves appropriately color coded to identify different phases and neutral bar. An earth bus of size not less than 40 x 6 mm aluminum/GI shall run throughout the length of switch board at top or bottom as required.

2.7 MCCB - MOULDED CASE CIRCUIT BREAKER

The Moulded Case Circuit Breaker shall be incorporated in the switch board wherever specified and shall be of the current limiting type. MCCB shall conform to IS 2516, IS 13947-1/ IEC 947-1 (part I & II / section 1) 1977 for general rules. It should be suitable for Horizontal and Vertical mounting and line load reversibility. MCCB shall be suitable either for Single Phase AC 230V On Three Phase 415V. The MCCB shall be available in four pole versions for neutral isolation. It shall have tropicalisation as standard feature.

The MCCB cover and case shall be made of high strength heat-resistant and flame-retardant thermosetting insulating material. The operating handle shall be quick make, quick break, trip - free type. The operating handle shall have suitable 'ON' 'OFF' 'TRIPPED' indicators and in order to ensure suitability for isolation complying with IS 13947-2/IEC947-2, the operating mechanism shall be designed such that the toggle or the handle can only be in 'OFF' position : if the main contacts are actually separated.

2.8 ACCESSORIES

MCCB shall be designed to have following accessories and it shall be fittable at site.
Under voltage trip , Shunt trip, Alarm switch, Auxiliary switch, Remote operation using motor mechanism with facility of using the same in auto/manual mode.

2.9 INTERLOCKING

MCCB shall be provided with following interlocking devices for interlocking the door of a switch board. Handle interlock to prevent unnecessary manipulations of the breaker. Door interlock to prevent door being opened when breaker is in ON position. The interlocking device to open the door even if the breaker is in ON position. In addition to the above, ant other features indicated in the Bill of Quantities shall also be provided.

2.10 BREAKING CAPACITY

Short time with standing capacities different ratings of MCCB's shall be as follows :

Ratings [Amps]	Breaking Capacity [KA]
01. Upto 400	35
02. 630 to 800	50
03. 1000 & Above	65

2.11 CONTACTORS

Contactor shall comply with IS 13947-1 for general rules and IS 13947 - 4.1 for Standards pertaining to Contactor and Motor Starter. The Contactors shall be capable of withstanding breaking and making capacities per following :

<u>AC3 category</u>	<u>AC4 category</u>
Making Current 10 x Rated	Current 12 x Rated Current
Breaking Current 08 x Rated	Current 10 x Rated Current

Contactor shall be capable of withstanding an impulse voltage of 8KV and have an insulation voltage of 1000V. Contactor shall be suitable for aluminum termination with a maximum permissible temperature rise of 650 C at the terminals with an ambient temperature of 500 C. The coils shall have three terminals and the insulation should be of class H type. The auxiliary contact block shall have a switching capacity of 220V, 2A. Contactor shall have one auxiliary in built and it should be possible to have additional NO/NC contacts in steps of two.

Miniature Circuit Breakers [MCB] :

MCB shall be in 1,2,3,4, pole versions. MCB casing shall be made of self extinguishing, tropicalised material. MCB shall comply with IS 8828-1996/IEC 898-1995. It shall be suitable for use in frequency range 40Hz to 60Hz and shall accommodate AC/DC supply according to requirements. It shall have a trip-free mechanism and toggle shall give a positive contact indication. It shall be suitable for mounting on 35mm DIN rail/surface mounting. It may be installed horizontally, vertically on the ceiling in any place without any change in electrical performance. Line supply may be connected to

either top or bottom terminals i.e. There should be no line-load restriction. Degree of protection when the MCB is flush mounted, shall be IP40. MCB shall be supplied with clamping terminals fully open. Contact closing shall be independent of the speed of operator. The breaking capacity of the MCB shall be 9KA/10KA. The MCB shall be capable of being used as Incomer Circuit Breaker and shall be suitable for use as isolator. In case of multiple MCBs in a single location (DB), it should be possible to remove any MCB without having to disturb other MCB in the vicinity.

2.13 CURRENT TRANSFORMERS

Current transformer shall comply with the requirements of IS 2705. They shall have ratios, outputs and accuracy as specified/required. All CT's shall be of resin cast type unless otherwise specifically called for. All CT's shall be of bar type primary or suitable for the cable given type and size and the CT's shall be provided with shorting links irrespective of the CT's ratio's preferably with ELMEX / PHOENIX. For all the CT's suitable type and size clamps are to be supplied for mounting in the switch boards. Polarities and terminal markings of primary and secondary shall be clearly marked on all CT's.

Specifications for CT's :

- a. Current Ratios :
 - i. Primary : As per feeder ratings
 - ii. Secondary : 5A
- b. Type : Resin Cast
- c. Class : PS-Differential Protection
5P10-O/C,E/F, RPR
Class 1 for metering
- d. System Voltage
 - i. LT : 415V 3Ph 50Hz

2.14 INSTRUMENTS & METERS

All instruments and meters shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. They shall be calibrated to read directly the primary quantities. They shall be accurately adjusted and calibrated at Works and shall have means of calibration, check and adjustment at site.

2.15 INDICATING INSTRUMENTS

Indicating instruments shall be flush mounted with anti-parallel white circular scales with black pointer and with black numbers and lettering. Knife edge pointers shall be preferred. Unless otherwise specified, the size of all instruments shall be 96mm x 96mm type. The dials shall be free from warping, fading and discolouring. Spring controlled instruments shall be provided with front of board zero adjuster, capable of being safely handled while the instrument is in Service. Instrument covers shall also have red marks on the dial corresponding to rated values of the

associated primary equipment. Synchronising instruments shall also meet the requirements of this clause. The indicating instruments shall conform to IS:1248 and shall have an accuracy class of 1. The Ammeter and Wattmeter current coils shall withstand 200% of rated current continuously and 10 times the rated current for 0.5 seconds without loss of accuracy. Voltmeter and Wattmeter potential coils shall withstand 120% of rated voltage continuously and twice the rated voltage for 0.5 sec. without loss of accuracy.

2.16 VOLTMETER

Voltmeter shall be suitable for operating directly on LT supply voltage 415V, 50Hz or with a PT as per the requirements. All the Voltmeters used for rated operating Voltage of 415/110V as required at 50Hz AC. With a scale as required at site.

All Voltmeters are 96 x 96mm, suitable for mounting on the panel. Type, Sl.No., accuracy class and borders of the Voltmeter shall be indicated on the dial.

2.17 AMMETER

All the Ammeters shall be CT operated (5A) with a dial marked for line currents. Type, Sl.No., Accuracy class, Operating Current, Burden etc., shall be indicated on the dial. All Ammeters shall be of panel mounting type and shall be provided with zero setting screw.

2.18 PUSH BUTTONS

Push buttons shall be of momentary contact type with rear terminal connection. These shall be suitably shrouded to prevent inadvertent operation. Integral inscription plates engraved with their functions shall be provided. All push buttons shall have two Normally Closed and two Normally Open contacts comprising rivets of pure silver. The contacts shall be able to make and carry 5 A and break up one amp inductive load at 250V DC.

2.19 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the switch board to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified in the detailed specifications. 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. Cable sockets shall be of tinned copper and of the crimping type.

2.20 CONTROL WIRING

All control wiring shall be carried out with 1100V grade single core PVC cable having stranded copper conductors with minimum cross section of 1.5 Sqmm for potential circuits and 2.5 Sqmm for

current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wires shall be identified by numbered ferrules at each end. The ferrules shall be of ring type and of non-deteriorating material. They shall be firmly located on each termination so as to prevent free movement. All control circuit fuses shall be mounted in front of the panel and shall be easily accessible.

2.21 TERMINAL BLOCKS

Terminal blocks shall be of 500 Volts grade and of stud/screwless type. Terminal blocks shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions. At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 150mm.

2.22 RELAYS

All Relays shall conform to the requirement of IS: 3231/IS 8686 or other applicable approved standards. Relays shall be suitable for flush and Semi-flush mounting on front with connections from the rear. All Protective Relays shall be of draw out or plug in type/Modular cases with proper built in test facilities. Test blocks and switches shall be located immediately below each relay for testing. The auxiliary relays shall be self reset type. All AC Relays shall be suitable for operation at 50Hz. AC Voltage operated relays shall be suitable for 110/v3 Volts PT secondaries and Current operated relays for 5Amp. CT. secondaries as specified in this specification. Voltage operated relays shall have adequate thermal capacity for continuous operation. Auxiliary Relays and Timers shall have pairs of contacts as required to complete the scheme. Contacts shall be silver faced with spring action.

All Protective Relays, Auxiliary Relays and Timers except the lockout relays and interlocking relays specified shall be provided with self reset type contacts. All, Trip and Timers shall be provided with externally hand reset positive action provided with inscription subject to /Consultant approval. Timers shall be of the electromagnetic or solid state type.

Wherever solid state relays are used the following requirement shall be met with: All Relays shall be designed for operating under or ambient temperature 55.C and 100% relative humidity. Electronic type timers shall be as far as possible avoided.

All accessories required for correct operation of each relay shall be supported by the Sub-contractor without any extra cost. The solid state relays shall be stable and suitably protected against transient/induced over voltages. The bidder shall state clearly in his list special requirements, if any, for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.

2.23 NAME PLATE

The panel as well as feeder compartments shall be provided with name plate of anodized aluminum with white engraving on black background. They shall be properly secured with fasteners/rivets. The panel/feeder descriptions shall be as indicated in the drawings/ by the employer.

2.24 TESTS

The routine tests shall be conducted as per IS standards on each Power Control Centre and shall comprise:

Inspection of the Switch Boards including inspection of wiring and electrical operational/functional tests where necessary.

2.25 DIELECTRIC TESTS

Insulation resistance of the power circuit between each pole and the earth and that between the poles shall be measured. Insulation resistance of all secondary wiring between phase and earth shall be measured. Insulation test shall be carried out both before and after high voltage test. Checking of protective measures and electrical continuity of the protective circuits.

2.26 HIGH VOLTAGE TEST

A high voltage test with 2.5 KV for power circuit and 1.5KV for Control Circuit, Duration one minute shall be applied between each pole and earth and between poles. Test certificate shall be submitted along with panel.

2.27 STORING, ERECTION AND COMMISSIONING

2.28 STORING

The panels shall be stored in a well ventilated dry place. Suitable polythene covers shall be provided for necessary protection against moisture, dust and vermin.

2.29 ERECTION

Switch boards shall be installed over trench/floor as required. Suitable grouting holes shall be provided in the flooring. Suitable MS base channel shall be embedded in the flooring on which the panel can directly be installed. The switch boards shall be properly aligned and bolted to the flooring by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. Either side, the switch board earth bus shall be connected to the local earth grid. The base channel used for erection of panels shall form part of the cost of the panel and shall not be measured or paid separately.

2.30 PRECOMMISSION TESTS

The panels shall be commissioned only after successful completion of the following tests. The test shall be carried in the presence of Architect's representative. All main and auxiliary bus bar connections shall be checked and tightened. All wiring terminations and bus bar joints shall be checked and tightened. Wiring shall be checked to ensure that it is according to the approved drawing.

All wiring shall be tested for insulation resistance by a 500 volt megger. Phase rotation tests shall be conducted. Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order if required by the Employer. All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit or shall produce calibration/test certificate as required by the Employer / Inspectorate / consultant. Functional tests on all feeders. Makes, type and ratings of all components shall be checked/verified as per approved drawings.

3.0 GENERAL SPECIFICATIONS FOR LOW VOLTAGE CABLES

3.1 TYPE

Low voltage cables shall be aluminum conductor, PVC insulated, PVC sheathed and steel wire armored or steel tape armored, FRLS- PVC out sheathed construction. The cables shall conform to IS 1554 Part I in all respects. Cables shall be laid in tray/Hume pipe/in ready made trenches etc., as required.

The FRLS outer sheath material shall meet the following requirements (if used),

- i) The oxygen index value shall be minimum 29 when tested at 27 ± 2 °C as per ASTM-D-2863-77 and temperature index value shall be minimum 250 °C when tested as per NES 715.
- ii) The maximum total acid gas generation as determined by titration shall be less than 20 % by weight. The test shall be conducted as per IEC-754-1 (1994).
- iii) The smoke density shall be 60 % maximum, when tested as per ASTM-D-2843-77 (1988).
- iv) The finished cable shall pass the flammability test as per IEC-332-1 (1993), In addition, it shall also pass flammability test as per Class F3 of Swedish Standard SS-424-1475 (1978).

The sizes of cables shall be selected to limit the voltage drop during running and voltage dip during starting to 5% and 10% respectively. Adequate derating factors shall be considered

3.2 RATING

The cable shall be rated for a voltage of 1100 Volts.

3.3 CORE IDENTIFICATIONS

Cores shall be provided with the following colour scheme of PVC insulation:

1 core	:	Red/Black/Yellow/Blue
2 core	:	Red and Black
3 core	:	Red, Yellow and Blue
3 1/2 / 4 core	:	Red, Yellow, Blue & Black

4.0 STORING, LAYING, JOINTING AND TERMINATIONS

4.1 STORING

On receipt of cables at site the cables shall be inspected and stored in a safe place.

4.2 LAYING

Cables shall be laid as per the specifications given below.

5.0 CABLES IN OUTDOOR TRENCHES

Cables shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75 cm from the final ground level. The width of the trenches shall suit easy laying of cable. Where more than one cable has to be laid in the same trench, all attempts shall be made to keep the axial distance between successive cables to be at least 1d where 'd' is the diameter of the bigger cable. The trenches shall be cut square with vertical side walls and with uniform depth. Wherever cables are bent, the minimum bending radius shall not be less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with sand cushion. Over this a course of cable protection tiles or burnt brick shall be provided on either sides and above. Trench shall be back filled with earth and consolidated. Cables shall be laid in hume pipes/stoneware pipes at all road crossings & wall entries. Approved cable markers made of CI indicating the voltage, no. of cables and the direction of run of the cables shall be installed at regular intervals.

6.0 CABLE IN INDOOR TRENCHES

Cables shall be laid in indoor trenches wherever specified. Suitable angle iron brackets, clamps, hoods and saddles shall be used for securing the cable in position.

7.0 CABLE ON TRAYS/RACKS

Cables shall be laid on cable trays/racks wherever specified. Cable racks/trays shall be of perforated steel section/slotted angles suitable for the purpose. The trays/racks shall be complete with plates, tees, elbows, risers and all necessary hardware. The steel trays shall be painted. Cable trays shall be erected properly to present a neat and clean appearance. Suitable cleats or saddles shall be used for securing the cables to the cable trays. The cable trays shall comply with the following requirements :

The trays are ladder type and shall have suitable strength and rigidity to provide adequate support for all contained cables. It shall not present sharp edges, burrs or projections injurious to

the insulation of the wiring/cables. If made of Sheet metal, it shall be adequately protected against corrosion or shall be made of corrosion resistant material. It shall have side rails or equivalent structural members. It shall include fittings such as horizontal, vertical bends, tie rods, hooks etc., or other suitable means for changes in direction and elevation of runs, fish plates and hardware.

8.0 INSTALLATION

Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid. Each run of the cable tray shall be completed before the installation of cables. In-ports where additional protection is required, non-combustible covers/enclosure shall be used. Cable trays shall be exposed and accessible. Where cables of different system are installed on the same cable tray, non-combustible solid barriers shall be used for segregating the cables. Cable trays shall be grounded by two nos. earth continuity wires. Cable trays shall not be used as equipment grounding conductors.

9.0 JOINTING AND TERMINATIONS

Cable jointing shall be done as per the recommendations of the cable manufacturer. Jointing shall be done by qualified cable jointers. Each terminations shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end terminations. Cable gland shall be bonded to the earth by using suitable size G.I. wire/tape.

Suitable identification tags with the feeder designation inscribed on an aluminum/G.I. sheet shall be tied to either ends of each cable.

10.0 TESTING

Cables shall be tested at factory as per the requirements of IS 1554 Part I. The tests shall incorporate routine tests, type tests and acceptance tests. Copy of such test certificates shall be furnished to the Employer prior to dispatch.

F. FIRE EXTINGUISHERS

Fire extinguishers shall be worked out in such a way that the Occupants shall not travel more than 15m to reach a Fire extinguisher. Also there shall be a Fire extinguisher for every 100 sq.m of floor plate / rooms of suitable type / size. Additional to utility areas, Extinguishers to be provided at Surface car parks, out door Transformers / electrical installations and on the landing of each Staircase of all floors.

All Fire extinguishers shall be portable and hand held, an operating instruction should be pasted on the extinguisher body.

Portable Fire extinguishers should be BIS approved and valid ISI certificates to be furnished at the time of delivery to site.

Note: The fire suppression system / extinguishers shall be free from CFC, HCFC and Halons.

SECTION - 6
MAKE OF EQUIPMENT

A. RECOMMENDED MAKES FOR MECHANICAL WORKS

1.	FIRE PUMPS	:	KIRLOSKAR BROS. LTD / LUBI / MATHER & PLATT / KSB
2.	DIESEL ENGINE ASHOKLEYLAND /	:	KIRLOSKAR OIL ENGINE / GREAVES / CUMMINS INDIA / LUBI
3.	G.I. PIPES	:	JINDAL (HISSAR) / TATA HEAVY / SURYA PRAKASH
4.	PIPE FITTINGS	:	UFI / ATC / NEW / NVR
5.	BUTTERFLY VALES	:	SANT / NEU-G / NVR
6.	NON – RETURN VALVES	:	SANT / NEU- G / NVR
7.	GATE VALVES (Screwed end)	:	SANT / NEU- G / NVR
8.	BALL VALES (Screwed end)	:	SANT / NEU- G / NVR
9.	STRAINERS	:	SANT / NEU- G / NVR
10.	C.I. GATE VALVES	:	SANT / NEU- G / NVR
11.	FLOW METRE	:	FORBES MARSHALL / EUREKA / MONSHER
12.	PRESSURE SWITCH	:	INDFOS / SWITZER / HONEYWELL
13.	PRESSURE GAUGE	:	H. GURU / FIEBIG / PRICOL / BELLS CONTROL
14.	ANTICORROSIVE MATERIAL	:	I W L / RUSTECH / PEDILITE
15.	HYDRANT VALVES	:	NEWAGE GUJRAT/ NEWTCH / ESSEL / KALPEX
16.	BRANCH PIPE WITH NOZZLE	:	NEWAGE GUJRAT/ NEWTCH / ESSEL / KALPEX
17.	FIRE HOSES	:	NEWAGE GUJRAT/ NEWTCH / ESSEL / KALPEX
18.	HOSE COUPLINGS	:	NEWAGE GUJRAT/ NEWTCH / ESSEL / KALPEX

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| 19. | HOSE REEL | : | NEWAGE GUJRAT/ NEWTCH / ESSEL / KALPEX |
| 20. | HOSE BOX / FIRE DUCT SHUTTER | : | NEWAGE GUJRAT/ NEWTCH / ESSEL / KALPEX |
| 21. | FIRE EXTINGUISHERS | : | INTIME / NEW TECH / KALPEX / ESSEL / MITRAS |
| 24. | SPRINKLERS | : | TYCO / HD / NEWAGE GUJRAT |
| 25. | SPRINKLER ALARM VALVE | : | TYCO / HD / NEWAGE GUJRAT |
| 26. | FLOW SWITCH | : | HONEYWELL / POTTER / SWITZER / LEVCON |
| 27. | PAINT | : | ASIAN / BERGER |
| 28. | AIR RELEASE VALVES | : | SANT/NEU-G/ NEWAGE GUJRAT |
| 29. | WELDING ELECTRODES | : | ESAB / ADVANI |
| 30. | SIGANGES | : | PROLITE/ TESLA |

B. RECOMMENDED MAKES FOR ELECTRICAL WORKS

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| 1. | ELECTRIC MOTORS | : | KIRLOSKAR ELECTRIC / LUBI /KSB/ ABB/SHAKTI PUMPS |
| 2. | BATTERY | : | EXIDE / STANDARD / AMAR RAJA/ MINIMAX |
| 3. | MOTOR CONTROL CENTRE
VOLT | : | VINTECH POWER SOLUTIONS/ ACE CONTROLS /BLUE
/ GV ENGINEERS |
| 4. | CONTROL / POWER CABLES | : | GLOSTER / RAVI CABS / SURBHI / HEMFLEX/ ORBIT |
| 5. | MCCB | : | GE/ L&T/ALSTOM/MERLINGERIN / ABB |
| 7. | SOFT STARTER | : | GE/ ABB / SCHNEIDER |
| 8. | CONTROL MCB | : | ABB/ MERLINGERIN / SIEMENS / MDS |
| 9. | VOLT METER SELECT SWITCH | : | SALZER / L & T / KAYCEE |
| 10. | VOLTMETER (AC / DC) | : | MECO / AE |
| 11. | AMMETER (AC / DC) | : | MECO / AE |

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| 12. | POWER CONTACTORS | : | ABB / SIEMENS /L&T/ SCHNEIDER |
| 13. | INDICATING LAPS (LED type) | : | BINAY / TEKNIC |
| 14. | PUSH BUTTONS | : | TEKNIC / SIEMENS |
| 15. | AUTO / MANUAL SELECTOR | : | SALZER / KAYCEE |
| 16. | TIMERS | : | EAPL / AE |
| 17. | TERMINAL BLOCKS | : | ELMEX / WAGO |
| 18. | CURRENT TRANSFORMERS | : | KALPA / VOLTAMPS / KAPPA |
| 19. | OVER LOAD RELAY | : | L & T / SIEMENS |
| 20. | SINGLE PHASE PREVENTORS | : | MINILEC / AE |
| 21. | ENGINE CONTROL SELECTOR | : | SALZER / KAYCEE / L&T |
| 22. | MAIN SUPPLY SELECTOR – DPMCB | : | SIEMENS / MERLINGERIN |
| 23. | BATTERY CHARGING SELECTOR | : | SALZER / L & T/ KAYCEE |
| 24. | BATTERY CHARGER | : | KAYBEE POWEREC / HBL-NIFE/ AFCO/CHABBI |
| 25. | SIREN / HOOTER | : | KHERAJ/EQUI. |
| 26. | TOGGLE SWITCH | : | JAY / EQUI. |
| 27. | END TERMINATIONS | : | DOWEWLS / MULTI |
| 28. | CABLE TRAY | : | STORACK / PAN / MAG |

C. FIRE DETECTION & ALARM WITH P.A. SYSTEM

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| 1. | SMOKE DETECTORS | : | RAVEL / MIRCOM / FIRE CLASS |
| 2. | HEAT DETECTORS | : | RAVEL / MIRCOM / FIRE CLASS |
| 3. | MAIN CONTROL PANEL | : | RAVEL / MIRCOM / FIRE CLASS |
| 4. | MANUAL PULL STATIONS | : | RAVEL / MIRCOM / FIRE CLASS |

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| 5. | HOOTERS / STROBES | : | RAVEL / MIRCOM / FIRE CLASS |
| 6. | MODULES | : | RAVEL / MIRCOM / FIRE CLASS |
| 7. | BATTERY | : | HITACHI / DRYCIL / JOHNSON |
| 8. | COPPER CONDUCTOR CONTROL CABLE / WIRES | : | HEMFLEX / SURBHI / RAVI CABLES / ORBIT |
| 9. | COMMUNICATION WIRES | : | HEMFLEX / SURBHI / RAVI CABLES / ORBIT |
| 10. | M S CONDUITS | : | BHARATH / GB /MANGOCAB |
| 11. | PVC CONDUITS | : | VIP / ATUL / AVON PLAST |
| 12. | P.A. SPEAKERS | : | GST/ WATTN/ SMART TECH MINDZ/INNOVATIVE |
| 13. | P.A.CONSOLE | : | GST / WATTN/ SMART TECH MINDZ/INNOVATIVE |
| 14. | P.A. AMPLIFIERS | : | GST/ WATTN/ SMART TECH MINDZ/INNOVATIVE |
| 15. | COMPUTER | : | IBM / DELL / HP / EQUI. |
| 16. | PRINTER | : | CANON / HP / WIPRO / EQUI. |